

Step 1: General Principles

The Step 2 exam will ask to either **identify the rhythm** or **choose an intervention**. In order to identify the rhythm, follow these simple principles. 1 - Determine the **rate**: **tachycardia** is  $> 100$ , **bradycardia**  $< 60$ . 2 - Determine the **QRS complex**: **wide** is  $> .12\text{msec}$  and means it's a **ventricular** rhythm while **narrow** is  $< .12\text{msec}$  and means it's an **atrial** rhythm. These two things will give you 80% of your answers on the test. The third and final decision is if the rhythm is **regular** or **irregular**. Of course, to determine any of this an **ECG**, preferably a **12-lead**, is needed.

With the ECG ask if there's an arrhythmia or not. Note that there are two, maybe three, rhythms that are not arrhythmias. **Normal Sinus Rhythm** is what everyone should be in. **Sinus tachycardia** is typically a normal, physiologic response to an underlying stressor. **Sinus bradycardia** may be a normal rhythm in a competitive athlete, though they usually do not appear in a vignette or in the hospital as an "arrhythmia."

Step 2: Symptoms or No Symptoms

Ask, "are there symptoms?" An arrhythmia without any symptoms does not warrant your attention. Simply: if there are **no symptoms** then you **do nothing**. "Nothing" means routine care: IV, O<sub>2</sub>, and Monitor. Likely, this will be a question about rhythm identification.

Step 3: Stable vs Unstable

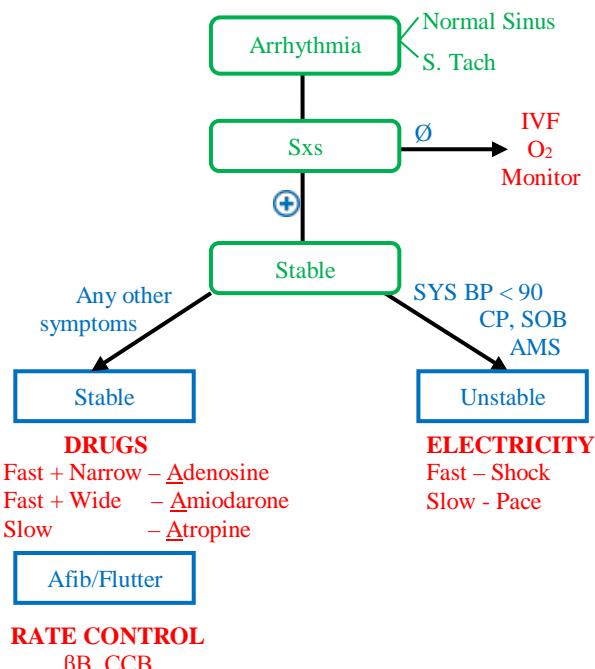
If the patient has symptoms decide whether there's time to stay and play or if definitive therapy is needed right now. Stability is a product of your own comfort. But for a test, if there's **chest pain, shortness of breath, altered mental status**, or a **systolic BP < 90**, then the patient is considered **unstable**. If they're unstable use **electricity**.

If instead the patient has symptoms, but not any one of those listed above, the patient is **stable**. A patient who is stable has time to fix the rhythm. He/she isn't going to die right now; **pharmacotherapy** can be used.

Step 4: Choose an intervention

If you've chosen **unstable/electricity** only one question needs to be asked - fast or slow. If the rhythm is **fast + unstable** then **shock**. If the rhythm is **slow + unstable** then **pace**.

If you've chosen **stable/electricity** it's a slightly more difficult task. For stable rhythms, there are three, maybe four, options. 1 - If the rhythm is **fast + narrow + stable** use **adenosine**. 2 - If the rhythm's **fast + wide + stable** use **amiodarone**. 3 - If the rhythm's **slow + stable** use **atropine** (epi drips can also be used in the new ACLS roll out). 4 - If the rhythm's **Afib/Aflutter** (note this is the only rhythm that actually had to be identified to do the right intervention), **rate control** is preferred. If he/she were unstable shock him/her since afib usually presents as a tachycardia. By "rate control" we mean **Beta Blockers** or **Calcium Channel Blockers**.

Tachy Rhythms

- Sinus Tachycardia
- Supraventricular Tachycardia
- Multifocal Atrial Tachycardia
- Afib
- Aflutter
- Vtach
- Vfib
- Torsades

Atrial  
Narrow  
Ventricular  
Wide

Brady Rhythms

- Sinus Bradycardia
- 1° Block
- 2° Block
- 3° Block
- Junctional
- Idioventricular

Varying degree  
of PR intervals

Intervention	Heart Rate	QRS Complex	Stability
Pacer	Brady	Any	Unstable
Cardioversion	Tachy	Any	Unstable
Atropine	Brady	Any	Stable
Adenosine	Tachy	Narrow	Stable
Amiodarone	Tachy	Wide	Stable
Rate Control	Tachy	Afib/Flutter	Stable

"Rate Control" = Verapamil / Diltiazem, Propanolol

**Supraventricular tachycardia** is an **aberrant reentry** that bypasses the SA node. It's **narrow** (atrial), **fast** (tachycardia), and will be distinguished from a sinus tachycardia by a **resting heart rate > 150** + the loss of **p-waves** (can you tell p-waves from t-waves?). It responds to **adenosine**.



**Ventricular Tachycardia** is a **wide complex** and **regular** tachycardia. Look for the "tombstones." Since it's ventricular there are **no paves** at all - just the **QRS complexes**. It responds to **amiodarone** (newer/better) or **lidocaine** (older/cheaper)



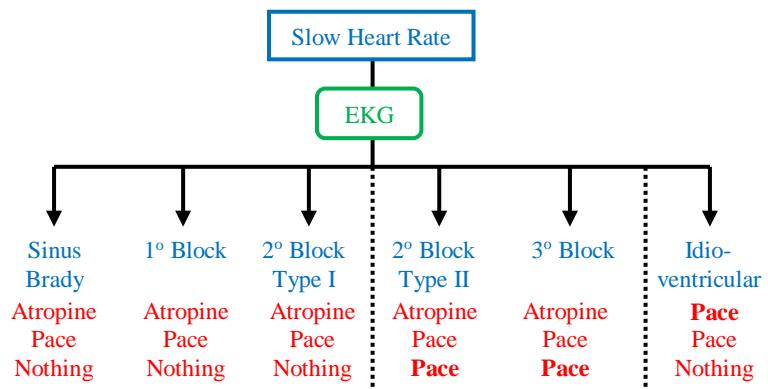
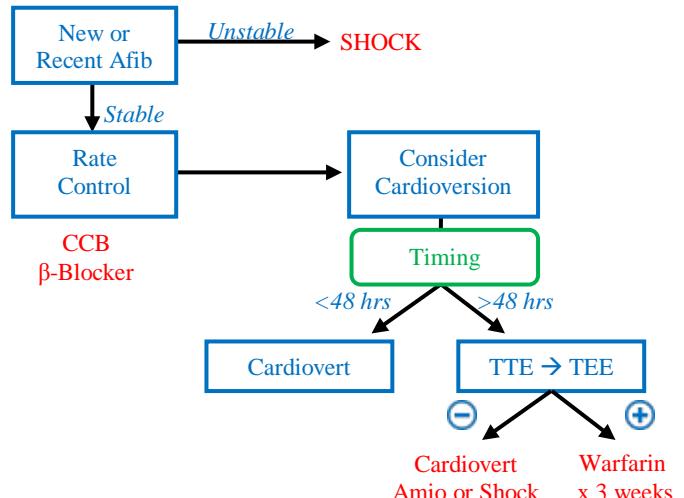
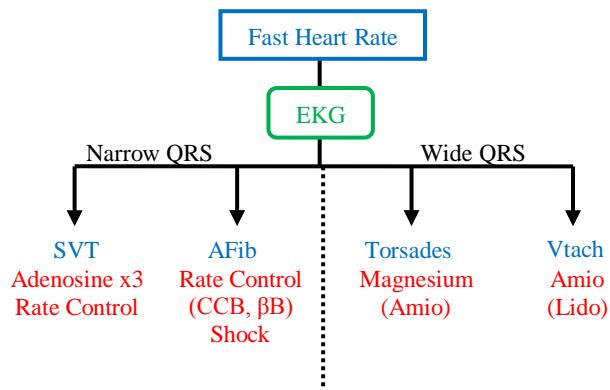
**Atrial Fibrillation** can be identified by a **narrow complex** tachycardia with a **chaotic background**, **absent p-waves**, and an **irregularly irregular** R-R interval. It has a special treatment algorithm. In the acute setting (ACLS in a nutshell) simply decide between shock and rate control. Once the decision to treat's been made be aware to two treatment options. **Rate control** is just as good as **cardioversion**. But, you have to weigh risks and benefits in each patient. If doing a cardiovert it's necessary to determine **how long** the afib's been present. Simply cardioverting an Afib that's lasted **>48 hrs** runs the risk of throwing an **embolism** (and a stroke). Thus, it's necessary to do a **TTE** (easy, but not great) and then a **TEE** if negative (make sure there is no clot in the heart). If there's no clot, you can cardiovert. If there is, the patient needs to go on **warfarin** (or the newer sexy option - **dabigatran**) until the clot clears. Then it's ok to cardiovert. If you decide to do **life-long rate control**, **anticoagulation** may still be needed. Decide this using the **CHADS2 score**. The higher the score the higher the risk of embolism and the more likely the patient is to benefit from **warfarin/dabigatran**.



**Sinus bradycardia** is simply a slow normal sinus rhythm. The blocks are a worsening of that normal bradycardia. Almost everything responds to **Atropine** until it gets really bad - then **only pacing will do**.



**1° AV-Block** is characterized by a **regularly prolonged PR interval**. There's no change in the interval between beats, but each is prolonged. There are no dropped beats.



**2° AV Block Type I** is a normal rhythm with a constantly prolonging PR interval with each beat, until a QRS complex is finally dropped. The signal comes from the atria so there is a narrow QRS complex.



**2° AV Block Type II** has a **normal PR interval** but simply drops QRSs randomly. The signal comes from the atria so the QRS complexes are narrow. This is the most severe a rhythm can be before atropine no longer works.



**3° AV Block**. There's total **AV node dissociation**. The **Ps march out** (regular interval between P waves) and the **QRSs march out** (regular interval between QRS complexes). At times, the P waves may seem lost or dropped; the QRS complex occurs at the same time and obscures the p wave. Because the impulse comes from the ventricles it's a wide QRS complex. In general, **avoid atropine** (just pace). This is controversial.



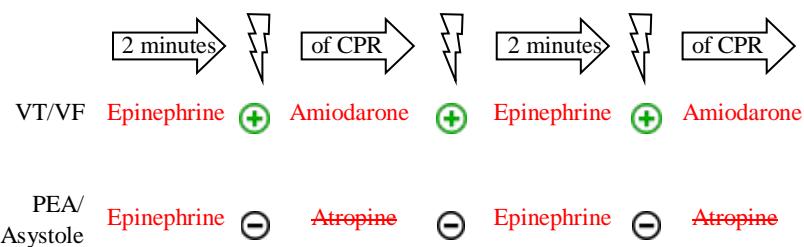
**Idioventricular Rhythm** is a rhythm without atrial activity. Only the ventricles are contracting, only the ventricles have electrical activity. It looks like a 3° block, but without p waves. **Avoid atropine** (it won't work), as there is no atrial conduction at all, so **just pace**.



This is not every rhythm you could see, but it's way more than you need to be prepared for the USMLE. You will see a rhythm, **MAYBE** two on the test. **MAYBE**.

## CARDIAC ARREST

When dead, remember 1 thing: compressions. Everything is based around 2 minutes of CPR. 2 minutes of CPR, check a pulse, check a rhythm, shock if indicated. Shock is indicated only in Vtach/Vifb arrest. Always start with Epi. Only in VT/VF can you shock, and so too only in VT/VF can antiarrhythmics be used. That's it. This is almost never tested on Step 2 but is here for completeness.



Introduction

There are three very distinct **mechanical diseases** of the heart. Anything that causes the heart to “not work right” (cardio = heart, myo = muscle, pathy = bad or broken) is a cardiomyopathy. Whether it’s **Afib**, **MI**, **infection**, **toxins**, **autoimmune disease** - it doesn’t matter. It is the heart’s response to these stressors that defines the cardiomyopathy. That’s our discussion.

1) Dilated Cardiomyopathy

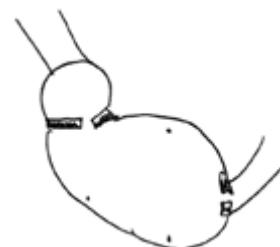
The heart works by overlying actin and myosin filaments. If they start too close together there’s nowhere for them to contract. Conversely, if they start too far apart there’s no overlap to generate contraction. When the heart **dilates** the wall gets **stretched out** (so it’s thin) and has a **decreased contractility** (producing a **systolic heart failure**). The heart becomes a bag of blood rather than a pump. The etiologies are vast: **ischemia**, **valve disease**, **idiopathic**, **infectious**, **metabolic**, **alcoholic**, **autoimmune**, etc. The point is that diagnosis and management are the same, regardless of the etiologies. A **Chest X-ray** will show an enlarged heart, **Echo** will show the dilated ventricle. The patient will present with **heart failure symptoms** and gets **heart failure treatment**. Getting the underlying etiology is an academic exercise and beyond the scope of this course.

2) Hypertrophic Cardiomyopathy (HCM)

An **autosomal dominant** mutation of **myocyte sarcomeres**, this causes an asymmetric hypertrophy of the septal wall. Because it occludes the **aortic outlet** it presents just like an **aortic stenosis** except that it’s heard at the **apex** and **improves with increased preload**. Why? Because increased preload causes the ventricular chamber to fill, pushing the septum away from aortic outlet and letting blood flow. This is the opposite of aortic stenosis. Also, HCM is found in **young people** while AS is found in the elderly. Symptoms may be **SOB (most common)**, angina, or what people know it for: **sudden death in athletes**. Treat this by **avoiding dehydration** and with  **$\beta$ -Blockers** to allow an increase in ventricular filling.

3) Restrictive Cardiomyopathy

Heart muscle should be able to contract and relax. Dilated cardiomyopathy has trouble with contractility - getting the blood OUT (systolic failure). **Restrictive** cardiomyopathy has trouble relaxing - getting **blood in** (diastolic failure). It can’t relax to accept blood because there is “junk in the way.” It’s caused by **Sarcoid**, **amyloid**, **hemochromatosis**, **cancer**, and **fibrosis** as well as other causes that are really rare. Treatment is tricky – it’s necessary to maintain an adequate preload while not overloading the pulmonary vasculature. **Gentle diuresis** and **heart rate control** are essential. **Transplant** in refractory cases.



Thin walls, weak contraction



The **hypertrophied septum**, growing from the **normal septum** overrides the **aortic opening**



By increasing preload the chamber fills, pushing the septum away from the aortic opening



All the junk in the myocardium won’t let the heart relax / fill

The old way to manage lipids

A lot has changed in the management of dyslipidemia. Let's start off by talking about what we USED to but **no longer do**. There was much talk about **targeting an LDL** (<100 for coronary artery disease equivalents, <70 for active stroke, heart attack, or peripheral vascular disease). That isn't done anymore. We used to look at whatever their current LDL is and compare it to the number of risk factors for coronary artery disease in order to determine whether to start a medication, lifestyle modifications, or both. That isn't done anymore. We used to use a **combination of anti-lipid drugs** in order to achieve those goals, adding medications to get the LDL down. Again, not done anymore. We used to **closely monitor lipids** and **LFTs** to assess success in treatment and for hepatotoxicity. It isn't done anymore.

Statins

The **statins (HMG-CoA reductase-inhibitor)** are the mainstay of therapy. They inhibit new liver synthesis of cholesterol, limiting LDL. LDL is the bad cholesterol that deposit plaques when in excess. They do little the HDL, the good cholesterol that removes plaques. Beware a small risk **for myositis (rhabdo) and hepatotoxicity**.

The New Way

The new recommendations essentially put everyone on a statin. Now, **statins are the only drugs used** to control cholesterol. The goal is to be **on a statin** - not a target LDL number. Lipids are only assessed after **one year of therapy**. Do **not** get screening LFTs unless there are signs and symptoms of liver toxicity or myositis.

So if the goal is to just "be on a statin" and statins are the only drugs used, how can a multiple choice question be made out of that? The new decision tree is to decide between **no statin, moderate potency statin, or high potency statin** then decide who should **avoid statins** because of comorbid conditions.

There is an algorithm published in the ACC-AHA lipid guidelines (don't memorize it). Instead, take this away:

Look in a vignette for signs of hepatotoxicity or myositis as a reason to STOP a statin. Get a **CK for Myositis**.

When statins are not able to be prescribed, THEN the indications of other drugs must be known.

Niacin is never the answer (formerly increased HDL)

Aspirin is used to reduce the flushing associated with niacin

*This section represents a major update to the way statins are managed. Because this is new (Dec 2013), it's unlikely the test will reflect questions of this content for 3-5 years. Just be current and answer the question as though the test is representative of new changes. You'll get it right. These new changes ARE implemented in practice.*

Risk Factors for coronary artery disease

1. Hypertension
2. Diabetes (this is an asymptomatic CAD equivalent)
3. Smoking
4. HDL < 40
5. Age 55 for women, 45 for men

Drug	Effect	Mechanism	Side Effect
Statins	↓LDL ↓TG	HMG-CoA reductase	<b>Myositis</b> <b>LFT ↑</b>
Fibrates	↓TG ↑HDL	Lipoprotein Lipase	<b>Myositis</b> <b>LFT ↑</b>
Ezetimibe	↓LDL	Cholesterol Absorption	<b>Diarrhea</b>
Niacin	↑HDL ↓LDL	↓ Fatty Acid Release ↓ LDL Synthesis	Flushing (treat with ASA)
Bile Acid Resins	↓LDL	Bile Acid Reabsorption	<b>Diarrhea</b>

1. Who gets a statin?

- a. Active disease (PAD, CVA, MI) High potency
- b. LDL > 190: High potency
- c. Diabetes: moderate potency
- d. Diabetes + another risk factor: high potency
- e. 2+ Risk factors: moderate potency

2. Who DOESN'T get a statin?

- a. LDL < 70 and no risk factors
- b. Liver disease (use low potency and caution)
- c. Age > 75 is the same as liver disease
- d. LDL < 70
- e. People with hepatotoxicity or myositis

3. Screening

- a. Start at 21 years old
- b. Do NOT check LFTs unless signs of hepatotoxicity
- c. Do NOT check Lipids at 3 months, wait 1 year
- d. Lifestyle Modifications at every visit

Introduction

Myocardial ischemia is produced where there is an **occlusion to blood flow**. It's caused by chronically progressive **atherosclerosis** limiting perfusion to the myocardium. This produces ischemia when cardiac demand increases; there's an imbalance in the demand to supply ratio. When an **acute thrombus** forms from endothelial injury the lumen can quickly become occluded (an MI). Over time, the patient will undergo **infarction** with permanent loss of myocardial tissue.

Risk Factors

Since this is a result of progressive **atherosclerosis** those things which perpetuate atherosclerosis will lead to ischemic heart disease. Risk factors provide something **to fix** and help steer the **diagnosis**. What makes this interesting is HOW you fix these risk factors. They're **HTN, smoking, dyslipidemia, diabetes**, and drug use (i.e. **cocaine**).

Patient Presentation

Myocardial ischemia on its own is painful. It causes a **crushing, retrosternal chest pain** that will **radiate down the arm and up the jaw**. It may also present with **dyspnea**. Ischemia on its own will not cause mechanical failure. Other signs and symptoms will be a result of myocardial infarction and **necrosis**. If the **Left Heart** fails it's **pulmonary edema**. If the **Right Heart** fails it's **hypotension and peripheral edema**. Any infarct can produce **arrhythmias**: atrial, ventricular - whatever. Separating severity of ischemia is typically based on whether or not the **pain is relieved with rest and/or nitrates**. Beyond that, laboratories are needed to differentiate between the "bad ones" (STEMI, NSTEMI).

Diagnosis

The first test is the **ECG**. It's noninvasive, cheap, and able to detect the highest acuity disease (STEMI). It also establishes an admission baseline for comparison. A **12-Lead ECG** is best. **ST segment elevation = transmural infarct = STEMI**.

To rule out active myocardial **infarct** you need cardiac **biomarkers** (Troponins, CKMB, etc). These are released from dying or dead myocytes. They separate unstable angina from NSTEMI.

Routine tests such as **CXR / CBC / TSH / CMP** are obtained but do not influence the diagnosis or management.

Multiple options exist for confirming the diagnosis of myocardial ischemia based on severity and acuity. There is the **stress test** (for someone who has neither NSTEMI nor STEMI) and the **best test** which is **coronary catheterization**. The higher the acuity, the more likely the cath. Let's talk about the low-acuity setting first.

Risk Factors

**HTN**  
**Smoking**  
**Dyslipidemia**  
**DM**  
**Cocaine**

	<b>Stable Angina</b>	<b>Unstable Angina</b>	<b>NSTEMI</b>	<b>STEMI</b>
Pain	Exercise	@ rest	@ rest	@ rest
Relief	Rest + Nitrates	Ø	Ø	Ø
Biomarkers	Ø	Ø	↑	↑
ST Δs	Ø	Ø	Ø	↑
Pathology	70%	90%	90%	100%

<b>Typical</b>	<b>Atypical</b>
<i>Levine Sign</i>	<i>Fatigue</i>
<i>Crushing Chest Pain</i>	<i>Malaise</i>
<i>Pale, Cool, Diaphoretic</i>	<i>SOB</i>
<i>Sense of Impending Doom</i>	

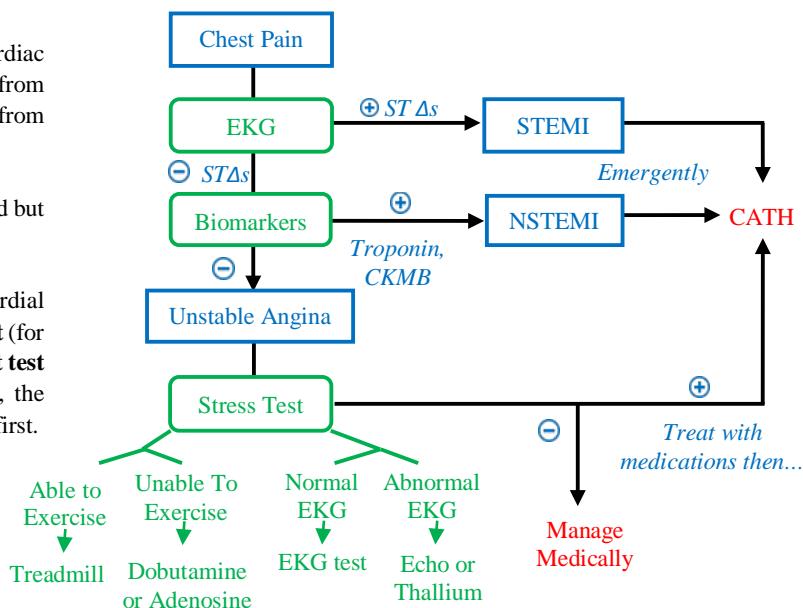
Diagnosis

In **Acute** disease (guy in the ER with active chest pain)

↳ get EKG, Troponins, and Cath.

In **Chronic** disease (guy in office with an h/o chest pain)

↳ get an EKG and Echo/Stress Test.



Diagnostic Modalities

## 1. The stress test

- a) **Treadmill stress test** - Requires the patient to be able to exercise (80% of max heart rate) and requires a **normal ECG**. Send him/her on an exercise and **stop the test** when there are **EKG changes** (ST depression or T wave inversion) or **Chest Pain**. If positive, go immediately to **cath**.
- b) **Dobutamine Stress Test** – Uses a **pharmacological challenge** and an **Echo**. Under the challenge (85% max HR), the echo will pick up **hypokinesis** or **akinesis** (decreased wall motion). Areas that are **infarcted** will persist with akinesis even at rest. Areas that become ischemic under stress (become akinetic) will **move again** after dobutamine is removed (revealing salvageable tissue).
- c) **Nuclear Stress Test** – Thallium looks like **sodium** to the heart. It will be picked up by myocytes and **light up healthy tissue**. Infarcted tissue will not under both rest and exercise. Ischemic tissue will not under stress, but will at rest (revealing salvageable tissue).

## 2. Catheterization

This is the **best test** for the diagnosis of coronary artery disease. It assesses the **severity of stenosis** AND helps rule out **Prinzmetal's angina** (clean coronary arteries producing ischemia as a product of vasospasm - treat with CCB).

Therapy

## 1. Adjust risk factors

- a. **LDL** – the goal is to  $\downarrow$  **LDL < 100** or  $< 70$  for active disease and get  $\uparrow$  **HDL > 40**. Do this with **statins**. Other drugs exist, but start with statins. Use **Fibrates** if there is a contraindication to statins.
- b. **DM** – tight glucose control to near normal values (**80-120** or **HgbA1C < 7%**) with oral medications or insulin.
- c. **HTN** – regular control of blood pressure to  $<140$  /  $<90$  with **Beta-Blockers** (reduce arrhythmias) and **ACE-inhibitors**. Titrate heart rate to between 50-65 bpm and 75% of the heart rate that produced symptoms on stress test.

## 2. Reduce Risk of Thrombosis

Manage this with either **Aspirin** (Cox-Inhibitor) or **Clopidogrel** (ADP-inhibitor) long term. Those spiffy **Glycoprotein IIb/IIIa inhibitors** like Abciximab are useful in the patient going for cath with stenting for additional antiplatelet effect, but they are not for long term.

## 3. Surgical Management

Surgical management choices are **angioplasty** or **CABG**. The decision is made based on the severity of occlusive disease. If it's really bad (i.e. requires multiple stents) do a CABG. If the atherosclerosis is global and no ground can be found for the stent, do CABG. Stents are now **drug-eluting** (require Clopidogrel) or **bare-metal** (do not require Clopidogrel)

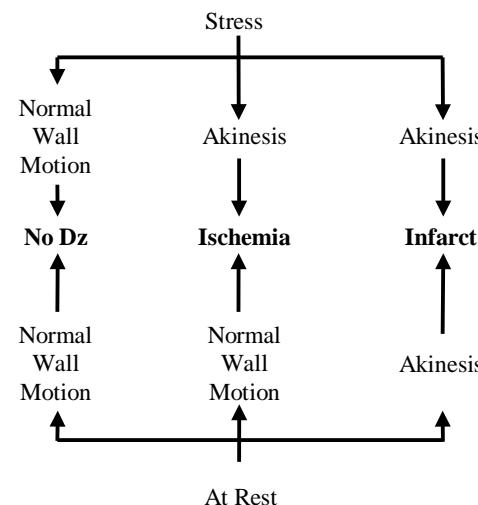
## 4. Thrombolytics

Either the administration of **tPA** (within **12 hours** of onset) or **heparin** is done only when catheterization is not available AND they are in an acute disease (NSTEMI or STEMI).

Can't Exercise: Peripheral Vascular Disease, Claudication, vasculitis, diabetic ulcers, SOB at rest, etc.

Can't Read ECG: Any BBB or old infarct

*"Dead Things Don't Move"*

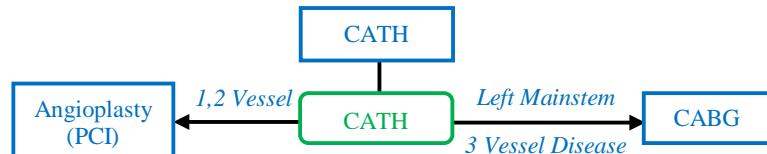


At Rest

Acute Presentation: MONA-BASH

Morphine	Beta-Blocker
Oxygen	ACE-inhibitor
Nitrates	Statin
Aspirin	Heparin

Treatment	When to use it	Goals
Statins	Any ACS	LDL < 70
$\beta$ -Blockers	Any ACS	SBP < 140
ACE-i	Any ACS	SBP < 140
ASA	Any ACS	No goal
Clopidogrel	ASA allergy or drug-eluding stents	No goal
Angioplasty	ST↑ or + Stress; 1 or 2 vessel disease	
CABG	ST↑ or + Stress; Left-Mainstem <u>or</u> 3 vessel disease	
tPA	ST↑ or + Stress; no PCI available, no transport	
Heparin	ST↑ or + Stress; contraindication to tPA,	



Surgery = Left Mainstem OR 3-vessel disease; surgery = CABG  
Angioplasty = 1,2 Vessel Disease

Introduction

Heart failure is enormously complex. There are multiple types, manifestations, causes, and treatments. You need to consider the chronic management of a regular heart failure and then decide what to do with an acute exacerbation.

Types of Failure

The first consideration to understand is **systolic** vs **diastolic**. **Systolic** failure arises when the heart can't push blood forward. It can go backwards (a **leaky** heart), be **floppy** (dilated cardiomyopathy), or be **dead** (secondary to myocardial ischemia). Plain and simple - systolic failure is a broken pump. The heart fills in diastole, hence, **diastolic** failure is when the heart **can't fill**. If something prevents the heart from relaxing and accepting blood it produces a diastolic failure. This might be from hypertrophy or infiltration.

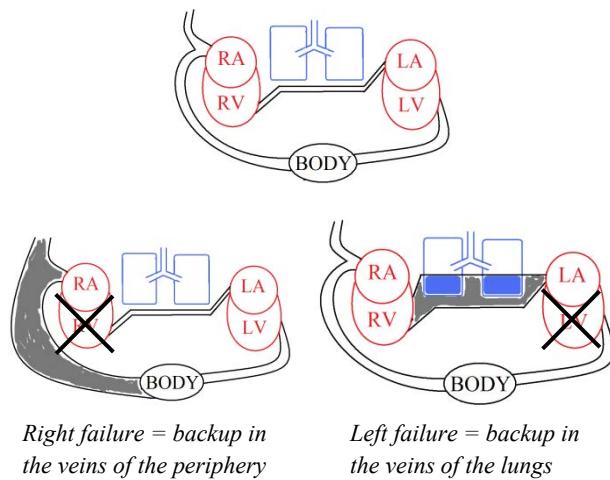
The second consideration is left versus right failure. **Left Ventricular Failure** is a failure to pump blood into the periphery; there's a backup of blood into the lungs. **Right Ventricular Failure** causes a backup of blood into the venous circulation.

Pathogenesis and Etiology

The typical chronic failure that occurs insidiously is by far the most common. It's caused by **hypertension**. High blood pressure causes an increase in systemic vascular resistance; the heart has to pump harder and harder to push the blood. It gets bigger and beefier to compensate. But just like any muscle, it putters out and eventually fails. The heart gets bigger, rounder, and eventually goes floppy. Pathologically, constant overstimulation by **catecholamines** first helps the heart overcome the hypertension. It eventually leads to **neural hormonal remodeling**, **cardiac toxicity**, and then **fibrosis**. Other etiologies are simply a matter of memorization. But anything that **dilates the heart** overstretches myocardial fibers and decreases contractility, or anything that **kills the heart** (ischemia), or anything that **stops up** (deposition disease) the heart can decrease contractility.

Symptomatology

Symptoms arise from where the fluid backs up. The classic patient is the triad of Exertional Dyspnea, Orthopnea, and Paroxysmal Nocturnal Dyspnea. **Exertional dyspnea** is shortness of breath limiting walking. **Orthopnea** is shortness of breath that's worse when lying flat. **Paroxysmal Nocturnal Dyspnea** is when the patient wakes up in the middle of the night gasping for breath. Because most patients have left and right failure together, **rales** (fluid on the lungs) may get mixed with **peripheral edema** and **hepatomegaly**. Symptoms like an **S3 heart sound** and **Jugular Venous Distension** are signs of acute exacerbation. In the chronic setting, it's critical to determine what **class** they are. Here, we use NYHA, as it directs treatment.



*Right failure = backup in the veins of the periphery*

*Left failure = backup in the veins of the lungs*

Failure	Path	Etiology	EF
Systolic Failure	Forward failure	<b>Leaky valves</b> = any regurgitation <b>Dead Heart</b> = Ischemia / infarction <b>Floppy</b> muscles = EtOH, HTN, Drug	⬇️
Diastolic Failure	Filling failure	<b>Pericardium</b> = Pericardial Tamponade Constrictive Pericarditis <b>Cardiomyopathy</b> = Restrictive Hypertrophic	⬆️

Symptoms	
Left Ventricular Failure	Right Ventricular Failure
Orthopnea, Crackles, Rales Dyspnea on Exertion, S3, Paroxysmal Nocturnal Dyspnea	Hepatosplenomegaly, <b>JVD</b> Peripheral Edema, Dyspnea on Exertion, ↑JVP

*S3 and JVD poor prognostic sign in acute exacerbation*

Chronic NYHA Class		
I	Ø Limited	Ø Symptoms
II	Slight Limitations	Comfortable at rest and walking
III	Moderate Limitations	Comfortable at rest only
IV	Totally Limited	<b>Bed bound, sxs @ rest</b>

*The ACC/AHA has a class A-D, based on the presence of structural heart disease.*

Diagnosis

When first attempting to diagnose CHF there are two tests that should be used. The **BNP** is useful to say, “volume overload or not.” It’s a blood test and requires no advanced training to interpret. The standard test is the **2D echocardiogram**, which can distinguish between systolic failure (ejection fraction <55%) and diastolic failure (preserved ejection fraction). There are more definitive tests such as a **nuclear study** which calculates the exact ejection fraction and identifies areas of ischemia (it is a stress test), or **Left Heart Catheterization** (even more definitive of EF and coronary artery disease) which can be performed with a right heart cath to demonstrate elevated pulmonary artery pressures. ECG (demonstrates old ischemia / arrhythmia), CXR (demonstrates cardiomegaly or pulmonary edema), and troponins (acute ischemia) are not inappropriate, but they also aren’t necessary.

Treatment

There are two goals: reduce fluid and reduce afterload. To reduce fluid it’s important to restrict salt intake (< **2g/day** of NaCl) and reduce fluid intake (< **2L H2O/day**). Everybody gets this. Once the patient reaches class II, keep the fluid off by using diuretics like **furosemide**.

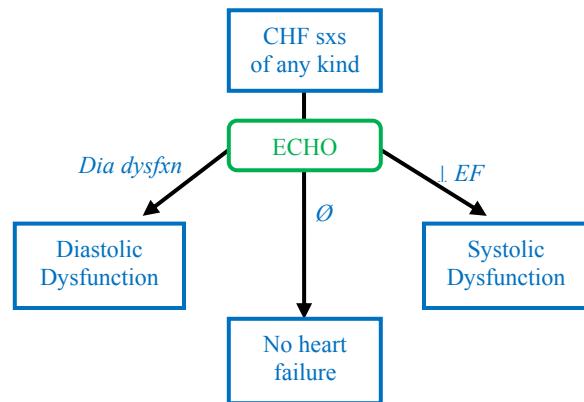
Afterload reduction is achieved with Ace-inhibitors (also Angiotensin Receptor Blockers). When CHF gets really bad (Class III and greater), add **Spironolactone**. The combination of Isosorbide **dinitrate** and **Hydralazine** can be used as well.

When the situation is dire (class IV) it’s time to add **inotropes** like **Dobutamine** (which is a drip) in the ICU while preparing for a **transplant** or **ventricular assist device** bridging them to transplant.

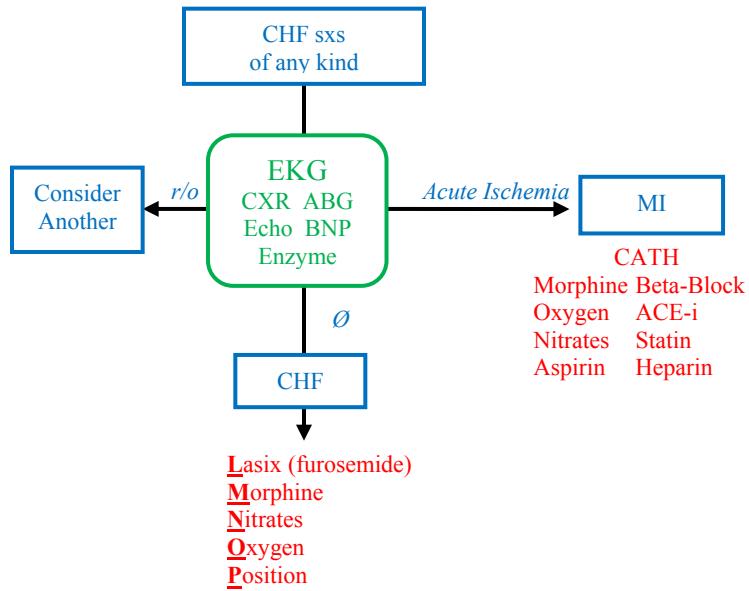
To reduce the risk of sudden cardiac death, **Beta-blockers** are used to reduce arrhythmia and neuro-hormonal remodeling. Other considerations are the placement of an **AICD** if the **EF < 35%**. If there’s need of symptom relief (knowing it won’t change mortality) **digoxin** can be used.

Acute Exacerbation

People live with heart failure. However, when there’s an acute exacerbation, a patient can go into **acute pulmonary edema** - a life threatening condition. It might be the patient took on too much fluid, neglected their meds, or the result of an **ischemic event** or **arrhythmia**. Presenting as a shortness of breath, you **start oxygen** and get an **ECG**. CXR, ABG, Echo, cardiac enzymes etc. will all be gotten to rule out or rule in other causes of pulmonary edema or shortness of breath. If there’s a question, a **BNP**, produced by atrial stretch, is highly **specific** when **elevated**. The goal is to rapidly decrease afterload (**nitrates**, **Hydralazine**, **anti-hypertensives**), get the fluid off their lungs (**IV diuretics**), and to decrease preload (**nitrates** and **morphine**). Patients should then be discharged on the appropriate **ACE/βB/Diuretic** combo.



Patient	Treatment
Everybody	Salt <2g per day H <sub>2</sub> O < 2L per day ACE-i or ARB (best mortality benefit) <b>Beta-Blocker</b>
Fluid and afterload reduction @ Death's Door	Diuretics like <b>furosemide</b>  <b>Spironolactone, ISDN+Hydralazine</b> <b>Inotropes like Dobutamine (ICU)</b> VAD bridge to transplant <b>Transplant</b>
EF < 35%	AICD (non-palliative only)
Ischemic	<b>ASA and Statin</b>



Introduction

Hypertension is defined by a **systolic BP > 140** or a **diastolic > 90**. HTN is often an asymptomatic, chronic, age-related condition that worsens and contributes to **atherosclerotic disease**. In **essential hypertension** (primary hypertension) the cause is **idiopathic** and independent of any one given risk factor. This must be differentiated from **secondary hypertension** - hypertension attributable to some hormonal, structural, or metabolic condition. Essential is by far the most common but other causes must be investigated.

Diagnosis

In order to diagnose hypertension there must be **two blood pressures** taken at **separate office visits** that are **greater than 140/90**. Normal is **120/80**. Pay attention to the severity/stage of hypertension. Remember the “20, 10, symptom rule”. Start at 120/80, then add 20 to the systolic and 10 to the diastolic to reach the next stage. Once at 180/120, the presence of end organ damage pushes from urgency to emergency. It’s important at the time of diagnosis to evaluate for **acute end organ damage**, which’d thrust the patient into the **emergent category**.

Management

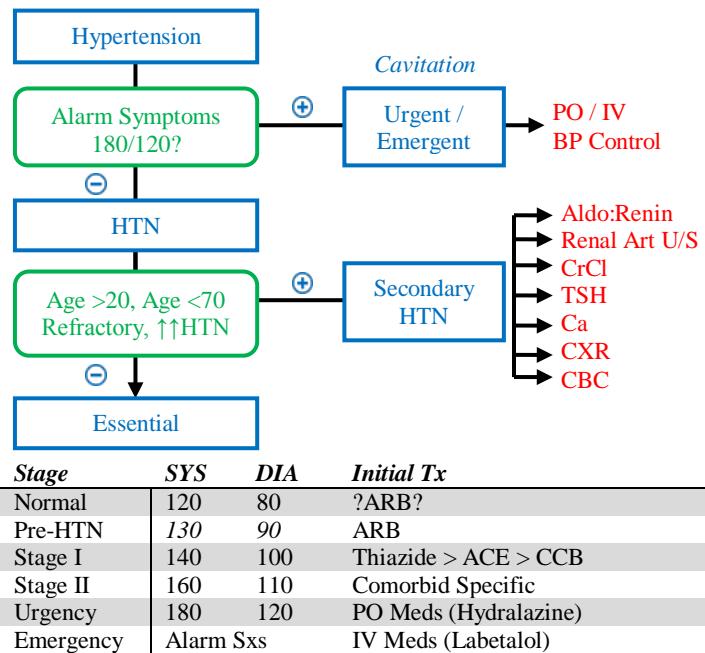
Treatment is dependent on the **stage** of hypertension. For **prehypertension** the renoprotective benefits of **ACE/ARB** doesn’t decrease the number of events but does prevent progression of hypertension. For **stage I**, diuresis is the name of the game. If drugs are to be added, **diuretics > ACE/ARBs > CCB**. When it comes to Stage II, many permutations exist with the expectation that 2-4 medications will be required. If using  **$\beta$ -Blockers** combined vasodilators (**Carvedilol**) are better than non-vasoactive (**Propranolol**). When using **CCB** be aware that addition or increasing dose may take **several days** to see effect.  **$\alpha$ -blockers** (like clonidine) should be **avoided** until no other options exist.

Secondary Hypertension

This is refractory hypertension caused by something. If the kidneys are not perfused (**renovascular**, **CHF**, **cirrhosis**) then the kidney responds with an **increased RAS** (which means ANGII = HTN). A primary aldosterone secreting tumor produces aldosterone without renin. **Pheochromocytoma** causes the release of **catecholamines**. **Hyperthyroid** causes an increase in T3 metabolism. Even an isolated **hypercalcemia** can cause hypertension by accelerating plaque formation. Each are discussed in detail in other sections.

Goals

In general, the minimum goal is **<140/<90**. Every 20 point systolic increase OR 10 point diastolic **DOUBLES** the risk of a cardiovascular event. More stringent blood pressure control is required for **diabetics** (**<135/<85**, some would even say **<130/<80**).



Alarm Sx = Stroke, MI, Papilledema, Proteinuria, ARF, eclampsia, aortic dissection

Condition	Option
CAD (pre-MI)	CCB + ACE > $\beta$ -Blocker + Diuretic
Angina	$\beta$ -Blocker
Post MI	$\beta$ -Blocker + ACE
CVA PPX	ACE
DM	ACE
CKD	ACE + Others

CCB = Calcium Channel Blocker = Amlodipine  
 $\beta$ -Blockers = Propranolol, Labetalol, Carvedilol  
 ACE/ARB = Lisinopril, Captopril, Losartan, Candesartan

Type	History	Workup
Renovascular	DM or glomerulonephritis ARF induced by ACE/ARB Renal Bruit, Hypo K	CrCl BMP Aldo:Renin < 10 U/S Renal Artery
Pheochromocytoma	Pallor, Palpitations, Pain, Perspiration, Pressure	24-Hr Urinary metanephrenes, CT
Hyperaldo	Refractory HTN or HTN and HypoK	Aldo:Renin > 20 CT Pelvis
Hyperthyroid	Weight Loss, Sweating, Heat intolerance, Palpitation,	TSH, Free T4
Hypercalcemia	Polyuria, AMS, “moans, groans, bones, kidney stones”	Free Ca

Introduction

The etiologies of all pericardial diseases are the same. We could memorize 50+ causes of pericardial disease but it's better to simply learn categories and keep a reference nearby to obtain the specifics. **Infections**, **autoimmune diseases**, **trauma**, and **proximate cancers** (lung, breast, esophagus, and mediastinum) cause pericardial disease. If **acute** they cause an **inflammatory condition** (pericarditis). If they happen to **make fluid** they cause an **effusion**, or in its worst form, **tamponade**. If **chronic**, the inflammatory condition can be around long enough to cause **fibrosis**, which leads to **constrictive pericarditis**. Focus on identification and treatment rather than etiology.

1) Pericarditis

Pericarditis is an inflammatory disease with an inflammatory treatment. It presents as **pleuritic** and **positional** (better when leaning forward) chest pain that will have a **multiphasic friction rub**. Caused by an inflammation of the sac around the heart, every heart beat causes irritation, producing constant pain. An ECG will show **diffuse ST segment elevation** (caution MI), but what is pathognomonic is **PR segment Depression**. An **Echo** will show an effusion but not the inflammation. Theoretically, MRI is best but not needed. Treat with **NSAIDs**. If they don't come through go up to **steroids**.

2) Pericardial Effusion / Tamponade

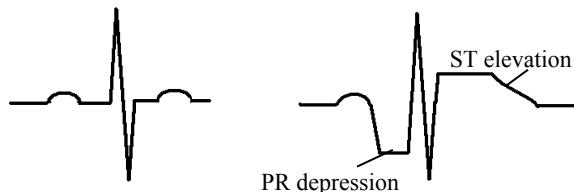
These represent a spectrum of the same hemodynamic-anatomic disease, requiring a hemodynamic-anatomic treatment. When a condition causes fluid to leak out it's an **effusion**. A small, slowly developing effusion may simply be an incidental finding in pericarditis. By treating the pericarditis, you treat the effusion. If there's **impaired filling** or a **repeat effusion**, it might be necessary to be more aggressive. **Pericardiocentesis** can be used as a one-time drain. A **pericardial window** may be required to allow continued drainage. If the effusion is **rapid** (or there's ventricular hemorrhage) the pericardium fills without time to compensate, producing **tamponade**. The heart **can't** fill, thusly causing a hemodynamic compromise. It results in **JVD** and **hypotension** (like heart failure), except the lungs are clear and the **distant heart sounds** (Beck's triad = JVD, Hypotension, Distant Hearts). There may also be **pulsus paradoxus**. Emergently get a needle and save this person's life. Do **EMERGENT** pericardiocentesis.

3) Constrictive Pericarditis

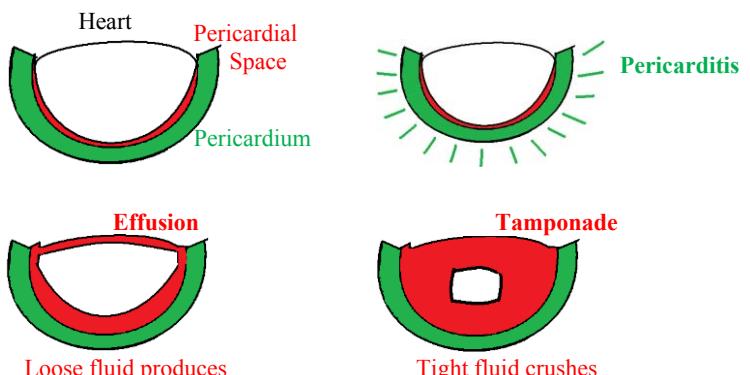
If an inflammatory process is left untreated long enough, **fibrosis** will set in. The loose membrane of the pericardium becomes **fixed and rigid**. It causes no trouble with contractility, but the heart relaxes into a **rigid box**, limiting filling. As the heart expands into too-small-a-space, it strikes the walls of the box, causing a pericardial **knock**. Treat by removing the rigid pericardium with a **pericardectomy**.

Etiology Categories

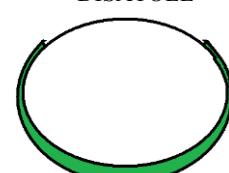
Infections	Viral (coxsackie) Bacterial (Strep/Staph) TB Fungus
Autoimmune	Lupus, Rheumatoid, Scleroderma
Trauma	Procainamide, Hydralazine, Uremia
Cancers	Blunt, Penetrating Lung, Breast, Esophagus, Lymphoma
Others	Many...



*Don't do an ECHO. Its ECG or MRI - echo will only show an etiology*



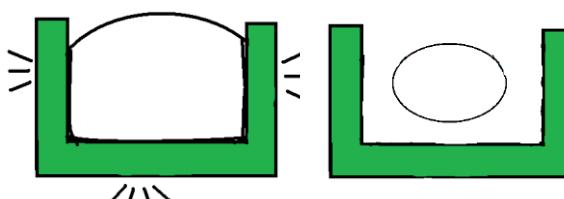
## DISATOLE



## SYSTOLE



Normal



Constrictive Pericarditis

Introduction

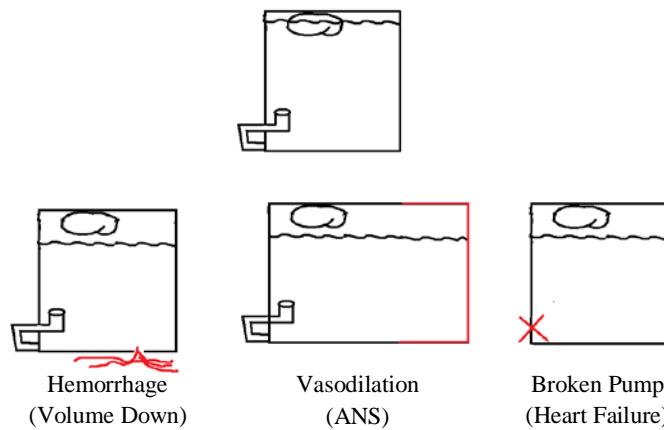
Syncope's a symptom defined as a **transient loss of consciousness** due to global cerebral hypo perfusion. The heart is a pump; it pushes blood into the vasculature, the "tank." The brain is at the top of the tank. Gravity works against the heart by pulling the blood towards the ground. Thus, it's necessary to have a strong pump, a normal sized tank, and enough blood to fill the tank to get the blood to the brain. If blood can't get up to the brain, we pass out, i.e. **syncope**. It all comes down to **blood pressure** - a product of multiple factors (equation to right). The etiologies of syncope are vast; each affects one of these elements directly. But they all can be narrowed down to: a broken pump, too big a tank, and not enough fluid. It's important to realize how the history and physical relates to the potential etiology and the tests that need to be done to confirm suspicions.

Neurocardiogenic (Vasovagal)

The vagus nerve goes everywhere: visceral organs, blood vessels, and the brain. It's both afferent and efferent. Its signal to the blood vessels causes them to dilate, reducing systemic vascular resistance. The signal given to the heart is bradycardia. If the **Vagus nerve activates** more than it should (for whatever reason), it can cause **bradycardia** (cardio-inhibitory) or **hypotension** (vasodepressor). In both cases blood pressure falls, blood to the brain falls, and the person passes out. Lots of things can cause the Vagus to fire: visceral stimulation, such as **cough / defecation / micturition**, an **overactive carotid sinus** as in **turning the head or shaving**, and, because the vagus nerve comes from the brain, **psychotropic causes**, such as the sight of blood. Vasovagal is both **situational** and **reproducible**. Do a **tilt-table** test to confirm suspicions.

Orthostatic Hypotension

Normally, when going from sitting to standing the blood follows gravity and pools in the legs. The person does not feel it but there's a drop in blood pressure. It's sensed by the same baroreceptors that could go overactive in vasovagal. These carotids send a signal which causes an almost immediate compensatory vasoconstriction and increased heart rate (which is why we don't pass out every time we stand). But this reflex can fail if there's insufficient sympathetic tone or volume. If the **autonomic nervous system is broken** (as in the **elderly** or a **diabetic**) or there's something fighting against the sympathetic tone (such as **sepsis**) there can be **no reflex sympathetics** to compensate, causing a person to pass out. In other words - SVR is insufficient. However, if there's **insufficient preload** to begin with, standing up exacerbates the condition; CO is insufficient. A decreased preload is seen in people with **hypovolemia** (diuretics, diarrhea, dehydration and hemorrhage). In both cases **vital signs** are highly suggestive of the disease. A **decreased systolic BP of 20, a decrease diastolic BP of 10, an increase in HR of 10**, or symptoms when moving from a laying position to a standing one give away the diagnosis. This person is said to be "orthostatic." Give back the volume with **IVF** if volume's down, or give **pressors**.



- BP = CO X SVR
- 
- Overactive Vagus → HoTN, Bradycardia
  - Situational Syncope
    - o Visceral → Cough, Defecation, Micturition
    - o Turning Head/ Shaving
    - o Site of blood → Psychogenic
  - Tilt Table

- Failure of Reflex Sympathetics
  - o Elderly/DM → Broken ANS
  - o Sepsis → Inflammatory Cytokines
  - o Anaphylaxis → Same as sepsis
  - o Addison's Disease
- Hypovolemia
  - o Hemorrhage
  - o Dehydration
  - o Diuretics
- Postural Hypotension
  - o Laying → Standing
  - o SysBP ↓ 20, DiaBP ↓ 10, HR ↑ 10
  - o Rehydrate or Add Constrictors

Mechanical Cardiac Disease

This is a rare cause of syncope. If there's a giant **obstruction to outflow** from the heart (saddle embolus, aortic stenosis, HOCM, LA Myxoma) cardiac output suffers. Because the patient is living, syncope occurs with an increase in cardiac demand, i.e. **sudden onset with exertion**. There might be an audible murmur but these diseases are structural so get an **Echo**. Cardiac output suffers because there's an obstruction to outflow. For a more thorough discussion of this phenomena please see hypertrophic cardiomyopathy in the cardiomyopathy section.



- *Structural Lesion*
  - o PE, AS, HOCM, LA Myxoma
- *Post Exertional Syncope*
- *ECHO*
- *Treatment Etiology dependent*

Arrhythmia

Arrhythmias are typically a disorder of **automaticity**. If the heart goes **too fast**, there's not enough time to fill ( $\downarrow$ **preload**). If the heart goes **too slow**, heart rate suffers + with it BP. Syncope will occur **suddenly**, without warning. An **ECG** will show the arrhythmia IF symptoms are occurring at the time of ECG, but it usually requires a **24-hr Holter** monitor to catch symptoms occurring with the arrhythmia. This will require **antiarrhythmics** or an **AICD** to flip them into a normal rhythm.

- *Sudden onset syncope, without prodrome*
- *Rapid change in CO*
  - o Too fast =  $\downarrow$  Preload
  - o Too slow =  $\downarrow$  HR
- *ECG → ECHO*
- *Antiarrhythmics or Defibrillator*

Neuro

Some things LOOK like a syncopal episode but they actually aren't. If you see someone "pass out," consider these diseases. This section is even more brief than usual; only one neuro cause is actually syncope. Decreased blood flow to the posterior circulation - **vertebrobasilar insufficiency** – may result in the patient passing out. Diagnose it with a **CT Angiogram** by looking at the vertebral arteries.

If the patient is **post-ictal** after "passing out" they may have had a **seizure**. Diagnose with an EEG. If the patient has a **focal neurologic deficit** he/she may have had a **stroke**. Diagnose with a **CT** or an **MRI**. If the patient simply **falls asleep** and **wakes refreshed** consider **narcolepsy**; treat with **amphetamines** and regularly scheduled naps.

Put it in practice: handling syncope: "Woman 3-2-1 PE"

	<i>History</i>	<i>Physical</i>	<i>Diagnosis</i>
<b>VV (Vaso Vagal)</b>	Situational, often Reproducible, with a positive prodrome	Vagal stimulation produces asystole or a $\downarrow$ SYS BP of 50 mmHg	Tilt Table
- Visceral Organs (micturition, defecation, cough) - Carotid Stimulation (turning head, shaving) - Psychogenic (site of blood)			
<b>Orthostatics</b>	Orthostatic hypotension	Defined as $\downarrow$ SYSBP by 20 $\downarrow$ DIA BP by 10 $\uparrow$ HR by 20 Sxs of orthostasis	Volume and Reassess, chase causes of hypotension if refractory to fluid
- Volume Down - Autonomic Nervous Dysfunction			
<b>Mechanical Cardiac</b>	Exertional syncope	Murmur	Echo
<b>Arrhythmia</b>	Sudden Onset, unprovoked,	None	24-hour Holter
<b>Neuro (vertebrobasilar insufficiency)</b>	Sudden Onset, unprovoked, very rare	Focal Neurologic Deficit	CTA
<b>Pulmonary Embolism</b>	PE	PE	Wells Criteria, CT scan
<b>Electrolytes (bG, Tsh)</b>	None	None	BMO

Introduction

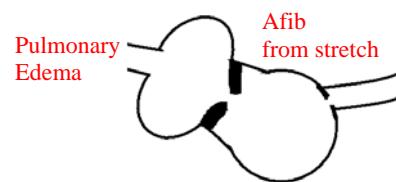
Cardiac murmurs occur as a result from **increased turbulence**, caused by **increased flow across a narrowed lumen**, either from a **stenotic valve** or a **regurgitant one**. The **location** and **timing within the cardiac cycle** are useful for identification of the murmur before imaging. Confirmatory diagnosis is always with **echocardiogram**. The good news is that not all murmurs are pathologic. If the murmur is < **grade 3** (out of 6), **systolic**, and **asymptomatic** it needs no investigation. Any **diastolic**, **symptomatic**, or > **grade 3** requires a workup. The goal should be to identify on auscultation, understand treatment and maneuvers (which mirror one another), and then learn the nuances found on history or physical.

Mitral Stenosis

Mitral stenosis represents an **obstruction to flow** across the **mitral valve** during **diastole**. Atrial pressures are near to 0, with blood normally just falling into the ventricle. Now forward flow is impeded - blood backs up in the lungs, and you get **CHF / SOB symptoms**. Because there's also an **atrial stretch**, a resultant **Afib** is possible. Caused almost exclusively by **rheumatic fever**, it's imperative that strep throat be treated appropriately. The auscultation will reveal an **opening snap** followed by a **decrescendo murmur in diastole** - the worse the stenosis the **earlier the snap**. Treatment is initiated when symptoms begin. Do not wait for congestive heart failure to set in! Because more flow = more murmur, treat this with **preload reduction**. For severe disease **balloon valvotomy** or **valve replacement** is required. If there is resultant afib, **anticoagulate** and cardiovert after the lesion is identified. Commissurotomy aren't performed anymore.

Aortic Stenosis

Aortic stenosis is an obstruction in getting **blood out** of the ventricle during **systole**. Because the most common cause is **calcification** (even in the case of congenital bicuspid valves, where calcification is just accelerated), and calcification takes decades to set in, this disease occurs in **elderly men**. The most common presentation is **angina, especially on exertion** (old men have coronary artery disease AND now they have calcification, too). **Syncope** is classic, especially as cardiac demand increases (as in with exertion). The worst symptom is active **CHF**, implying the worst prognosis - a 1-3 year survival from diagnosis. Heard best at the **aortic region**, it's a **crescendo-decrescendo** murmur. Because it will cause hypertrophy and eventual failure (as the left ventricle pushes against an enlarged "afterload") treatment is a must. Start with **preload reduction** so there is less to push. A **valve replacement** is required sooner rather than later. In this case, a commissurotomy or valvotomy is not possible, because the calcifications are too thick. A valve replacement will result in the **ostea** being lost; it prompts a **CABG** regardless of CAD status.



*Makes for a **big beefy heart** that eventually **fails** leaving the **heart full of blood***



Mitral Regurgitation

Blood should exit the left ventricle through the aortic valve. The mitral valve prevents it from going back into the atria. When the mitral valve fails, blood shoots from the high pressure left ventricle to the low pressure left atrium causing **atrial stretch** (potential Afib), **pulmonary congestion** (full blown pulmonary edema to CHF), and a **decreased forward flow** (cardiogenic shock). The process may be **acute** (rapid, sudden, devastating) and is a result of valve destruction. Causes include **ruptured papillary muscle** or **Chordae Tendinae** (via myocardial ischemia), **infective endocarditis**, or direct trauma. Onset will be **sudden** and the symptoms **fulminant**. Rapid identification and surgery is required. In the **chronic** (slowly developing - time for compensation) condition, usually secondary to **ischemia** or **mitral valve prolapse**, the onset is **gradual** and the symptoms are simply **exertional dyspnea** or **fatigue**. Heart failure may be controlled with normal medications, but **replace before CHF / Afib / Dilation** occur. Treat it when it's found. This is the classic **holosystolic murmur radiating to axilla** heard best at the **cardiac apex**.

Aortic Insufficiency

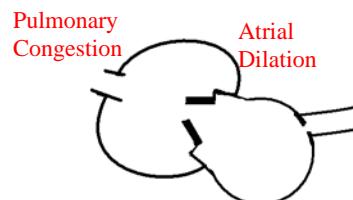
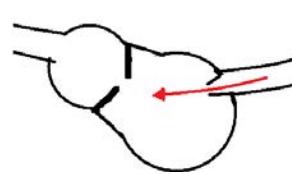
Blood should not fall back into the left ventricle during diastole. In fact, aortic contraction maintains diastolic blood pressures. If the aortic valve is floppy (**ischemia** or **infection**) as the aorta's contractility squeezes blood, it will squeeze it back into the ventricle rather than forward into the periphery. This presents with **dilated heart failure** if chronic or **cardiogenic shock** if acute. Some end-stage findings have been characterized and named. Impress the attending with their knowledge but the valve should be **replaced** before that happens. This is a **decrescendo murmur** heard best at the **aortic valve**.

Mitral Valve Prolapse

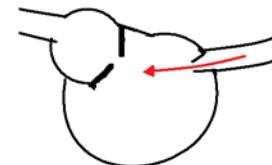
Generally, mitral valve prolapse is a **congenital defect** of the valve leaflets. They are **too big** for the annulus; they poach into the atria. The murmur sounds like **mitral regurgitation** but the pathogenesis and treatment is far different. Expanding intravascular volume and allowing the heart to fill will stretch the annulus and make the leaflets fit better. Look for the **Pregnant woman** (whose decreased venous return exacerbates this murmur).



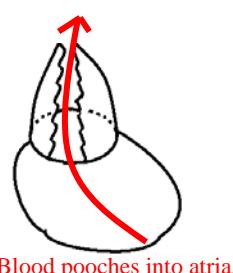
Blood shoots back into the atria

Pulmonary Congestion  
Atrial Dilation

Blood pours back into the left ventricle



Cardiac Dilation + Systolic Dysfxn



Blood poaches into atria, rather than lock, allowing back flow



Expanding the ventricle pulls the valve together

	<b>Murmur</b>	<b>Location</b>	<b>Leg Raise</b>	<b>Valsalva</b>	<b>Tx</b>	<b>Path</b>	<b>Presentation</b>	<b>Def Tx</b>
Mitral Stenosis		Apex	Worsens	Improves	Preload Reduction	Rheumatic Fever	Afib, CHF SOB	Replace
Aortic Stenosis		Aortic to Carotids	Worsens	Improves	Preload Reduction	Calcification Bicuspid	Angina, CHF Syncope	Replace
Mitral Regurg		Apex to Axilla	Worsens	Improves	Preload Reduction	Infxn Infarction	CHF	Replace
Aortic Regurg		Aortic	Worsens	Improves	Preload Reduction	Infxn Infarction	CHF	Replace
HCOM		Apex	Improves	Worsens	Increase Preload	Congenital	SOB, Sudden Death	Replace
Mitral Valve Prolapse		Apex	Improves	Worsens	Increase Preload	Congenital	CHF	Replace

Alopecia Areata

A systemic **autoimmune disorder** against hair follicles. Ranging from **small patches** to **total body hair loss**, it's a poorly understood disease. Because it's primarily cosmetic, without alternatively associated disease, it's more about clinical **diagnosis** than management.

Traction Alopecia

Permanent **scarring** resulting in permanent **alopecia** that's secondary to keeping the hair **pulled tightly** (extreme braiding) that puts excessive traction on the root. This is **preventable** but **irreversible** once it occurs.

Male Pattern Baldness

A cosmetic issue whereby **5-DHT strangles** hair follicles causing hair loss starting at the crown and working its way around to the front of the head. Treat with **Minoxidil topical** and **Systemic Finesteride**.

Trichotillomania

Trichotillomania is a **psychiatric** disease labeled under anxiety or OCD. It presents as **patchy alopecia** with hair at **different lengths**. Tell the **girl** to stop and do behavioral therapy to treat the anxiety.

Chemo

Sometimes the hair falls out. Chemotherapy targets rapidly dividing cells. This means the cancer (yay!) but also the gut (diarrhea), bone marrow (anemia, infection), and hair. Hair loss is expected, anticipated, and without treatment.

Tinea Capitis

Tinea Capitis is a **fungal** infection that causes **patchy alopecia** on the head. All of the hairs will be lost at the same time, so **all hairs** in the affected region **are gone** or **are regrowing** at the **same length**. A **KOH prep** must be gotten to visualize the infection. Treat with topical and oral antifungals; failure to do so will result in permanent hair loss.

**FACTT M**

**F**ungus (Tinea Capitis)

**A**reata (Alopecia Areata)

**C**hemo

**T**raction Alopecia

**T**richotillomania

**M**ale Pattern Baldness

Pemphigus Vulgaris

Pemphigus is an **autoimmune disorder** against **desmoglein**. It's present in **desmosomes** that interconnect the epithelial cells of the epidermis. Because the destruction is between epithelial cells (**intra-epidermal**), the blister is **thin** and **tears easily** (⊕ **Nikolsky's Sign**). Diagnosis is made by **biopsy** showing a **tombstone** effect as basement membrane cells remain attached while epithelial cells split apart from each other. **Immunofluorescence** reveals **antibodies on epithelial Cells throughout** the skin lesion. Because it's an autoimmune disease, treatment starts with **systemic steroids**. Once controlled, swap to **steroid sparing** immune modulators when possible (mycophenolate mofetil, rituximab). This disease is **life-threatening**, does **involve mucosa**, and occurs in people ages **30-50**.

Bullous Pemphigoid

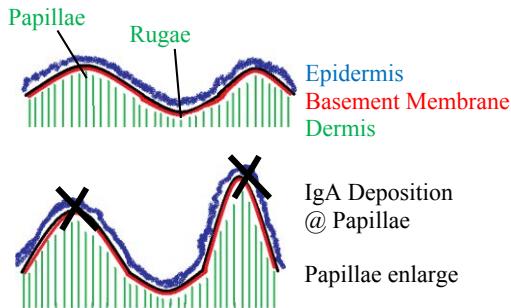
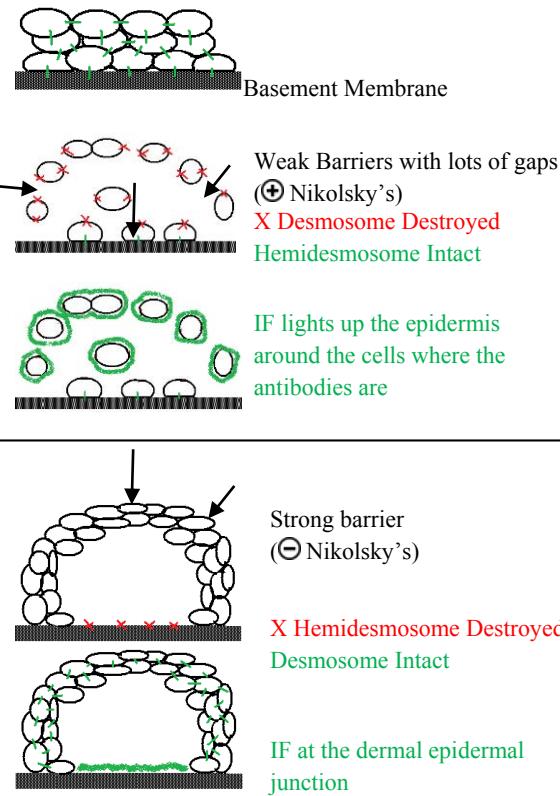
Pemphigoid is another **autoimmune disorder**, this time against the **hemidesmosomes** that attach basement membrane cells to the basement membrane (**sub-epidermal lesion**). The detachment causes a **blister** but the intact epithelium results in a **tense, rigid** bullae (⊖ **Nikolsky's**). Again, a biopsy is used for diagnosis showing **intact epithelium** that's **detached from the basement membrane**. **Immunofluorescence** shows antibodies at the **dermal-epidermal junction**. Treatment is with **steroids** during acute attacks – topical for limited disease, systemic for severe. This **ISN'T** life threatening and **DOESN'T** involve the mucosa. It's most commonly found in ages **70-80**.

Dermatitis Herpetiformis

This isn't a true blistering disease but is commonly tested against them. It's another **autoimmune disease** caused by **IgA antibodies** against **transglutaminase**. It's the **cutaneous manifestation** of celiac sprue and has the same pathology. The antibody-antigen complex gets deposited at the **dermal papillae** and causes an extension of the epidermis. It manifests as multiple small eruptions that are **pruritic** and found on the buttocks / legs or **extensor surfaces**. A biopsy is not needed, though if performed it'll show "**neutrophilic abscess**." Make the diagnosis instead by diagnosing the Sprue with anti-endomysial or anti-transglutaminase antibodies and an endoscopy. Treat the skin manifestation by treating the underlying disease: **remove gluten from diet** entirely.

Porphyria Cutanea Tarda

The most common porphyria disease, it's the lowest yield of the four. **Bullae on sun-exposed areas** is highly suspicious for the disease. The diagnosis is made with **coral red urine under Wood's Lamp** caused by accumulation of urinary uroporphyrins. The underlying etiology is a deficiency of uroporphyrinogen decarboxylase but can be brought on by OCPs, alcohol, Hep C, or Hemochromatosis. **Avoid the sun**.



Disease	Age	Mucosa	Blisters	Target	Dx	IF	Tx
Pemphigus Vulgaris	40-50	Involved	⊕ Nikolsky Thin, Tears	Dermatomes (intracellular)	Bx	Within Epidermis	Steroids → MM
Bullous Pemphigoid	70-80	No	⊖ Nikolsky Tense, Tough	Hemidesmosomes (to BM)	Bx	On Basement Membrane Epidermal-Dermal Junction	Steroids
Dermatitis Herpetiformis	20-30	No	⊖ Nikolsky	IgA Deposition @ papillae	<b>Antibodies</b>	Deposition at the papillae (though this is not needed)	Remove Gluten from Diet
Porphyria Cutanea Tarda	Any	No	⊖ Nikolsky Tense, Tough	N/A	<b>Wood's Lamp</b>	Don't do it	Avoid the sun

Nevi (Moles)

Nevi are benign hyperplasia of **melanocytes**. Use the ABCDE mnemonic to ensure a benign lesion. (**A**)**symmetric**, **irregular Border**, **mixed Color**, a **large Diameter** (>5mm), or **Evolving** (changing over time) is suspicious of cancer and requires biopsy. If anyone is positive, biopsy. If ALL are negative, offer reassurance. There are three kinds of nevi depending on the layer the melanocytes are growing in. They're often a subject of Qbanks rather than actual test questions. Be more concerned about whether it's ABCDE or not. What you care about is **melanoma**. Do a **wide excisional biopsy** and refer to the surgery skin cancer topic for more details.

Seborrheic Keratosis (NOT Seborrheic Dermatitis)

This is an **ugly looking mole** here to remind you that not all **⊕** ABCDE is melanoma. These are often **large, brown, greasy looking**, and **crusted**. They look, “**stuck on**” the face of an **old person**. Here’s the thing, it’s a cosmetic mark of aging, but it can look an awful lot like melanoma. If it’s been present for a long time and is unchanged, leave it be; it’s Seborrheic Keratosis. If it’s new or changing, do the biopsy to rule out melanoma. Board exams can get tricky about this, so be careful.

Actinic Keratosis

A **premalignant** condition appearing as **erythematous with a sandpaper-like yellow to brown scale**. This is **squamous cell carcinoma** in the making and carries all the same risk factors. Look for the sun-exposed patient (farmer, sailor, burns early in childhood) and the sun-exposed area (face, arms, hands). **Primary prevention** is key (wide-brimmed hats, sunscreen, avoidance of sun). Local ablation with **cryosurgery** is first line treatment. **5-FU** cream is used for diffuse lesions not amenable to cryosurgery. Actinic Keratosis, Bowen Disease (carcinoma in situ), and Invasive Squamous Cell Carcinoma are the same disease along a common spectrum.

Squamous Cell Carcinoma

SCC is a locally invasive malignancy of keratinocytes that **can metastasize** (unlike basal cell). Risk factors are sun exposure (see Actinic Keratosis). If it involves the lip, the lesion is almost **always on the lower lip**. The lesion itself will be fleshy, erythematous, and crusted or ulcerated. Biopsy the lesion, then perform **surgical excision**.

**Keratoacanthomas** look and sound like squamous cell carcinoma but grow more rapidly and regress spontaneously. Because of their similarities to SCC, if found they’re **resected** like SCC. If a patient describes a SCC that “**went away on its own**” it was keratoacanthoma.

Kaposi Sarcoma

Malignancy of vascular endothelial cells that occurs with co-infection of **HHV-8** and **Immunosuppression (AIDS)**. It’s a **purple** lesion. Treat the AIDS and the tumors go away. Failure to resolve with HAART (rising CD4) implies the need for local or systemic chemotherapy. Also, they can be anywhere.

**ABCDE = Cancer**

**Asymmetric**

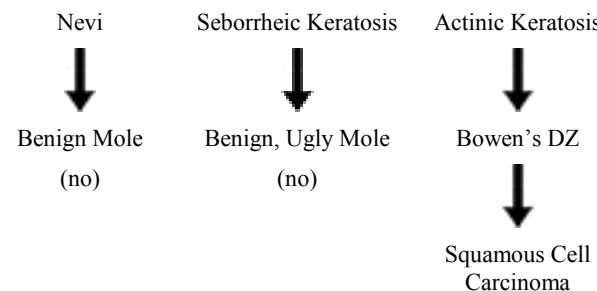
**Irregular Border**

**Mixed Colors**

**Large Diameter > 5mm**

**Evolving (changes in ABCD)**

You need ANY 1 to suspect cancer

*Is it Cancer?*

**Urticaria**

Urticaria aka hives is a **Type I Hypersensitivity Reaction**. Caused by exposure to an antigen, it crosslinks IgE on **mast** cells causing **Histamine** to be released. This causes leaky capillaries, producing an **annular, blanching red papule** of varying size. That antigen can be anything: bee stings, pressure, heat, food, contact dermatitis. If there's **no anaphylaxis** a clinical diagnosis may be made and **anti-histamines** are used to decrease the rash. Since any antigen can cause urticaria it's critical to identify the agent and avoid using it again. Send them to **RAST** to identify the culprit antigen.

**Drug Reaction**

These are commonly a **pink, morbilliform** rash (though any rash may be the case) occurring **7-14 days after exposure** (so new drugs are not culprits) in **hospitalized patients**. They're generally **widespread, symmetric, and pruritic**. Always stop the offending agent. Give diphenhydramine for mild symptoms, corticosteroids for severe symptoms.

A **fixed drug eruption** is any rash or blister that occurs in the same one spot in reaction to one drug every time it's administered. It occurs within 24 hours of exposure. Avoid the drug. It's never life-threatening.

**Erythema-Multiforme**

This is primarily a **cutaneous** drug reaction to **medication** (Sulfa, Anticonvulsants, NSAIDs, and PCN) that appears as a **target shaped** lesion that can occur on the **palms and soles**. It's benign and **self-limited**. Remove the drug and watch. Two other possibilities to consider: 1 – It can be caused by **chronic HSV** and refractory cases need **acyclovir** and 2 – if it's spreading or involving the oral mucosa get ready for **Steven-Johnson Syndrome**. Syphilis may also present with Targetoid lesions on the palms and soles and might be present as a distractor on the tests.

**Steven-Johnson Syndrome + Toxic Epidermal Necrolysis**

Both diseases are the same disease that exist as a continuum in severity commonly occurring from **drug reactions** (sulfa, anticonvulsants, NSAIDs, PCN). Each causes **widespread loss of sheets of skin** with a **⊕ Nikolsky's Sign**. Two things differentiate the diseases: Body Surface Area + Biopsy. SJS involves **<10% BSA** and has **basal cell degeneration** on biopsy. TEN involves **>30% BSA** and shows **full-thickness epidermal necrosis**. **Removal ALL meds** (including steroids) and admit to the **burn unit** (heat, electrolytes, fluid, infection risk). The biopsy is critical to differentiate between the **SJS / TEN** (which responds to removal of antibiotics) and **Staphylococcus Scalded Skin Syndrome** (which responds to the administration of antibiotics), as well as separating severity of SJS versus TEN. SSSS **doesn't have mucosal involvement**.

Give antibiotics (**clindamycin** to stop toxin production).

*Anaphylaxis = shortness of breath and hypotension with exposure to allergen. Give epinephrine. Follow with systemic steroids, H1 blocker and H2 blocker.*

Dz	Pt	Tx	Bx
Urticaria	IgE-Mast Cell mediated release of histamine after exposure to any antigen, blanching red papule	Diphenhydramine, Epinephrine if Anaphylaxis	N/A
Drug Reaction	Widespread Symmetric pruritic rash OR Any One rash at One spot in reaction to One Drug	Stop the drug, monitor	N/A
Erythema Multiforme	Targetoid lesion on palms and soles caused either by HSV or will progress to Steven Johnson	Acyclovir and/or Remove Drug	N/A
Steven Johnson	<10% BSA affected ⊕ Nikolsky's, ⊕ Oral Mucosal Involvement	Admit to the burn unit, fluids, electrolytes, supportive care.	Basal Cell Degeneration
Toxic Epidermal Necrolysis	>30% BSA affected ⊕ Nikolsky's, ⊕ Oral Mucosal Involvement	Steroids AREN'T helpful and may exacerbate the condition	Total epidermal thickness necrosis

Introduction

Finding a lesion on someone that's **Hypopigmented** isn't a big deal but is often the subject of board examinations. There isn't one algorithm to follow - just a loose group of associations to remember – which is perfect for building a summary table.

Tinea Versicolor

When there's a **patchy depigmentation** one of the things to consider is a fungal infection with **Malassezia globosa**. A normal fungus present in skin flora, it's unclear what causes it to overgrow, though **Cushing's** and **Immunosuppression** are risk factors. Hypopigmentation is a result of inhibited melanin production. Patients present with **small scaly patches** of **varying color** (typically in summer, as these spots don't tan). Diagnosis is made by **KOH prep** of the scale that reveals **hyphae + spores** that looks like "spaghetti and meatballs." Treat with topical **selenium sulfide**.

Vitiligo

An **autoimmune disease** that causes **small sharply demarcated depigmented macules or patches** with irregular borders that can coalesce. They're usually found on the **extremities, face, and genitalia**. Lesions can be picked up by the **Wood's Lamp Test** (no pigment at all), but definitive diagnosis is confirmed by the **absence of melanocytes** on histology. It's associated with autoimmune disorders such as hypothyroidism and lupus. Treatment is often ineffective. Steroids and UV light have been attempted.

Albinism

If a patient is **completely white** with **pale hair** and **pale eyes** they likely have albinism. It's a **genetic disorder of tyrosinase** (normal melanocytes, deficient enzyme) so there is no treatment; the diagnosis is clinical. Simply protect these people from UV exposure and educate on preventing skin cancer. Albinism is tested against Piebaldism and PKU, which can result in pale-skinned kids.

Ash Leaf

A **child** with a single hypopigmented (**NOT depigmentation**) spot that's positive on **Wood's Lamp** is an Ash Leaf Spot and pathognomonic for **Tuberous sclerosis**. Watch for early onset seizures. Get a CT scan to visualize the tubers in the brain. Look for **Shagreen patches** and adenoma sebaceum.

*Piebaldism is inadequate melanocyte migration with a white forelock on the scalp)*

*Albinism is inadequate tyrosinase activity, total depigmentation in all surfaces*

*PK is a deficiency in phenylalanine hydroxylase, causing a relative deficiency of tyrosine. Screened for at birth. Mental retardation, seizures follow if not for a special diet*

*Shagreen patches (elevated fleshy collagen plaques)*

*Adenoma Sebaceum (hyperplastic blood vessels)*

Dz	Patient	Diagnosis	Biopsy	Treatment	Path	Risk Factors
Tinea Versicolor	Small Patchy Scales of varying color Back and Chest	KOH Prep "spaghetti and meatballs"	Ø	Topical selenium Sulfide	Overgrowth of fungus (normal flora)	Cushing's Immuno↓
Vitiligo	Macule or Papule on Hands and Face	Wood's Lamp enhances lesion	Absent Melanocytes on histo prep	Ø tx Ppx vs Sun	Autoimmune	Other Autoimmune
Albinism	All body		Genetic Testing	Ø tx Ppx vs Sun		
Ash Leaf	Hypopigmented lesion from birth	Wood's Lamp then CT	Ø	See Peds		

### Seborrheic Dermatitis (NOT Seborrheic Keratosis)

Think of this as super-dandruff. Dandruff is flaking of the scalp. Seborrheic Dermatitis is a **fungal infection** that causes an inflammatory reaction in areas rich in sebaceous glands. That means **hair**. Look for a rash on the **scalp and eyebrows** that spares other areas of the face and ears. Treat with **selenium shampoo**. Topical steroids can be used as well if the inflammation doesn't settle with selenium. Low-yield test associations include: **HIV infection, cradle cap** (infants), and Parkinson's disease.

### Psoriasis

Psoriasis is an autoimmune disease which causes proliferation of keratinocytes with excessive accumulation of the stratum corneum. It's thought to be caused by dysregulation of T-Helper cells. The patient will have **symmetric, well-demarcated silvery scales that bleed when picked** that commonly affect the scalp, gluteal fold, elbows, and knees. **Nail pitting** and onycholysis (detachment of the nailbed) are common. If **joint pains** are present, consider Psoriatic Arthritis (see rheumatology – seronegatives). The first step is **UV light** (sunlight or artificial exposure). **Topical steroids** are used in flares. Other agents, both topical and systemic, are beyond the scope of a med student (methotrexate, calcineurin-inhibitors, Anti-TNF-alpha). There MAY be the need to biopsy to rule out lymphoma if the diagnosis is in question.

### Pityriasis Rosea

A benign and self-limiting condition that resolves on its own (~6 weeks). We don't know what causes it. The disease begins with a **flat, oval, salmon-colored macule** (hyperpigmentation in darker skinned races) called the **herald patch**. The disease progresses to **several salmon-colored scaling lesions** with a **trailing scale** (the scale does not reach the border of the salmon-colored lesion). This will always **spare the palms and soles**. While this is self-limiting, it may be the presentation of syphilis; rule it out with an **RPR**. Involvement of the hands and soles greatly increases the chance of syphilis.

### Lichen Planus

Lichen Planus is an inflammatory disorder of unknown etiology. It causes an **intensely pruritic pink or purple** flat topped **papules** (you can feel them) with a **reticulated network of fine white lines**. It usually involves the wrists and ankles but may involve the trunk, the oral mucosa or the vaginal mucosa. Treatment is similar to psoriasis. **Topical steroids** are the mainstay of therapy, but should not be continued long term. **UV light** can be used as an adjunct (as opposed to psoriasis where it's more effective). Topical and systemic immune modulators are beyond the scope of this text. Be aware that a **lichenoid drug eruption** (drug-induced lichen planus) can occur with Ace-I, thiazides, furosemide, and Beta-blockers.

Cushing's Syndrome

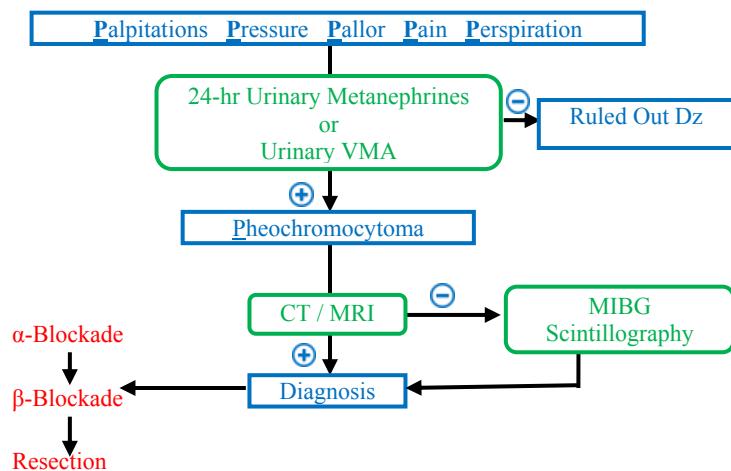
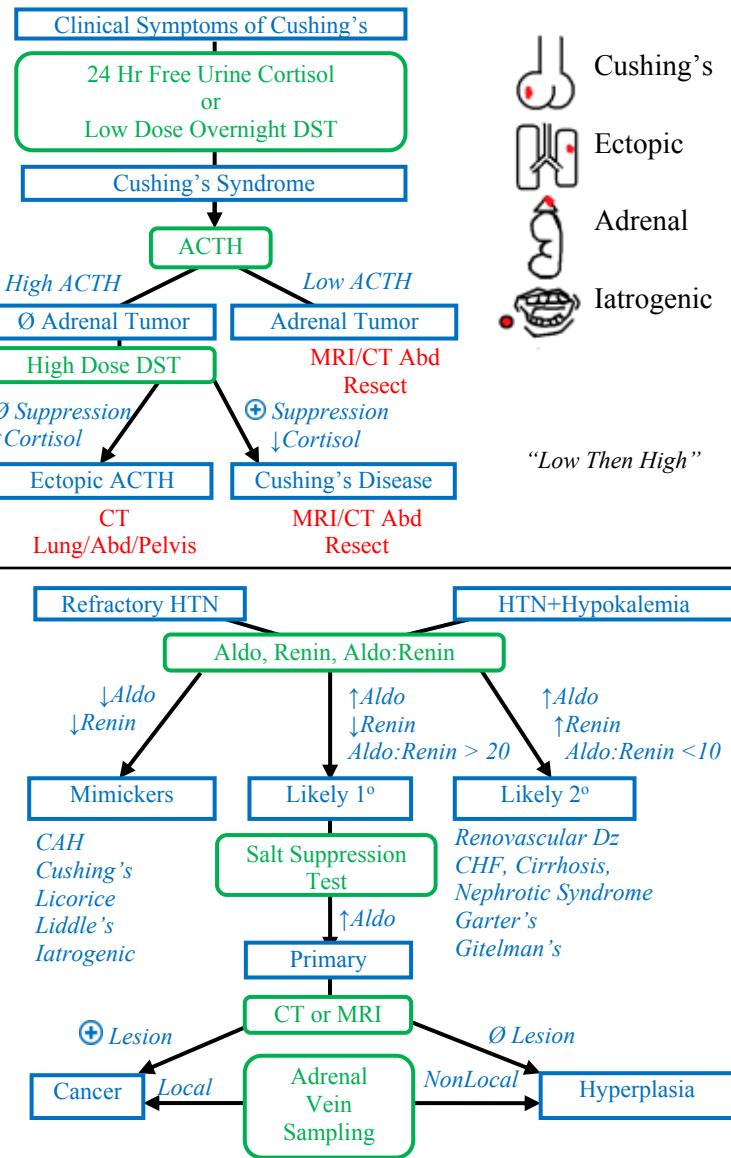
A disease of **excess cortisol**, it's caused by one of four conditions: (1) **Iatrogenic** (most common, taper off to fix), (2) **Pituitary tumor** (Cushing's disease), (3) **Adrenal Tumor**, (4) **Ectopic ACTH**. The patient will present with a "Cushingoid appearance" meaning **central obesity, moon facies, extremity wasting, a buffalo hump, glucose intolerance or diabetes, and hypertension**. When faced with this condition, get a **24-hr free cortisol level** or use the **1mg Low Dose Dexamethasone Suppression test**. If cortisol is ↑ it's **⊕ Cushing's**. Follow that with an ACTH level to distinguish adrenal (**↓ ACTH**) from extra-adrenal (**↑ ACTH**). If adrenal, spot it with a **CT/MRI of the Adrenals**. If extra-adrenal, perform a **high dose dexamethasone suppression test** to determine pituitary (suppresses) vs ectopic (**Ø suppression**). Confirm pituitary Cushing's with an **MRI** followed by transsphenoidal resection. If ectopic, find it with **CT/MRI of (1) Chest (Lung Ca), (2) Abd (Pancreatic ca), then (3) Pelvis (adrenals)**. Remember "Low-Dose ACTH Then High-Dose."

Hyperaldosteronism

Aldosterone causes resorption of Na and H<sub>2</sub>O producing an expanded vascular volume and hypertension by ↑E<sub>Na</sub> in the collecting tubules, trading Na for K. This produces a **refractory HTN** or a **Diastolic HTN and Hypokalemia**. Differentiate between: **primary** (a tumor or adenoma called **Conn's Syndrome**) where aldosterone production is independent of Renin, **secondary** (renovascular disease, edematous states of CHF, Cirrhosis, Nephrotic Syndrome) where the production of aldosterone is dependent on renin and is an appropriate response to ↓ renovascular flow, and **mimickers** (CAH, Licorice, or exogenous mineral corticosteroids). When suspected, perform 8am levels for **Aldosterone, Renin, and Aldo:Renin Ratio**. Ensure any hypertension medication is discontinued (ACE, CCB, Diuretics confound the test). If **elevated** (>20 Aldo and >20 Aldo:Renin) it's likely **primary**. Confirm with the **salt suppression test** (where aldo will not decrease after a 200g Na load). The tumor is found by **CT or MRI**. If early AM levels are **Ø elevated** a different disease is likely provoking the aldosterone increase.

Pheochromocytoma

An overproduction of **catecholamines** produces either a **sustained refractory HTN** or **Paroxysmal Five P's** which are (1) **Pressure** (HTN), (2) **Pain** (Headache or Chest Pain), (3) **Pallor** (vasoconstriction), (4) **Palpitations** (tachycardia, tremor), and (5) **Perspiration**. This follows the rule of 10 percents (excellent pimping question, useless for practice). Screen for this disease with **24 hr urinary metanephrenes** or **Urinary VMA** (metanephrenes is better, VMA is cheaper). If **⊕**, do an **MRI/CT** of the pelvis. They should be easy to spot. If not, a **MIBG scintigraphy** can be done. The treatment is **resection** but with caution; touching one can cause release of catecholamines. Pretreat first with **α-blockade** to prevent unopposed α-action with β-blockade, then **surgery**.



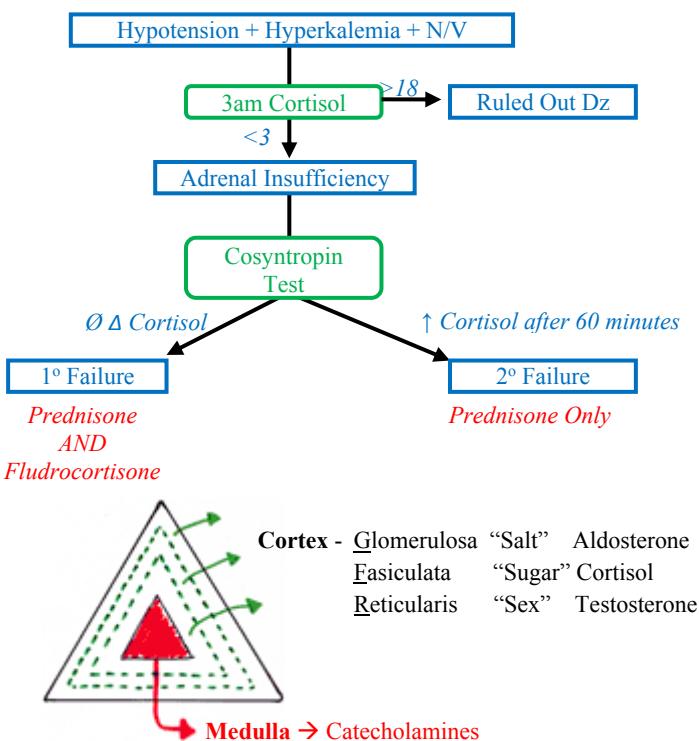
**Adrenal Incidentalomas**

These are **asymptomatic adrenal masses** found on CT scan for something else - an “incidental finding.” It’s important to rule out **functioning adenomas** (pheo, aldo, cortisol, androgen) from **nonfunctioning adenomas**. All above findings must be done to rule out Cushing’s (DST), Pheo (24-hr urine metanephrenes) and Aldo (plasma renin and Aldo). A direct needle biopsy should **NOT** be done until pheo is ruled out. It’s ok to **watch and wait** if <4cm, but intervene with treatment if >4cm or there’s an **increase in size over time**.

**Adrenal Insufficiency**

The loss of adrenal function may be from a variety of **etiologies**, and may be sudden/acute with multiple **presentations**. The **most common cause** in the US is **autoimmune adrenalitis**; it’s **TB worldwide**. In the setting of **sepsis** there may be bilateral adrenal destruction from **hemorrhage** (Waterhouse-Friderichsen). Weird **deposition disease** can also compromise the adrenals (amyloid, sarcoid, and hemochromatosis). In **primary failure** (loss of cortisol, maintenance of ACTH) the symptoms will be **hypotension, fatigue, N/V** of cortisol loss, as well as the **hyperpigmentation and hyperkalemia**. Hyperpigmentation is a result of ACTH production trying to increase cortisol while hyperkalemia is from deficient aldosterone. In **secondary failure**, no ACTH is produced so hyperpigmentation is absent. Because aldosterone production is intact there’s also no hyperkalemia. It’s key to make sure it’s not a primary deficiency so perform a **cosyntropin test** (exogenous ACTH administration). Establish a baseline cortisol in the morning (<3ug = Dz, >18ug = **ruled out**). Give the ACTH then reassess in 60 minutes to determine if there’s any change in cortisol. (3, 3, 3 = Ø ACTH problem =  $1^{\circ}$  deficiency) vs (3,3,20 = ACTH problem,  $2^{\circ}$  Deficiency). Treat this by **giving the steroids** they don’t have. **Prednisone** for all types and **fludrocortisone** for primary only (it’s a synthetic aldo that has its function retained through the RAAS in secondary).

r/o...	With
Cushing's	Dexamethasone Suppression test
Pheo	24-Hr Urine
Conn's	Aldo/Renin



Dz	Path/Etiology	Presentation	Diagnostic	Tx
Cushing's	Iatrogenic Pituitary Tumor Adrenal Tumor Ectopic Tumor	Obesity, Diabetes Moon Facies, Buffalo Hump	Low Dose Dexamethasone Suppression ACTH levels High Dose Dexamethasone Suppression CT/MRI Abd/Pelvis/Thorax	Stop Steroids or Cut out Tumor
Hyperaldo (Conn's)	1° Dz = Tumor 2° Dz = Systemic Mimickers	Hypertension and HypoK OR Refractory HTN	Aldo, Renin, Aldo:Renin Salt Suppression CT/MRI MIBG Scintigraphy	Cut out Tumor Fix Systemic Dz
Pheo	Adrenal Tumor	Paroxysmal Pain Pressure Palpitations Pallor Perspiration	24-hr Urinary Metanephrenes or VMA Urine CT/MRI	α-Blockade β-Blockade Adrenalectomy
Adrenal Insufficiency	Autoimmune Infection Hemorrhage Deposition Disease Pituitary Failure	Hypotension Fatigue Anorexia Nausea/Vomiting Hyperpigmentation	Cortisol Level @ 3am Cosyntropin Test CT/MRI	1° = Prednisone (cortisol) and Fludrocortisone 2° = Prednisone Only

Anatomy

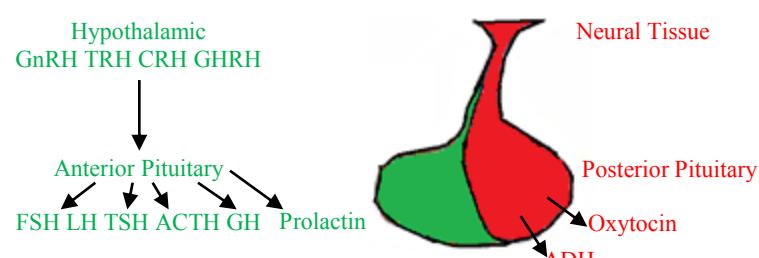
The pituitary is divided into two structures: the **adenohypophysis** (anterior pituitary), which receives **endocrine** signals from the hypothalamus and the **neurohypophysis** (posterior pituitary), which has axon terminals from neurons of the hypothalamus in it. The pituitary's a **small endocrine gland** that regulates **endocrine** and **metabolic function** throughout the body. There can be problems with overproduction or underproduction of just one or all hormones. Because of its location within the **optic chiasm**, tumors of the pituitary can present with **bitemporal hemianopsia**. We'll discuss the typical hyper and hypo secretory disease here.

1) Prolactinoma

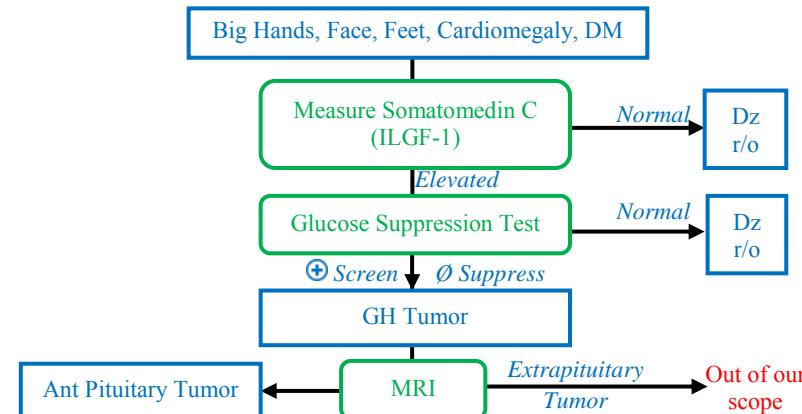
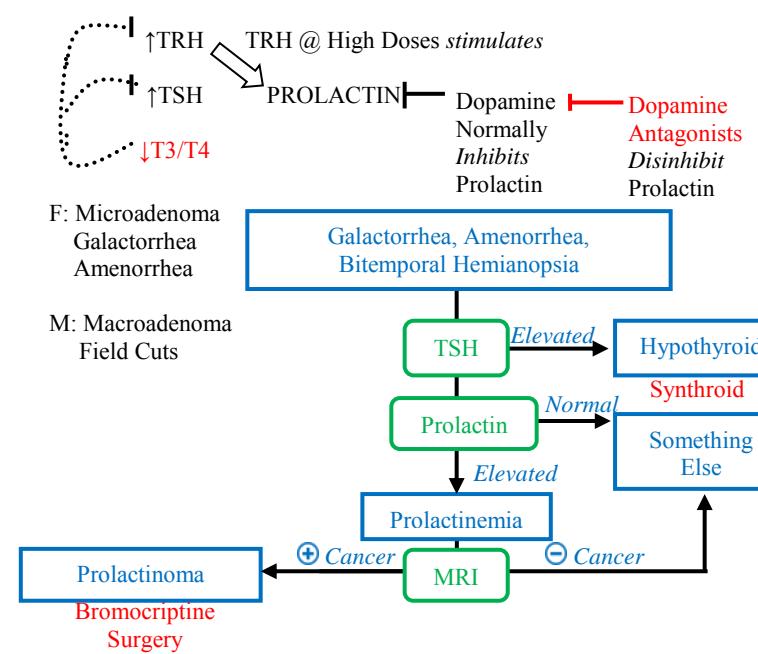
A benign tumor that **autonomously secretes Prolactin** will cause a prolactinemia. Prolactinemia presents differently in men than women. In **women**, they're caught early as **microadenomas**, because women tend to notice **galactorrhea** and **amenorrhea**. There's been no time for the tumor to grow; it's small and presents **without field cuts**. In **men**, who don't lactate or have periods, there's nothing to tip them off that something is wrong. Thus, the tumor grows. As it becomes a **macroadenoma** it digs into the **optic chiasm** producing a **bitemporal hemianopsia**. In the case of field cuts it's easy to be pretty sure there's a tumor. But in the case of a microadenoma other causes of prolactinemia must be ruled out. For example, **dopamine antagonists** (antipsychotics) disinhibit Prolactin while ↑TRH (from **hypothyroidism**) stimulates its production. So, before getting an **MRI** test for **Prolactin levels** and a **TSH** after looking over his/her med list. Treat by using **Bromocriptine**. Consider **surgery** when **desiring pregnancy**, when there are **field cuts**, or when **medication fails**.

2) Acromegaly

A benign tumor that **autonomously secretes Growth Hormone** will cause things that can grow to grow. In a **child**, before the closure of the growth plates, that means the long bones - resulting in **gigantism**. But in an **adult** it means the **hands, feet, face, and visceral organs**. The thing that kills these patients is the **cardiomegaly** and subsequent diastolic heart failure. GH exerts its effects through the liver via **ILGF-1 (somatomedin)**. It also induces **gluconeogenesis** and causes the patient to present with **glucose intolerance** or even **frank DM**. Due to this the **glucose suppression test** (next page) can be used to screen for acromegaly. A **failure to suppress** is a **⊕** finding and should prompt the confirmatory **MRI**. Treatment begins with **octreotide (somatostatin)** to ↓GH production, ↓ILGF effects, and ↓tumor size. Definitive therapy is **surgery**.

3 Levels of Feed Back and Endocrine Regulation of the Ant Pituitary

	GnRH	TRH	CRH	GHRH
(1) Hypothalamus Portal Circulation				
(2) Pituitary Systemic Circulation	FSH/LH	TSH	ACTH	GH
(3) Target Organ Metabolic Effect	Ovaries Estrogen Progesterone	Thyroid T3 T4	Adrenals Cortisol	Liver ILGF
	Ovulation	Metabolism	Stress	Growth

Octreotide Surgery

**3) Cushing's Disease**

Autonomous secretion of **ACTH** causes ↑cortisol. This is covered in the adrenal disorders.

**4) Central Hyperthyroidism**

An incredibly rare secretion of **TSH** causes ↑T<sub>4</sub>/T<sub>3</sub>. This is covered in thyroid disorders.

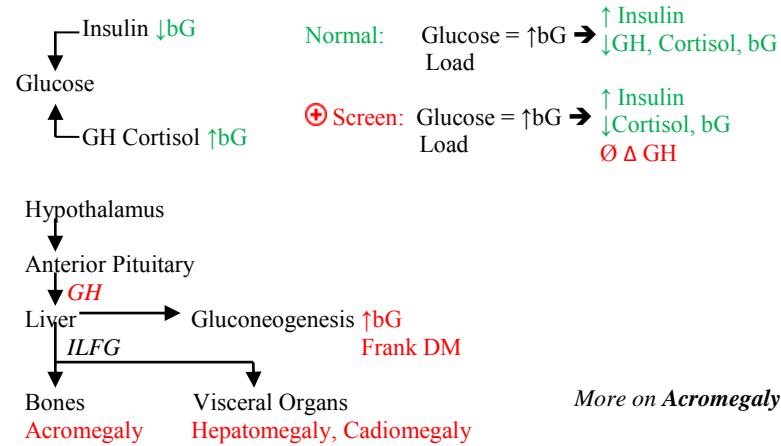
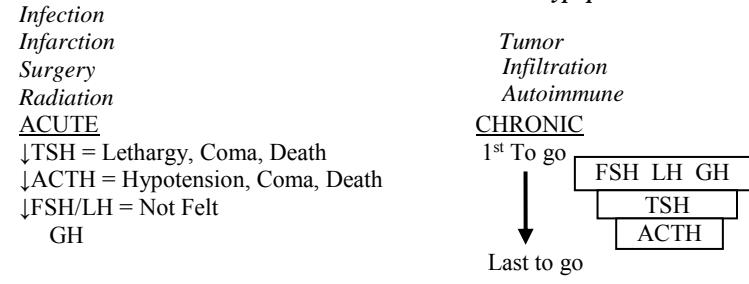
**5) Hypopituitarism**

The lack of one or all pituitary hormones can cause some problems for the body. There are a variety of ways one can lose pituitary function. There are acute losses that usually present as really sick (**coma, hypotension, death**) and **chronic** losses that result in losing lesser hormones first. Let's start with **chronic** then go over some specific syndromes that need to be known about acute diseases. Because the less important hormones are lost first (FSH and GH before TSH), **screening** can be done with an **insulin stimulation test** - the reverse of the glucose suppression test. If hypoglycemia fails to stimulate GH then it's hypopituitarism. Confirm with an **MRI** and **replace deficient hormones**. If possible, reverse the underlying cause if there is one.

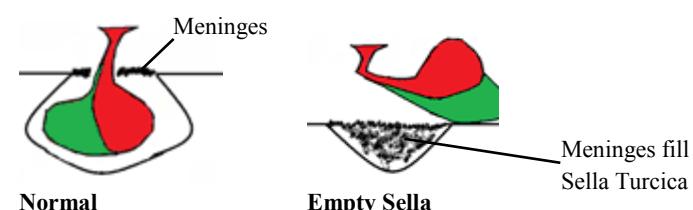
Acute loss of function is much worse. Specific syndromes to be aware of are Sheehan's and Apoplexy. **Sheehan's** is a post-partum hypopituitarism after prolonged labor, usually with some blood loss. The pituitary becomes ischemic and dies. This can typically be detected by the inability to lactate as the first sign. **Apoplexy** is a medical emergency; a pre-existing pituitary tumor outgrows its blood supply and bleeds into the pituitary. The patient rapidly decompensates with stupor, nuchal rigidity, headache, nausea and vomiting, etc.

**6) Empty Sella Syndrome**

This is an **incidental finding** in a patient who has **no endocrine abnormalities** but is found to have an "absent pituitary" on an MRI they had for **some other reason**. If it ain't broke, don't fix it. They have a pituitary - it's just not in the sella.

**Hypopituitarism**

Normal: Insulin = ↓bG → ↓Insulin ↑GH ↑Cortisol ↑Glucagon  
 ↓Insulin  
 + Screen: Insulin = ↓bG → Ø Δ GH (early disease) ↑Glucagon  
 Ø Δ Cortisol (late disease)



	<b>Patient Presentation</b>	<b>Pathology</b>	<b>Dx</b>	<b>Tx</b>
<b>Prolactinoma</b>	F: Amenorrhea, Galactorrhea, Ø Vision Δs, Microadenoma	Dopamine Antagonists Hypothyroid Pituitary Tumor ↑Prolactin	<u>1<sup>st</sup>:</u> Prolactin <u>Then:</u> TSH/T4 <u>Best:</u> MRI	<u>Start:</u> Bromocriptine <u>Best:</u> Surgery when pregnancy, field cuts, medication failure
	M: Vision Δs, Macroadenoma			
<b>Acromegaly</b>	Children: Gigantism Adults: Big hands, Big Feet, Big Heart and DM	↑GH	<u>1<sup>st</sup>:</u> Glucose Suppression Test <u>Best:</u> MRI	<u>Start:</u> Octreotide <u>Best:</u> Surgery
<b>Hypopituitary</b>	Acute: Coma, Lethargy, Hypotension Chronic: Less important go first	Infection, Infarction, Surgery, Radiation	<u>1<sup>st</sup>:</u> Glucose Stimulation Test <u>Best:</u> MRI	<u>Start:</u> Replace Missing Hormones
<b>Sheehan's Apoplexy</b>	Post-partum after a long labor Previous Tumor Bleeds, Stupor Nuchal Rigidity, Nausea/Vomiting	Tumor, Infiltration, Autoimmune		<u>Best:</u> Treat underlying disease if possible
<b>Empty Sella Syndrome</b>	Asx	Not pathological	<u>1<sup>st</sup> and Best:</u> MRI	Ø: Needs no treatment

Introduction

A very common problem in clinic and on the wards is how to control blood sugar. With so many drugs and many more being developed, it becomes a struggle to keep track of them all. I'm going to show the options, which are considered best, and how to correct the problems that may be encountered.

1) Target A1c

A **normal A1c** is **<6** and indicates a **3 month bG** of **<100**. Diabetes causes a host of chronic problems, all of them with enormous morbidity, but it's **hypoglycemia** that **kills the patient**. When people tried to achieve an A1c of **<6**, people died. But we've found an A1c level that is doable, ↓chronic disease to "normal people levels," and that doesn't kill people. Target HgbA1c for **diabetics** is **<7.0**, or a **bG 100-150**. In general, the higher the A1c, the more destroyed the pancreas and the more insulin required. **Oral medications** can decrease A1c by about **3 points** while **insulins** can bring the A1c down by up to **7 points**.

2) Getting There

This discussion refers mainly to **Type II DM** - a product of **insulin resistance** and slowly burning out of the pancreas. **Type I DM** is simple: take insulin because the body has none. I don't want a rehash of 2<sup>nd</sup> year pharmacology so let's talk from the perspective of **cost** and **success**.

i. Non-Insulins

There are many drugs available. Learning which generation one is, even the mechanism, is specialist stuff. The reasons to choose a medication are **cost** and **side effects**. Clear guidelines are set for what **SHOULD BE DONE** (Metformin → Metformin Glyburide → Insulin) but what most people actually get is dependent on what works for them. For that reason, we usually start with **Metformin**, a great drug. Patients may not tolerate it because it causes **diarrhea**. A doctor may not start it for fear of **lactic acidosis** in the setting of **Renal Failure** or **CHF**. If Metformin is started and more coverage is needed, add **Glyburide**. If a patient cannot tolerate a medicine, switch it for a **Thiazolidinediones**. A combination of any two of the three are acceptable (Actos/Met, Met/Gly, Actos/Gly). From there, the **DDP-4-I** and **GLP-1 Analogs** are additive coverage. They require **SQ injections** and are effective supplements to any **insulin** or **non-insulin** regimen. The GLP1-Analogs have an added benefit of **weight loss**. In reality, if using all of these drugs the only treatment is insulin.

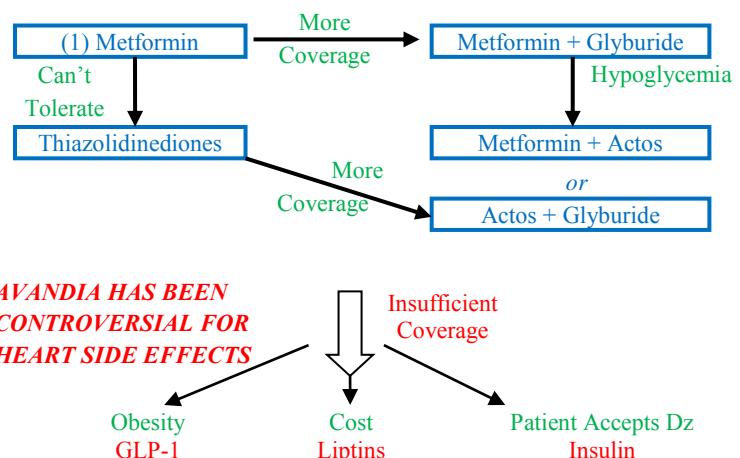
ii. Insulins

Learning insulins for exams is a nightmare. Everything makes sense when by using **trade names**. I'm going to let you learn how to recall generics, because in real life, we use trade names. It's imperative to learn the difference between their **peak onset** and how long **they last**. All insulins require **SubQ injections**. Some hints to help get started. 1) **L** drugs (Lantus and Levemir) are **Long acting** and except for how good the meal is at the drug rep dinner, are all equivocal. 2) **Log** math is more advanced than drawing a **Line**, so **Log** drugs (Humalog Novolog) are used in more complex ways (qAc) versus the 3) **Lin** drugs

<i>Fasting bG</i>	<i>Interpretation</i>	<i>Tx</i>
<100	Normal	Diet + Exercise
100-125	Glucose Intolerance	Diet + Exercise
≥ 126	Frank DM	Get HgbA1c

	<i>HgbA1c</i>	<i>bG</i>
Normal Pt	<6	<100
Diabetic	<7	100-150
Non-Insulins	↓3 pts	-
Insulins	↓7 pts	-
Diet + Exercise	Limited effect, may improve insulin sensitivity	

<i>Type</i>	<i>Name</i>	<i>Mechanism</i>	<i>SE</i>
Sulfonylurea	Glyburide	↑Insulin secretion	↓bG
	Glipizide	↓ Hepatic glucose Production, ↑ Insulin Sensitivity	Diarrhea, RF, CHF (acidosis)
Biguanides	Metformin	↓ Hepatic glucose Production, ↑ Insulin Sensitivity	Diarrhea, RF, CHF (acidosis)
	Thiazolidinediones	Pioglitazone (actos) Rosiglitazone (Avandia)	↑Insulin Sensitivity Weight Gain
DDP-4-i (laptins)	Sitagliptin (Januvia) Saxagliptin (Onglyza)	DDP-4-i ↑GLP-1	
GLP-1 analogs	Exenatide (Byetta) Liraglutide (Victoza)	↑GLP-1 ↑Incretin	Weight Loss



<i>Drug</i>	<i>Class</i>	<i>Use</i>	<i>When</i>
Lantus	Long Acting	Basal insulin	qPM
Levemir	Insulin		
HumaLog	Rapid acting	Prandial Insulin	qAC
NovoLog	Insulin Combo		
Humalog	Medium acting Insulin	Idiot Insulin	biD
Novolin	Combo (old school, easy)		
NPH	Rapid Acting	Prandial	qAC
Regular	Rapid Acting	Generally useless	

(HumuLin NovoLin), which, as we'll see, are ancient, not great, and useful for those who don't want to think. Finally, 4) **NPH** is the **rapid** part of the log combos, while 5) **regular** insulin is a longer acting (medium) insulin.

### iii. Insulin Regimen

The goal of insulin regimens is to control the blood glucose as though it were a normal pancreas. That means **post prandial glucose spikes** are met by **insulin spikes post-prandially**. There is also a certain level of insulin always floating around in the body called **basal insulin**. So to simulate a normal pancreas the **basal-bolus** is **best**. Insulin demand can be approximated by **0.5 Units/kilogram** the total amount per day. In the basal bolus method,  $\frac{1}{2}$  is in the **night time** as **Long Acting Insulin** (the basal). The other  $\frac{1}{2}$  is divided **qAC of short acting insulin** (the bolus). It's important to remember that a blood sugar is affected by the **insulin that precedes it**. If the **AM Dose** is high, increase the nighttime dose. If the bG taken near lunch is high, increase the breakfast dose.

A lot of people try the **Idiot Insulin** method. It's called (I call it) idiot insulin because the **same amount of medium acting insulin** is given regardless of the blood sugar. If patients don't want to check bG or are afraid of needles, they can use this method. It has **poor basal coverage** and **poor post prandial coverage**, but it's only biD dosing.

The **worst** method is **sliding scale insulin** where **no basal insulin** is given. Rather, a certain amount of **short acting insulin** is given with each accucheck. **Bad hospitalists** will do this. Since current bG is a product of the last insulin this will create **hyperglycemic peaks** and **hypoglycemic troughs** as the nurse tries to chase down the bG on your orders. If following another regimen and sugars are still high, adjustment of daily doses is appropriate. However, if the patient eats a **cake** or has **ridiculous bG** one time, using the sliding scale is a great supplement - but only **on top of** an existing regimen.

### Two Effects are Commonly Tested

**Somogyi Effect.** Too much insulin at night induces a hypoglycemia. In response, the body attempts to make more sugar to correct it. The insulin wears off and the extra sugar that was there to keep the patient alive persists. The early morning glucose is high. Decrease night insulin.

**Dawn Phenomena.** Too little insulin at night can't overcome night time counter regulatory hormones and the early morning glucose is high. Increase night insulin.

The only way to tell the two phenomena apart is to check blood glucose level in the middle of the night (around 3 AM). If the blood sugar is high, the patient is probably experiencing the dawn phenomenon; if it's low, rebound hyperglycemia (Somogyi) is probably at work.

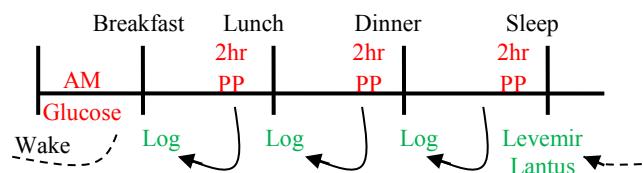
### Controlling Complications

A simple review is shown to the right

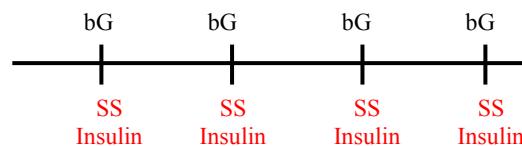
### IDIOT INSULIN



### BASAL BOLUS



### CHASING THE SUGAR (DON'T EVER DO THIS)



Effect	Findings
<b>Somogyi Effect</b>	Too MUCH insulin at night → High AM bG
<b>Dawn Phenomena</b>	Too LITTLE insulin at night → High AM bG
	Check early AM bG to tell the difference

Complications	What We do
CAD or HF	ACE-i
Nephropathy	Microalbumin Screen, ACE-i
Peripheral Neuropathy	Foot care, education, educations
Eyes	Fundoscopic Exams, Laser
Erectile Dysfunction	Nighttime Tumescent, Viagra
Control the Blood Sugars is paramount	

*MEN syndromes are low yield and included just for completeness.*

#### MEN1 Syndrome.

Also known as **Wermer's Syndrome**, is an **autosomal dominant** mutation of **MEN1 gene** that causes hyperplasia or adenomas of the “3 Ps:” **Pituitary Adenomas**, **Parathyroid Adenomas**, and **Pancreatic Adenomas**. There’s a strong association with Gastric Ulcers (Zollinger-Ellison syndrome from the pancreatic adenomas), Hypoglycemia (Insulinoma), and Hypercalcemia (PTH).

#### MEN2A and MEN2B.

These are essentially the same disease and aren’t clearly separated. Both are caused by a mutation in the **RET proto-oncogene**. These cause endocrine tumors everywhere except the 3ps. Look for **Pheochromocytomas** and **thyroid adenomas**. The parathyroid gland can also be involved, but isn’t classic. Really, the only difference between 2A and 2B is the presence of **neuronal tumors** found in MEN2B.

MEN1 = Pituitary + Pancreas + Parathyroid

MEN2A = Pheochromocytomas + Thyroid + Parathyroid

MEN2B = Pheochromocytomas + Thyroids + Neuronal

Simple Summary of Pathophysiology of Diabetes.

Familiarize yourself with it but don't worry about the details. If the purpose is studying for the test - don't learn this stuff. It's more Step 1 than Step 2.

**Type 1 diabetes** is a disease of children caused by **autoimmune destruction** of the pancreatic  $\beta$ -islets by targeting glutamic acid carboxylase following a viral infection. The child will present with polyuria, polydypsia, and polyphagia with weight loss, despite eating. He/she has **no insulin** and can suffer **diabetic Ketoacidosis** with sugar above 600. The only treatment is **insulin** injected with meals and with basal doses.

**Type 2 Diabetes** is a disease typically in **obese adults** caused by **burnout** of the pancreatic  $\beta$ -islets. A crap diet and obesity cause **dysregulation** and **downregulation** of the insulin pathway, requiring more insulin to achieve the same goal. Pancreatic output can keep up for a while, but eventually an increased amount is required with an insufficient production.

**Diabetics** are at risk for a host of deficiencies regardless of the type. These patients have **retinopathy** (Sorbitol pathway), increased risk of infections (Candida, Mucor), **nephropathy** (Kimmelstiel-Wilson Nodules with sclerosis of glomeruli), **peripheral neuropathy** (loss of sensation, erectile dysfunction, impaired wound healing), and **accelerated atherosclerosis/macrovacular disease**.

Diagnosis of Diabetes

A **fasting glucose > 125** on **two occasions** is diabetes and is the best way to diagnose diabetes.

An **HgbA1C > 7%** is not currently sufficient, though new guidelines recommending its use are under way.

A **non-fasting glucose > 200** is diabetes.

*This is a summary review of the information that should have been acquired when preparing for Step I and the basic sciences. The salient points are reviewed here.*

**COMPARISON OF TYPE I AND TYPE 2 DIABETES**

Characteristic	Type I	Type II
Named	Insulin Dependent Diabetes Mellitus (IDDM)	Non-Insulin Dependent Diabetes Mellitus (NIDDM)
Age	<b>Childhood</b> (<20 years)	<b>Adult</b> (>30 years)
Onset	<b>Rapid</b>	<b>Insidious</b>
Weight	<b>Thin to Normal</b>	<b>Obese</b>
Genetics	<b>HLA-DR3, HLA-DR4 Haplotype</b> Family history uncommon	Family History Common, no HLA haplotype African American and Native American at risk
Pathogenesis	<b>Autoimmune</b> destruction of $\beta$ -islets, target is <b>glutamic acid carboxylase</b> No insulin production at all after destruction Trigger suspected to be a viral mimicry	<b>Initial glucose intolerance</b> <b>Insulin resistance</b> followed by $\beta$ -Cell dysfunction Need more insulin, Pancreas meets it, then burns out <b>↓ Insulin Receptor, Insulin Pathway Alterations</b>
Clinical Findings	Polyuria, Polydypsia, Polyphagia and Weight loss, usually in kids Nephropathy, Retinopathy, Neuropathy, Cardiovascular	Recurrent Blurry Vision ( <b>retinopathy</b> ) Recurrent Infections ( <b>Candida, Bacteria</b> ) Nephropathy, Retinopathy, Neuropathy, Cardiovascular
Metabolic Derangement	<b>DKA</b> – hyperglycemia, coma, ketone bodies (butyric and acetoacetic), <b>bg 400-600</b>	<b>HHNKC</b> – hyperglycemia, coma, without Ketoacidosis, sugars in the <b>bg &gt; 600</b>
Treatment	Insulin	Weight loss (upregulates Insulin receptor synthesis) Oral Hyperglycemic (See pharm)
DKA	IV Normal Saline <u>then</u> Potassium <u>then</u> Insulin, once bG ~ 180, <u>then</u> switch to $\frac{1}{2}$ NS or D5W	

Introduction

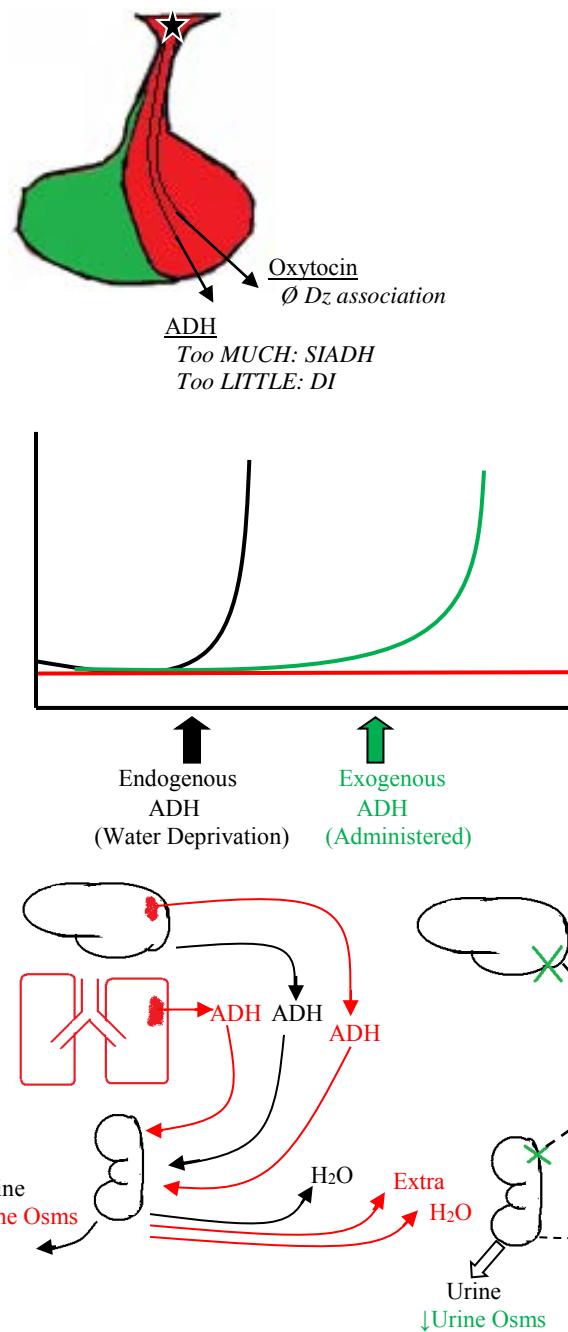
The **posterior pituitary** is actually an extension of the hypothalamus. Neurons of the hypothalamus produce **oxytocin** and **ADH**, where they are transported to the posterior pituitary for storage. Deficiency in or excess of **Oxytocin** causes no disease. **ADH** on the other hand has two potential diseases. ↑**ADH** = **SIADH** = **Hypo Na** from too much water being retained. ↓**ADH** = **DI** = **HyperNa** from too much water lost. Any **acute** or **chronic** process can disrupt the stalk or neuronal processing, leading to either condition.

1) Diabetes Insipidus

In a patient **deficient in ADH** the kidneys get no signal to retain water so they will pee a lot. Because they pee a lot they'll get thirsty and drink a lot. Thus the patient with DI will present with **polydipsia** and **polyuria**. Sounds like regular ol' diabetes. The difference is in the urine; DM has **hypertonic urine** full of **glucose** pulling water with it. DI has **hypotonic urine** because even though the patient is becoming dehydrated, the kidneys cannot retain the water. So the first test is to get a **U/A** looking for **glucose** (to rule out diabetes mellitus). If  $\Theta$ , the decision's between **Nephrogenic** ( $\oplus$  ADH but broken receptors) and **Central** (kidneys work fine - there's just  $\ominus$ ADH being made). Do that with a **water deprivation test** (see to the right). Treat psychogenic polydipsia with psychotherapy, **central diabetes** with **desmopressin**, and **Nephrogenic DI** with **diuretics**. Obviously, start with hydration with IVF to correct electrolyte abnormalities.

2) Syndrome of Inappropriate ADH

When you have **too much ADH** the kidneys absorb all the water there is leaving behind a urine rich in Na. The patient **dilutes their blood** (hyponatremia and hypotonic serum) and **concentrates their urine**, the opposite of DI. The ADH came from the **brain** (tumor, infection, trauma, or granuloma) or from the **lungs** (TB, COPD, and Cancer). However, **hypothyroid** can do it as well, as **TSH simulates ADH** at high doses. The patient will present with **hyponatremia**. Get a **serum Osms** (low) and **Urine Osms** (high). The goal should be to **treat the underlying disease**. In the meantime, induce a **Nephrogenic DI** with **Demeclocycline** to get rid of the free water. If HypoNa is severe, replace with hypertonic saline.



Dz	Pt	U/A	Water Deprivation Test	Tx	Cause
Diabetes Mellitus	Polydipsia Polyuria Weight Loss	Hypertonic Urine with Glucose	N/A	Insulin	Autoimmune Obesity
Central DI	Polydipsia Polyuria ⊕ Nocturnal Sx	Hypotonic Urine	Corrects with ADH	Desmopressin	Trauma, Stroke, Tumor Granulomas
Nephro DI	Polydipsia Polyuria ⊕ Nocturnal Sx	Hypotonic Urine	Does Ø Correct	Diuretics	Lithium Demeclocycline
Psychogenic Polydipsia	Polydipsia Polyuria Ø Nocturnal Sx	Hypotonic Urine	Corrects with Water Restriction	Stop drinking so much water	Psychiatric Disease

**Thyroid Nodule**

When a patient complains of a lump on their neck or you palpate a **thyroid nodule**, it needs to be determined if it's cancer or not. As a general rule **all nodules get FNA**. There are two exceptions: 1) it's certain that this is a **functioning adenoma** ( $\downarrow$ TSH,  $\uparrow$ T4) or (2) it's in a patient with a **history of neck cancer**. In the former, leave it alone. In the latter, go straight to excision. Otherwise, there are additional studies that can be done.

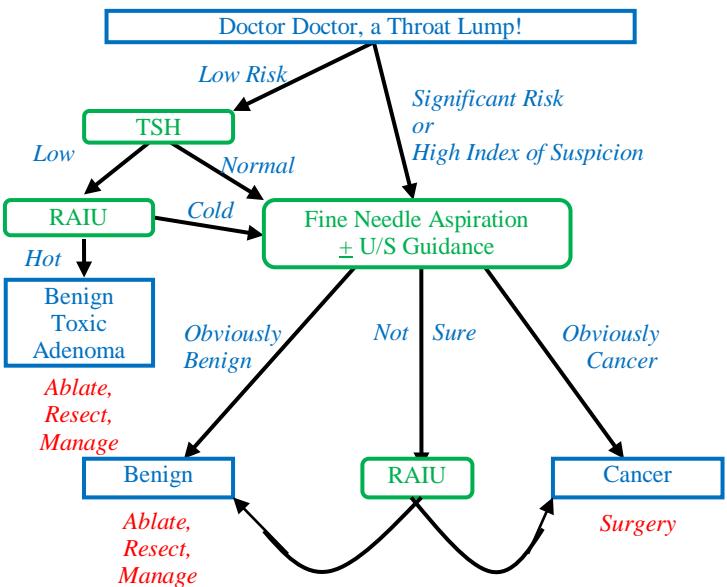
An **Ultrasound** can be obtained to identify alarm properties that can direct to a **FNA faster**. An **RAIU scan** can be used to further investigate if it's still unclear after the TSH or the FNA. But both should enter into the clinical decision making. **Get the FNA then decide if surgery's needed.**

When we say "significant risk" or "high index of suspicion" we mean any number of potential issues. In a question stem look for a **history of radiation therapy** to the neck, or an **age > 70**.

This tree is pretty complicated looking. What it really says is "if low risk get a TSH; if high risk get an FNA." Regardless of the decision, add an RAIU if still not sure. The ultrasound is only for helping with the FNA – not the diagnosis.

**Specific Cancers**

In addition to learning how to work up a thyroid nodule, the four cancers in the table on the bottom right must be known. It's sufficient knowledge to cover what's necessary about the Thyroid Cancers. Also know that CT scans, Sestamibi scans, or tracer dyes can be used to stage cancer once diagnosed.



Test	When to use them
FNA	<b>Best Test</b> except excisional biopsy. This is the hinge point. If any doubt - get an FNA
TSH	Nodule suspected of being hot/active
RAIU	If not sure, either before or after FNA to push one way or another
U/S	Assess nodule before FNA, identify good sites for biopsy, confirm an index of suspicion

Cancers	Need-to-know
Papillary	Most common thyroid cancer, associated with XRT Orphan-Annie Nuclei and Psammoma Bodies Papillary Architecture (FNA), h/o Head and Neck Ca Positive Prognosis (Slow Growing) → <b>Resection</b>
Follicular	Tumor difficult to diagnose on biopsy, looks normal Spreads hematogenously, tx <b>resection &amp; I<sub>2</sub> ablation</b>
Medullary	C-Cells producing Calcitonin = Hypo-Ca Part of MEN2a and MEN2b genetics
Anaplastic	Found in elderly patients Grows locally and quickly Dismal Prognosis correlated with degree of Anaplasia

Before discussing thyroid diseases, let's review some **physiology** and **tests** which will help with decision making.

### Physiology

TRH is secreted by the hypothalamus. It stimulates the anterior pituitary to make TSH. TSH stimulates the thyroid to make T4/T3 in a 10:1 ratio. T3 is **more potent** than T4; T4 is converted into T3 in the periphery to exert its effects. Most of the T4 is **inactive**, bound to **Thyroglobulin Binding Protein**. Only 0.1% is free and active. **Free T4** is tightly regulated and **doesn't change** in the absence of thyroid disease. **Total T4** changes with alterations in **protein** (pregnancy, OCPs, cirrhosis, nephrosis). The effect of T4/T3 is to ↑ metabolism (**catabolic** and **thermogenic**).

### Tests

**TSH.** Screen people with a history of thyroid disease and any **woman over the age of 50**. The best screen is the **TSH**. If the TSH is: low = hyperthyroidism, high = hypothyroidism, normal = euthyroid.

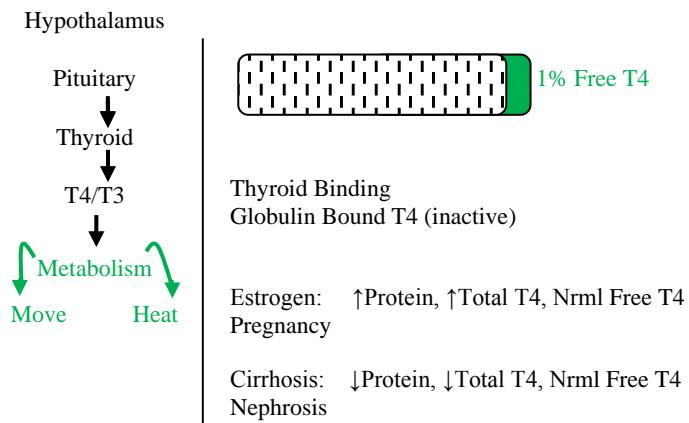
**T4.** Looking at **Free T4** is useful in confirming an atypical screening TSH because there's a disease associated with every TSH+T4 combination. However, a **normal TSH means Euthyroid** (highly sensitive). Do **NOT** get a Free T4 if TSH is normal and ignore the Free T4 if TSH is normal. Sick people can get what's called **sick euthyroid syndrome** (they're sick, T4 is wacky but TSH is normal) but there's no need do anything.

**Free T3** is pretty much useless unless you suspect hyperthyroid despite a normal T4.

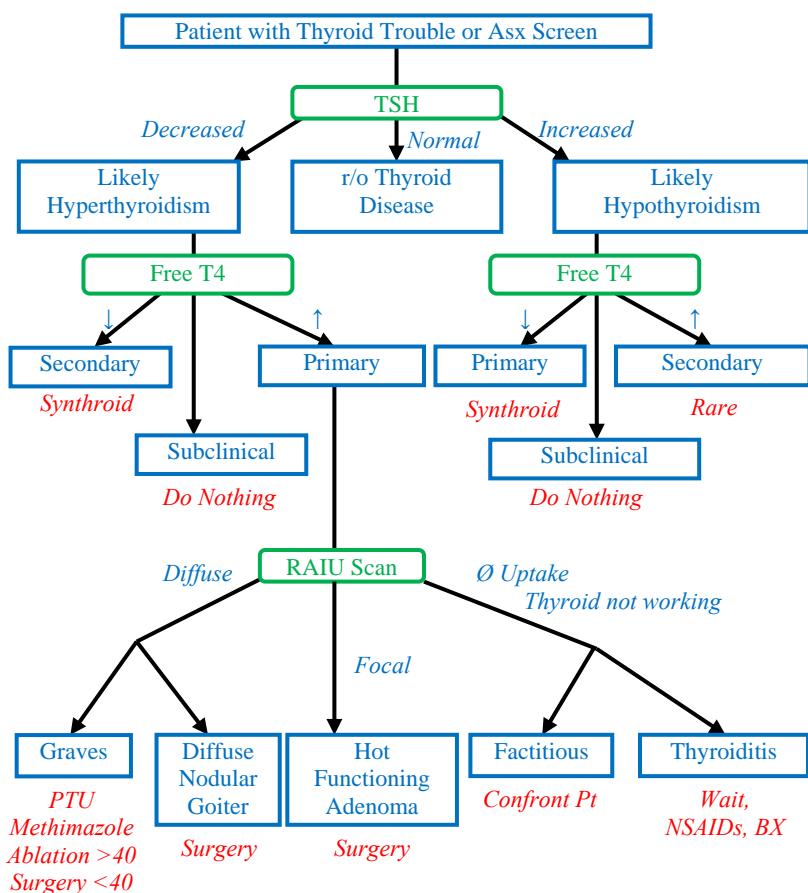
Look at the chart to the right. What it says is, "the only diseases that really matter are High TSH + Low T4 and Low TSH + High T4." That's **primary hypothyroidism** and **primary hyperthyroidism**. If there's a primary hypothyroidism, simply give synthroid.

**RAIU scan.** When a **hyperthyroid** patient is encountered a **RAIU scan** can help with a diagnosis. Radiolabeled Iodine is picked up by active thyroid tissue which lights up = "**hot**" while inactive tissue does not = "**cold**." Finally, there are **antibodies** present in some diseases that when present are **specific** (but they're **not sensitive**). While helpful, they're academic rather than confirmatory.

Confirmation is made by **FNA Biopsy**. More on Biopsying and RAIUs in the thyroid nodule section.



Tests	
TSH	Best Screening Test. ↑ Hypothyroid, ↓Hyperthyroid Normal = Euthyroid. Some states can fool you, so...
Free T4	Confirms TSH findings
Free T3	Only if ↓TSH and normal or ↓T4
RAIU	Evaluate a 1° Hyperthyroidism. Differentiates between causes of hyperthyroid. May not be necessary with a good story



Introduction

**Hypothyroidism** is a product of ↓metabolism secondary to ↓T4. This causes the patient to slow down. A variety of things slow: heart (**bradycardia**), mind (**dementia**), reflexes (↓DTRs), bowel function (**constipation**), and metabolism (**weight gain**). Hypothyroidism is easier than hyperthyroidism because regardless of how he/she got there, there's only one treatment - **Levothyroxine**. Screen with **TSH** (it will be elevated). Confirm with **T4** (it will be low) and replace as needed. Don't do any **biopsies** or **RAIU scans** as they aren't needed.

Iatrogenic

The **most common** cause of hypothyroidism is **iatrogenic**. We treat hyperthyroidism and cancer with ablation or surgery, leaving the patient without a thyroid. This is why close follow up is necessary with these patients. Eventually, the circulating T4 diminishes and the patient becomes hypothyroid. When the patient's TSH begins to rise, exogenous **T4** must be substituted with **Levothyroxine**.

Hashimoto's

The **most common disease** that causes hypothyroidism is Hashimoto's. It's caused by a **lymphocytic infiltrate** secondary to antibodies (**Antithyroid Peroxidase** and **antithyroglobulin 90% Specific**). The only way to definitively diagnose is with a biopsy, but because Hashimoto's is **irreversible** and the patient presents with hypothyroidism, just treat the hypothyroid. The natural course of the disease is a period of transient hyperthyroidism followed by transient hypothyroidism.

Myxedema Coma

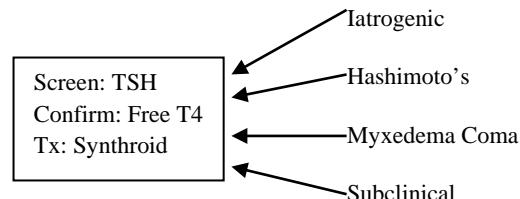
If the hypothyroid gets really bad, or there's a precipitating event, everything shuts down. Like thyroid storm this is a **medical emergency**. This time it's characterized by **hypothermia, hypotension, and coma**. Initiate supportive care (**IVF, Warming Blankets**) and give **high-dose T4**. Because peripheral conversion is impaired, also give straight up **T3** if **T4 fails** or symptoms are severe from the start.

Subclinical

If the ↑TSH + **Normal T4/T3**, the patient needs to be followed. If **Ab⊕** he/she will eventually progress to hypothyroid. If **Ab⊖** he/she might get better. There's no consensus on when to start treatment but generally, make the patient happy by **treating when symptoms start** and treat everyone with **overt hypothyroidism (TSH>10)**.

Hypothyroid  
Bradycardia  
Dementia  
↓DTRs  
Constipation  
Brittle Hair/Nail

Myxedema coma  
Hypothermia  
Hypotension  
Altered Mental Status



Ø Complicated Nonsense. Be able to spot it, give Levothyroxine as needed. That's it.

Introduction

Hyperthyroidism is caused by too much T4. It can come either from **overproduction** as in Graves, **exogenous intake** (factitious or struma ovarii), or **↑release** as in Thyroiditis. The symptoms are **↑metabolism** (heat intolerance, diarrhea, sweating, palpitations, tachycardia, Afib, and Weight Loss). Determining a definitive diagnosis may require a **biopsy** but it's usually not necessary.

1) Graves

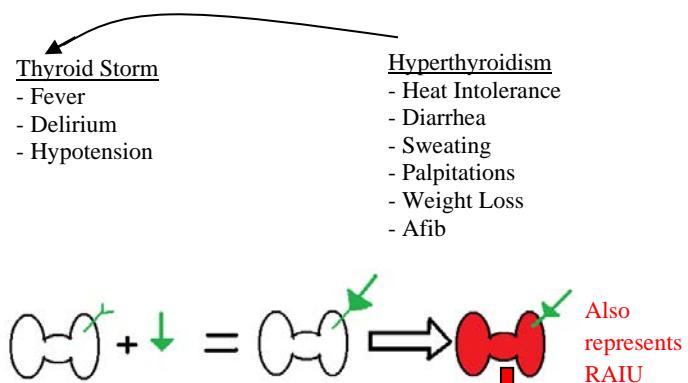
An **autoimmune disease** caused by **thyroid stimulating antibodies** that mimic TSH and cause proliferation of cells as well as ↑production of T4. This causes a **diffuse homogeneous** enlargement of the thyroid. It's the most common cause of hyperthyroidism. Beyond the usual hyperthyroid condition there can also be **pretibial myxedema** and **ophthalmopathy (proptosis and exophthalmos)** - both unique to Grave's. It's essentially a clinical diagnosis, but thyroid labs will show: ↓TSH, ↑T4, and a **Diffuse RAIU**. **Antibodies** (80% Sp, Ø Se) can be checked but the focus should be on treatment. Control their **symptoms** with **propranolol**. To help them out of a hyperthyroid state use **PTU** (safe in **pregnancy**) or **Methimazole**. Be careful not to start these drugs if awaiting RAIU or ablation. These patients require definitive therapy: **Radioactive Iodine Ablation** or **Surgery** (usually if pregnant, 2<sup>nd</sup> trimester surgery). Since this will make them hypothyroid follow up and start **synthroid** when hypothyroid. Finally, the **ophthalmopathy** may worsen despite treatment; treat it with **steroids** or **radiation**.

2) Thyroiditis

In an inflammatory process, even **destructive ones**, the first step is to break open the cells and **release stored T4**. This causes a **transient hyperthyroidism**. If the insult is acute (**infection/trauma**) or subacute (**subacute thyroiditis**) the thyroid will recover - sometimes with a period of hypothyroidism. Rarely does this require intervention. If chronic (Hashimoto's), destruction wins = persistent hypothyroidism. Because TSH/T4 looks like Graves, differentiate with **RAIU** (cold inactive thyroid) and **ESR/CRP** (elevated in Hashimoto's only).

3) Toxic Multinodular Goiter or Adenoma

For whatever reason, **autonomous nodules** referred to as "**hot**" produce T4 without an off switch. Rarely cancer (see workup for thyroid nodules), nodules can usually be seen on **RAIU** or felt on an **exam**. Because the rest of the thyroid senses too much T4 it shuts off, so only the toxic nodules light up. "Toxic" means "Makes T4."

**Pt: Hyperthyroidism "Plus"**

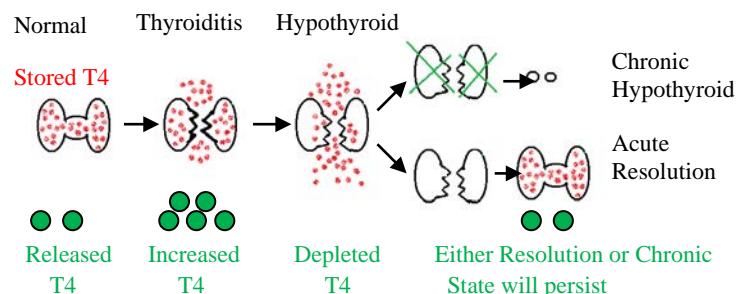
- Pretibial Myxedema = Swelling of the Feet
- Ophthalmopathy = Proptosis + Exophthalmos

**Dx:** ↓TSH, ↑T4, Diffuse RAIU ↑,  $\oplus$  Anti-Thyroid Ab

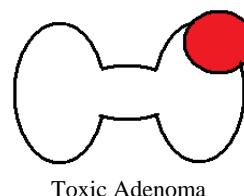
**Tx: Acute:** Propranolol to control adrenergic symptoms  
PTU or Methimazole to quell hyperthyroid state

**Chronic:** Radioablation with radioactive iodine  
Surgery if Pregnant

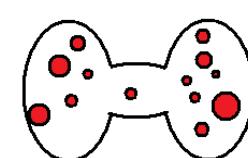
**f/u:** Synthroid when hypothyroid, after treatment  
Steroids/Radiation for Ophthalmopathy, if worsens



<b>Thyroiditis</b>				
Acute: trauma, infection, drugs		Supportive	Resolution	
Subacute: Silent = Lymphocytic, $\oplus$ TPO Antibodies		Supportive	Resolution	
Painful = Viral Granulomas		NSAIDs	Resolution	
Chronic: Hashimoto's		Steroids	Hypothyroid	



Toxic Adenoma



Toxic Multinodular Goiter

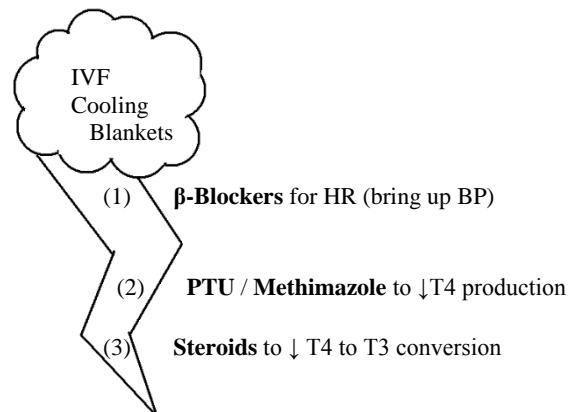
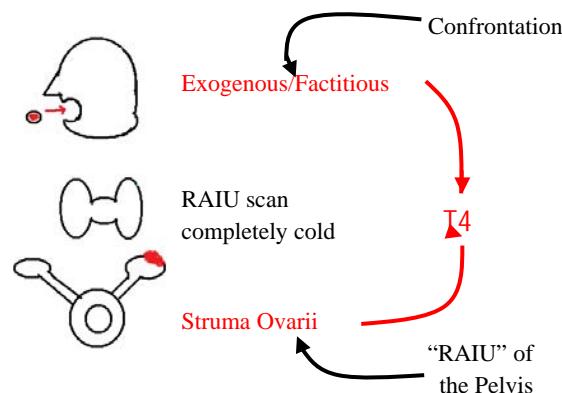
4) Factitious and 5) Struma Ovarii

If someone that's normal to begin with gets levothyroxine the thyroid will **shut off** ( $\downarrow$ TSH Ø RAIU). Still, the T4 will remain high. The only way this can happen is if she's taking it **exogenously** (as in **Synthroid** to lose weight or we dosed a hypothyroid patient with too much of it) or if there's a **tumor somewhere** other than the thyroid (usually a dermoid cyst/teratoma of the ovary). Use the **Sestamibi scan** of the ovaries to r/o tumor then confront her about her factitious disorder. These two are together because one, the RAIU is normal, and two, on the test both will be woman.

6) Thyroid Storm

When the hyperthyroidism gets out of control it's a life threatening **emergency**. It's a clinical diagnosis - defined by someone with hyperthyroidism plus **alarm symptoms = fever, delirium, and hypotension**. He/she has such heat intolerance that he/she burns up and such tachycardia that there's hypotension. After making the diagnosis start immediate supportive therapy with **IVF** and **cooling blankets**. To treat, start **Propranolol** ( $\beta$ -Blockers) to slow the heart down and get the BP back up. Give **PTU or Methimazole** to reduce the production of new thyroid hormone. Finally, **steroids** will reduce the T4 to T3 conversion.

In storm, **Iodide** can be given. The thyroid can **either** pick up Iodide or make Thyroid Hormone; it preferentially picks up Iodide. For a temporizing measure, use Iodide to  $\downarrow$ T4. If not fixed that Iodide will be used to make T4 (**Iodide Escape**). That'll make the patient worse. A single storm is indication for definitive therapy (removing the thyroid altogether).



Disease	Path	Patient	TSH	T4	RAIU	Diagnosis	Treatment
Graves	Autoimmune stimulating antibodies	Hyperthyroid +ophthalmopathy +Pretibial Myxedema	$\downarrow$	$\uparrow$		Anti-TSH-R Antibody	Propranolol PTU/Methimazole Radioactive Ablation Surgery
Thyroiditis	Painless Subacute Lymphocytic +TPO Painful Subacute Granuloma Viral Chronic Lymphocytic	Either painful or painless transient hyperthyroidism that may persist	$\downarrow$	$\uparrow$	N/A	Bx for Infiltrate Anti-Peroxidase Antibody (TPO)	NSAIDs Wait <b>Synthroid</b> if Hypothyroid
Toxic Goiter	Autonomous Nodules Secrete T4	Hyperthyroid with palpable nodules	$\downarrow$	$\uparrow$		Bx if suspicious for cancer	
Factitious	Exogenous T4, Oral	Hyperthyroid, often in a woman	$\downarrow$	$\uparrow$		Confrontation	Stop taking exogenous T4
Struma Ovarii	Ovarian tissue Dermoid Cyst produces T4	Hyperthyroid, always in a woman	$\downarrow$	$\uparrow$		"RAIU" of the Ovaries, <b>Sestamibi Scan</b>	Remove the Cyst
Thyroid Storm	Super mega ultra hypothyroidism ⊕ CHF ⊕ AMS ⊕ Fever	Hyperthyroid	$\downarrow\downarrow$	$\uparrow\uparrow$	Any , no one diagnostic	Diagnosis Ø Needed Just Treat, and treat fast	IVF, Cooling Blankets, Steroids, Propranolol, PTU, Iodide

Introduction and Definitions

Diarrhea itself is defined by **>200g stool / day**. Unfortunately, no one is going to measure their stool every day in a bucket at dry weight. Clinically, diarrhea is defined as **≥ 3 loose/watery stools** per day or even ↓**consistency** of stools. When talking about an **acute diarrhea** it really means **infectious diarrhea**. Most causes of diarrhea are infectious and **self-limiting**. If dealing with hospital patients the goal is to rule out infection and look for underlying causes. In terms of variety there are two forms of infections: invasive + noninvasive.

**Invasive** bacteria get into the mucosa which causes **fever + leukocytosis**. They destroy the endothelium and produce a **bloody diarrhea** with **WBC in stool**. This is easy to spot but may be confused for one of the chronic diarrheas, as they can cause an inflammation as well. Rule out invasive diarrhea with a **stool ex + stool WBC + ova & parasites**.

**Enterotoxic** bacteria produce a compound that turns the absorptive gut to a **secretory gut**. This may be in the form of an **active toxin** (vibrio) or a **preformed toxin** (staph). In any case, there's **no fever, leukocytosis, or blood** but there is **watery stool**. The history can alert you to a specific agent and corresponding antigens should be investigated (reheated rice, protein dip, shellfish). However, because this person is pooping a lot right now, there's little ability to trace his/her last 72 hrs of eating, presuming there was a preformed toxin somewhere in his/her history (it's likely he/she'll have risk factors for several organisms in any given 72 hr period). Since these are usually self-limiting, treatment centers around **hydration** and **loperamide**. Be cautious - do NOT give loperamide to a diarrhea from an invasive organism as you'll make it worse!

C. difficile

This particular infection follows **hospitalization** or **broad-spectrum antibiotics**. It may produce colonization (**pseudomembrane colitis**, diagnosed on colonoscopy but is poorly sensitive) but the diarrhea is from a **toxin**. If a patient comes in without diarrhea and gets it in the hospital look for the **C. diff stool toxin**. If positive, stop broad-spectrum antibiotics and start either **oral metronidazole** (better) or **oral Vancomycin** (may produce VRE). Stay clear of colonoscopies; instead follow the stool toxin to ensure eradication.

Hemolytic Uremic Syndrome

In the presence of **anemia + worsening Cr + Bloody Diarrhea** do not assume the Cr is rising from dehydration. Suspicion of Shigella and the Shiga toxin must be high. If suspected, get a **serum shiga toxin assay** and **E. coli O157:H7**.

Community Acquired Diarrhea: Stool Cx

Hospital /Abx Acquired Diarrhea: C. diff Toxin

All Severe Diarrhea: O+P, Cx, Specific Toxin

Overall:

**Fecal WBC, Fecal Blood, C. Diff Toxin, O+P,**

**Stool Cx**

If admitting to hospital

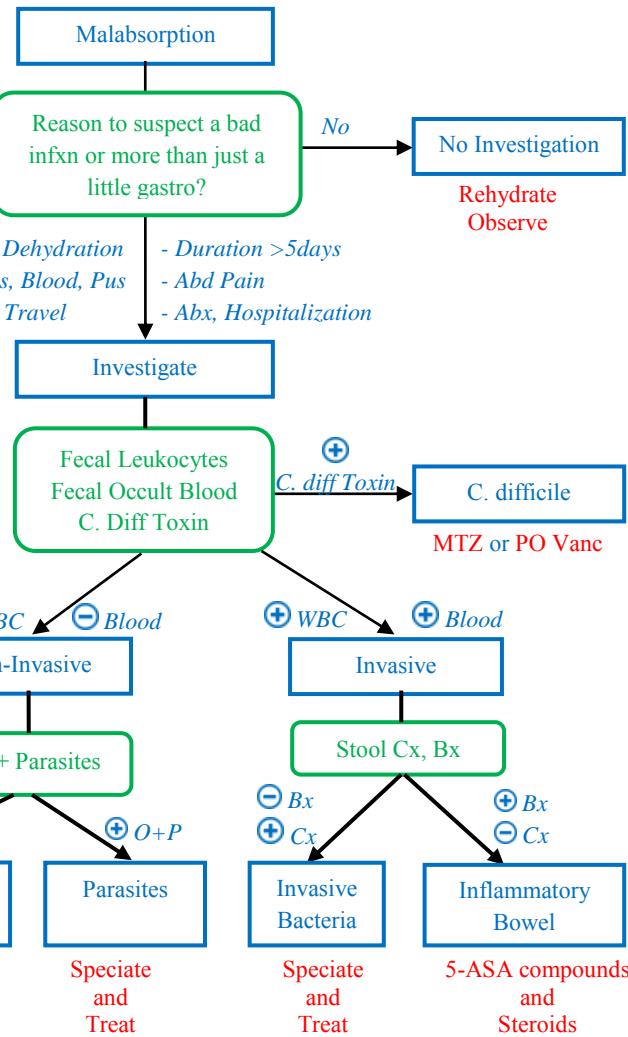
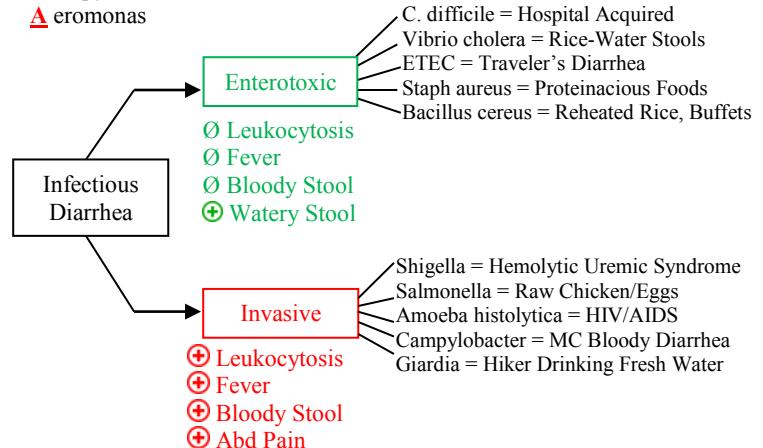
Bloody Diarrhea

**M**edical Disease  
**E. coli** (EHEC)  
**S**higella  
**S**almonella  
**Y**ersinia enterocolitica

**C. difficile**  
**A**moeba histolytica  
**C**ampylobacter  
**E**romonas

Common Acute Diarrhea

Medical Disease  
E. coli (ETEC)  
Bacillus cereus toxin  
Viruses (Adeno, Roto)  
Giardia  
Staph aureus toxin



Definition and Introduction

A cirrhotic liver is one that's been annihilated, replaced by **extensive fibrosis**, and with minimal **regenerating nodules**. It's the end-stage of liver disease - regardless of the etiology. It produces a number of complications that become targets of therapy. Once cirrhotic, the only option is **transplant**. Knowing etiology, presentation, and the unique considerations is key to mastering cirrhosis.

Presentations and Labs

The liver does a lot of things. It clears **bilirubin** - failure causes **jaundice** and **sclera icterus**. It produces **bile** - accumulation of bile causes **pruritus**. It also produces **coagulation factors** - a deficiency produces **bleeding**. Because all blood flow from the visceral organs flows through the liver, a cirrhotic liver, like a plug, ↑resistance, causing **portal hypertension**. This HTN causes **porto-caval shunting** (hemorrhoids, caput medusa, esophageal varices) and transudation of fluid (ankle edema and **ascites**). Ascites is exacerbated by a ↓protein production (**hypoalbuminemia**, **Total protein ↓**). Estrogen is degraded and converted to testosterone while **estrogen excess** produces **gynecomastia**, palmar erythema, and spider angioma. Finally, the liver controls **ammonium** metabolism. Excess ammonium can cause **asterixis** (flapping tremor) and **encephalopathy**. Get an **Ultrasound** (1<sup>st</sup>, to identify cirrhosis), a **CT Scan/MRI** to evaluate nodules or masses, and finally a **biopsy** (best) to confirm the diagnosis and etiology. Acute hepatitis causes an elevation of liver enzymes. A cirrhotic liver is burned out and AST/ALT will be low or smoldering just above elevated. The MELD score (calculated using the bilirubin), INR, and creatinine show how sick a liver is. 1 is normal, 40 is death. Transplant workup starts at 15.

The full workup of a liver involves the LFTs (AST, ALT, ALk Phos, Bili, TP, Albumin), Coagulation Factors, Ultrasound, CT scan, and Biopsy.

Ascites and SAAG

Fluid in the abdomen (**ascites**) has multiple etiologies - one of which is cirrhosis. The patient will have **flank dullness**, a **fluid wave**, and **shifting dullness** on physical exam. To detect fluid an **Ultrasound** may be performed. Fluid may also be detected via **CT/MRI** (which helps with differentiation). What we worry about is a **1<sup>st</sup> time presentation** (etiology unknown) or a return customer with a fever or abdominal pain. For both cases do **paracentesis** first to get a **SAAG** score (Serum Albumin – Ascites Albumin) and an **AFTP** (cirrhosis vs cardiac ascites). If a SAAG is  $\geq 1.1$  it's from portal HTN (**cirrhosis, R Heart Failure, Budd-Chiari**) If a SAAG is  $< 1.1$  it's non-portal HTN related, with ↑ risk of TB and malignancy. The result will direct the workup. The goal is to treat the underlying causes. If secondary to cirrhosis, treat is by restricting fluid + salt and supplementing with diuretics. Everyone with ascites gets ↓Na Intake (2g max/day), **limiting H<sub>2</sub>O** (2L /day). Some people get

**Cirrhosis Etiologies = "VW HAPPENS"**

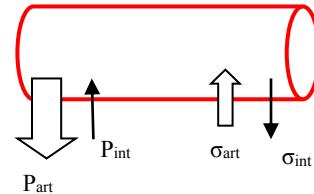
Viral	Hep B/C
Wilson's	Eyes, Liver, Basal Ganglia (Cu)
Hemochromatosis	"Bronze Diabetes" (Fe)
Alpha-1 Anti trypsin Deficiency	Emphysema and Cirrhosis
Primary Sclerosing Cholangitis	Men with Crohn's
Primary Biliary Cirrhosis	Women, Autoimmune, ANA, "Biliary Cirrhosis is for Bitches"
Ethanol	Drinkers
NASH/NAFLD	Fat people
Something Rare	

**Function      Effect of Cirrhosis**

Bilirubin	Jaundice, Scleral Icterus, Dark Urine
Bile	
Coagulation	Bleeding = ↑PT, ↑PTT, ↑ INR (coags)
Protein	Hypoalbuminemia ↑Ascites, Edema
Blood Flow (Portal HTN)	Porto-caval shunt, Ascites (hemorrhoids, caput, esophageal varices)
Estrogen	Gynecomastia, Palmar Erythema
Nitrogen	Asterixis and AMS/Coma

\*\*Also: Parotid Enlargement, Dupuytren's Contracture, clubbing, axillary hair loss\*\*

$$J = K (P_{\text{art}} - P_{\text{int}}) + (\sigma_{\text{int}} - \sigma_{\text{art}})$$



<b>P<sub>arterial</sub></b> Portal HTN Related <b>SAAG <math>\geq 1.1</math></b>	<b>σ<sub>int</sub> or K</b> Non-Portal HTN Related <b>SAAG &lt; 1.1</b>
<b>Cirrhosis</b> R-sided CHF Budd-Chiari Portal/Splenic Thrombosis Schistosomiasis	<b>Cancer</b> Peritoneal TB Nephrotic Syndrome Protein-Losing Enteropathy Post-Op Lymphatic Leak Bowel Obstruction

<b>Cirrhosis</b>	Na < 2g/day
Ascites	H <sub>2</sub> O < 2L/day
Therapy	Diuresis with spironolactone 100, Lasix 80 Tap 4-6L off requires Albumin infusion TIPS ↑ blood flow, ↑NH <sub>4</sub> , ↑Asterixis, AMS

**diuretics** (high dose spironolactone and furosemide). To treat the symptoms of distention, repeated **therapeutic paracentesis** can be performed. A **TIPS** procedure can relieve ascites, but because of the risk of hepatic encephalopathy, it's often avoided except for the treatment of refractory varices. Treatment or vaccination against any Hepatitis virus is critical. The patient must **stop drinking alcohol**. Finally, avoid **NSAIDs** which may ↓GFR and ↓Diuresis.

#### Spontaneous Bacterial Peritonitis (SBP)

A whole bunch of fluid sitting in the abdomen is a nidus for infection. So the first step is **rule out infection** - especially in a first time case or a return with fever. Do a **paracentesis** and get a **cell count** and **Gram Stain / Culture / Sensitivity**. The cutoff is **250** cells; 250 neutrophils to diagnose SBP. No introduction site may be present (why it's called spontaneous) and it's usually **70% GNR** (E. coli, Klebsiella) and sometimes **30% GPC** (Strep pneumo). Treat with **ceftriaxone** for double coverage (**fluoroquinolone** ok if pen allergy) and **prophylax** with **fluoroquinolone**. Since this disease can go from asymptomatic to fatal rather quickly, tap all hospitalized patients with ascites. The MELD goes up, tap. The patient has a fever, tap. The patient has pain, tap.

If you do the tap and it finds 250 polys, make the diagnosis of SBP. BUT, if the tap then comes back **polymicrobial**, it means the diagnosis is actually a **secondary bacterial peritonitis** (NOT spontaneous) with inoculation from visceral organs. In this case it's necessary to add **metronidazole** to Ceftriaxone to cover anaerobes. Go find the perforation with an **Ex-Lap**. The risk of SBP increases with a Total Protein < 1.0 in fluid, so put these patients on prophylaxis.

If **they've had SBP** they get fluoroquinolone prophylaxis. If they haven't had SBP, but **total protein is <1.0**, they get fluoroquinolone prophylaxis.

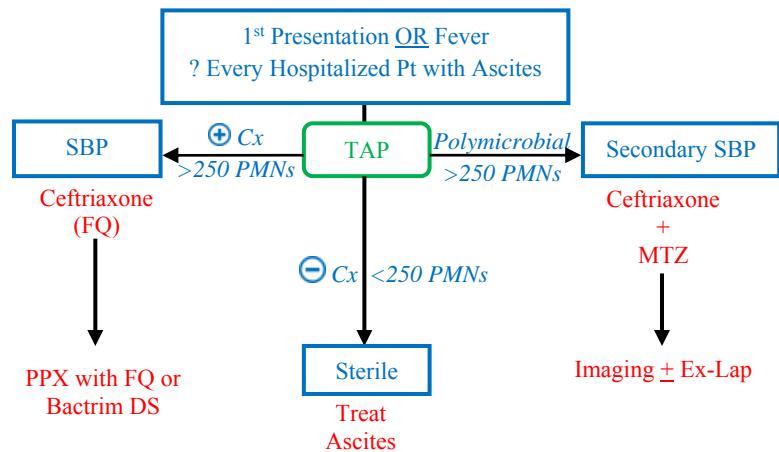
#### Other complications of Cirrhosis

These are VERY important to the management of a patient with cirrhosis, but are likely above the level asked of a medical student. Pay more attention to the etiologies of cirrhosis

**Hepatocellular Carcinoma** is screened **q6month**. Obtaining a **RUQ Ultrasound** and **AFP** will likely alert(flag the potential diagnosis. A **triple phase CT scan** is sufficient to diagnose HCC. **No biopsy** is needed.

**Hepatic Encephalopathy** is treated with **lactulose**. A patient with hepatic encephalopathy has altered mental status, asterixis, and cirrhosis.

**Hepatorenal syndrome** is fatal. Treat a patient with renal failure and cirrhosis by holding the diuretics, **giving albumin** and then **octreotide**.



Laboratory	Findings
AST/ALT	Moderately Elevated in smoldering dz Normal or Low in cirrhosis
Alk Phos	Moderately Elevated in smoldering dz Normal or Low in cirrhosis
Coags	↑INR deficiency of 2,7,9,10
Platelets (CBC)	Thrombocytopenia most sensitive test
Total Protein	Low Total Protein – synthesis failure
Albumin	Low Albumin –synthesis failure
U/S	Nodules, Vein Patency, Fatty Liver strongly indicative of cirrhosis or not
CT Scan	Nodules, Masses, and Ascites, even low amount undetected by U/S or physical
Biopsy	Definitive Diagnosis by histologic confirmation, evidence of underlying etiology, specimen for analysis

Secretory vs Osmotic vs Inflammatory

Chronic diarrhea is persistent or recurrent symptoms for **>4 weeks**; it's usually the result of a chronic underlying condition. It becomes initially important to differentiate pathologically and clinically. The **Osmotic Gap**, **Blood/Mucous**, and **Pattern of Bowel Habits** provide clues to clinically separate the different types.

The **Secretory** type of diarrhea is caused by molecules that transform the normal absorptive gut to a secretory one. This may be via **hormones** (VIPoma, Gastrinoma) or a persistent infection (**enterotoxins**). It produces an enterotoxicogenic picture: **Normal Osmotic Gap** (not osmotic), **no blood** or **mucus** (not inflammatory), and because the toxin is already there, **no changes in BM after NPO**.

The **Osmotic** diarrhea is caused by something being in the lumen that draws water out of the body and into the lumen. This is usually a product of **malabsorption** (lactose, gluten, fat, protein). There won't be an inflammatory picture (**no blood** or **mucus**) but something other than Na + K will make up the osmolarity of stool, thus there will be an **↑Osmotic Gap**. Furthermore, tests will likely find **↑Fecal Fat** (a byproduct of malabsorption). If the osmotic load is taken away (that is, go NPO) this diarrhea gets a lot better.

The **Inflammatory** diarrhea looks like acute inflammatory diarrhea: **⊕ Blood** and **⊕ Mucus**. But because it recurs, or has been chronic, it's likely due to a medical disease (like IBD).

Specific Diseases within Chronic Diarrhea

**Osmotic** diarrheas have been discussed in the malabsorption syndromes lecture. **Inflammatory** diarrhea is discussed in the acute diarrhea (Bloody Diarrhea) and in the Inflammatory Bowel Disease lecture (Crohn's and UC). Let's cover some **secretory** diseases here.

i. Gastrinoma

Persistent **ulcers** despite treatment with **diarrhea** raise suspicion for **Zollinger-Ellison** syndrome and the presence of a **gastrin-producing tumor**. First, measure a **serum gastrin** then allow for an **increased gastrin** on secretin stimulation. Do a **CT scan** or a **SRS** (Somatostatin Receptor Scintigraphy) to find the tumor then **resect**. (See GI Gastric Disorders)

ii. VIPoma

Chronic diarrhea without a real presentation to go along with it. **High Serum VIP** is sufficient for diagnosis. **Resect it**.

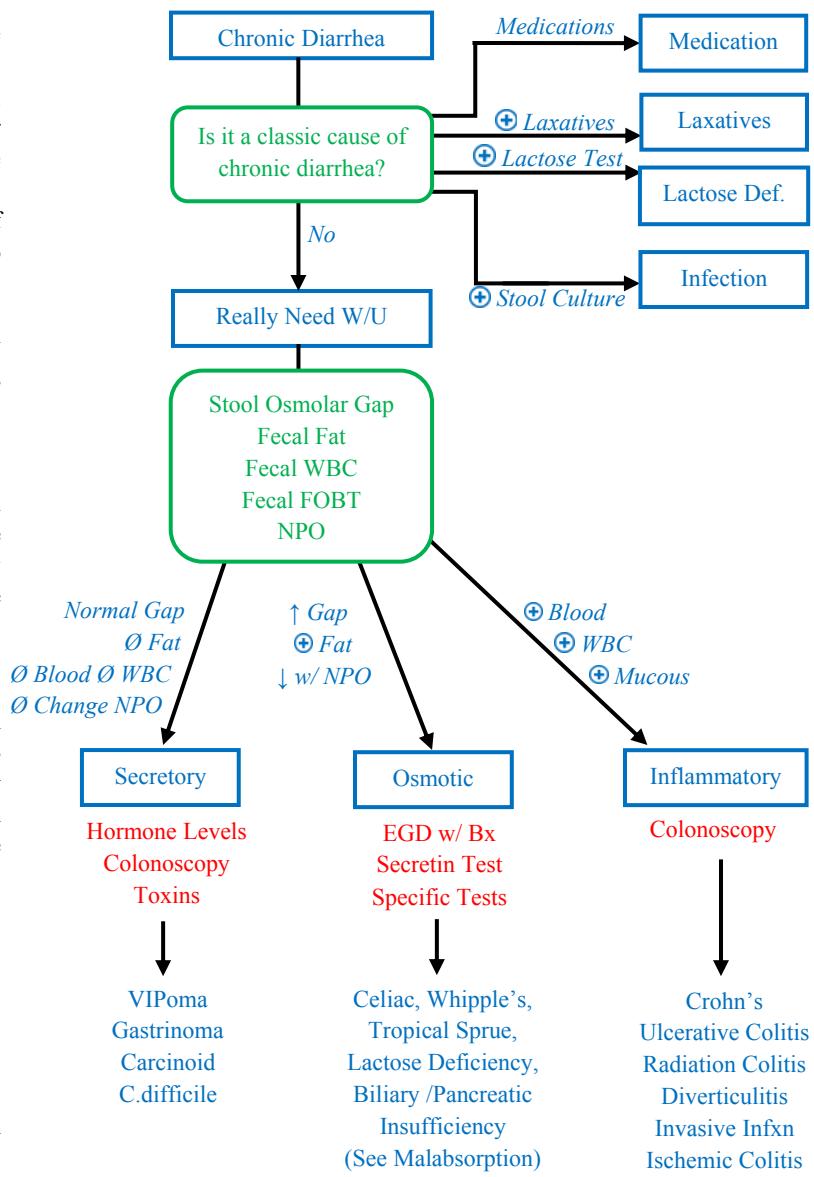
iii. Carcinoid

A tumor usually found in the **small intestine** that has no symptoms until it **metastasizes to the liver**. There, serotonin enters the blood stream causing **right heart failure**, **flushing**, and **Diarrhea**. Get a **Urinary 5-HIAA** to confirm the diagnosis and resect (see GI Cancers).

Secretory	Osmotic	Inflammatory
Secretagogues: VIP, Gastrin, Toxins	Ø Absorption = Fat, Protein, Osmolar Load,	
<b>Nrm1 Osmotic Gap</b>	<b>↑Osmotic Gap</b>	<b>⊕ Blood</b>
Ø Blood Ø Mucus	Ø Blood Ø Mucus	<b>⊕ Mucus</b>
⊕ Nocturnal Sxs	Ø Nocturnal Sxs	
Ø Change with NPO	⊕ Change with NPO	
Normal Fecal Fat	↑ Fecal Fat	

Measure Stool Osmoles (reported value)  280	Calculated Stool Osmoles (Stool Na + Stool K) *2  210 280	= Osmotic Gap  = 70, Osmotic = 2, Secretory
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Wilson's Disease (Cu)

Wilson's is a genetic disease of **copper excretion** resulting from a defective transport in the biliary system. It prevents extrusion of copper, which results in **copper retention**. Copper gets deposited in the liver (**cirrhosis**), basal ganglia (**chorea**) and eyes (the **Kayser-Fleischer Rings**). Copper studies will show a ↓**Serum Ceruloplasmin** (it's all bound up trying to decrease the serum copper) and an ↑**Urine Copper**. Serum copper is useless. Performing a **slit-lamp exam** on the eyes will show the rings and is diagnostic. Confirmation requires a **Liver biopsy** showing >250ugCu/g Liver Dry Weight. The goal is to get the copper out so use **penicillamine** to chelate Cu and excrete it in the urine. Transplant is curative or cirrhosis and Wilson's.

Hemochromatosis (Fe)

A disease of **Iron Absorption**. There's no "off" signal and the gut absorbs all iron. The classic triad is "**Bronze Diabetes**": **Cirrhosis**, **Diabetes**, and **Hyperpigmentation**. While a **transferrin** (>60% men, >50% women) is most sensitive, it's common to start the diagnosis with **Ferritin** (very elevated) and confirm it with a **liver biopsy**. The goal is to eliminate iron so chelate it with **deferoxamine** or **serial phlebotomy** titrating to an Fe sat <30 or ferritin < 50. Transplant cures the cirrhosis but not the Hemochromatosis. "Black Liver on MRI."

 $\alpha$ 1-Antitrypsin Deficiency

These patients have a mutation in a protease inhibitor that prevents release of  $\alpha$ 1-AT from the liver. It results in junk accumulating in the liver (**cirrhosis**) and overactive elastase in the lungs (**emphysema**). To confirm, take a **biopsy** and see the **PAS + Hepatocytes** or do PCR + phenotyping. **PiZZ** is the worst phenotype while **PiMM** is normal. Since the problem is with the liver a **transplant** is **curative**.  **$\alpha$ 1-AT replacements** will help the emphysema but not with the cirrhosis.

Primary Sclerosing Cholangitis

An **autoimmune disease** that affects **males** and causes fibrosis of **extrahepatic ducts** (macroductal disease). There's a high association with **Ulcerative Colitis**. It presents with an obstructive picture of the biliary system that may involve the pancreas. Screen suspected patients with an ANCA. The **MRCP** is essentially diagnostic, showing a "**beads on a string**" pattern. ERCP and biopsy is **NOT required**, but will show **onion-skin fibrosis** if performed. Do **NOT** place a stent to alleviate obstruction (it just makes transplant harder) though symptoms should be treated with cholestyramine or **ursodeoxycholic acid**.

Primary Biliary Cirrhosis

An **autoimmune disease** that affects **females** and causes fibrosis of **intrahepatic ducts** (microductal disease). Since these are small structures MRCP will look normal. Patients are otherwise **asymptomatic young women** with cirrhosis. Screen with an **AMA**, **confirm with a biopsy**. Immunosuppression to start, then transplant - though it may recur even after transplant.

Cirrhosis Etiologies

<b>AST/ALT in the 1000s:</b>	
Viral	Autoimmune Hepatitis
Wilsons	Acetaminophen Toxicity
Hemochromatosis	Aflatoxin (rare)
$\alpha$ 1 Anti trypsin Deficiency	Acute Viral Hepatitis (A, B) Shock Liver (hypotension)
Primary Sclerosing Cholangitis	Budd-Chiari
Primary Biliary Cirrhosis	
Ethanol	
NASH/NAFLD	
Something Rare	

Patient has...    Key Facts and Diagnosis

Cirrhosis and COPD	A1-AT deficiency Get a biopsy = PAS + Macrophages
Cirrhosis, Diabetes, Tan Skin	Hemochromatosis Get a <b>ferritin</b> (very high) or <b>transferrin</b> then get a <b>biopsy</b> Transplant cures the cirrhosis, not the hemochromatosis
Cirrhosis, Chorea, and the "eye"	<b>Wilson's Disease</b> Start with a <b>slit lamp</b> (Kayser-Fleischer) Do <b>NOT</b> get Serum Copper - this is wrong Either <b>ceruloplasmin</b> or <b>urine copper</b> Transplant cures cirrhosis and disease
Cirrhosis and Inflammatory Bowel Disease	<b>Primary Sclerosing Cholangitis</b> Start with an <b>MRCP</b> Biopsy / ERCP is <b>NOT</b> needed Do <b>NOT STENT</b> - ursodeoxycholic acid Can recur in transplant
Cirrhosis and alcohol consumption	<b>Alcoholic cirrhosis</b> Stop drinking alcohol Transplant curative
Cirrhosis and positive serology	<b>Viral hepatitis</b> Treat Hep B, Treat Hep C Vaccinate against A and B
Cirrhosis and a long list ensuring everything is negative	<b>NASH</b> Diagnosis of exclusion Treat symptoms and transplant

Serology    Diagnosis on the TEST

ANCA	PSC
AMA	PBC
ANA	Nothing... Don't be fooled
Ceruloplasmin	Decreased in Wilson's Disease
Ferritin	Elevated in Hemochromatosis
Hep B, Hep C	Viral Hepatitis
Smooth Muscle	Autoimmune Hepatitis
Anti-LKM	Autoimmune Hepatitis

EtoH cirrhosis and NASH are essentially diagnoses of exclusion. Viral hepatitis has a positive serology.

Pathogenesis

Typically a disease of **>50 yr olds** that's a progression of either **genetic errors** (see the chart to the right) or **long term inflammation** (Crohn's, UC) into cancerous growth. The mechanism is Ø important, but there's loss of the APC, ATM, and p53 genes - in that order - that eventually turns a **premalignant polyp** into an **invasive carcinoma**. The process (polyp → Cancer) occurs over 3-7 yrs.

Patient

The initial presentation can be highly variable. The best way to discover colon cancer is with **appropriate screening** (see next section). People who are at increased risk are those who present with **Iron Deficiency Anemia** (other than reproductive age females), those who have **alternating bowel habits** (diarrhea and constipation) and those with a **change in the caliber of their stool** (generally to "pencil thin"). Finally, there may be nothing to tip you off, and the initial presentation is a **metastasis** to the **liver or lung**.

Screening

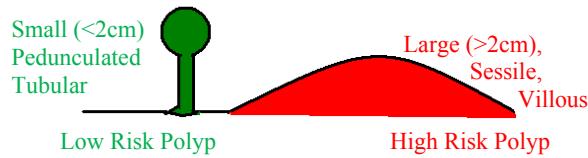
**Colonoscopy** is the golden standard done **q10y** unless abnormalities are found, at which the frequency is increased. This will identify **adenomatous polyps** which will be removed and analyzed. **Sessile, Villous** polyps have an increased risk of malignant transformation, while **pedunculated, tubular** polyps have a lower risk. Colonoscopy is required in order to visualize the entire colon because only 50% of polyps are Left sided (opposed to rigid sigmoidoscopy). In communities where colonoscopy isn't available screening with **FOBTx3 annually** or **FOBT q3 yrs with Flex Sig q5yrs** is also appropriate. **Barium Enema** is now never the right answer as it only detects colon cancer at  $\geq$  Stage III disease (incurable with resection). If either the barium enema or the flex sig are positive a colonoscopy must be done anyways to get a biopsy.

Diagnosis

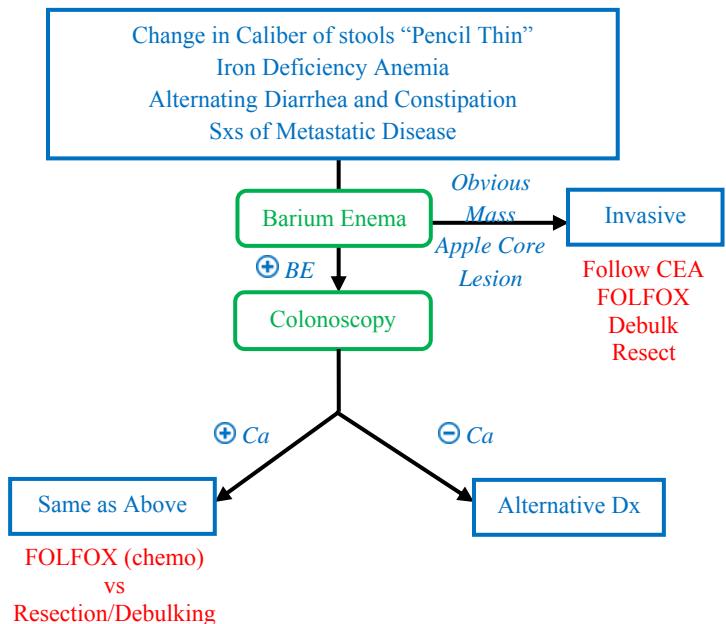
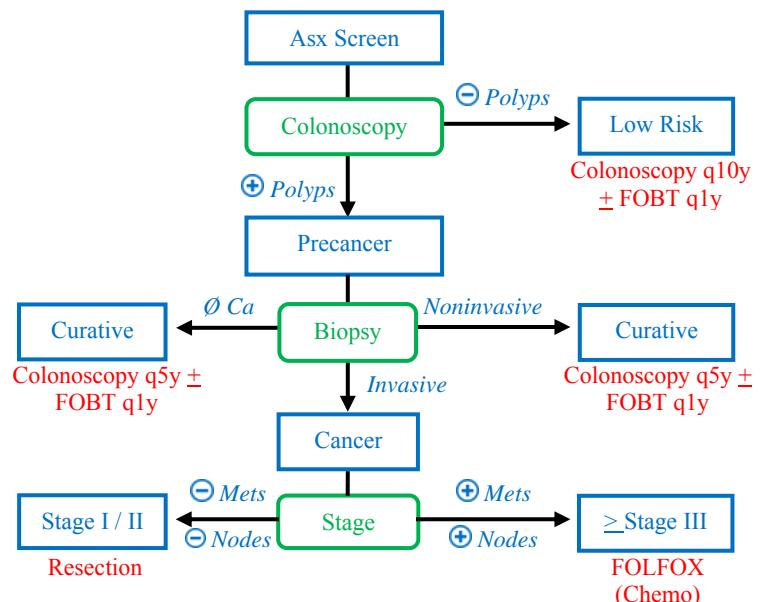
In someone with severe disease all that's necessary is a **barium enema** to reveal the **apple core lesion**. The best test is obviously the **colonoscopy with biopsy**. If there's invasive disease a **metastatic workup** (CT liver, lungs, brain or PET-CT) is required for **staging**. Alternatively, intraoperative staging can be performed. Disease regression or relapse is followed by the **CEA** levels - it is never diagnostic.

Treatment

This is dependent on staging. If there's **extracolonic involvement** (Lymph Nodes or Mets) the treatment is **FOLFOX** (5-Fu + Leucovorin + Oxaliplatin) or **FOLFIRI**. Recently added to improve remission is **Bevacizumab**, a **VEGF Inhibitor**. If there's no extracolonic involvement a simple resection is curative.



Disease	Presentation	Pathology	Treatment
Familial Adenomatous Polyposis (FAP)	1000 polyps by 18, Cancer by 40, Death by 50	APC gene Mutation	PPX Colectomy
Hereditary Nonpolyposis Colorectal Cancer (HNCC)	3 family members 2 generations 1 under 50	DNA Mismatch Repair	↑ Screening Start at 20. Or 10 years prior to first CRC.
Turcot	Colon Cancer AND reproductive organs	GI tumors and Brain Tumors	<u>Turcot</u> , <u>Turban (head)</u>
Gardner	GI Tumors + Jaw Tumors		
Peutz-Jeghers	Nonmalignant polyps and hyperpigmented buccal mucosa + small intestine tumors (hamartomas)		



Diverticulosis

Diverticulosis is the actual pocket - the physical outpouching of the colon caused by ↑ **luminal pressure** in the colon. It's typically the result of a diet rich in **red meat** and **deficient in fiber**. Repeated constipation causes the colon to contract against hard stool resulting in ↑ pressures and eventually **outpocketing** of the colonic mucosa. It's a very common condition in the United States that's **asymptomatic** and often an incidental finding on routine screen. By eating a higher fiber diet and reducing red meat the **disease and its complications** (conditions listed below) **can be prevented**. Diverticuli are typically a disease of the **elderly** (> 50 yo). Diverticuli occur more often on the left than the right because stool is harder on the left. They can be an incidental finding on CT scan but are definitely diagnosed by **colonoscopy**.

Diverticular Spasm

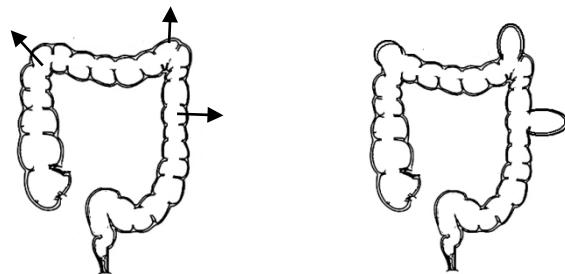
This is caused by a spasm of the diverticulum - especially when diet hasn't been changed. It will present as an **LLQ post-prandial pain** that's **relieved** by a **bowel movement**. The question stem will read like IBS but in an elderly patient. It's treated with a **high fiber diet** to prevent future spasms.

Diverticular Hemorrhage

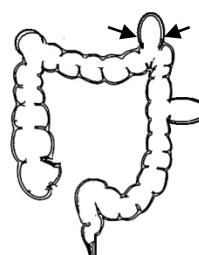
An arteriole in the dome of the diverticulum gets stretched, tears, and bleeds. This presents as a **brisk, painless bleeding** per rectum. It isn't the FOBT of Iron Deficiency Anemia slow bleed – it's a severe GI bleed with rapid blood loss. It'll be diagnosed by first ruling out an upper GI Bleed (**NG Tube / EGD**) and found either on **colonoscopy**, **tagged RBC scan**, or **Angiogram** (see GI Bleeding for details). Diverticuli bleed from the right colon more often than the left (but diverticula occur on the left more than on the right).

Diverticulitis

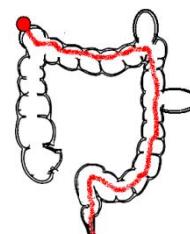
Diverticulitis has a similar pathogenesis and presentation as a **Left Sided Appendicitis** of the elderly. A fecalith forms across a diverticulum causing obstruction, inflammation, and compromise of the blood supply to the diverticulum. This results in **infection, inflammation, and perforation**. The presentation is highly variable - from a **mild inflammation** (low fever, mild leukocytosis, and abdominal tenderness) to **florid peritonitis** or perforation (high fever, massive leukocytosis, rebound, guarding). Diagnosis is made by first ruling out a surgical emergency with a **KUB** to assure no free air or ileus, then with a **CT scan** to identify the extent of the disease. **Avoid Colonoscopy** until 2-6 wks after acute disease has resolved (to minimize the risk of perforation). Treatment is dependent on the severity. **Mild Dz** is treated with oral antibiotics and adequate bowel rest (liquid diet only). In more **severe disease** use **NPO, IVF, and IV Antibiotics**. Multiple combinations are acceptable as long as they get gram negatives and anaerobes (**Ampicillin-Gentamicin and Metronidazole, Ciprofloxacin and metronidazole, OR pip/tazo**). If there's an abscess on the CT it needs to be **drained**. Finally, colectomy is indicated in **severe or refractory** disease.



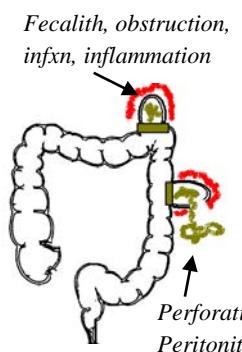
**Diverticuli.** The normal colon (left) generates intraluminal pressures (the arrows) as a result of low fiber and chronic constipation. At select locations, the wall of the colon protrudes, stretching the mucosa (right)

Spasm:

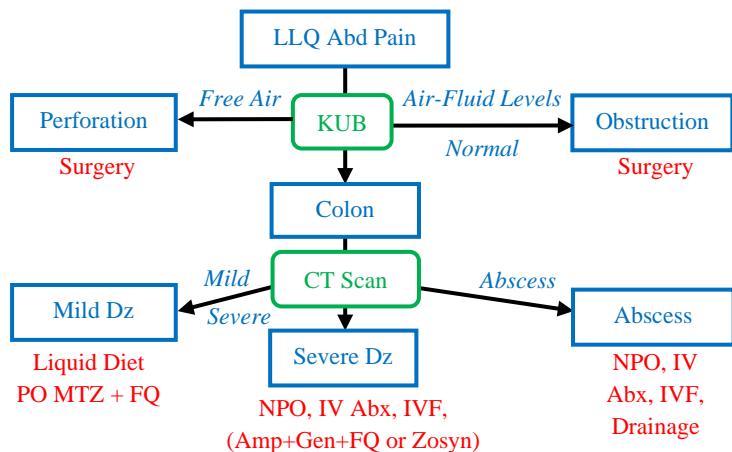
Px: Diverticulosis + Continued Poor Diet  
Pt: Elderly pt + LLQ post prandial pain relieve with BM  
Dx: Clinical, Severe disease r/o  
Tx: High Fiber Diet

Hemorrhage

Px: Arteriole at the dome of diverticuli tears  
Pt: Elderly bright red bleed from rectum  
Dx: (1) r/o UGIB w/ NGT + EGD  
     (2) Colonoscopy (Ø Bleeding)  
         Arteriogram (Brisk Bleeding)  
         Tagged RBC (Slow Bleeding)  
Tx: Embolization, Cautery, Resection

Fecalith, obstruction, infxn, inflammationDiverticulitis

Px: Diverticulitis + Fecalith ± Perforation  
Pt: LLQ Pain in an elderly pt w/ acute onset and mild to severe fever + leukocytosis  
Dx: (1) r/o Perforation/Ileus with KUB  
     (2) CT Scan for severity  
     (3) Avoid Colonoscopy  
Tx: Mild = PO FQ + MTZ + Liquid Diet  
Severe = NPO, IVF, IV Abx  
Abscess = Drainage  
Refractory = Colectomy



Introduction

If a patient presents with **Odynophagia, dysphagia, or chest pain**, one consideration should be an inflammation of the esophagus.

Infectious Esophagitis

Infections of the esophagus are not common. The patient must have a **risk factor** that makes him/her **immuno-suppressed** such as organ transplant, leukemia or lymphoma, steroids, or **HIV/AIDS**. Concurrently, he/she will get **opportunistic infections** like **candida, HSV, and CMV**. While an **Endoscopy** with **Biopsy** is needed to get a definitive diagnosis, certain physical findings can enhance the chances of pre-procedural diagnosis. **Oral ulcers** (herpes labialis) are linked to **Herpes** while **thrush** is associated with **Candida**. Treatment for the infections is dependent on the infectious agent (see the chart to the right).

Pill-Induced Esophagitis

Prolonged direct exposure of the esophagus mucosa cause erosive esophageal ulcerations. Some drugs are notorious: **NSAIDs, NRTs**, and/or **Antibiotics** (doxycycline, clindamycin, Bactrim) - especially the cheaper, non-enteric coated pills. Because it's a direct result of constant exposure, patients should take pills with **4oz H<sub>2</sub>O** and while **erect and upright**. After exposure occurs **endoscopy** can reveal and allow removal of the tablet or pill. It takes time to heal after pill removal.

Caustic Esophagitis

Caustic Esophagitis is covered in detail in the toxic exposure lecture (surgery videos), so the review will be brief here. Either accidentally (**children**) or purposefully (adult **suicide**) drinking caustic substances (i.e. **alkali-like lye, drain cleaner, or any acid**) ruins the esophagus. The burning of the esophagus produces **chest pain + odynophagia**, leading to the avoidance of swallowing, resulting in **drooling**. Burning of the larynx causes **stridor** or **wheezing**. The first thing to remember is that one should **NEVER** induce vomiting to expel a caustic ingestion. An **endoscopy** is done within 24 hrs to evaluate the severity. **Low Severity** (edema, erythema, shallow ulcers) can be moved from liquid to solid diet in the first 24-48hrs. **High severity** (deep ulcers, circumferential burns, black necrosis) has a high incidence of **perforation, bleeding, strictures, and fistulas** so must remain NPO for 72 hrs, with constant monitoring for the development of complications. 70% develop strictures while 2-3% develop cancer (surveillance required 15-20 years later).

Eosinophilic Esophagitis

A long history of **dysphagia** in a kid, especially one with other **eosinophilic** disorders like eczema or asthma, raises suspicion. **EGD** shows **eosinophilia** (>15/hpf). It's in response to a food allergy. Use antacids and **PPIs** while withdrawing any new foods to find the offending culprit.

**Causes of Esophagitis = "Piece of the Esophagus"**

<u>Pill Induced</u>	NSAIDs, Abx, NRT
<u>Infectious</u>	HIV, CMV, Herpes, Candida
<u>Eosinophilic</u>	Asthma, Eczema, Food Allergy
<u>Caustic</u>	Alkali (Drain Cleaner), Acid
<u>Everything else</u>	GERD, Rare causes

Bug	Finding	Treatment
Candida	Thrush	Nystatin and Fluconazole
Herpes	Oral Ulcers	(Val)Acyclovir or Foscarnet
CMV	-	(Val)Ganciclovir or Foscarnet
HIV	AIDS	HAART

Diagnosis	Review
<b>Pill Induced</b>	Pt: NSAIDs, NRTs, Abx (clinda, doxy, Bactrim) Dx: Endoscopy Tx: Pill removal, time, PPIs for comfort PPx: Enteric Coating, Erect Ingestion, 4oz H <sub>2</sub> O
<b>Infectious</b>	Pt: Immunocompromised, Thrush, Ulcers Dx: Endoscopy with Biopsy Tx: Cause dependent, Antifungal, Antiviral
<b>Eosinophilic</b>	Pt: Child with Asthma, Eczema, Odynophagia Dx: Endoscopy with Bx shows Eosinophilia Tx: Remove foods then reintroduce, PPIs
<b>Caustic</b>	Pt: Children (accident) Adult (suicide) ingestion of caustic alkali or acid, presenting with drooling, odynophagia Dx: endoscopy w/i 24 hrs Tx: High Severity: NPO x 72 hrs (risk perf) Low Severity: Liquid → Solid w/i 48 hrs
<b>Everything Else</b>	Consider GERD, cancer, other mechanical/motility disorders

Introduction

The purpose of the esophagus is to carry food from the mouth to the stomach - AKA **swallowing**. So it's no surprise that disorders of the esophagus present as **dysphagia** (difficulty swallowing) or **odynophagia** (pain on swallowing). An important initial step is to separate the **motility/functional** dysphagia from the **mechanical/obstructive** dysphagia. The former is dysphagia to everything at once, the latter is dysphagia **progressive from foods to liquids**.

**MOTILITY**Achalasia

This is a failure of the **LES** to relax and presents as dysphagia to solids and liquids. Food enters the esophagus, moves just fine to the stomach, but can't fit through a tightened LES. Patients describe a **knot** or **ball of food** behind their sternum along with dysphagia. A diagnosis can be made on **barium swallow** demonstrating a **bird's beak**. It's confirmed with a **manometry** that shows hyperactive contraction and inactivity of the rest of the esophagus. An EGD must be done, revealing **absent auerbach plexus** and ruling out cancer. For treatment, the LES has to be opened. You can do **Botulinum** or **Balloon Dilation** (risk of perforation). The preferred treatment is surgery: **Heller Myotomy**.

Scleroderma

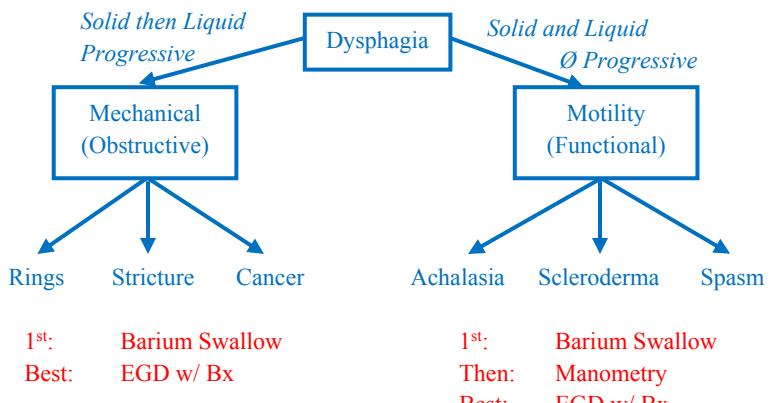
An **autoimmune disorder** that presents with a **severe and refractory GERD**. Found typically in **reproductive aged females**, it can be screened for with **Anti Scl-70 Abs**. A definitive diagnosis is made with **manometry** showing a **relaxed esophagus** ( $\emptyset$  tone) and  **$\downarrow$ pressure** in the **LES**. There's not much we can do for the scleroderma or the relaxed esophagus so focus on the **relentless GERD** that it produces. Prevent esophageal cancer in these patients by giving them **high-dose PPIs**.

Esophageal Spasm

This looks like an MI at first glance. It presents with a crushing, retrosternal chest pain that's **relieved with nitrates** but isn't an MI. After the patient spends a good time **ruling out myocardial ischemia**, esophageal spasm is diagnosed by **manometry** showing **erratic, diffuse spasm** unrelated to eating, drinking, or position. While not usually performed, a **barium swallow** done at the time of pain may show multiple regions of spasm, the "**corkscrew esophagus**." Treat this with **Calcium Channel Blockers** or **Nitroglycerin** as needed.

**MECHANICAL**Schatzki Ring

A **fibrous ring** located at the **LES** causes only **large diameter** foods to get stuck. This will be a very **episodic** (months in between) **dysphagia** with **odynophagia**. Since most food is cut or chewed well most foods get by the ring - hence **episodic**. A **barium swallow** will show a narrowed lumen and an **EGD** will yield definitive diagnosis with visualization and biopsy. Breaking the ring will alleviate symptoms.



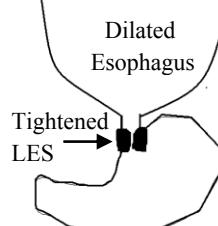
1<sup>st</sup>: Barium Swallow

Best: EGD w/ Bx

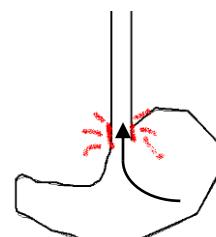
1<sup>st</sup>: Barium Swallow

Then: Manometry

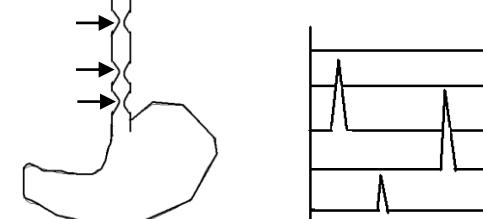
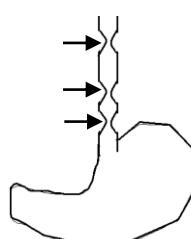
Best: EGD w/ Bx



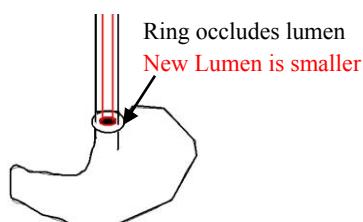
**Achalasia.** Depiction and Manometry studies. LES contracts as normal but cannot relax, producing sustained contraction.



**Scleroderma.** Depiction and Manometry studies. LES is persistently relaxed permitting regurgitation of acid contents. LES has no activity at all.



**Esophageal Spasm.** Depiction and Manometry. Diffuse, uncoordinated, painful contractions of the esophagus.



"Steakhouse Dysphagia"

**Schatzki Ring,** Depiction. Only once in a while does that large caliber food get stuck. Thus it is the **critical diameter** food that makes this disease

Plummer-Vinson Syndrome

**Esophageal Rings + Esophageal Webs + Iron Deficiency Anemia**, typically in a woman is Plummer-Vinson. Note that these patients have a special type of ring located in the **upper esophagus**. They also have an ↑ risk of **squamous cell carcinoma** of the esophagus. There's no treatment but ppx esophagectomy is not indicated. Recognize the syndrome.

Stricture

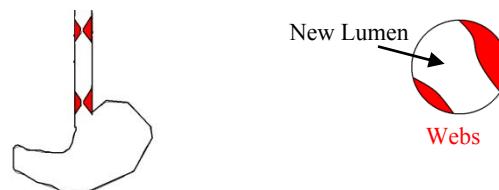
Potential consequences of long-standing GERD is Barrett's and Cancer. Another, considered **grade 4 GERD**, is a stricture. So much inflammation over such a long period causes scarring. Another cause of stricture is **caustic ingestion** (harsh acid or base). The scarring **enters the lumen**. This is a **progressive history of GERD** or remote history of ingestion followed by motility dysphagia. There **may** be weight loss (b/c they can't eat as much, distracting you towards cancer) but that's **atypical**. Diagnosis is made first with a **barium swallow** then confirmed by **EGD with Biopsy** for definitive diagnosis. Treatment is the aggressive management of GERD (high dose PPI) and **resection** of the stricture.

Cancer

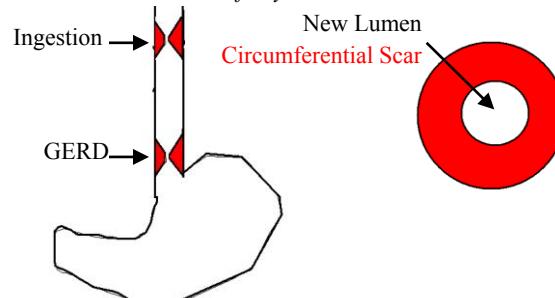
Cancer presents as **progressive weight loss** and **progressive dysphagia** in an **older person** with **GERD** (adenocarcinoma) or in a **smoker/EtOH** (squamous cell). There's often an associated **weight loss**. Progressive = obstructive, weight loss = cancer, risk factors = which cancer. A **barium swallow** is done 1<sup>st</sup> to identify the area of the lesion and to rule out cancer high in the esophagus (which you might perforate if you did an EGD first). Follow up the swallow with an **EGD** and **Bx**. If positive, **stage** with a (PET)CT. **Resection** and **chemo** is the treatment as most of the cancers are invasive at the time of diagnosis. Because acid refluxed from the stomach into the bottom of the stomach, **adenocarcinoma** is at the **↓1/3** of the esophagus. Because smoke and hot drinks enter at the top of the esophagus, **squamous cell** is at the **↑1/3**.

Zenker's

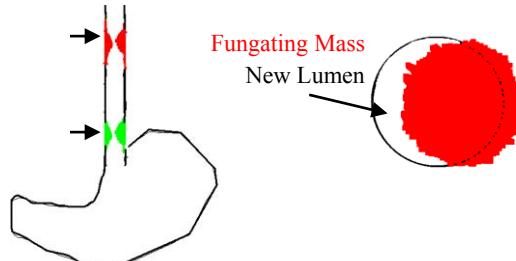
In a **really old guy** with **bad breath** who has trouble eating (**coughing + gurgling** at the start of eating) suspect a Zenker's diverticulum. The diagnosis is sealed if the patient **regurgitates undigested food** days after eating it. The diverticulum is a **false diverticulum** caused by **decades of ↑pressure**. Do a **barium swallow** to identify and an EGD if need be. Treat with resection.



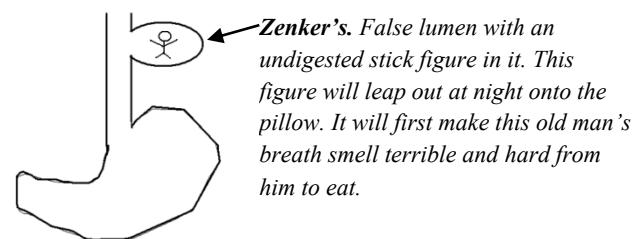
**Esophageal Webs.** Side view and cross-section. Webs can occur anywhere in the esophagus. They stay within the lumen, and can be of any size



**Stricture.** Side view and cross-section. GERD causes stricture at lower esophagus, ingestion can be anywhere, usually at entrance. Scar is circumferential with a new, smaller lumen in the center



**Cancer.** Side view and cross-section. GERD causes adenocarcinoma in the distal esophagus. Toxic exposure causes squamous cell in the proximal esophagus. Fungating mass eats into the lumen from a single focus, new lumen is oddly shaped. This tumor is depicted as having invaded the wall of the esophagus.



**Zenker's.** False lumen with an undigested stick figure in it. This figure will leap out at night onto the pillow. It will first make this old man's breath smell terrible and hard from him to eat.

Disease	Presentation	Classic Sxs	1 <sup>st</sup> Test	Best Test	Treatment
Achalasia	Motility	Knot or Ball of Food at esophagus		Manometry	Dilation, Botox, Myotomy
Scleroderma	Motility	CREST, Female			GERD tx, Ø cure
Esophageal Spasm	Motility	CP better with Nitro, CCB			NTG, CCB prn
Schatzki Ring	Mechanical	Episodic to Large caliber foods			Resection
Plummer Vinson	Mechanical	Iron Def Anemia, Webs, Female			Ø, Monitor for Cancer
Stricture	Mechanical	GERD with Weight Loss or h/o Caustic Ingestion	Barium Swallow		Resection
Zenker's	Mechanical	Old Man, Halitosis, regurgitation			Resection
Cancer	Mechanical	GERD + Weight Loss Or Smoking + EtOH	EGD +Bx		Resection Resection ± Chemo

**Cholelithiasis**

There are **two** types of stones. Most disease is caused by **mixed** stones. The **Cholesterol stone** is the green stone, with risk factors being Fat, Female, Fertile, Forty, and Native American. The **pigmented stones** are caused by **hemolytic disease** classically found in African Americans. Most people who have gallstones are **asymptomatic** and don't require prophylactic cholecystectomy. Better diet, exercise, and ↓ cholesterol can prevent the stones from becoming symptomatic. Symptoms arise as the stones **obstruct the lumen**, converting to symptomatic at a rate of about 30% every 2 years. Symptoms are **colicky RUQ abdominal pain** that **radiates to the right shoulder**. There may be belching or bloating after eating. Treat with **cholecystectomy** (surgery) or **ursodeoxycholic acid** for non-surgical candidates.

**Cholecystitis**

When a gallstone gets in the cystic duct and **stays there** an inflammatory process develops. This causes **constant RUQ abdominal pain** (opposed to the colicky pain above) accompanied by a **mild fever** and **mild leukocytosis**. It's often preceded by episodes of cholecytic colic. Diagnose with an **ultrasound** (pericholecystic fluid, gallstones, and gallbladder thickening), though a **HIDA scan** can be used if the ultrasound is equivocal. Do **IVF+NPO+NG+Abx** to let the acute process cool down and the stone to pass. Then do an **elective cholecystectomy**. If symptoms do not dissipate with therapy, **emergent cholecystectomy** (the only time emergent surgery is done) is done to prevent perforation.

**Choledocholithiasis**

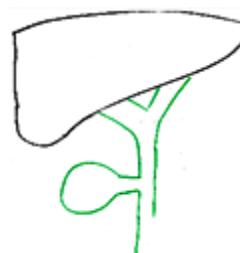
When the stone moves into the **common bile duct** it does two things: (1) **Obstructs** bile and/or pancreatic outflow and (2) produces **Bile Stasis** - a nidus for infection. This is cholecytis + obstructive symptoms of hepatitis and/or pancreatitis.

- **Hepatic** obstruction = **pruritis, jaundice**, and ↑LFTs.
- **Pancreatic** obstruction = **Pain, N/V, ↑Amylase, ↑Lipase**

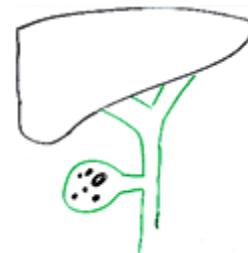
Because there's inflammation there may be a little fever or mild leukocytosis. While a **cholecystectomy** is indicated, the emergent thing to do is to decompress the biliary system with **ERCP** together with NPO, IVF, and analgesia.

**Ascending Cholangitis**

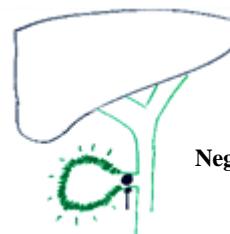
With bile stasis comes a nidus for **infection**. Infection by **E.Coli**, **Klebsiella**, or **Enterobacter** cause a high fever and a sick looking patient. **Temp > 104°** with **chills** and **severe leukocytosis** in the setting of symptomatic gallstones are a tip-off. This patient needs **emergent ERCP** with bowel rest, IVF, analgesia, but most importantly needs **IV antibiotics** to cover gram negative rods (**Amp-Gen** or **FQ**) and anaerobic coverage (**MTZ**).



Normal Anatomy of the Hepatobiliary system



Asx Gallstones present, without obstruction

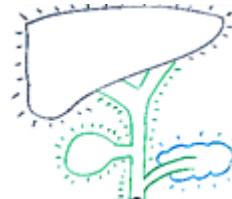
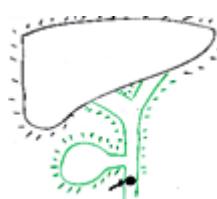


Neg Dz

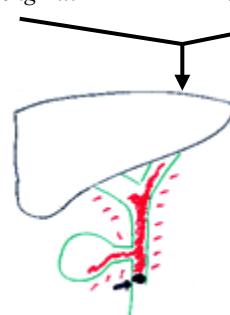


Acute Cholecystitis. Gallstone lodges in Cystic Duct, inducing Inflammation of the Gallbladder. No hepatic/pancreatic involvement

HIDA scan. Normal on left has tracer throughout biliary system. Obstruction on right prevents filling of the gallbladder. Positive study.



Choledocholithiasis. Obstruction of Choledocholethiasis. Obstruction common duct proximal to pancreas. Pancreas not involved, liver is. Both involved. ↑AST/ALT, ↑Cong Bili, ↑Amylase, ↑Lipase

**Ascending Cholangitis**

Choledocholithiasis + Infxn Proximal to obstruction. Chills, High Fever, Severe Leukocytosis

**Charcot's Triad (Cholangitis):**

- (1) RUQ Pain
- (2) Fever,
- (3) Jaundice

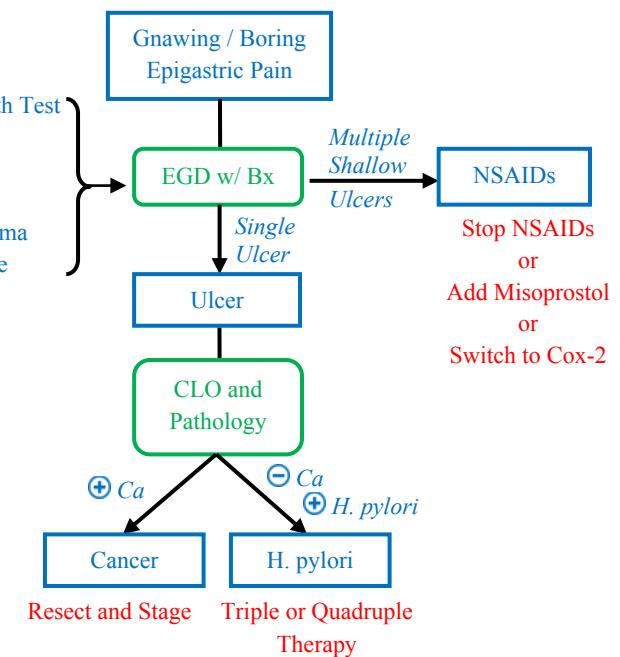
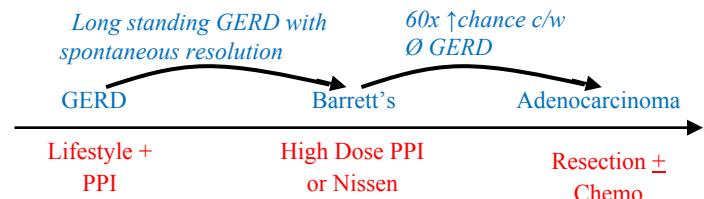
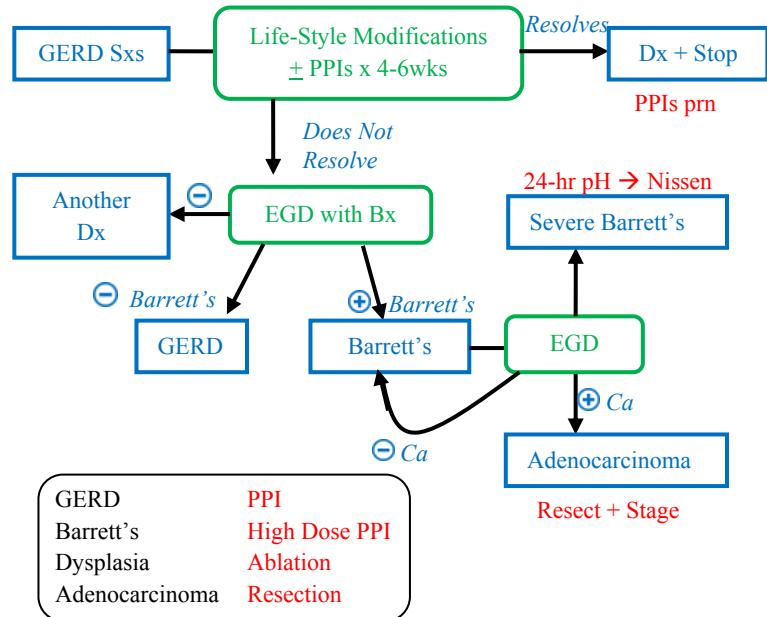
Dz	Path	Pt	Dx	Tx
Stones ("Lithiasis")	Cholesterol = the "Fs" Pigmented = Hemolysis	ASX	U/S, Diagnosis not required	None
Cholecystitis	Cystic Duct Obstruction	RUQ Pain, Murphy's Sign	U/S → HIDA mild fever, mild leukocytosis	Cholecystectomy
Choledocholithiasis (koh-lee-doh-koh)	Common Bile Duct Obstruction = Hepatitis and/or Pancreatitis also	RUQ Pain, Murphy's Sign + ↑AST/↑ALT, ↑Lipase/↑Amylase	U/S → HIDA mild fever, mild leukocytosis	ERCP, Cholecystectomy
Ascending Cholangitis	All of the above PLUS Infection behind the stone	RUQ Pain, Murphy's Sign + ↑Labs, T>104, Leukocytosis	U/S → HIDA severe fever and leukocytosis	ERCP Urgent Cholecystectomy

Gastro Esophageal Reflux Disease GERD

GERD is a disease of corrosive damage to the lower esophagus. It's caused by a **weakened LES** that allows gastric acid and bile to regurgitate into the esophagus. There are two types of symptoms: 1) **typical** (esophageal) symptoms such as **burning retrosternal chest pain** worse with **spicy foods** or by **laying flat**, relieved by **antacids** and **sitting up** and 2) **atypical** symptoms (extra-intestinal) such as **cough, wheezing, hoarseness** secondary to corrosive acid searing the larynx and trachea while flat (asleep), and **nocturnal asthma** (asthma that wakes people from sleep). It's important to realize that if no alarm symptoms are present the **1<sup>st</sup> step is NOT diagnosis**, but rather therapeutic **lifestyle modifications** (for mild sxs) and **PPIs** (for troublesome ones). Try <sup>1</sup>small meals, <sup>2</sup>no food hours before recumbency, <sup>3</sup>elevating the head of the bed, <sup>4</sup>avoiding smoking, EtOH, caffeine, and chocolate, or <sup>5</sup> a **4-6wk trial** of **azole drugs (PPIs)**. If the symptoms persist or there are any **alarm symptoms** (odynophagia, dysphagia, weight loss, nausea/vomiting, or anemia) on initial presentation, go straight to **EGD** to rule out cancer / **Barrett's Esophagus** and to grade the **esophagitis** or **ulceration**. This also allows for biopsies of the esophagus. Even after EGD, which shows only the effect of acid, a definitive diagnosis is made with **24-hr pH monitoring** (best test, rarely done). Once diagnosed, **PPIs** are the standard treatment. If a patient desires to get off PPIs a **Nissen Fundoplication** is indicated. Before choosing surgery, do every test for the esophagus (EGD, 24-Hr pH, Manometry).

Peptic Ulcer Disease

Ulcers are erosions through the muscularis caused by a break in the gastric or duodenal mucosa. It's caused by one of three things: 1) **NSAIDs (multiple, punctuate, shallow** lesions in the gastric mucosa 2) those caused by **H. pylori/Cancer (singular, large and deep ± heaped margins of cancer)** and 3) **Zollinger-Ellison Syndrome** (see the next section). Ulcers occur in two places - they're far more common in the **duodenum** and nearly 100% associated with **H. pylori**, but can also occur in the **stomach** (75% associated with **H. pylori**). Although lifestyle (smoking, EtOH, caffeine) impacts the rate of formation they are **not independent risk factors**. Special types of ulcers exist - especially in the ICU. **Curling Ulcers** are associated with **burns** ("curling irons are hot") while **Cushing's Ulcers** are associated with **↑ICP** ("cushion the brain"). Finally, **Zollinger-Ellison** should be suspected in refractory or virulent ulcers with diarrhea. To suspect an ulcer, look for patients who have a **gnawing abdominal pain that bores to the back** and that's **relieved (duodenum) or exacerbated (gastric) by eating**. To diagnose ulcers there must be 1) an **EGD** to see the ulcer, 2) a **biopsy** taken to rule out malignancy, 3) test for **H. pylori** using **CLO** (blue turns pink in endoscopy sweet) or through **pathology** (actually see the bug). To treat, stop **smoking + stop EtOH**. If there are NSAID ulcers stop the NSAIDs or give back the prostaglandin protection by **adding misoprostol**. If there is a cancer, resect it.

**Triple Tx:**

- Clarithromycin
- Amoxicillin or MTZ
- PPI

**Quadruple Tx:**

- MTZ
- Tetracycline
- Bismuth
- PPI

**All ulcers helped by:**

- Smoking Cessation
- EtOH cessation
- PPIs

If it's *H. pylori* give **triple or quadruple therapy**. ALL ulcers can be helped with either antacids (-tidines) or PPIs (-azole).

Let's talk a little bit about *H. pylori*. The bug is present in 50% of the population and antibodies are present in 95%. But its presence can be disastrous - increasing risk of ulcers and cancer. The best test is **biopsy**. Other tests for *H. pylori* are the **urea-breath test** (best non-invasive test for a positive diagnosis though the patient must be off PPIs), the **stool antigen test** (confirms eradication), and **serology**. Since the serology is almost always positive, it "is not very useful." However, a patient with dyspepsia can follow a **test and treat** algorithm for first-time sufferers. That means NO EGD is necessary. If the serology is positive, treat. However, the serology can't be used to confirm eradication or to treat subsequent symptoms (always positive).

#### Zollinger Ellison Syndrome

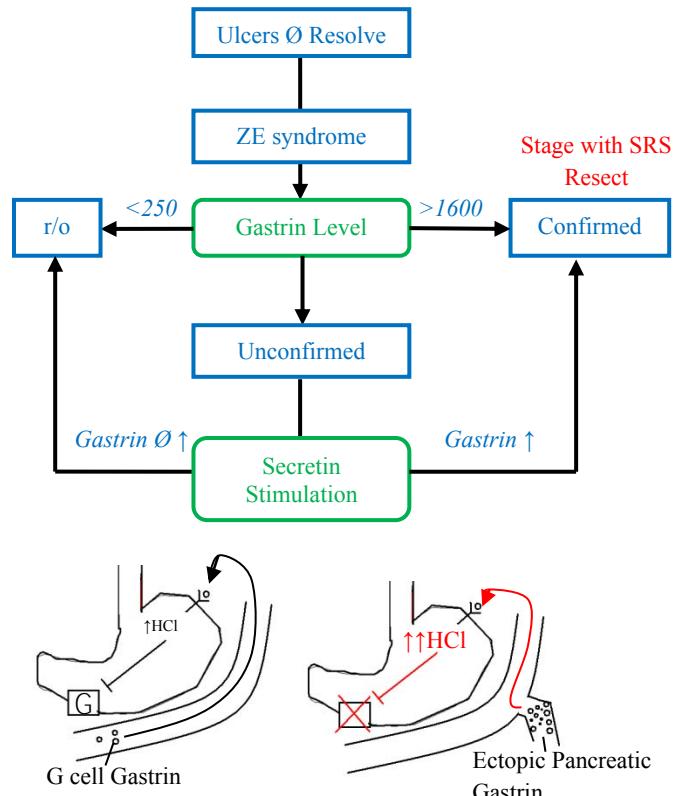
In the presence of **virulent** or **refractory** ulcers despite adequate therapy, consider ZE. This is especially true when considering **Ulcers** and **Diarrhea** together. Caused by a cancer in the head of the pancreas, this endocrine tumor **erroneously secretes Gastrin** causing ↑ production of gastric acid. ↑ Acid = ↑ Mucosal Barrier Destruction = ↑ Ulcers. Test for this disease by 1<sup>st</sup> getting a **serum gastrin level**. If elevated, follow it with a **secretin stimulation test** which will cause an ↑ **Gastrin**. Finally, it's a tumor so it's essential to know where it is. Get a **Somatostatin Receptor Scintigraphy (SRS)** or a CT scan. It's usually **benign** so resection is curative. Though it's benign, the high acid content can produce a **malignant gastric cancer**.

#### Gastroparesis

This is caused by a **neuropathy** - specifically an **autonomic neuropathy**. It's often secondary to long standing **diabetes** in the presence of other **neuropathies**. The patient has a stomach that cannot empty. Food will stay in the stomach. He/she will feel **bloated**, **gassy**, and have **abdominal pain** that's relieved by vomiting. Get a **nuclear emptying study** and confirm the dye fails to exit the stomach. Help the patient by **controlling diabetes** and giving **prokinetic agents** (Metoclopramide, Erythromycin). This might also present as repeated **hypoglycemia** ("proper" insulin timing + delayed gastric emptying = extra insulin and not enough sugar). Before treating, get an **EGD** to rule out mechanical obstruction (**cancer**).

#### MALToma

Is a gastric cancer that looks like lymphoma that's metastasized to the stomach, a "**gastric lymphoma**," but the workup is negative for lymphoma anywhere else. Treat the ***H. pylori*** and the tumor will go away. Tell the patient to thank the stars it wasn't the really bad signet-ring gastric cancer - a malignant tumor that causes early satiety and metastasizes to the supraclavicular node.



**Zollinger-Ellison.** The normal condition (left) is a balance between HCl and Gastrin production, HCl inhibiting the production of Gastrin. The ZE-condition (right) causes constant HCl production, depression of the G cells, but unopposed gastrin stimulation of acid.

Upper vs Lower

GI bleeding has a wide variety of differential diagnoses and potential workups. One of the fundamental determinations is **Upper** (proximal to the ligament of Treitz) versus **Lower** (distal to the Ligament of Treitz) Bleed. While no single finding on history or physical definitively determines the location, there are findings that are more suggestive of one versus the other. **Hematemesis** is vomiting blood. The blood must be near the “in hole” for it to come back out. **Melena** is dark tarry stools indicative of long-standing blood in the GI tract. **Nausea, Vomiting, Hematemesis, and Melena** are all indicative of an Upper GI bleed. Meanwhile, **diarrhea, FOBT +, and Hematochezia** (bright red blood per rectum) are indicative of a lower GI bleed.

Initial Management

Determining **stability** is the 1<sup>st</sup> order of business; make the things that will keep the patient alive the priority. Obtaining **2 large bore IVs, Type + Cross, and CBC** are essential. **Transfusions** may be required for absolute anemia ( $\text{Hgb} < 7$ ) or symptomatic anemia at any Hgb. **PT/PTT** determines if there's a clotting/bleeding problem or if **FFP** is required. Finally, **EKGs** will rule out risk for mesenteric ischemia.

Work-Up = Find the Bleed

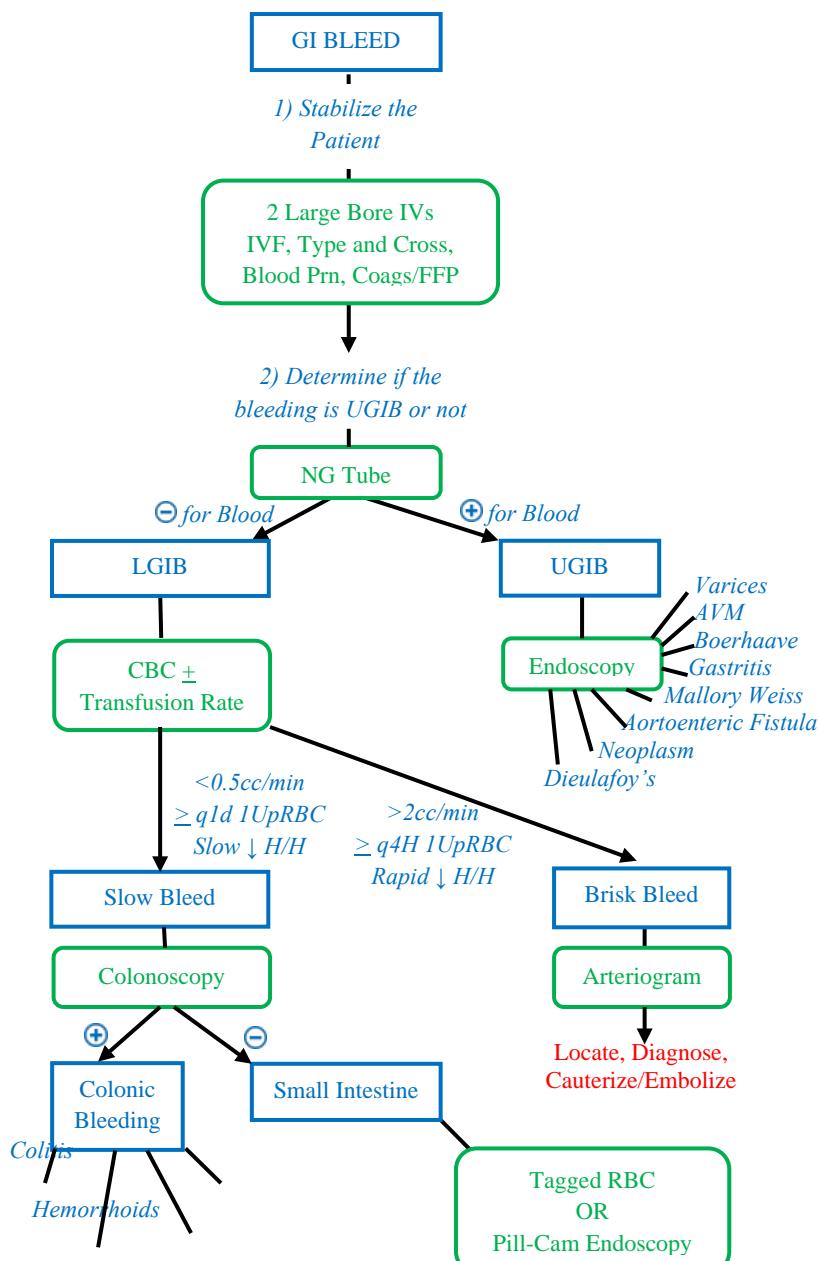
The simplest test one can do is to place an **NG Tube**. If the fluid is **green** the sample's been taken from the stomach and the duodenum and has effectively **ruled out Upper GI bleed**. Alternatively, if **frank blood** or **coffee grounds** were found it's highly suspicious for UGIB. Because blood tends to flow downstream an **Endoscopy** is the best test for UGIB. It will help identify lesions that are currently bleeding (as well propose a therapy).

**If the NG is negative do an EGD in almost all cases.** The next step is to move to the colon. Here, the decision's based on if there's a lot of bleeding (Brisk Bleeding is  $>2\text{cc/hr}$  or **1Unit pRBC q4H**), slow bleeding ( $<0.5\text{cc/hr}$  or **1Unit pRBC q1day**), or no bleeding (**none**). The idea is since blood is moving downstream, attempting a colonoscopy with brisk bleeding will just visualize a river of blood coming at you (not very useful) while trying to find the source of a very slow bleed with an angiogram might not show anything. A tagged RBC study can find the source of the bleed - especially in locations where the colonoscopy can't reach - but is unable to offer any intervention. A pill cam is the last resort; it's notoriously unsuccessful for finding a bleed. In general, testing goes like this:

- 1) **Brisk Bleed  $\rightarrow$  Angiogram** = Possible Intervention
- 2) **Slow Bleed  $\rightarrow$  Tagged RBC** = localization only
- 3) **No Bleeding  $\rightarrow$  Colonoscopy** = Definitive diagnosis

Etiologies and Characteristic Findings

UPPER GI BLEED	LOWER GI BLEED
↑Ligament of Treitz	↓Ligament of Treitz
Hematemesis and Melena	Hematochezia and
N/V	Diarrhea
66% of all GI Bleeding	FOBT +
CAUSES UGIB	CAUSES LGIB
Oropharyngeal Bleed	Diverticular Hemorrhage
Epistaxis	Angiodysplasia
Erosive Esophagitis	Colitis
Gastritis or Ulcer	Anorectal / Hemorrhoids
Varices	Polyps
Mallory-Weiss / Boerhaave	Neoplasm
Dieulafoy's Lesion	
Neoplasm	



*Neoplasms***Etiologies → Management***Diverticular***a) Esophageal Varices**

Caused by ↑**Portal HTN** secondary to liver failure, portosystemic shunts form and these veins become engorged. Vomiting or retching causes them to **bleed**, which is NOT self-limiting and may be fatal. The patient is **NG Tube** ⊕, **Hematemesis** ⊕, and the **EGD** shows the **definitive diagnosis**. In a patient bleeding right now with known variceal bleeding, give **octreotide**. With Endoscopy there's the option to do **cautery**, **banding**, or a **balloon tamponade**. Tamponade is merely a temporary bridge to a **TIPS** procedure, where the portal pressures are reduced by bypassing the cirrhotic liver (which also increases the risk of asterixis and hyperammonemia). Finally, **Propranolol low dose** (10mg tID) may actually shrink varices and decrease the risk of bleeding.

**b) Mallory Weiss Tear**

Present in people who go on a drinking binge or are **one-time vomiters** who produce **hematemesis after retching**. The bleeding is usually **self-limiting**; it's caused by a tear in the **mucosa only** at the GE Junction. If the patient presents with active bleeding then perform an EGD.

**c) Boerhaave Syndrome**

Present in **Alcoholics** or **Bulimics** who present like a sick Mallory-Weiss. They have a **transmural** tear and it isn't self-limiting. They'll have ⊕ **Hematemesis**, ⊕ **Fever**, ⊕ **Leukocytosis** and ⊕ **Esophageal Crepitus**. The Hamman's Crunch is a crepitus heard with each heartbeat, indicating there's air in the mediastinum. These patients require emergent surgical intervention. Diagnose them with a **gastrografin swallow** (water soluble but less harsh than barium on the mediastinum) and follow up with an EGD. See surgery for more details.

**d) Dieulafoy's Lesion**

An **anatomic variant** in the cardia of the stomach, this lesion is a superficial artery that becomes easily eroded by gastritis or ulcers. It presents as **sudden massive UGIB** and often requires subtotal gastrectomies.

**e) Esophagitis**

Just a simple inflamed esophagus can bleed - especially as the inflammation progresses to cancer. Think of **GERD 1<sup>st</sup>**, but also consider **CMV or Herpes** (ganciclovir or foscarnet), **Candida** (nystatin), and **HIV** (HAART). Biopsy and culture on EGD yield diagnosis. See GI - Esophagitis for more details.

**f) Gastritis/Ulcers**

NSAIDs (multiple shallow ulcers), Malignant (heaped up margins, necrotic core), or Acid-Induced ulcers may erode into blood vessels or perforate. Diagnose with EGD and treat with PPIs or resection. See Gastric Disorders.

**g) Colitis**

Ulcerative Colitis, in particular, may present as a **bloody diarrhea** diagnosed by EGD with biopsy. Control the flares with steroids and control the bleeding. Other forms of colitis, including **bacterial infections**, should be excluded with **Stool Culture** and treated with **antibiotics**.

**h) Diverticular Hemorrhage**

While diverticuli occur more often on the left than the right, hemorrhage occurs on the right more than the left. An arteriole in the dome of the diverticulum tears, producing massive **LGIB** and **hematochezia**. Resection or cautery will cure the lesion. See the diverticular disease lecture for more details.

**i) Cancer**

Cancer can cause an **UGIB** if in the stomach or esophagus, or a **LGIB** if in the colon. Cancer has its own specific screening, diagnosis, and treatment based on the cancer it is. Regardless, the general principle of a camera (**endoscopy with biopsy** or **colonoscopy with biopsy**) is required for diagnosis. **Stage** with (PET)CT and treat with **resection** or **chemo/radiation**. See the corresponding sections for specifics on each cancer.

**j) Mesenteric Ischemia**

This is the gut's equivalent of a "heart attack." Caused by **atherosclerosis** or **A fib**, the mesentery dies. This hurts. Chronic mesenteric ischemia will present with **postprandial abdominal pain** (intestinal angina) and likely weight loss. Acute mesenteric ischemia presents with **pain out of proportion** to the physical exam. An angiogram is diagnostic and resection is usually necessary.

**k) Ischemic Colitis**

Ischemic colitis occurs at the watershed areas of the colon during periods of hypotension. This is often painless, results in a self-limiting bleed, but does need a **colonoscopy** to definitively diagnose.

There are many other causes of GI Bleed. It becomes paramount to focus on the classic presentations of some of the more common and identifiable diseases, but most importantly, on **stabilizing** the patient before worrying about which diagnosis it truly is.

**Ulcerative Colitis**

A disease of **unknown origin** that's an **inflammatory disease** limited to the **colon only** and may involve the **rectum**. It's especially prevalent in **Ashkenazi Jews**. Presentation is typically with flares of **grossly bloody diarrhea** associated with abdominal pain / urge / fecal incontinence. Abdominal pain may be the only presenting symptom. Acute causes (especially infection) of bloody diarrhea must be ruled out. The inflammation is **limited to the mucosa**, although there are characteristic extra-intestinal manifestations. There's a link to other inflammatory disorders such as **primary sclerosing cholangitis** (association with **p-ANCA $\oplus$** ), erythema nodosum, and aphthous ulcers. At times, flares can be severe and produce **fulminant colitis** ( $\downarrow$ Hgb/Hct,  $\uparrow$ ESR, Fever,  $>6$ BM/day, weight loss). **Colonoscopy with Biopsy** is definitive for the diagnosis. It'll show **contiguous inflammation** that may involve the **rectum** on visualization and **crypt abscesses + mucosal inflammation** on biopsy. Medical therapy is simpler: use of **5-ASA compounds** that release in the rectum are crucial for mild disease. For flares, use **steroids**. For UC, **resection is curative** and removes the potential for malignant transformation. Some patients may not wish resection; **Infliximab** has been shown to improve severe disease. Since there's long standing inflammation there's risk of **cancer** developing. A colonoscopy **q1y** starting **8 years** after initial diagnosis is required.

**Crohn's Disease**

This is an **inflammatory disease** capable of arising anywhere in the GI tract from the **mouth to the rectum** in a discontinuous fashion (**skip lesions**). The patient will complain of massive **nonbloody diarrhea** and rapid weight loss. Screening with a barium enema may show evidence of **stricture** with a **string sign**. Definitive diagnosis may not be possible if lesions are within the small intestine and outside the colon. In this case, a **pill-cam endoscopy** can be used to identify potential areas of inflammation. If lesions are present in the colon a **colonoscopy with biopsy** will show **noncaseating granulomas** and **transmural inflammation**. Because the lesion is transmural it can extend into adjacent structures; it'll form **fistulas** from the bowel to other visceral organs or even the skin. A common consequence is the **perirectal abscess**, presenting as a fluctuant, palpable mass requiring **incision and drainage** and **IV Abx (MTZ + Cipro)**. Finally, the **terminal ileum** can be affected, producing a **B12 deficiency** (megaloblastic anemia + neuro symptoms). There's no link to cancer as in UC, but there is a small risk of small bowel carcinoma. Though removal of an inflamed segment is possible the symptoms will recur.

Treatment of Crohn's is quite complex.

<i>Ulcerative Colitis</i>		<i>Crohn's</i>
<b>Pop</b>	Ashkenazi Jews, Caucasian 20-25	Ashkenazi Jews, Caucasians, Smokers 20-25 and 50-70
<b>Scope</b>	Contiguous lesions starting @ rectum up the colon, spares extracolonic gut.	Skip lesions that may affect any GI region
<b>Biopsy</b>	Mucosal Inflammation Only (Superficial) $\ominus$ Granulomas $\oplus$ Crypt Abscess	Transmural Inflammation $\oplus$ Noncaseating granulomas
<b>Barium</b>	Barium Enema = Hazy	Barium Enema = String Sign
<b>Cancer</b>	Cancer Risk, Colonoscopy Screen	$\ominus$ Cancer Risk, $\ominus$ Screen
<b>Extra colonic</b>	Primary Sclerosing Cholangitis p-ANCA	Perirectal Abscess, B12 Def. Fistula Formation
<b>Colectomy</b>	Colectomy ultimate treatment	Colectomy $\ominus$ Indicated
<b>Infliximab</b>	Does work	Does work
<b>5-ASA</b>	Does Works	Does not work

**Mild:** **5-ASA Compounds** designed to prevent flare by releasing in the rectum to quiet inflammation. These work for UC

Sulfasalazine

Mesalamine

**Mod:** **Oral steroid** taper quells the acute flare Then... follow with **immune modulators**

**Prednisone**

Azathioprine / 6-Mercaptopurine

**Severe:** **IV steroids** to quell acute flare, then...  
For UC → **Infliximab** or **Cyclosporine**  
For UC → Resection

**SURGERY IS CURATIVE**

**Mild:** **5-ASA Compounds** don't really work for Crohn's disease.

Sulfasalazine

**Mod:** **Oral steroid** taper quells the acute flare Then... follow with **immune modulators**

**Prednisone**

Azathioprine / 6-Mercaptopurine

**Severe:** **IV steroids** to quell acute flare, then...  
For CD → **Infliximab**

**DO NOT PERFORM SURGERY** except for Fistulas (see surgery videos)

Antibiotics are good when there is a perirectal abscess, otherwise, no benefit

Introduction and Differential

Jaundice is a clinical finding where there's **yellowing** of the sublingual region (1<sup>st</sup>), the **sclera** (2<sup>nd</sup>) and then the **skin** (3<sup>rd</sup>). It's a result of elevated **bilirubin** in the blood. Bilirubin is processed by the liver and excreted into the small intestine by the biliary tree. Defects in any three regions can cause a buildup of bilirubin: 1) **PreHepatic**, which essentially means **hemolysis** producing an unconjugated bilirubinemia from increased RBC turnover, 2) **Intrahepatic**, a defect in anything involving **uptake, metabolism, or excretion** of bilirubin producing an unconjugated bilirubin, and 3) **PostHepatic**, typically a **mechanical obstruction** preventing efflux of conjugated bilirubin.

Conjugated vs Unconjugated

Unconjugated bilirubin comes from broken down red blood cells. Glucuronyl Transferase is an enzyme in the liver that **conjugates** the unconjugated bilirubin. Conjugated bilirubin can then be excreted in the GI tract. **Unconjugated** is generally the "worse" type. It **can't be renally excreted** and **can cross the blood brain barrier** because it's lipid-soluble. **Conjugated** on the other hand is water-soluble and **is renally excreted** but **can't cross the blood brain barrier**. A conjugated hyperbilirubinemia will therefore present with **dark urine**.

1) Hemolysis

See the heme section for all hemolytic anemias. Look for a **history of transfusions**, culpable medications (like **Dapsone**), or **African Americans**. Since actual hemolytic anemia rarely causes jaundice, look only for a mild elevation of the bilirubin. A **blood smear** and **Hgb Electrophoresis** can distinguish hemolytic subtypes.

2) Gilbert's and Crigler-Najjar

Disease of uptake of bilirubin. They're either **fatal early** (Crigler-Najjar) or present as **asymptomatic jaundice** when the body is **stressed** (infection, dehydration, etc). Because bilirubin can't enter the liver or get conjugated there's an ↑ **unconjugated bilirubin**. The enzyme deficiencies are for step 1 and aren't required.

3) Dubin-Johnson and Rotor syndrome

Diseases of excretion of already conjugated bilirubin, these cause an **asymptomatic jaundice** when the body is **stressed** just like Gilbert's. However, there's **conjugated hyperbilirubinemia** so the urine will be **dark** and ⊕ for blood (representing the bilirubin, not actually hematuria). Being able to separate these two disease is not necessary.

4) Gallstones

Discussed in gallbladder pathology. The patient will present with a history of **colicky RUQ pain** and will have either **hemolytic anemia** or be **fat, fertile, + forty**. Diagnosis is made with **ultrasound** then treated/confirmed with **ERCP** to remove stones. Gallbladder jaundice is painful obstructive jaundice.



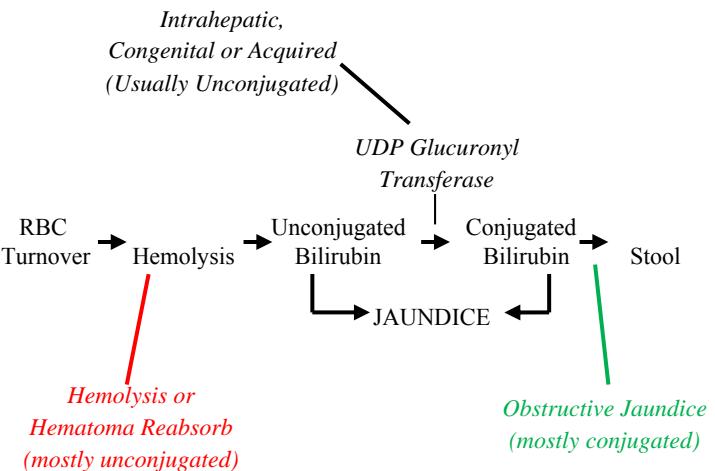
<b>Prehepatic</b>	<b>Hemolysis</b>
	<b>Hematoma</b>
<b>Intrahepatic</b>	<b>Gilbert's</b>
	<b>Crigler-Najjar</b>
	<b>Dubin-Johnson</b>
	<b>Rotor's</b>
	<b>Cirrhosis</b>
<b>Posthepatic</b>	<b>Gallstones</b>
	<b>Pancreatic Cancer</b>
	<b>PBC</b>
	<b>PSC</b>

UNCONJUGATED

Lipid-Soluble	Water-Soluble
Crosses BBB	Ø Cross BBB
Ø Urinary Excreted	⊕ Urinary Excretion
⊕ Kernicterus	Ø Kernicterus

CONJUGATED

Intrahepatic, Congenital or Acquired (Usually Unconjugated)	UDP Glucuronyl Transferase
RBC Turnover → Hemolysis → Unconjugated Bilirubin	→ Conjugated Bilirubin → Stool
Hemolysis or Hematoma Reabsorb (mostly unconjugated)	JAUNDICE



5) Pancreatic / Biliary Tract Cancer

There will be an **obstructive jaundice** with a conjugated hyperbilirubinemia. An **ultrasound** will show a **thin-walled, distended gallbladder**. See surgery videos for more information on obstructive jaundice.

6) Primary Biliary Cirrhosis

**PBC** is for **Bitches**, an **autoimmune** disease affecting **females** and **intrahepatic ducts**. Conjugated bilirubin can't get out, causing a **conjugated hyperbilirubinemia**. The only diagnostic tool is a **biopsy** and treatment is **transplant**. See cirrhosis.

7) Primary Sclerosing Cholangitis

An **autoimmune** disease affecting **MALES** with an association with **ulcerative colitis** (p-ANCA). This affects **extrahepatic** ducts causing a macroscopic pattern of disease. A diagnostic **MRCP** can be used to see a **beads-on-a-string** pattern. Biopsy (not needed) via ERCP will show **onion-skin fibrosis**.

8) Stricture

Stricture is the **other painless obstructive jaundice**. It presents just like a cancer (insidious, dilated ducts, conjugated hyperbilirubinemia) but there is no cancer or PSC. Strictures are diagnosed with MRCP, confirmed by ERCP and treated with stenting (do not stent PSC, only stents). To identify a potential stricture look for iatrogenic causes - especially a history of manipulation of the biliary tree surgically or with ERCP.

Disease	Bilirubin	Dysfunction	Patient Picture	Diagnosis	Treatment
Hemolysis or Hematoma	Unconjugated	PreHepatic	African American, Transfusions, Medications	Heme/Onc Lectures	
Cirrhosis (any acquired form)	Unconjugated	IntraHepatic	EtOH, Viral, Wilson's, Hemochromatosis, Acetaminophen toxicity, etc. etc.	Diagnose underlying dz	Supportive Care
Gilbert's	Unconjugated	IntraHepatic	Asx, Unconjugated Hyperbili,	Genetics	Asx, ØTx
Crigler-Najjar			Death In Infancy	Biopsy	
Dubin-Johnson	Conjugated	IntraHepatic	Asx Conjugated Hyperbili	MRI, Biopsy	Asx, ØTx
Rotor					
Gallstones	Conjugated	PostHepatic	h/o colicky pain, RUQ worse with fatty food, Female, Fat, Forty, or Hemolysis	U/S RUQ ERCP, HIDA	ERCP
Pancreatic Cancer	Conjugated	PostHepatic	Weight Loss and Asx Jaundice	U/S RUQ CT Scan	Surgery
Primary Sclerosing Cholangitis	Conjugated	PostHepatic	MALE with Ulcerative Colitis Extrahepatic Dilation	p-ANCA MRCP Biopsy	Transplant
Primary Biliary Cirrhosis	Conjugated	PostHepatic	FEmale with conjugated hyperbili	AMA Biopsy	Transplant
Cancer	Conjugated	PostHepatic	Weight loss, Painless Jaundice	CT scan EUS biopsy	Resection
Stricture	Conjugated	PostHepatic	Previous manipulation of the biliary system, painless jaundice	U/S RUQ MRCP	Stent

Introduction

Digestion begins with mastication and amylase in the mouth, continues into the stomach with gastric acid, and completes in the duodenum. Absorption then occurs in the “lower GI tract” south of the Ligament of Treitz. **Fats** require **bile salts** and a **terminal ileum** to be absorbed. Fat absorption is required for absorption of vitamins **ADEK**. The **proximal** bowel is the site of absorption for the **FIC** vitamins (Folate, Iron, Calcium). **Protein** is required for growth and needs **pancreatic enzymes** to be digested. Some **general malabsorptions** follow.

Celiac Sprue

This is an **autoimmune** disorder caused by a **gluten allergy**; the body produces antibodies in reaction to gluten of wheat, rye, and barley. Antibodies cause a destruction of intestinal villi, ↓surface area and prevent absorption of everything. That yields the **classic symptoms** (chronic diarrhea, weight loss, abdominal distention). Since the small bowel also absorbs **FIC** the **nonclassic** symptoms are anemia (↓Folate and Iron) and osteoporosis (↓Ca). Diagnosis begins with **anti-endomysial** and **anti-transglutaminase antibodies**. Anti-gliadin antibodies are not useful. Confirmation is made with a **biopsy** via **EGD** showing **atrophic villi**. Because it's an autoimmune disorder, withdrawal of the offending agent will show improvement - but only after antibodies diminish (**3-4 months**). Finally, **Dermatitis Herpetiformis** is a cutaneous variant of celiac (all DH have celiac, Ø all celiac has DH).

Whipple Disease

When malabsorption occurs with systemic symptoms (“malabsorption plus”) think Whipple Dz. There’s a **malabsorption** with **brain, lymph, and joint** problems. Caused by the organism **T. whipplei**, the bug can either be seen as **Pas** or **Macrophages** on EGD Biopsy or via Electron Microscopy. Additionally, **PCR** on the **Blood/CSF** can yield a positive result. This requires **Long-Term Abx** to eradicate (pick either Bactrim DS or Doxycycline).

Tropical Sprue

A distractor for celiac, it's also called sprue b/c it causes an **atrophic villi** on biopsy that occurs in Caribbean farmers. It's likely due to an **infection** and thusly doesn't improve with gluten withdrawal. It does, however, respond to antibiotics.

Lactase Deficiency

As the body ages the amount of Lactase decreases. When lactose (i.e. **dairy products**) is consumed the sugar is not digested or absorbed so it's passed to the colon. Bacteria in the colon love lactose, eat it, and produce lots of gas. Lactose is an osmolar load that draws water into the lumen. This causes **foul flatulence, diarrhea, and bloating**. **Immediate improvement** can be seen by the **elimination of dairy** or **adding lactase**. Ø invasive procedures are required for diagnosis or therapy.

Disease	Patient	Deficiency	Pathology	Diagnosis	Treatment
Celiac Sprue	Adults	FIC	Autoimmune	Antibodies → Bx	Gluten Free Diet
Tropical Sprue	Tropics	B12	Infxn	Bx	Abx + B12
Whipple's Dz	Tropics	CNS, Joints	Infxn	Bx or PCR	Abx (Bactrim)
Lactase Deficiency	Asians	Dairy	↓ Enzyme	Relief w/ Tx	Lactase or Ø Dairy
Pancreatic Insufficiency	Cystic Fibrosis, Gallstones	ADEK	Ø Enzymes	CT/MRI/Bx	Add Enzymes

Pancreas/Bile Salts

Either an obstruction (**cystic fibrosis, gallstones**) or destruction (chronic **pancreatitis**) causes insufficient digestive enzymes. Without enzymes, no digestion or absorption can occur. In an adult it causes **weight loss, foul diarrhea**, and feces that are **difficult to flush** (“floaters”). It causes stunted growth in a child. Giving back the enzymes the patient's lacking will correct the condition.

**FATS**

**ADEK** and **Steatorrhea**

**A** = Night Blindness

**D** = Hypo Ca / Osteoporosis

**E** = Nystagmus

**K** = Bleeding (2,7,9,10) → INR

**Protein**

**Weight Loss and Edema**

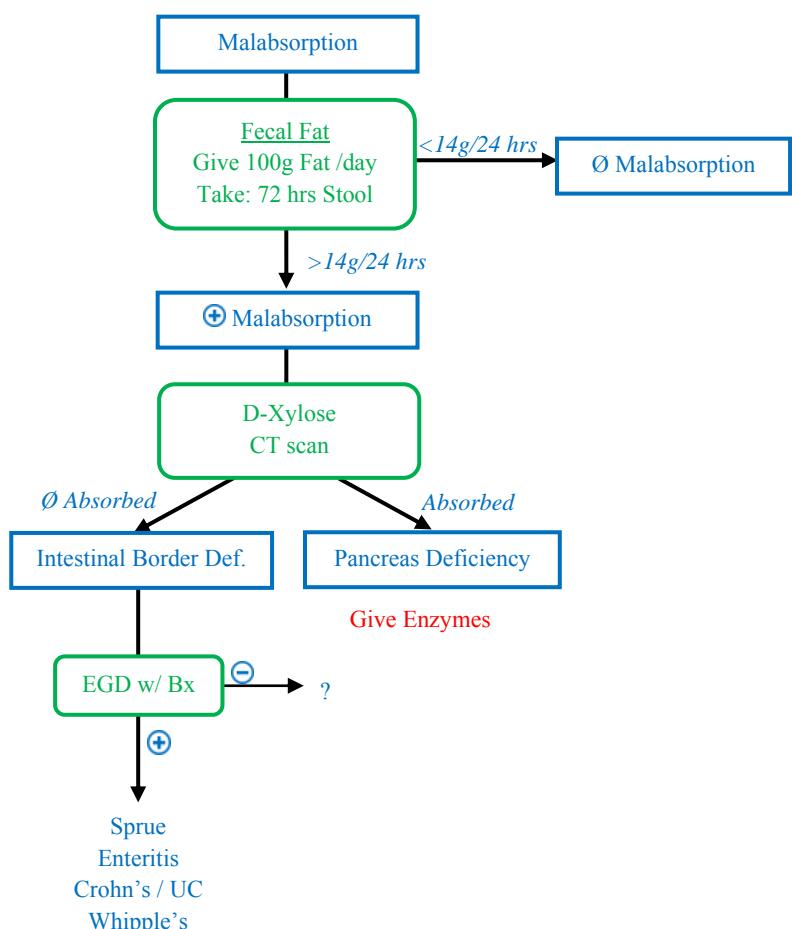
**Proximal Bowel**

**FIC** vitamins

**Folate** = Megaloblastic Anemia

**Iron** = Microcytic Anemia

**Calcium** = Hypo Ca / Osteoporosis

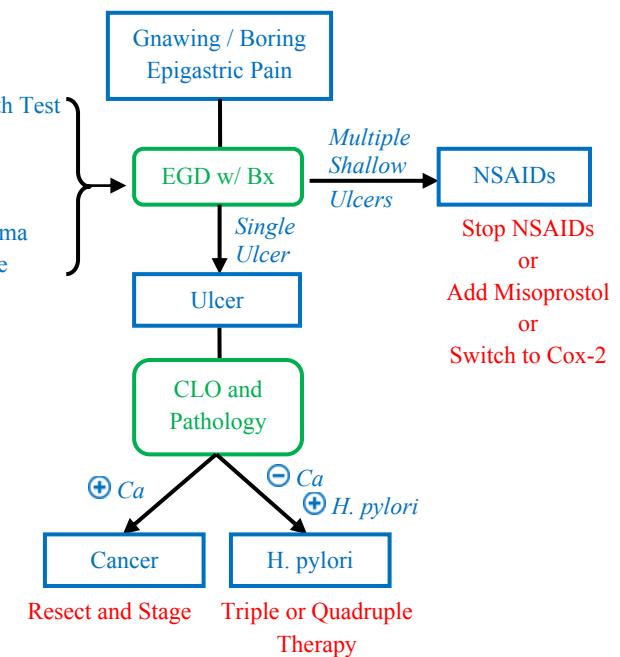
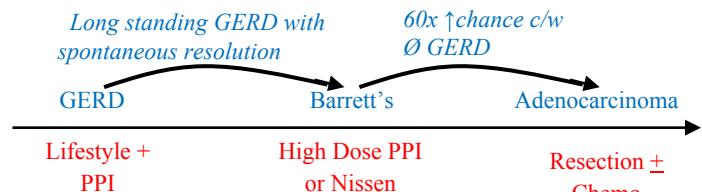
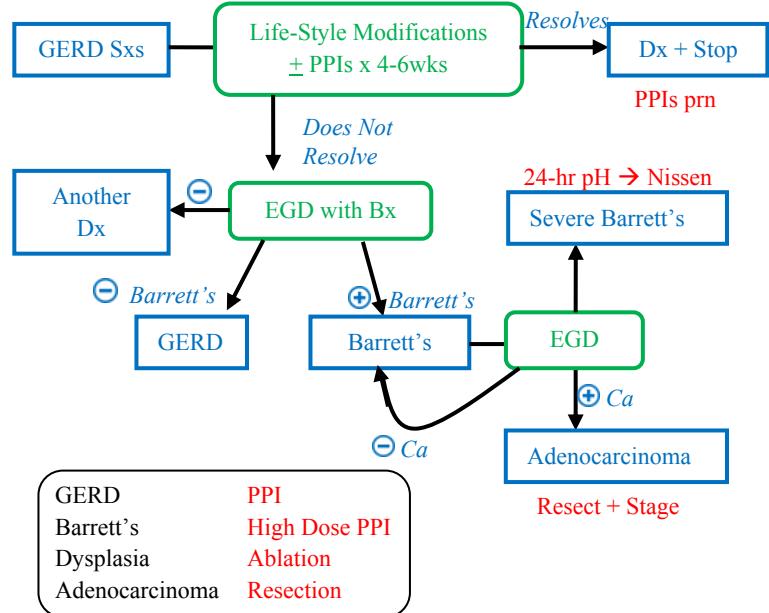


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Ulcers are erosions through the muscularis caused by a break in the gastric or duodenal mucosa. It's caused by one of three things: 1) **NSAIDs (multiple, punctuate, shallow** lesions in the gastric mucosa 2) those caused by **H. pylori/Cancer (singular, large and deep ± heaped margins of cancer)** and 3) **Zollinger-Ellison Syndrome** (see the next section). Ulcers occur in two places - they're far more common in the **duodenum** and nearly 100% associated with **H. pylori**, but can also occur in the **stomach** (75% associated with **H. pylori**). Although lifestyle (smoking, EtOH, caffeine) impacts the rate of formation they are **not independent risk factors**. Special types of ulcers exist - especially in the ICU. **Curling Ulcers** are associated with **burns** ("curling irons are hot") while **Cushing's Ulcers** are associated with **↑ICP** ("cushion the brain"). Finally, **Zollinger-Ellison** should be suspected in refractory or virulent ulcers with diarrhea. To suspect an ulcer, look for patients who have a **gnawing abdominal pain that bores to the back** and that's **relieved (duodenum) or exacerbated (gastric) by eating**. To diagnose ulcers there must be 1) an **EGD** to see the ulcer, 2) a **biopsy** taken to rule out malignancy, 3) test for **H. pylori** using **CLO** (blue turns pink in endoscopy sweet) or through **pathology** (actually see the bug). To treat, stop **smoking + stop EtOH**. If there are NSAID ulcers stop the NSAIDs or give back the prostaglandin protection by **adding misoprostol**. If there is a cancer, resect it.

**Triple Tx:**

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- Amoxicillin or MTZ
- PPI

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- Tetracycline
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**All ulcers helped by:**

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If it's *H. pylori* give **triple or quadruple therapy**. **ALL** ulcers can be helped with either antacids (-tidines) or PPIs (-azole).

Let's talk a little bit about *H. pylori*. The bug is present in 50% of the population and antibodies are present in 95%. But its presence can be disastrous - increasing risk of ulcers and cancer. The best test is **biopsy**. Other tests for *H. pylori* are the **urea-breath test** (best non-invasive test for a positive diagnosis though the patient must be off PPIs), the **stool antigen test** (confirms eradication), and **serology**. Since the serology is almost always positive, it "is not very useful." However, a patient with dyspepsia can follow a **test and treat** algorithm for first-time sufferers. That means NO EGD is necessary. If the serology is positive, treat. However, the serology can't be used to confirm eradication or to treat subsequent symptoms (always positive).

#### Zollinger Ellison Syndrome

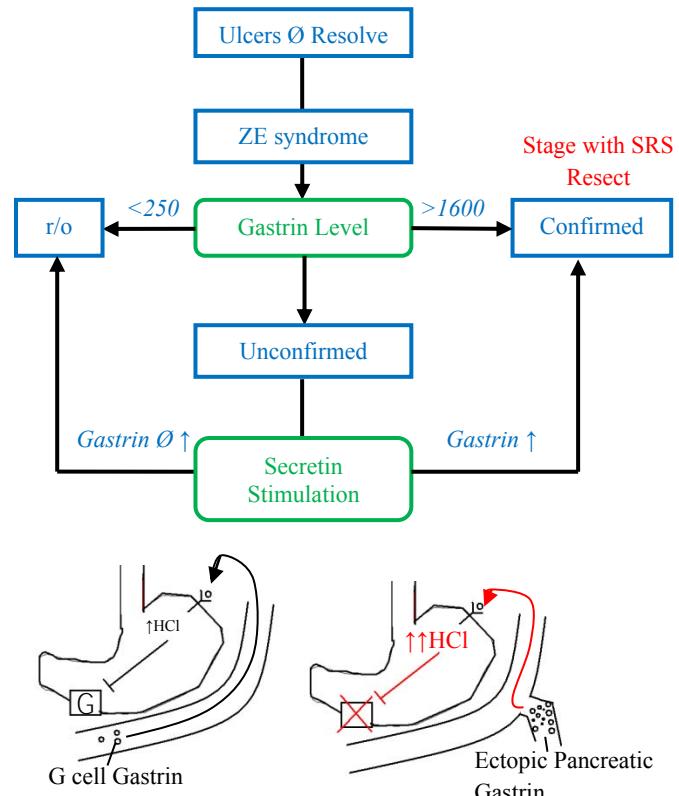
In the presence of **virulent** or **refractory** ulcers despite adequate therapy, consider ZE. This is especially true when considering **Ulcers** and **Diarrhea** together. Caused by a cancer in the head of the pancreas, this endocrine tumor **erroneously secretes Gastrin** causing ↑production of gastric acid. ↑Acid = ↑Mucosal Barrier Destruction = ↑Ulcers. Test for this disease by 1<sup>st</sup> getting a **serum gastrin level**. If elevated, follow it with a **secretin stimulation test** which will cause an ↑**Gastrin**. Finally, it's a tumor so it's essential to know where it is. Get a **Somatostatin Receptor Scintigraphy (SRS)** or a CT scan. It's usually **benign** so resection is curative. Though it's benign, the high acid content can produce a **malignant gastric cancer**.

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This is caused by a **neuropathy** - specifically an **autonomic neuropathy**. It's often secondary to long standing **diabetes** in the presence of other **neuropathies**. The patient has a stomach that cannot empty. Food will stay in the stomach. He/she will feel **bloated**, **gassy**, and have **abdominal pain** that's relieved by vomiting. Get a **nuclear emptying study** and confirm the dye fails to exit the stomach. Help the patient by **controlling diabetes** and giving **prokinetic agents** (Metoclopramide, Erythromycin). This might also present as repeated **hypoglycemia** ("proper" insulin timing + delayed gastric emptying = extra insulin and not enough sugar). Before treating, get an **EGD** to rule out mechanical obstruction (**cancer**).

#### MALToma

Is a gastric cancer that looks like lymphoma that's metastasized to the stomach, a "**gastric lymphoma**," but the workup is negative for lymphoma anywhere else. Treat the ***H. pylori*** and the tumor will go away. Tell the patient to thank the stars it wasn't the really bad signet-ring gastric cancer - a malignant tumor that causes early satiety and metastasizes to the supraclavicular node.



**Zollinger-Ellison.** The normal condition (left) is a balance between HCl and Gastrin production, HCl inhibiting the production of Gastrin. The ZE-condition (right) causes constant HCl production, depression of the G cells, but unopposed gastrin stimulation of acid.

Etiologies

Most acute pancreatitis is caused by either **gallstones** (#1) or **EtOH** (#2). The mnemonic “pancreatitis” reminds you that hypercholesterolemia and scorpion stings exist, but don’t spend too much time memorizing the list. Other common-ish causes are **trauma** (MVA or ERCP) or **toxins** (drugs like AZT). The damage to the pancreas is caused by **proteolytic digestive enzymes** released prematurely within the pancreatic parenchyma (literally digesting itself).

Presentation

It’s **severe epigastric abdominal pain** that will **radiate to the back** and is **relieved by leaning forward** (sounds a lot like a pericarditis). There are also non-specific signs and symptoms such as N/V/Anorexia/Fever. Physical exam findings indicative of intraperitoneal hemorrhage, but associated with pancreatitis are listed to the right.

Diagnosis

This is mainly a clinical diagnosis, however, the best test is an **elevated Lipase** ( $\uparrow$ Se) often seen in conjunction with an **Amylase  $> 3x$  Upper Limit of Normal** ( $\downarrow$ Se). Since there are multiple etiologies it’s important to also get an **ultrasound** to rule out stones and possibly identify lesions in the ducts. If stones are present change the diagnostic (and conveniently the therapeutic intervention) to decompressing the biliary tree with **ERCP**. A **CT scan** should **never** be performed on initial presentation; it can be **harmful** so only use it to **rule out complications** after several days of admission. **Ranson’s Criteria** are taken at admission and at 48 hrs - use it to assess severity. Don’t memorize the Ranson’s Criteria.

Treatment

Initial management is **NPO Bowel Rest, IVF, and Analgesia**. NPO prevents pancreatic secretion. 3<sup>rd</sup> spacing can occur so IVF keeps them perfused. Analgesia keeps them from anxiety and unnecessary motion which can exacerbate the pain. Prophylactic Antibiotics are not required. Gallstones are removed with **ERCP**.

Complications

The most common is a **pseudocyst** which should be allowed to spontaneously resolve if  **$<6\text{cm}$  and  $<6\text{wks}$** . If these criteria are not met the risk of infection, hemorrhage, or failure to resolve increase. This requires **surgical drainage**. Do this percutaneously, surgically (open), or with a pancreaticogastrectomy (pancreas to stomach).

Other problems that may develop are **necrotizing pancreas** requiring surgical debridement, **abscess** requiring I&D and broad-spectrum antibiotics, and carries an increased risk for chronic pancreatitis. The complications of acute pancreatitis are covered in detail in the surgical videos.

**P**arathyroid Hormone

**A**lcohol

**N**eoplasia

**C**alcium

**R**ocks (Gall Stones)

**E**strogens

**A**CE-i

**T**riglycerides

**I**nfarction (Ischemia)

**T**rauma (ERCP, MVA)

**I**nfection (Mumps)

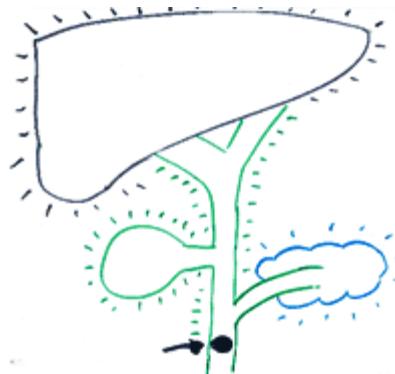
**S**corpion Stings

Grey Turner Sign – Flank Ecchymosis

Cullen’s Sign – Umbilical Ecchymosis

**Acute Pancreatitis**

<b>Path</b>	Activation of digestive proteases w/i the parenchyma of the pancreas causing necrosis and lysis of the pancreas
<b>Etiologies</b>	Obstruction (Gallstones) or Destruction (EtOH, Trauma, Toxins, Scorpion Stings)
<b>Patient</b>	Boring epigastric pain radiating to the back, relief with leaning forward.
<b>Dx</b>	$\uparrow$ Amylase $> 3x$ ULN, $\uparrow$ Lipase (Lipase better) U/S if stones suspected → ERCP CT scan only if unsure or complications
<b>Tx</b>	NPO, IVF, Analgesia x 2 days Aggressive support if Ranson’s is High
<b>Comp</b>	Pseudocyst, Abscess, Necrotizing Pancreatitis, Hemorrhagic Pancreatitis



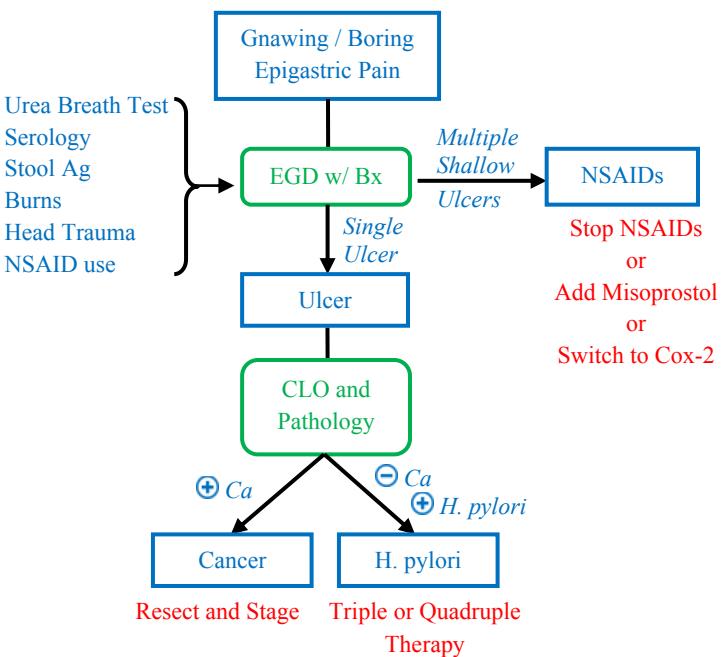
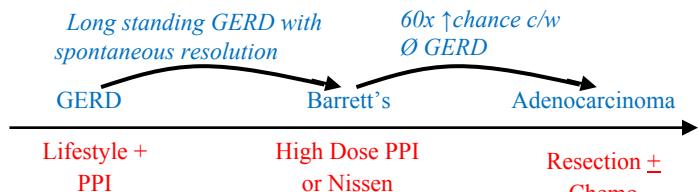
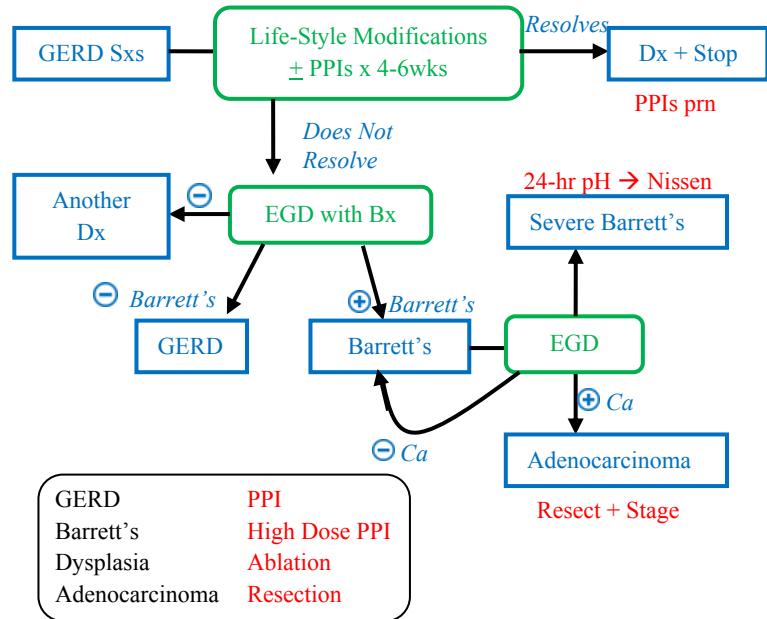
**Gallstone Pancreatitis.** The obstructing stone prevents the digestive enzymes from leaving the pancreas, resulting in erroneous activation and destruction of the pancreas.

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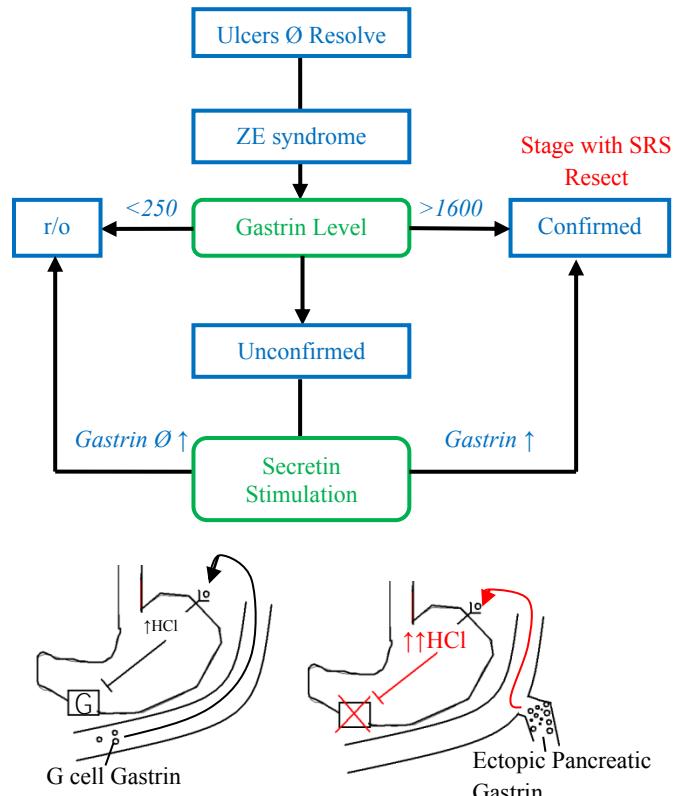
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### Introduction

Viral Hepatitis is an umbrella categorization of the different viruses that can cause an infection of the liver. Some are chronic, some are acute, some can be prevented, others only avoided. Let's talk about each.

### Hepatitis A

This is an **Acute** form of hepatitis spread by fecal-oral contamination. It has a 2-6 week incubation and is carried in contaminated water, shellfish, and daycares. It produces a **nonbloody diarrhea** and a **modest LFT ↑**. Because it's self-limiting a diagnosis is rarely required. However, serologies will show **IgM** for active infection while **IgG** indicates immunity. A **vaccine** is available and given as a child. Boosters are recommended for travel to endemic regions >2 wks before the trip. **Post Exposure Prophylaxis** with IgG can be started **with vaccine** within 2 weeks of exposure.

### Hepatitis B

This can be **Both** acute and chronic. The stronger the immune response the less likely it's in the chronic carrier state and more likely it's a devastating hepatitis case. **Adults** acquire it through **Sex** more than **IVDA**. Because adults are generally healthy (an intact immune system) they suffer **jaundice, LFTs in the 1000s**, and only the acute phase without chronic carrier state. **Fulminant Hepatitis** is rare (and nearly fatal). **Babies** acquire it through the **birth canal** (vertical transmission) and will likely have **Ø symptoms** (a poor immune system) but are almost always **chronic carriers**. Since there's chronic inflammation infection of the chronic carrier may result in **cirrhosis** or **hepatocellular carcinoma**. **Screen for HCC** with **Alfa-fetoprotein (AFP)** and **Ultrasound**. To treat the hepatitis infection give **peg IFN- $\alpha$ -2a** for 48 weeks coupled with antivirals (lamivudine, adefovir, telbivudine, entecavir) with the goal of eliminating HBeAg. There's a vaccine against Hep B so **vaccinations** are a must to prevent chronic illness. If a patient is not vaccinated and gets stuck, give him/her **vaccine** and **ppx IgG**. Understanding serology is critical. **IgG** indicates either past exposure or immunity. **IgM** is only during acute infection. The virus has a **surface antigen (HBsAg)**, a **core antigen (HBcAg)**, and a protein of infectivity (HBeAg). **IgG HBsAb⊕ ONLY** is a sign of **vaccination**. **IgG HBeAb** but without the presence of Antigen is a sign of immunity following exposure. **HBsAg⊕** (the presence of antigen, not antibody) occurs early and denotes infection. **HBeAg⊕** indicates active infection and **infectivity**. During the **window period** where the Antibodies and Antigens cancel each other out (binding to each other prevents binding of the test antigen), Anti-HBe is the only indicator of infection. Incubation is generally **1-6 months**.

*Fecal Oral*

*RNA*

*Vaccine ⊕*

*IgM = Active Infxn*

*IgG = Immunity*

*PPX = IgG w/I 2 weeks of exposure*

*IVDA/Sex = Adult = Acute*

*Baby = Vertical = Chronic*

*HCC/Cirrhosis if chronic*

*HBsAg initial infxn*

*HBeAg infectivity*

*IgM HBxAg window period*

*IgG HbeAb waning infection / infectivity*

*IgG HBsAb long term immunity*

*Vaccine ⊕*

*PPX = IgG*

*DNA Virus*

*Peg-IF- $\alpha$ -2a + antivirals = ↓ HCC Transformation*

Hep C

Hep C is the **chronic** hepatitis that has **no vaccine**. Until recently there was also no treatment. Hepatitis C is on its way to eradication. Good thing too - chronic hepatitis is chronic inflammation, leading to **cirrhosis** after 20-30 years. Cirrhosis progresses to **hepatocellular carcinoma** at a rate of 2-5%. Even in the absence of cirrhosis, chronic Hep C can lead to hepatocellular carcinoma. Hep C is transmitted by **blood** and essentially not at all by sex (people who sleep with people who do IV drugs tend to also do IV drugs, which is how they get the virus). Blood transmission means **IVDA** and **Blood Transfusions**. The goal with all Hep C is to **prevent further inflammation** by abstaining from alcohol and to **screen for HCC** with annual Ultrasound and AFP.

There are two treatments for Hep C. If genotype 1b, we can use **Pegylated Interferon with Ribavirin** which causes psychosis, depression, and flu-like symptoms for a year. If genotype 2 or 3, we have the new **Direct Acting Antivirals** which all end in -ivir. There are many of them and more are coming.

Viral serology is either **acute** ( $\emptyset$ Anti-HCV,  $\oplus$ HCV RNA), **resolved** ( $\oplus$ Anti-HCV,  $\emptyset$ HCV RNA), or most commonly, **chronic** ( $\oplus$ Anti-HCV and  $\oplus$ HCV RNA).

Hep D

This is essentially **mini-B**. It requires the presence of **Hep B** (reliant on one of Hep B's proteins) and is transmitted the same way. It causes a **more severe hepatitis** and a **faster progression to cirrhosis**.

Hep E

Pregnant ladies in third world countries contract it through fecal-oral route. Think of this as Hep A of women in the 3<sup>rd</sup> world.

*IVDA//Blood Transfusions = Chronic*

*HCC/Cirrhosis*

*Antibody  $\ominus$  and HCV RNA  $\oplus$  = Early Infection*

*Antibody  $\oplus$  and HCV RNA  $\ominus$  = Resolution (rare)*

*Antibody  $\oplus$  and HCV RNA  $\oplus$  = Chronic*

*NO Vaccine*

*PPx = IgG*

*RNA Virus*

*Peg-IF- $\alpha$ -2a + Ribavarin = Remission and  $\downarrow$  HCC*

*Direct Acting Antivirals = Hep C cure*

*Requires coinfection with Hep B  
makes B worse*

*Pregnant ladies in third world countries*

<b>Hepatitis</b>	<b>Route</b>	<b>Acute</b>	<b>Chronic</b>	<b>Cancer</b>	<b>RNA/DNA</b>	<b>Vaccine</b>	<b>Serology</b>
<b>Hep A</b>	Fecal-Oral	Always	Never	Never	RNA	>2 weeks before endemic travel	N/A
<b>Hep B</b>	IVDA, Sex, Vertical through birthing	Strong Immune = Acute	Weak Immune = Chronic	HCC, Only with chronic infxn	Incomplete DNA	All @ risk, especially health care providers	See Above
<b>Hep C</b>	IVDA, Horizontal, or through blood transfusions	Never	Always	HCC	RNA	None	See Above
<b>Hep D</b>	IVDA, Sex, requires Hep B	Never	Always	HCC	DNA	None	-
<b>Hep E</b>	Fecal-Oral	-	-	-	-	-	-

Introduction

Much like vaginal bleeding, the most common and most dangerous cause of adnexal masses changes based on the age. In the **premenarchal** group think **cancer** (germ cell). In the **postmenopausal** group think **cancer** (epithelial). In the **reproductive** age group, where **physiologic** (simple) cysts can occur, and where cycles, pregnancy, and infections occur, a more expansive differential exists. Regardless, **all age groups** need a **sonogram** (ultrasound) if a mass is felt. It'll help us distinguish a **simple** (smooth, small, like a balloon) versus a **complex** (loculated, lobulated, large) cyst. The simple cyst needs watchful management while a complex cyst requires additional workup.

Simple Cyst

A simple cyst represents a follicle of the corpus luteum that's become **fluid filled**. It looks like a mass but is physiologic, not pathologic. It'll present as an **asymptomatic adnexal mass**. The **ultrasound** will show a **simple cyst**: smooth, continuous, and small. Because follicles grow in response to FSH/LH, if we **turn off the axis** with **OCPs x 2 months** the cyst should resolve on its own. Resolution must always occur within 2 months, else it's designated complex regardless of appearance. If there's **no resolution**, or the cyst occurred while she was **already on OCPs**, or if it's **large (>7cm)**, it's automatically a complex cyst and requires a CT scan.

Complex Cyst

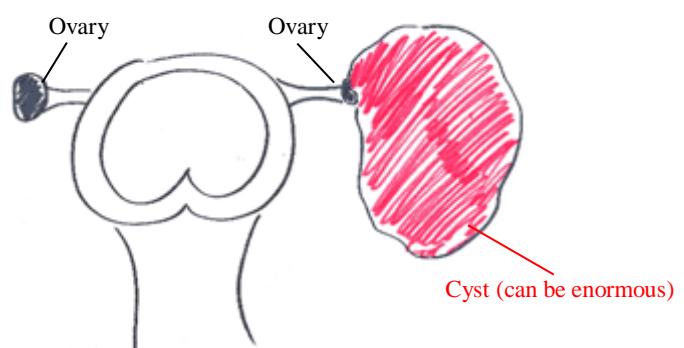
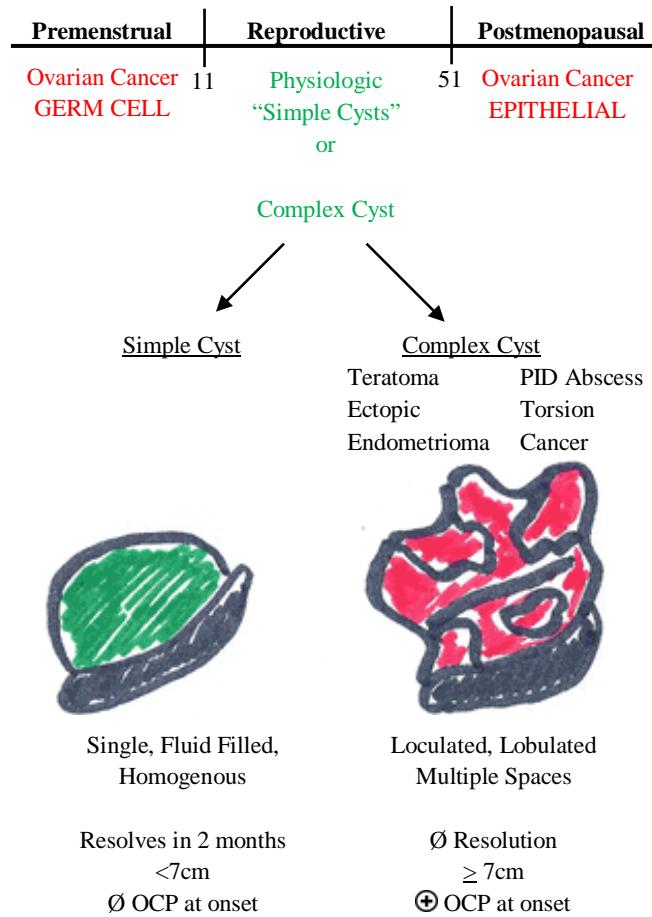
A complex cyst can be anything. Often "a mass" is the presenting complaint. Let's use this opportunity to discuss some topics that are pathologic and present as a mass.

Teratoma / Dermoid Cyst

The teratoma is a **benign** (in girls) **germ cell tumor** of the ovary. Since it's germ cell expect the patient to be **young (<20)**. She'll complain of weight gain or **increased abdominal girth**. The ultrasound will show a complex cyst which is often **enormous**. Due to the weight it's likely to cause the ovary to twist about its vascular supply; it's a risk factor for torsion. Since it's complex it must be removed. **Cystectomy without oophorectomy** is the treatment of choice. Because it's benign, the patient is young, the chance for recurrence on the contralateral side is high, and we don't want to put her into menopause early we **spare the ovary**.

Ectopic Pregnancy

A complex cyst may simply be an ectopic pregnancy. In a patient with a history of **salpingitis** where inflammation may have created a **stricture**, fertilized eggs cannot pass. Ectopics most commonly occur in the **ampulla**. This is a botched pregnancy. The patient will present with **amenorrhea** (pregnant), **lower abdominal pain** (as the cyst grows), and **vaginal spotting**. The ultrasound will



Risk of Ectopic: 1%

Risk with previous ectopic: 15%

Risk with previous ectopic with salpingostomy: 15%

Risk with previous ectopic with salpingectomy: 15%

show a complex cyst and absent uterus. An elevation of the B-HCG quant confirms ectopic. If there isn't a rupture a **salpingostomy** is performed. If there is a rupture perform a **salpingectomy**. In very select patients where the diagnosis is made very early (<3.5cm and HCG<8000) and the patient is not on Folate, methotrexate can be used. The risk of ectopic pregnancy is about 1% in the general population. The risk with previous ectopic, previous ectopic with ostomy, and previous ectopic with gectomy are all 15%. This is discussed in greater detail in the Obstetrics section.

#### Endometrioma / Endometriosis / Chocolate Cyst

**Retrograde menses** (presumed, unknown true cause) leaves estrogen-sensitive endometrial tissue outside of the uterus. This produces proliferation and hemorrhage with each cycle, leading to many problems: **dysmenorrhea**, **dyspareunia**, and **infertility**. A sonogram will show a complex cyst. It may be anywhere: on the uterus, ovary, or even distant in the peritoneal cavity. This often takes time to diagnose - as in weeks to months. While a **diagnostic scope with laser ablation** (i.e. laparoscopic exploratory laparotomy) is both diagnostically superior and curative, it's invasive. Usually, the goal's to 1) turn off the axis with OCPs, continuous Leuprolide, or Progesterone 2) see symptomatic improvement 3) and only then go in for surgery when suspicion is high enough.

#### Torsion of the Ovary

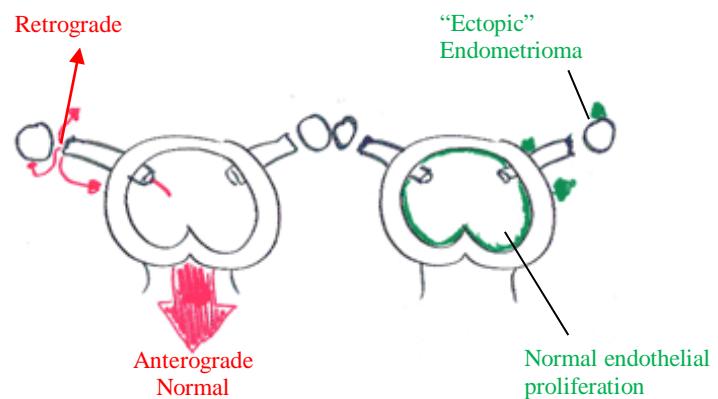
This won't be a diagnostic mystery as it's a surgical emergency. The **suspensory ligament** acts as a hinge that the ovary spins around, cutting off its own vascular supply. Often, it's the **weight of the cyst** that causes torsion. There will be a **severe** and **sudden onset** abdominal pain that was not provoked by any inciting event. The sonogram will show a cyst, but can't tell if the ovary is necrotic or not. The patient must be brought to the OR immediately so the ovary can be **untwisted**. If the ovary pinks up simply remove the **cyst only**. If the ovary is necrotic remove the **cyst and ovary**.

#### Tubo-ovarian Abscess

This is discussed in gyn infections. Essentially - **repeated acute PID** (Gc/Chla) causes inflammation and allows the **vaginal flora** to access the uterus, tubes, and ovary. One consequence is abscess. The patient will present with a **fever**, **leukocytosis**, and an adnexal mass. The sonogram will show said abscess. Treat it with **antibiotics x 72 hrs** and continue if there's improvement. If not, the abscess needs to be **drained**. Indications to go to emergent surgery for TOA is if the patient is very ill or if it's very large. TOA is one of the few abscess conditions that does not require emergent drainage.

#### Ovarian Cancer

Any complex cyst can be cancer. Please see the Ovarian Cancer section for details.

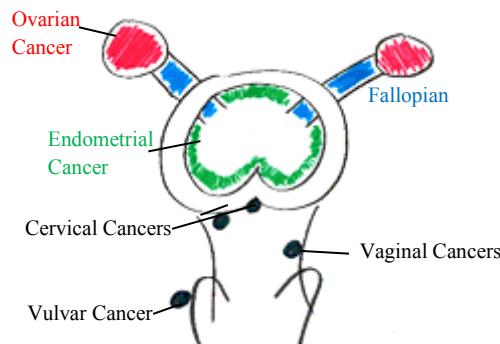


In reading this first section some elements may seem out of place or confusing. We're going to use the concepts discussed here over and over again in each subsequent section regarding cancer. Each will have an etiology/risk that creates a precancer, and, if left untreated, will eventually become a fully invasive cancer. In women's health certain diseases are more prevalent in different age groups, which are divided into three categories: premenstrual, reproductive, and postmenopausal. Having these conceptual understandings will help you move through each of the individual cancer sections.

Cancer rates are often a subject of board examination. Having an idea of what's going on is also useful for discussion with patients. Let's hit the highlights. The most common cancers for women are also the most common cancers for men: **Sex** (Breast/Prostate), **Lung**, and **Colon**. However, they do kill in a different order: Lung, Sex, Colon. For gynecologic cancers **ovarian cancer kills** (though it's very rare) while **endometrial** is the most common. Historically, cervical cancer has been the most common. But now that we're armed with the HPV vaccine and pap smears, the incidence of cervical cancer is very low. We usually catch it in a precancerous phase so it "doesn't count" as cervical cancer.

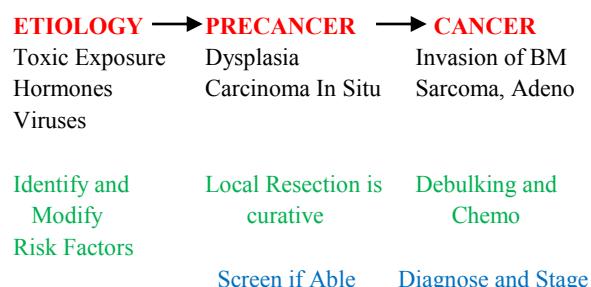
It's necessary to be able to identify the pathogenesis for every cancer. All gynecologic cancers have an **etiology** with subsequent **risk factors**. As a patient's risk factors increase so should the index of suspicion. The goal's to catch cancer **before it's invaded** - as **precancer**. For most gynecologic cancers (excluding cervical cancer) there are **no screens** that catch cancer this early. Once it's precancer it takes about 3-7 years to penetrate and become an **invasive cancer**. This is particularly important for **reproductive aged** females - especially those who wish to become pregnant.

Finally, it's useful to think of everyone as being in one of three age groups. **Premenstrual** girls have not been exposed to teratogens except the toxins in mom. **Reproductive** aged women can have sex and be exposed to **viruses**. **Postmenopausal** women have had a lifetime of exposure to estrogen, lose the protective progesterone of ovulation, and have been exposed to whatever else they've put into their body or come in contact with throughout their lives.



Mortality GYN	Incidence GYN	Incidence Women	Mortality Women
Ovarian	Endometrial	Breast	Lung
Endometrial	Cervical	Lung	Breast
Cervical	Ovarian	Colon	Colon

Colonoscopy at 50 then q10years  
Mammograms at 40 then q1year  
PapSmears at 21 then q3years



Premenstrual	Reproductive	Postmenopausal
Ø Ovulation	11 + Ovulation	51 Ø Ovulation
Ø Estrogen	+ Estrogen	+ Lifetime of Estrogen and toxins
+ Maternal Toxin	+ Sex and Virus	

Locale	Etiology	Precancer	Cancer	Symptoms	Screen
Cervical	HPV	Dysplasia and Carcinoma In Situ	Invasive Squamous cell Carcinoma	Post-Coital bleeding in Reproductive Age Black Vulvar Lesions (Melanoma) Red Vulvar Lesions (Paget's)	Pap
Vaginal	HPV				Ø
Vulvar	HPV				Ø
Ovarian	Ovulation	Borderline	Substrate Specific	Ascites / Pelvic Mass / Asymptomatic	Ø
Endometrium	Estrogen	Hyperplasia	Adenocarcinoma	Post-Menopausal Bleeding	Ø
Chorio	Pregnancy	Moles	Choriocarcinoma	↑B-HCG despite delivery or abortion	B-HCG

**Intro and Etiology**

Cervical cancer is caused by the **Human Papilloma Virus**. It's carried in asymptomatic males and infects a woman during sex. While not all cervical cancer is HPV related, for our purposes it's ok to assume it is. Therefore, it occurs in **sexually active females**. HPV causes an infection of the cervical mucosa, transforming the cells of the cervix through inflammation. The cells with a nucleus are located at the basement membrane; this is where cells will be first transformed (**CIN I**). As cancerous cells grow and fill the epithelial layer (**Carcinoma In Situ**) they eventually penetrate the basement membrane and become full blown **cancer**. HPV causes cancer (subtypes **16, 18, 30s**) and genital warts (subtypes **6, 11**). Risk factors are number of sexual partners and history of STDs.

**Symptoms and Patient Presentation**

Hopefully, she'll get **screened** with **Pap Smears** and avoid symptoms altogether. In any patient who has **post-coital bleeding**, consider cervical cancer. Do a pelvic and stage. In a post-menopausal woman it's likely secondary to vaginal atrophy, but all women who bleed after sex deserve a pelvic, and soon.

**Diagnosis and Treatment**

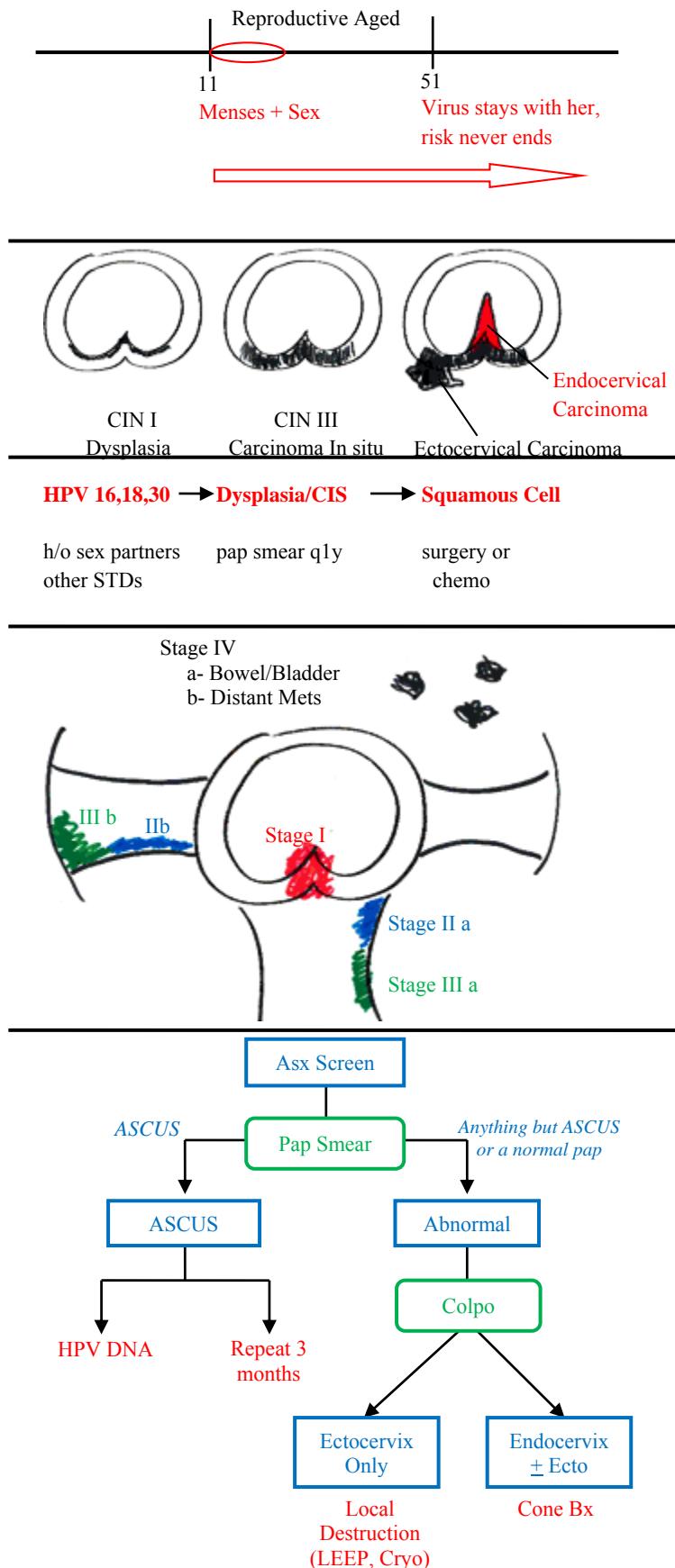
If a **mass** is identified on exam the diagnosis is made by **biopsy** of that mass. The patient must then be **staged**. Cervical cancer is the only cancer that is **clinically staged** rather than surgically. The further down the vagina the higher the grade. "B" classification denotes involvement of the cardinal ligament or the pelvic sidewall. Involvement of the bowel, bladder, or distant mets makes it stage 4. In addition to the physical a **CT scan** can be used to stage. Cancers that are **IIa** or better are cured surgically. Cancers that are **IIb** or worse are treated with debulking and chemo.

**Screening**

The most high-yield topic for cervical cancer is **screening**. A woman should receive a **pap q3y** starting at **21 years old** (regardless of if/when she began having sex). If there's ever an **abnormal pap** (other than ASCUS) do a **reflexive colposcopy**. From the colpo we get a sampling of two things: **ectocervical biopsy** and **endocervical curettage**. If **Ecto⊕** and **Endo⊖** the problem is on the outside of the cervix and a **local destruction** can be done: LEEP, Cryo or laser. If the **Ecto⊖** and the **Endo⊕** or couldn't be sampled, it must be assumed it's in the endocervix; a **cone biopsy** is required. Both local destruction and cone biopsy are curative. If the original pap showed **ASCUS**, don't do a colpo. Either **repeat the pap q3month** to watch for resolution or do an **HPV DNA** to confirm it's high risk HPV. If the patient is **pregnant** a cone biopsy may harm the pregnancy - it can be deferred until after delivery. Remember, it takes 3-7 years to develop cancer from precancer, so 9 months of pregnancy won't make a huge difference.

**Prevention**

**Everyone** (including males) should get the HPV vaccine.



Etiology and Presentation

Endometrial cancer comes from **exposure to estrogen** causing endometrial proliferation. Normally, progesterone is protective. Because estrogen is required for cancer to develop, and estrogen comes from active ovaries, kids just don't get endometrial cancer. On the other hand, a lifetime of excess estrogen exposure puts postmenopausal females at greatest risk. Since **progesterone is protective** the normal ovulatory cycle of reproductive aged females protects them from endometrial cancer.

So it's not surprise that certain conditions that increase estrogen exposure or reduce progesterone activity will increase the risk of endometrial cancer. In general, the things that increase estrogen in a female are: **nulliparity** (estrogen shuts off during pregnancy), **early menarche** and **late menopause**, (more years of estrogen) and **obesity** (increasing the peripheral conversion of estrogen).

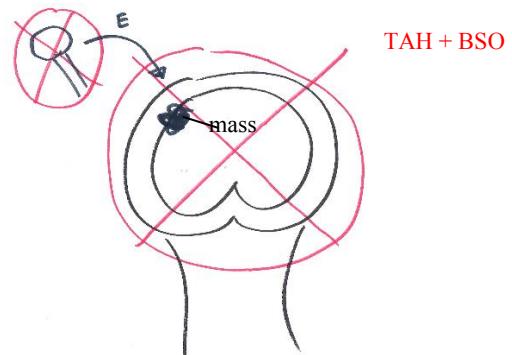
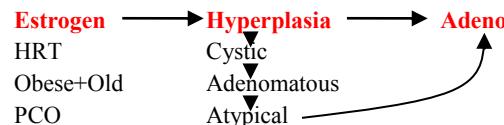
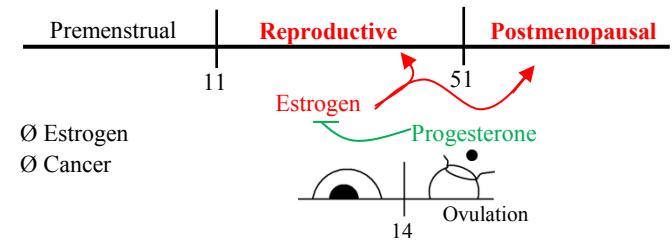
Endometrial cancer will be seen in four scenarios:

1. The **obese** and **post menopausal** (fat and old) patient - the typical patient with endometrial cancer. She's the greatest risk since she's had a lifetime of estrogen exposure, loss of progesterone after menopause, and increased peripheral estrogen conversion. She'll present with **postmenopausal bleeding**. While it probably isn't cancer, treat it as such until definitive.
2. **Young** but **PCO**. Anovulation doesn't just ↑ estrogen exposure – it also prevents progesterone secretion.
3. **Thin, Postmenopausal** and on **hormone replacement** therapy. She's postmenopausal with a lifetime estrogen exposure. If she's on long-term estrogen for menopausal relief or takes a SERM-like Tamoxifen for breast cancer there's ↑ **risk of endometrial cancer**. Like #1, it'll present with postmenopausal bleeding.
4. Rarely, **estrogen secreting granulosa-theca** tumors of the ovary can increase estrogen exposure.

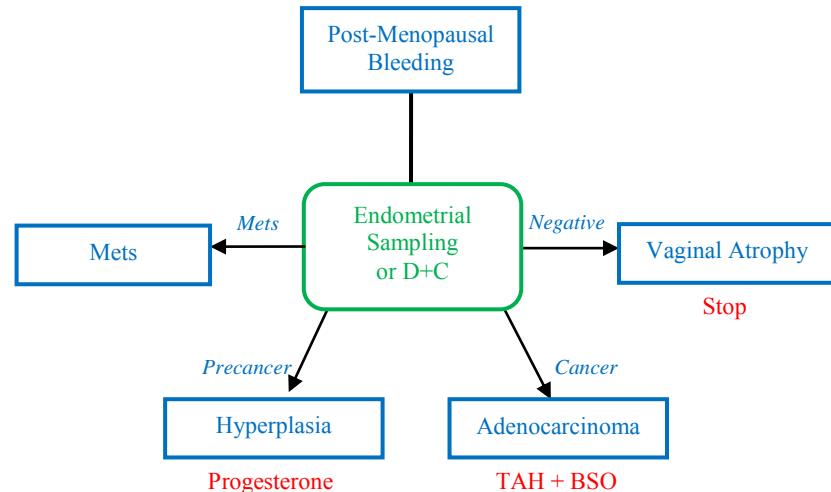
Diagnosis and Treatment

Any **postmenopausal bleeder** needs immediate **endometrial sampling** and **dilation with curettage (D+C)**. As we'll see later in gyn, a post-menopausal bleeder has more common causes of bleeding, but we just can't miss a cancer. A **reproductive aged woman** will eventually get a biopsy or D+C for dysfunctional uterine bleeding, but let's focus on those issues later.

- If simple **hyperplasia** treat with **progesterone**
- If **atypical hyperplasia** or **adenocarcinoma** treat by removing the uterus via hysterectomy and the source of estrogen with BSO in order to eliminate the estrogenic drive
- If there are **mets** add **chemo** to TAH + BSO



Total Abdominal Hysterectomy (gets the cancer)  
Bilateral Salpingo-oopherectomy (gets the stimulus)



Introduction

Infections in a female can be either of the vagina or the cervix.

Vaginal Infections

Patients with a vaginal infection come down to three diseases: Candida, Gardnerella, and Trichomonas. The patient presentation is very **nonspecific** but involves **pruritus**, **odor**, and **discharge**. Nothing is very sensitive or specific from patient history so always do a pelvic exam and run some tests before treating. Though it's the best test, a **culture** often **isn't necessary**. However do these in order: **speculum exam**, **microscopic exam**, and then **antibiotics**. The microscopic exam should be of the cervical mucous. There should be two samples on one slide - one with **normal saline** the other with **KOH**.

Cervical Infections

Cervical infections come in three varieties: cervicitis, acute PID and chronic PID. All involve **cervical motion tenderness**. The pathogenesis, organisms, and physical findings separate the diseases.

1) Cervicitis

Cervicitis is essentially the same thing as a vaginal infection - including the same bugs. The difference is there'll be **cervical motion tenderness**, **cervical discharge**, but in the absence of **PID** symptoms. Do a **wet mount** as well as a **Gonorrhea/Chlamydia PCR** + treat accordingly.

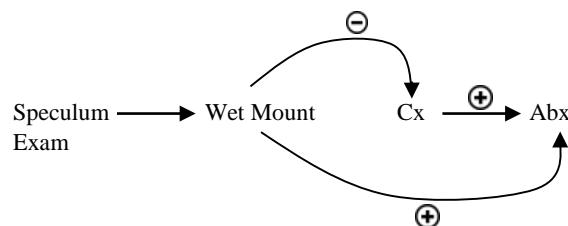
2) Acute Pelvic Inflammatory Disease

Acute PID is essentially cervicitis "plus." The distinction often isn't necessary except on a Board exam. Acute PID is caused by **gonorrhea** or **Chlamydia**. There will be **cervical motion tenderness** and **coital pain** with **cervical discharge**. Essentially assume the diagnosis by history and physical; treat with antibiotics while Gc/Chla PCR is pending. Treat Gonorrhea with **ceftriaxone IM x 1** and Chlamydia with **Doxy po x 14 days** (azithromycin can also be used). These are STDs, and because chronic PID (ectopic, tubo-ovarian abscess, infertility, and chronic pain) is possible she should be **educated** towards safe sex practice.

3) Chronic PID

After repeated trauma to the cervix from Acute PID, **vaginal organisms** are able to penetrate the mucosal barrier and get into the should-be-sterile uterus. They create an **ascending infection** with or without **abscess**. Chronic PID will present with **chronic abdominal pain** and a **pelvic mass**. There will be **cervical motion tenderness** and **adnexal tenderness**. Often there's **fever**. Initially, assume there's no abscess and treat with **Amp-Gen** and **Metronidazole**. This can be continued if there's improvement. If there isn't it's time to investigate for an abscess. Use **ultrasound** or **CT scan**. An abscess can be drained percutaneously or with a colpotomy. If peritonitis, perform **ex-lap** (best diagnosis/treatment for abscess).

	<i>Discharge</i>	<i>Micro</i>	<i>pH</i>	<i>Abx</i>
Candida	Sticky white, adherent to wall	Pseudohyphae (KOH prep)	4 normal	Anti-Fungals topical then oral
Gardnerella (Bacterial Vaginosis)	Fishy odor, KOH, whiff test	Clue Cells (saline prep)	> 5 Basic	Metronidazole
Trich	Yellow-Green and Frothy	Motile Flagellated (saline prep)	> 5 Basic	Metronidazole Both partners!

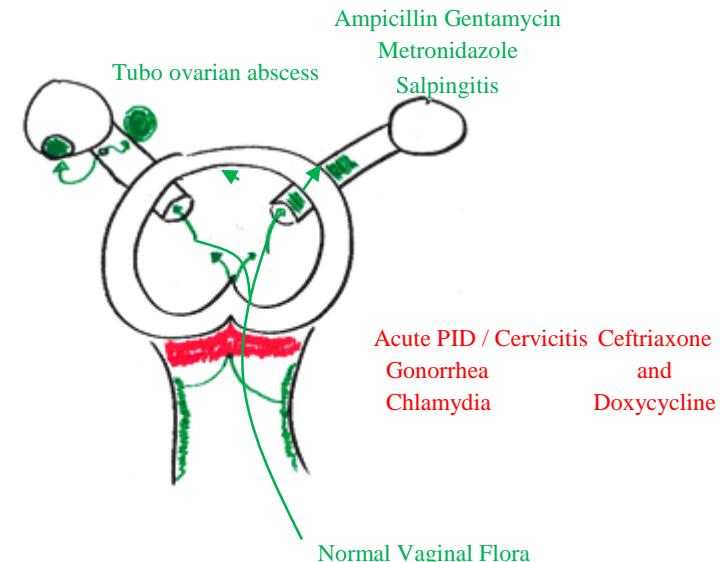


Only use a culture when your speculum and Wet Mount/KOH are negative, otherwise, just treat by what you see!

Acute PID → Chronic PID  
 Cervicitis + Salpingitis

Ceftriaxone (Gonorrhea)  
 Doxycycline x 14 days (Chlamydia)

Amp-Gent x 72 H  
 Clinda or MTZ  
 I&D if no improvement



Stress Incontinence

With **multiple** or **large** births the **cardinal ligament** gets stretched. This weakens the pelvic floor and the bladder falls into the vagina - a high-grade **cystocele**. Basically, the sphincter of the bladder falls into the vagina, while most of the bladder remains in the abdomen. In a normal patient abdominal pressure is translated to both the bladder and the sphincter; the patient has to relax the sphincter to void. In a cystocele, as abdominal pressure increases it's translated to the bladder but not the sphincter. Thus, there's **loss of urine** with any **increase in abdominal pressure** (cough, sneeze, tennis) but no loss any other time. The diagnosis is made clinically: cystocele can be seen on exam (**physical**) and there will be a rotation of the urethra by more than  $30^\circ$  on the **Q-Tip Test**. No additional testing's required. Treatment begins with attempts to strengthen the pelvic floor using **pessaries** and will eventually require **surgery** (Burch, MMK, or anterior vaginal repair).

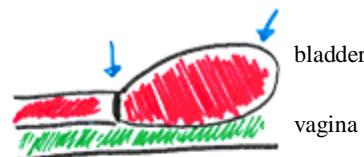
This is the only form of urinary incontinence that is unique to women. All others can be found in both men and women.

Motor Urge or Hypertonic

The normal bladder fills with urine. At around 250cc there's the urge to void. 500cc plus and it begins to hurt. The bladder does not contract until the patient relaxes the sphincter and chooses to void. In motor urge incontinence there are **random detrusor muscle contractions** that occur at any time, randomly, and at all volumes. The patient can sense (urge) the contraction (motor) and will have involuntary loss of urine **day and night** with frequent, **insuppressible urges**. The diagnosis can often be made clinically though **cystometry** will demonstrate contractions at all volumes. All other testing (urinalysis, urine culture, physical exam) are normal. Quell these contractions with **antispasmodics** such as Solifenacain or other antimuscarinic drugs such as oxybutynin or propantheline.

Overflow or Hypotonic

Lesions of the **spine** or **nerves** of any kind (trauma, diabetic neuropathy, multiple sclerosis) can induce overflow incontinence. The patient loses **sensory feedback** indicating fullness, and can't sense the urge to void. The patient may lose the **motor outputs** that initiate bladder contractions, even if the sensation of fullness is intact. Either way, the bladder gets **massively distended** - filled with urine. Eventually, the intrinsic stretch of the bladder muscles contracts against massive pressure. A small amount of urine dribbles out, decreasing the pressure to just under critical. As the kidneys filter more urine the volume slightly increases to just over the critical pressure - more urine leaks. Then there's a constant balance of "just too



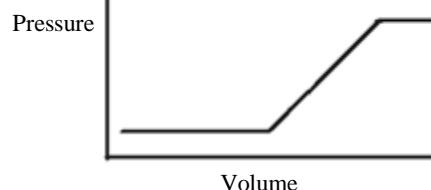
Abdominal pressure (→) is translated to both sphincter and bladder



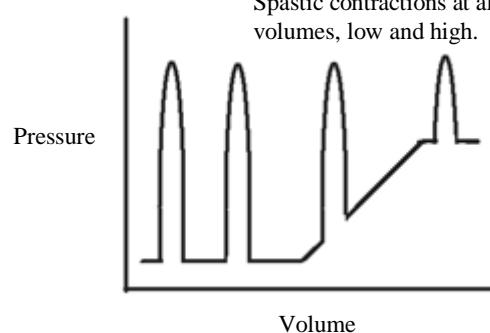
Abdominal pressure (→) is translated to bladder only causing leak

Normal Pressure-Volume Cystometry

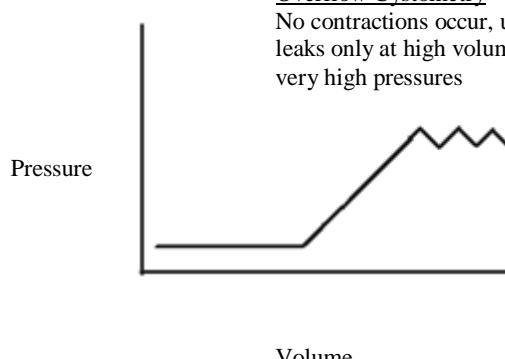
Notice that pressure increases naturally as volume increases

Motor Urge Cystometry

Spastic contractions at all volumes, low and high.

Overflow Cystometry

No contractions occur, urine leaks only at high volumes, at very high pressures



much" and "just under enough" where the patient has involuntary loss of urine **day and night** without the urge or ability to void. Additionally, the bladder **never empties**. Physical exam, urinalysis, and urine culture are normal. **Cystometry** demonstrates **absent detrusor contractions** and an **always full bladder**. To treat the condition we either need to induce contractions with **bethanechol with timed voids** or use regular and scheduled **catheterization** to relieve the pressure. Some patients may have permanent foley or suprapubic catheters in place.

#### Irritative Bladder

Some kind of inflammation (**stones, infection, tumor**) irritates the lining of the bladder and produces contractions. Unlike hypertonic, they're suppressible. The patient will present with the typical symptoms of urinary inflammation (i.e. a UTI): **urgency, frequency, and dysuria**. A urinalysis will show **WBC**. If leukocyte esterase, nitrates, or bacteria are seen it's infectious and a **culture** will speciate the organisms. If not, cytology will help confirm or reject cancer. The medicine section has lectures dedicated to UTI, Kidney Stones, and cancer. Essentially, **infection** gets **antibiotics**, **stones** get **passed, lithotripsy or nephrostomy** depending on their size, and **cancers** need **surgery**. Be able to recognize the symptoms of irritative bladder in OB/GYN and know that no cystometry is needed; U/A and Urine culture are sufficient for the diagnosis.

#### Fistula

Fistulas are epithelialized connections between one organ and another. One such fistula can be from the bladder to any other organ such as the vagina, rectum, or skin. Fistulas are caused by **inflammatory disease** (such as Crohn's) or with **radiation exposure** (as in cancer treatment). There's a permanent connection without valve or sphincter between the bladder and the connected organ. Thus there's a **constant and continuous leak** of urine day and night. The **dye tampon test** can be used to determine if there's a fistula or not. Dye injected into the bladder will appear on a tampon in the vagina or rectum (or visually seen leaking from the skin) indicating the fistulous tract. Surgical repair is curative - a LIFT procedure, a **fistulotomy**.

<b>Path</b>	<b>Urine</b>	<b>Nocturnal</b>	<b>Patient</b>	<b>Diagnosis</b>	<b>Treatment</b>
Stress Incontinence	Big babies Multiple Births	Cough, Sneeze, Tennis	No	Cystocele	Q-Tip Test Pessary Surgery
Motor Urge Hypertonic	Detrusor Instability	Random Day and Night	Yes	Insuppressible urges	Cystometry Anti-Ach medications
Overflow Hypotonic	Spinal Lesions Neuro dysfxn	Dribble, Day and Night	Yes	Involuntary loss, bladder never empties	Cystometry Bethanecol
Irritative Bladder	Stones, Cancer Infection,	U/F/D	No	Urgency, Frequency, Dysuria	Urinalysis Urine Culture Antibiotics Surgery
Fistula	Radiation, Cancer, Crohn	Constant Leak	Yes	Constant leak	Tampon Test Surgery, Fistulotomy

Infertility

Infertility is defined as the **inability to conceive after 1 year** of attempting to conceive with reasonable frequency. AKA banging without babies after 1 year. Most women will conceive in the 2<sup>nd</sup> year of attempting. However, investigation should begin after 1 year without a conception (abortions are a different disease). Conception means a fetus is developed and implants.

There are occasions where an accelerated workup is indicated, such as an anovulatory woman with PID or advanced maternal age. However, for the standard patient, 1 year is when you start.

The Workup #1: Blame the Dude First

This is not some liberal propaganda. The problem is more often with the male partner than with the female, plus evaluation is far less invasive for the guy than for the woman. There are two main diagnoses that are male related: erectile dysfunction and insufficient sperm.

**Erectile dysfunction** is evaluated with a **night time tumescence** test. If the man cannot achieve or maintain an erection there are two main causes. The first is **psychological** which is treated with counseling (erections are spontaneously achieved at night but not with his partner). The second is **organic** which will require phosphodiesterase-inhibitors to overcome (there are no spontaneous erections at night). This is discussed in detail in subspecialty: urology.

**Semen Analysis** is the mainstay of evaluation of the infertile couple. There must be **sufficient number** of sperm and they must be **sufficiently motile** (flagellated and actually moving).

While frequent sex will decrease the sperm concentration, the negative effect of frequent sex is negated by proper timing. Before you touch the woman, you should rule out erectile dysfunction and hypospermia. Then counsel them on the **window of conception**; 5 days prior to ovulation through the day of ovulation. Daily sex is recommended.

**Erectile Dysfunction**

<b>Path:</b>	♂ fault
<b>Pt:</b>	Psychogenic or Organic
<b>Dx:</b>	Night-Time Tumescence
<b>Tx:</b>	Psychogenic: Counseling Organic: Sildenafil
<b>f/u:</b>	Always blame the dude first

**Insufficient, Dysfunctional Semen**

<b>Path:</b>	♂ fault
<b>Pt:</b>	↓ numbers or nonmotile sperm
<b>Dx:</b>	Semen analysis
<b>Tx:</b>	ICSI
<b>f/u:</b>	Always blame the dude first

The Workup #2: Blame the Chick Last

The first thing to assess is **hostile mucous**. Sperm is a foreign body and the uterus fights to kill the sperm. To evaluate the woman for hostile mucous, the couple should have sex and then come into the office (pun not intended). A uterine sample is taken and a number of tests are performed. First, if the mucous can't achieve greater than **6cm** on a **smush test**, it's inhospitable (hostile mucous breaks at short distances, hospitable mucous can extend quite far). Then you actually look at the uterine secretions. If you see **fern sign** or **sperm**, the mucous is hospitable. The absence of fern sign or semen is indicative of a hostile mucous. Treat this with **estrogen** (to soften the mucous) or simply bypass with ICSI.

If she has a normal uterine mucous, it's time to assess for **anovulation**. This can be done a number of ways and these methods are often employed by couples looking to conceive by choosing the "ideal" time to copulate. Look for a **1° rise of basal temperature** as a sign of ovulation. More specific tests include an **endometrial biopsy** between day 14 and 28, ensuring there's a secretory uterus. Finally, a blood test can be used. Look at **progesterone level** on day 22; it should be elevated. If a woman has a history of irregular menses, it's a potential clue that she may be anovulatory. If the woman is **anovulatory**, treat her with **clomiphene** or **pergonal** to stimulate ovulation. Note that this runs the risk of multiple pregnancies as multiple eggs are released.

If she has regular ovulation, assess her **anatomy**. Do this with a **Hysterosalpingogram** (this can also be achieved with Ultrasound or MRI). Look for anatomic defects such as fibroids, tubal strictures, or a bicornate uterus. Tuboplasty, ICSI, or other surgical maneuver can be employed. Care must be made to protect the uterus to allow for implantation.

At the very end of the workup, go after **endometriosis**. The last step is to do a **diagnostic scope with laser ablation**. If a chocolates cyst is found, ablate it and hope that works. It's a long shot and you're hoping to find something.

If all else fails, it's **unexplained fertility**. The only treatment is adoption.

Treatment

**Adoption** is always an option.

**Clomiphene** is used when anovulatory. Look for PCOS

**Estrogen** is used for a hostile mucous

**ICSI** (artificial insemination) is used when the problem is with the dude's sperm

**Inhospitable Mucous**

<b>Path:</b>	Soft mucous needed
<b>Pt:</b>	Inability to conceive
<b>Dx:</b>	Mucous Workup <ul style="list-style-type: none"> <li>- Smush test &lt; 6 cm smush</li> <li>- No sperm</li> <li>- No fern sign</li> </ul>
<b>Tx:</b>	Estrogen Bypass = Artificial Insemination

**Ovulation Issues**

<b>Path:</b>	♀ fault
<b>Pt:</b>	Inability to conceive
<b>Dx:</b>	Normal mucous workup <ul style="list-style-type: none"> <li>Basal Temp rises 1° on ovulation</li> <li>Endometrial biopsy day 14-28 = secretory uterus</li> <li>Progesterone levels at day 22</li> <li>Hx... anovulatory = h/o irregular menses</li> </ul>
<b>Tx:</b>	Clomiphene Pergonal

**Anatomic Issues**

<b>Path:</b>	♀ fault
<b>Pt:</b>	Fibroids (implantation), Stricture, PID (tubes)
<b>Dx:</b>	Inability to conceive
<b>Tx:</b>	Normal mucous, normal ovulation <ul style="list-style-type: none"> <li>Hysterosalpingogram</li> <li>ICSI, in vitro fertilization, Surrogate</li> <li>Tuboplasty</li> </ul>

**Endometriosis**

<b>Path:</b>	♀ fault
<b>Pt:</b>	Retrograde Flow
<b>Dx:</b>	Abdominal pain, dyspareunia
<b>Tx:</b>	Ex-Lap with Laser Ablation

**Idiopathic**

All other tests have failed to find a cause
Adoption
Surrogate, ICSI

Introduction

**Menopause** is defined as the period 1 year after the cessation of menstruation. **Perimenopause** is the same thing as **menopausal transition** and refers to the time period from the onset of menstrual irregularity to the initiation of menopause. On average, this happens at 51 years of age, but can happen at any time before or after.

**Premature ovarian failure** has the same consequence of menopause, but occurs at an age <40.

What to look for and what to do

The loss of estrogen leads to a number of consequences. Regarding ovulation, pregnancy becomes impossible. And with ovarian cycles, **bleeding cycles stop**. During menopause transition, dysfunctional uterine bleeding is normal.

**Vaginal atrophy** results from lack of estrogen. This is the most common cause of post-menopausal bleeding. Lubricants during sex and **estrogen creams** can be used.

**Hot Flashes** (also called Hot Flushes) are symptomatic only. Heat intolerance, sweating, and mood changes are variable and can be debilitating. Phytoestrogens do NOT work. Soy products do NOT work. **SSRIs**, specifically **venlafaxine**, can be used to control symptoms. **HRT** has an increased risk of **endometrial cancer** and should be avoided.

Post-menopausal women also lose the bone-protective effects of estrogen; they should be placed on **Vit D3 + Calcium** supplementation. **Dexa scans** at 65 are part of normal screening. If diagnosed with osteoporosis, **bisphosphonates** are used. If Vit D deficiency is diagnosed, use Vit D2 50,000 units weekly.

Making the Diagnosis**DO NOT GET ANY TESTS OR IMAGING**

**GnRH** is released in a pulsatile fashion. This pulsatility induces release of **FSH**. FSH then stimulates folliculogenesis of the ovaries and estrogen is released. As the ovaries fail, the feedback inhibition on GnRh and FSH fails, so levels soar. Estrogen fails to be produced and levels fall. Thus, while it **should not be performed** in a woman who in the age group expectant of menopause, an **elevated FSH** is consistent with ovarian failure. It should be considered in a woman with premature ovarian failure to ensure the diagnosis.

The diagnosis can be made with age-appropriate symptoms and physical exam. There's no need to document ovarian failure.

*Be aware of, but DON'T memorize the STRAW report, which is a complicated description and categorization of the process of the menopause transition.*

What You Care About	What You Do
Contraception	Infertile, sorry
Menstrual Irregularities	Give it time
Vaginal Atrophy	Estrogen Cream
Hot Flashes	Venlafaxine
Osteoporosis prophylaxis	Vit D3 + Ca
Osteoporosis screening	Dexa Scan @ 65
Osteoporosis treatment	Bisphosphonates
Hormone replacement Therapy	↑ cancer risk, don't do it

*Ovarian failure hormones:*

↑↑ FSH  
↑↑ FSH / LH Ratio (LH does not rise)  
↓ Estrogen

Moles (aka Gestational Trophoblastic Disease)

Moles are not cancerous, but they are potentially premalignant as choriocarcinoma may arise from Moles. Let's discuss the precancer before getting to the cancer.

A **complete mole** is "complete." It's a product of **normal fertilization**, has a "completely" normal number of chromosomes (46), and is "completely" molar; there are **no fetal parts**. It's a product of a broken egg. One single sperm gets inside one single egg, but that egg has no nucleus, so the sperm spontaneously doubles its chromosomes. Though normal in the number of chromosomes, it isn't normal in chromosome complement; all the genetic material is of the sperm.

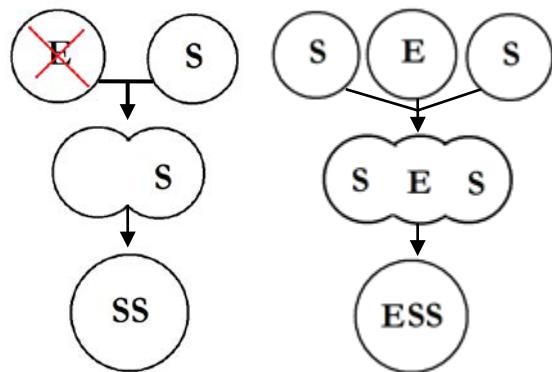
An **incomplete mole** is "incompletely molar" in that it contains **some fetal parts**, doesn't have the normal number of chromosomes (69), and is a product of **two separate sperm** fertilizing one normal egg. Aside from the differences in fertilization, genetic content, and presence of fetal parts, all moles present the same way.

A mole grows faster, produces more B-HCG, and looks different than a normal pregnancy on exam and ultrasound. That being said, there are a couple of ways it can present. If the **B-HCG** is super high, much higher than for dates, or there's a **size-date discrepancy** (that is, it's growing too fast), that's a sign of a molar pregnancy. Because the B-HCG is elevated so high and B-HCG "looks like" TSH, the patient may present with **hyperthyroidism**. But B-HCG also causes "morning sickness," presenting with nausea and vomiting in the first trimester. Too much B-HCG causes **Hyperemesis Gravidarum** - a severe, dehydrating morning sickness or one that lasts beyond the first trimester. A pelvic exam may demonstrate a **grape-like mass** in the vagina. Finally, that grape-like mass looks like a **snowstorm** on an **ultrasound**, which is how it's diagnosed. It's not normal; the only way to get rid of it is to cut it out with **suction curettage**.

**Track the HCG weekly** to assure it was all gotten. It should decline linearly. Put her on **OCPs** to prevent pregnancy; if she gets pregnant it's impossible to sure if it's a molar or regular pregnancy!

Choriocarcinoma

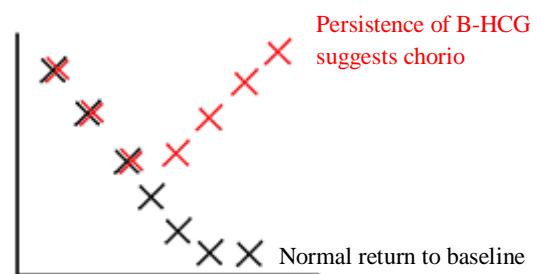
Any pregnancy, molar or regular, can result in a cancer: Choriocarcinoma. It's a cancer of gestational contents. After a **miscarriage**, **normal delivery**, or **molar pregnancy**, if there's **elevation of the B-HCG** or its symptoms (listed above), suspect chorio. Diagnose it with an **ultrasound** first, cut it out with a **curettage**, and stage it with a **CT scan**. The treatment is with **Methotrexate**. More severe forms can be treated with the addition of **Actinomycin D** (dactinomycin) and **Cyclophosphamide**.



Complete Mole

Incomplete Mole

Each letter represents 23 chromosome, S: Sperm, E: Egg



Introduction

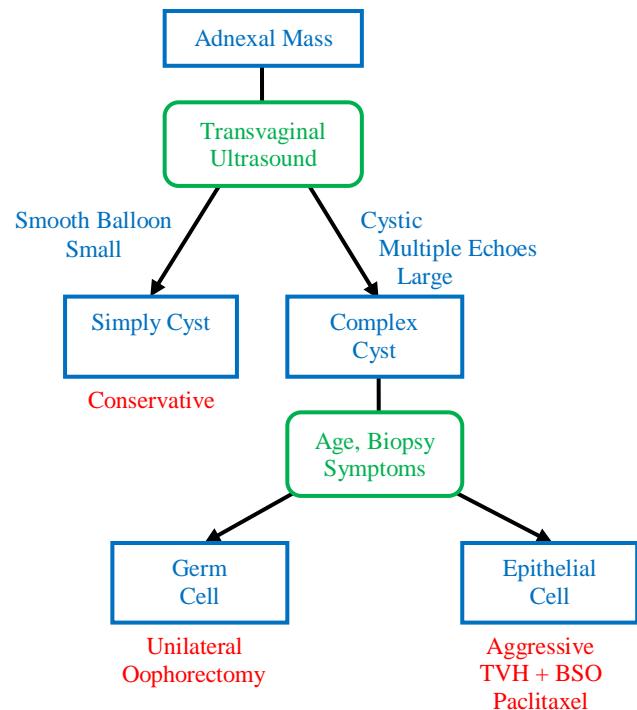
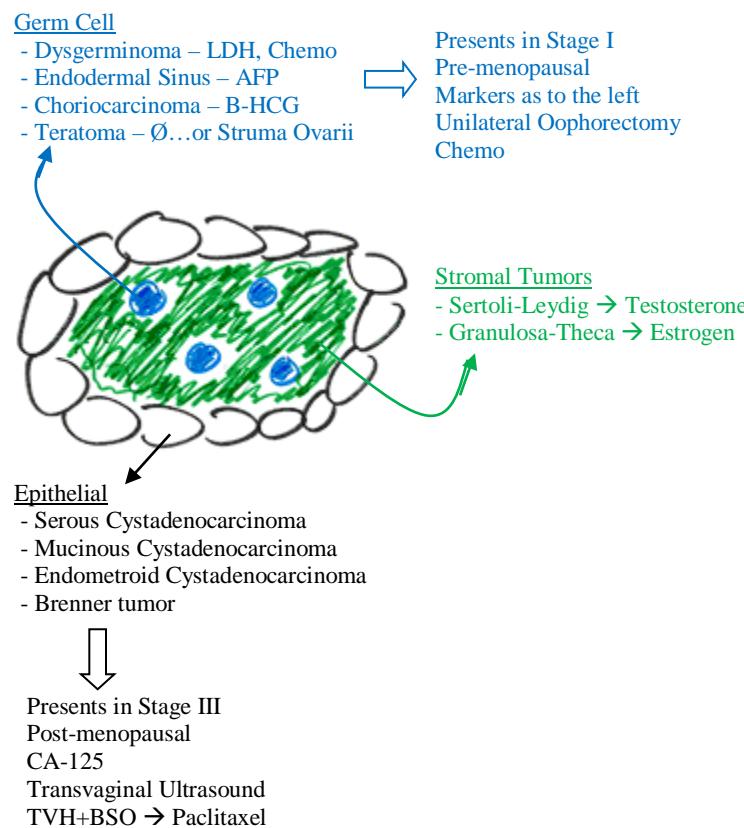
Ovarian cancer is the **leading cause of reproductive aged cancer death**. This is because there's **no good screening tool** for ovarian cancer; it often presents as Stage III or worse when trying to screen. Because it's in the pelvis there are no structures to bump against and plenty of room to grow before becoming symptomatic. However, it isn't as simple as "ovarian cancer;" there are many **subtypes**. You need to be able to visualize the cross-section of an ovary, know which tumors come from which type of cell, and recognize the presentation of each.

Epithelial Ovarian Cancer

When we talk about the highest mortality and late presentation, what we really mean is **epithelial ovarian cancer**. With **repeated trauma** of ovulation comes inflammation. Inflammation leads to cancer. The more ovulations, the higher the risk. Therefore, it's not surprising this shows up in an older (**post-menopausal**) patient. Likewise, states that increase ovulations (**low parity, delayed child bearing, early menarche**) increase risk. Other risk is genetic (HNPCC, BRCA1 > BRCA2), while **having children** and **5 year OCP** is protective. Epithelial cancer spreads by **peritoneal seeding** and remains **asymptomatic** until it's too late, presenting with **renal failure, small bowel obstruction, and ascites**. An **ultrasound** or **CT scan** confirms diagnosis and stages the cancer, while remission can be tracked with **CA-125** levels. Since it's often Stage III, the only option is **debulking surgery (TVH+BSO)** followed by chemo with a platinum-based drug such as **paclitaxel**. For women at super-high risk (BRCA1+) screening can be done with **annual Ca-125** and **transvaginal ultrasound**. After she's done having kids a prophylactic **BSO @ 35** will prevent the need for screening. Screening the general population doesn't work since it detects cancer at Stage III or worse.

Germ Cell Cancer

Unlike the malignant epithelial cancer that occurs in post-menopausal women, **germ cell** tumors occur in **teenage reproductive girls** and are often **benign**. These tumors usually get big before they get dangerous and are often found at **Stage I**. A mass may be palpated then confirmed on **transvaginal ultrasound**. Just as in testicular cancer, there are multiple types, with each followed by a given tumor marker. In **girls** a **teratoma** is usually **benign**, and the **chemoreceptive cancer** is **Dysgerminoma**. Because they're usually benign, Stage I, and present in a young girl, treatment is **conservative (unilateral oophorectomy)** because we want her to grow and have kids!



Ovarian Blood Supply:

The Aorta feeds the major tributaries to the body. The **ovarian arteries** both exit from the aorta - they are their own branches. The **uterine arteries** are discussed below.

The venous drainage of the ovaries mimics the venous drainage of the kidneys and adrenals. On the left side the vena cava is far away. Thus, like the kidneys and adrenals the ovarian vein **joins the renal vein on the left**. Conversely, since the vena cava is so close to the left ovary, like the kidneys and adrenals the ovarian vein **joins the vena cava directly on the right**.

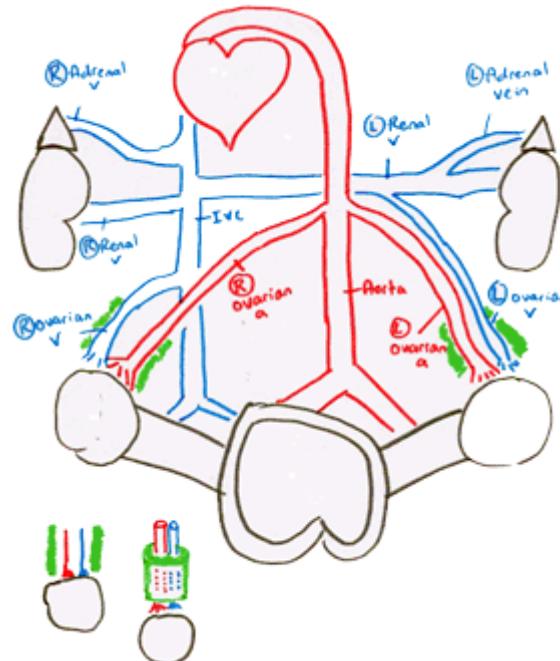
Both the artery and vein pass through the **suspensory ligament of the ovary** (in green)

Clinical Correlate: Ovarian Torsion. The ovary can spin around. This twisting cuts off the arterial supply much like kinking a hose. This happens when the ovary is weighed down, such as by a cyst. The surgeon would have to go in to the pelvis and untwist the ovary to see if revascularization can save the ovary or if it needs to be removed because of necrosis.

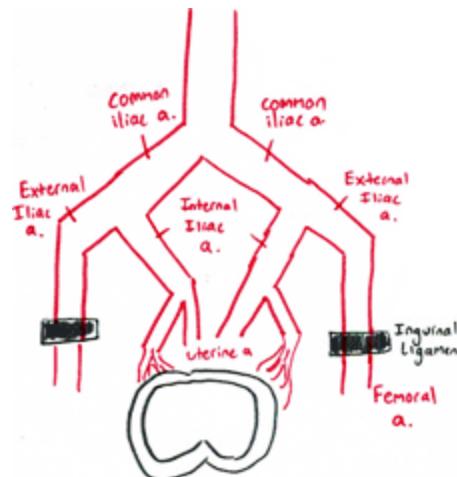
Uterine Supply

The aorta first branches into the common iliac arteries. The **common iliac arteries** then split into the **external iliacs** (which will become the **femoral arteries** as they exit the pelvis under the inguinal ligament). The arteries we REALLY care about are the **internal iliacs** that then give rise to the **uterine arteries**. Deep down in the pelvis are these arteries that feed the uterus and supply the blood. This matters when mom bleeds. What you need to see is that you can't cut off the external iliacs as that will lead to death of the legs. But you CAN ligate the uterine arteries and even the internal iliacs without affecting a whole lot of organs other than the uterus.

Clinical Correlate: In post-partum bleeding the goal's to do everything possible to preserve mom's ability to reproduce. Start with uterine massage, trying to get the uterus to contract down. If that fails, try medications - oxytocin and methergine. Of course keep her tanked up with blood if mom loses A LOT of it. But ultimately there will be surgery. Staying closest to the uterus is best, so as to not compromise the blood supply of nearby structures. Start with the uterine arteries, then internal iliacs, but don't go farther than that. If it still can't be kept under control a total abdominal hysterectomy is what she gets; her life is worth more than preserving her ability to reproduce.

**Ovarian Torsion**

Path	Twists about the suspensory ligament
Pt	Spontaneous, Sudden onset pelvic pain
Dx	Clinical --> Ultrasound --> Surgery
Tx	Untwist ovary during Ex-Lap - Pinks up, leave it in - Stays grey, take it out

**Management of Post-Partum Hemorrhage**

1. Physical	Definition
Uterine Massage	500 cc Vaginal
2. Medications	1000 cc C-Section
Oxytocin	
Methergine	
Transfuse prn	
3. Surgery = Ex-Lap	
Uterine Arteries	
Internal Iliacs	
TAH	

Ligaments

There are three ligaments that must be worried about. They keep everything in place in the pelvis; failure to do so can result in pathology.

1) **Suspensory ligament of the ovary** we talked about above. See clinical correlate with ovarian torsion.

2) **Uterosacral Ligament**. This is the ligament that keeps the uterus tacked down to the sacrum and contained in the pelvis. To get the uterus out of the pelvis they must be cut. But they're in the same place as and look very similar to the **ureters**. Yes, cut the uterosacral ligament. No, don't cut the ureters. This would be a urologic emergency.

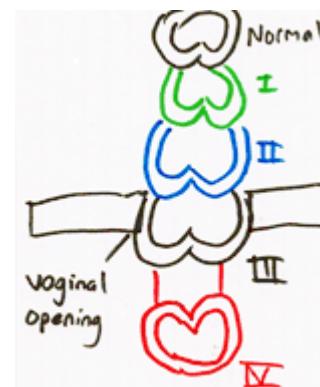
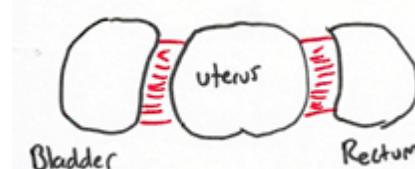
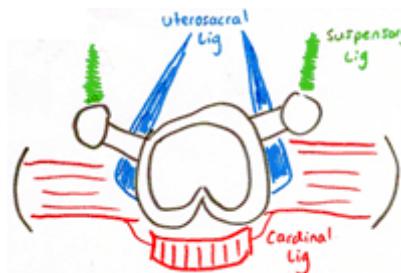
3) **Cardinal Ligament of the Uterus**. This is a ligament that comes off the pelvic side walls and keeps the uterus in place left to right, side to side. But it also has bands that branch forward and backwards, attaching to the bladder and the rectum. When young, prior to children, these ligaments are tight and keep everything in place as they should be. But this ligament can be tugged and pulled in all three directions. So these ligaments can get stretched out as a woman goes through pregnancy and birth.

## Pelvic Floor Relaxation (Clinical Correlates)

1) **Uterine Prolapse**: The uterus is no longer held in the pelvis and begins to literally fall out, to invert, and come out the vaginal opening. Cervical exam reveals a prolapsed uterus or a shortened vagina with the cervix too close to the opening.

2) **Cystocele / Stress Incontinence**: see the urinary incontinence lecture. The bladder falls into the vagina and allows urine to leak with increased intrabdominal pressure (sneezing, coughing, tennis). Cervical exam shows a Q-tip sign or an anterior prolapse (the bladder falling in).

3) **Rectocele / Constipation**: the rectum falls forward into the space occupied by the vagina. The patient can relieve the constipation by inserting fingers into her vagina and pressing. Cervical exam shows a posterior prolapse (the rectum).

**Uterine Prolapse**

Grade I	In vaginal canal
Grade II	At the vaginal opening
Grade III	Out of vagina but not inverted
Grade IV	Inverted and out of vagina

**Pelvic Floor Relaxation**

Path	Multiple births, stretched ligaments
Pt	Vaginal Fullness, Chronic Back Pain, Speculum exam shows prolapse
Dx	Clinical, Physical exam
Tx	Vaginal Hysterectomy (prolapse) Colporrhaphy (Cystocele, Rectocele) Sling / Reconstruction (Cystocele)

Introduction

For a girl who's **never had a period** both her **anatomy** and the **axis** must be investigated. The diseases can be differentiated based on the table to the right. Let's review embryology as we highlight the 4 major need-to-know diseases for the shelf / step.

Mullerian Agenesis

The **Mullerian ducts** create the **tubes, uterus**, and the **upper third of the vagina**. If they fail to form the girl will still be genetically XX (female), so will have **normal primary** and **normal secondary sex characteristics** (the ovaries are working great), but she'll have no uterus. She can **never have children** and will never bleed. However, to increase satisfaction with sex **elevate the vagina** to increase the length. This is considered a Breast  $\oplus$  Uterus  $\ominus$  disease. This is differentiated from testicular feminization based on the **karyotype** (XX) and **testosterone level** (normal).

Testicular Feminization

A male genotype expresses **mullerian inhibitory factor** as well as **testosterone**. In this disease testosterone is made fine, but there's an **insensitivity to testosterone** by the body. Thus, despite **having testes**, the **primary and secondary sex characteristics** are as if there was no testosterone - she appears totally female. MIF works perfectly and inhibits the mullerian ducts (see above). She'll **never have children** or ever bleed. It's also imperative to **elevate the vagina** in this patient we did in mullerian agenesis. There's also the issue of the testes - perform an **orchectomy** to prevent testicular cancer. Do this **after age 20** (i.e. after puberty) to allow her to develop normally. This is considered a Breast  $\oplus$  Uterus  $\ominus$  disease. This is differentiated from Mullerian Agenesis by the **karyotype** (XY) and **testosterone level** (elevated).

Turner Syndrome

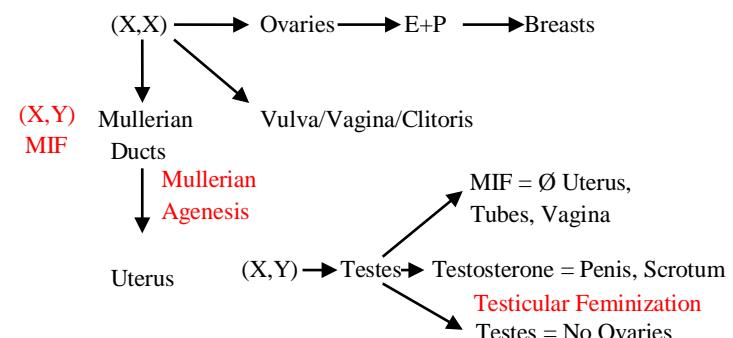
A genetic abnormality (X,O) that causes the production of **streak ovaries**. Patients are female with intact **primary sex characteristics** and **mullerian structures** ( $\oplus$  uterus). But, in the absence of estrogen she'll never develop secondary sex characteristics. She'll also have a **broad, shield-shaped chest** with wide spaced nipples and a **webbed neck**. Lacking both Estrogen and Progesterone, treat by giving them what they don't have (**estrogen** and **progesterone**) to induce puberty. Also investigate for cardiac abnormalities with an Echo (transposition). In this disease, the **FSH and LH** will be high as the normal pituitary tries to drive the production of estrogen and progesterone. **Karyotype** confirms.

Craniopharyngioma and Kallmann Syndrome

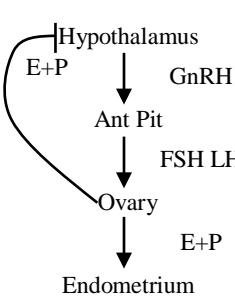
Lesions of the **hypothalamus** will cause the **entire axis** to shut down. GnRH is low, FSH/LH are low, and estrogen and progesterone are low. The anatomy is fine and intact (she's female on the outside as well as inside), but the **absence of endocrine effects** leaves the girl without secondary sex characteristics. **Kallmann syndrome** is a defunct hypothalamus despite a normal FSH and LH. **Anosmia** and **Primary amenorrhea** gives the diagnosis away.

Visual Axis	Ultrasound Anatomy	Disease	Diagnosis
Breast	Uterus		
$\oplus$	$\oplus$	Imperforate Hymen Anorexia/Weight Loss Pregnant before period	Visual Inspection History UPT / B-HCG
$\oplus$	$\ominus$	Mullerian Agenesis Testicular Feminization	Testosterone and Karyotype
$\ominus$	$\oplus$	Cranipharyngioma Kallmann Turner	$\downarrow$ FSH, $\downarrow$ LH, MRI Anosmia, FSH/LH $\uparrow$ FSH, $\uparrow$ LH, (X,O)
$\ominus$	$\ominus$	Enzymatic deficiency beyond our scope	N/A

## (X,O), Turner



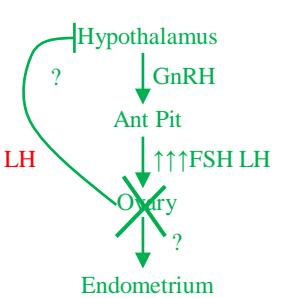
## Normal Axis



## Kallmann's



## Turner's



1. **Kallmann:** Absent hypothalamus can't drive any endocrine function, so FSH and LH are low.

2. **Turner:** Absent ovaries can't make E+P, so no signal to turn off FSH and LH is present

All girls should develop **menarche** by age **16**

All girls should develop **secondary sex char** by age **14**

Girls who have not met age get reassurance

Girls who have not met milestones by age, get worked up

Introduction

If a woman is within her **reproductive** age and **was having periods** that have since **stopped for > 6 months** she's said to have secondary amenorrhea. Most OBs won't wait 6 months to decide if she's pregnant so diagnostic intervention can begin after just 2 cycles, even 1 for UPT. In general, the workup begins with the "three most common causes" (pregnancy, thyroid, and prolactin) then proceeds in reverse order of how the HP axis is set up; beginning with the endometrium, then the ovary, then the anterior pituitary with the hypothalamus as the diagnosis of exclusion. The chart and diagram to the right give an overview of the topics discussed and the order in which they should be investigated. The next page has an algorithm that can be used to work up a patient with secondary amenorrhea.

Pregnancy

The **most common** cause of 2<sup>o</sup> amenorrhea is pregnancy. Get a **UPT** to rule out pregnancy in every patient every time. There is a section called "OB" for this condition.

Thyroid Disease

While both hyper and hypo thyroidism can cause absence of bleeding or too much bleeding, it's usually ↑TRH secondary to **Hypothyroid** that causes ↑ **prolactin** thereby inhibiting GnRH that leads to the amenorrhea. During the first visit we screen with a **TSH** alongside the UPT. If the TSH is **elevated** she needs **synthroid** (see medicine, endo).

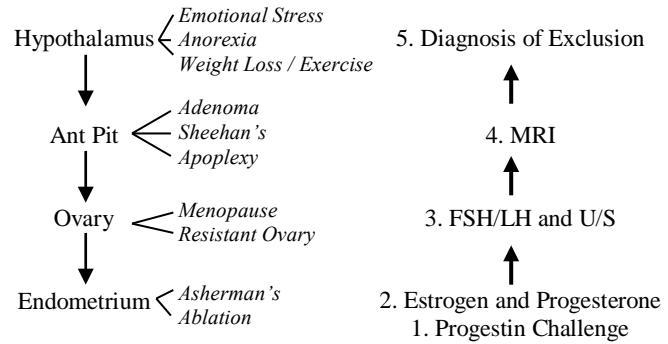
Pituitary Tumor (Prolactinoma)

While a tumor of the anterior pituitary can either cause crush syndrome (↓FSH and ↓LH), bleed (**apoplexy**), or die (**Sheehan's**), it's more likely that an otherwise healthy woman would develop amenorrhea from a tumor that produces **prolactin erroneously** (the first free would make her much sicker than "just stopped bleeding"). Just as in thyroid disease, elevated prolactin will inhibit the axis and turn off her cycle. It doesn't matter how you get prolactin; if you have there's too much it messes with the axis. Suspect prolactinoma if **galactorrhea** and **amenorrhea**. Screen her **prolactin level** and get an **MRI** if it's elevated. The options are **bromocriptine** if small or **surgery** if large or desires pregnancy. See medicine, endo.

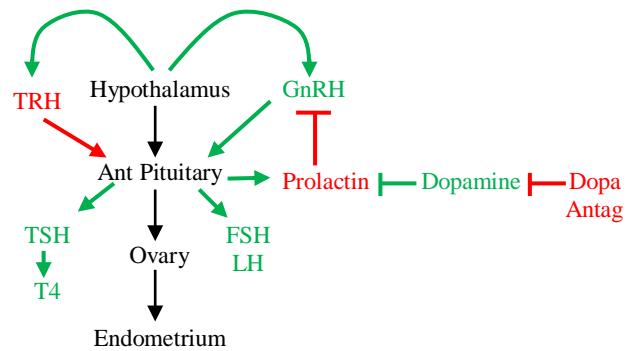
Medications

Anything that **inhibits dopamine** (aka Prolactin-Inhibiting Factor) will **disinhibit prolactin**. Unrestrained prolactin acts just like a prolactinoma (i.e. **prolactinemia**), presenting with **galactorrhea** and **amenorrhea**. **Switch medications** (typically a typical for an atypical antipsychotic) or **add bromocriptine**. If it's the medication that could be the culprit there's no need for an MRI if you've found prolactinemia!

Disease State	Test	Treatment
1. Pregnancy	UPT	⊕ Prenatal Care
2. Thyroid	TSH	↑ Levothyroxine
3. Prolactin	Prolactin	↑ Surgery or Bromocriptine
4. Medications	Prolactin	↑ Switch or D/C



See the correlation to the algorithm on the next page



— Means "inhibits"  
 → Means "stimulates"  
 Green = ↑FSH/LH = Normal  
 Red = ↓ FSH/LH = Amenorrhea

Menopause

If menopause occurs in a woman **<40 years old** it's **pathologic**. Unfortunately, nothing can be done for her. Menopause is menopause and there are no more cycles for her. The typical findings of menopause will be present ( $\uparrow$ FSH and  $\uparrow$ LH) and **absent follicles on ultrasound**.

Savage Syndrome = Resistant Ovary Syndrome

This is **effectively menopause**. It's caused by an **FSH-R insensitivity**. The FSH and LH will be elevated trying to induce ovulation (just like in menopause) but nothing will happen. An **ultrasound** will show **many follicles** (she's NOT in menopause yet). Try giving **HRT** to achieve **pregnancy** but this is generally considered menopausal; there's no treatment or procedure to be done.

Asherman's Syndrome

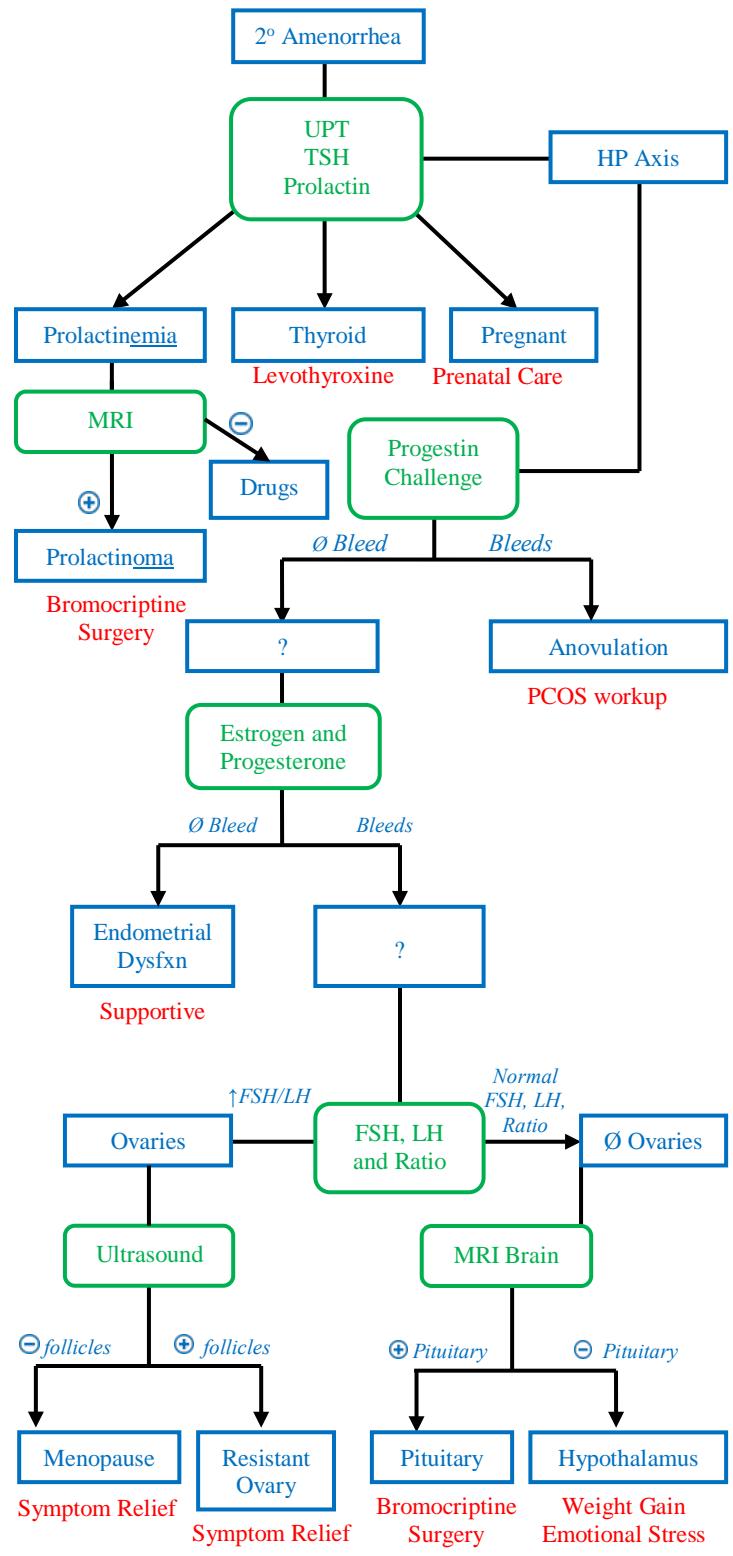
**Scarring and fibrosis** of the endometrium prevents the endometrium from developing properly, and, if nothing grows, nothing can slough off. It's an **unresponsive endometrium**. She's hormonally intact (FSH and LH induce estrogen, ovulation, and progesterone), but she is anatomically deficient. This is a product of **vigorous D+C** (and is a complication of elective abortions). It can also be done **on purpose** with **endometrial ablation** to help patients with menometrorrhagia who are no longer interested in pregnancy. Don't forget to check their surgical history!

Hypothalamus

There isn't a test for the hypothalamus; it's diagnosis by exclusion. All endocrine function begins there. While it's determined by exclusion something can likely be elicited from the history that'd allow for reassurance if TSH, UPT, and Prolactin are negative. If the woman has experienced **anorexia** or **extreme weight loss / exercise**, that might induce amenorrhea. Emotional stress might have her miss a single cycle (bringing her in to check for pregnancy), but it shouldn't cause prolonged cycle loss.

## Algorithm:

1. Is it the common stuff?  
(UPT, TSH, Prolactin, Meds)
2. Is the endometrium ready to bleed?  
(Progestin Challenge)
3. Is the endometrium capable of bleeding?  
(Estrogen and Progesterone)
4. Is there a signal coming from the pituitary? (FSH and LH)
  - 5a. Is there a problem with the anterior pituitary? (MRI)
  - 5b. Are there follicles? (U/S)
6. All has been negative - Hypothalamus



Pregnancy and Bleeding

Bleeding in pregnancy is normal. There may be **spotting** in the first trimester and/or a **bloody show** in the third trimester. But bleeding can also be ominous. The goal is to either reassure mom or identify something more sinister. The process begins with a **urine pregnancy test (UPT)** and is followed up with a **transvaginal ultrasound**. We'll discuss Ectopic Pregnancy and Abortion in this lecture.

Ectopic Pregnancy

An ectopic pregnancy is a potentially life threatening condition; the decision tree is quite complex. The first step is to determine if there is indeed an ectopic pregnancy, then to decide what to do about the diagnosis. Ectopic pregnancies can present with **pain, bleeding, or both**. A **qualitative UPT** will be positive.

When an intrauterine pregnancy is suspected, the first step is a **transvaginal ultrasound**. If the ultrasound reveals an intrauterine pregnancy, it's time to figure out why she's bleeding (IUP, Abortion, Mole).

If the ultrasound reveals an **ectopic pregnancy** we have the answer and treatment is needed.

But if the ultrasound reveals **neither** it's a conundrum. It's here where a **Beta-Quant** actually matters.

A pregnancy can't be seen if the Beta-Quant is  $< 1500$ . If the beta quant is  $> 1500$  and there is no IUP, then it is an ectopic pregnancy. If the **Beta-Quant  $< 1500$**  it's too soon to tell. **Watch and wait for 48 hours** then repeat the Beta-Quant. An intrauterine pregnancy will **double in size in 48 hours** while an ectopic will not.

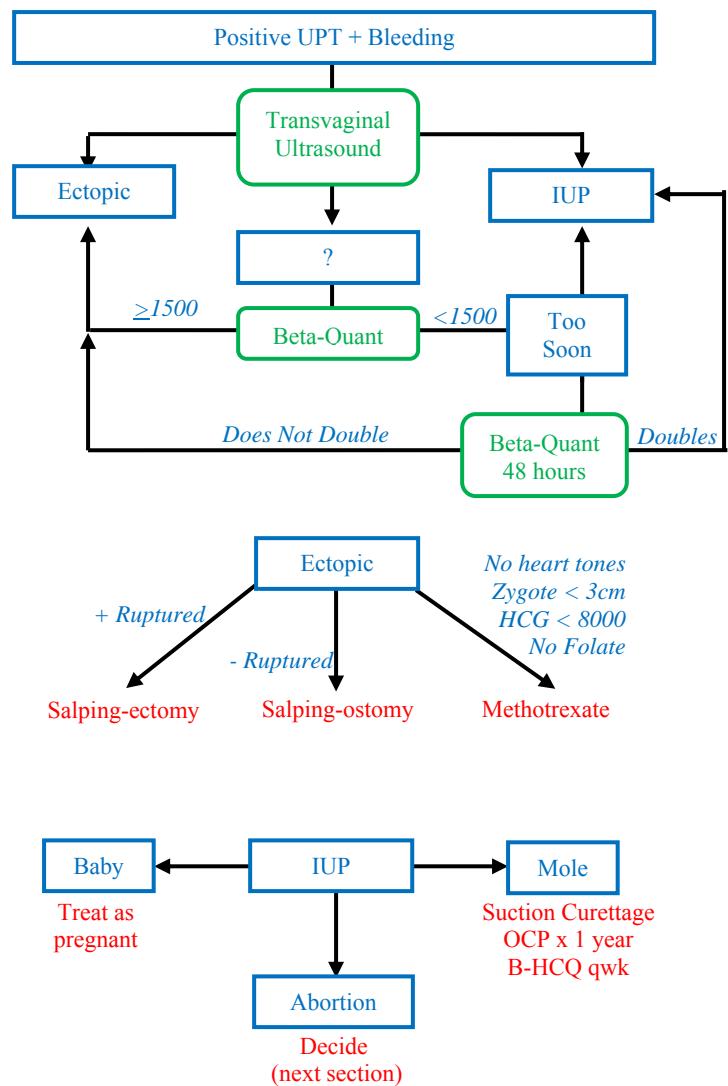
If there's a **doubling** of the beta-quant it's a pregnancy - repeat the ultrasound. If there **ISN'T doubling** of the beta-quant it's ectopic – go find it.

The treatment of an intrauterine pregnancy depends on what it actually is:

1. Live Baby = IUP = See Obstetrics
2. Dead baby = abortion = see below
3. Molar pregnancy = see Gyn-Moles

The treatment for an ectopic depends on a number of things:

1. Ectopic without rupture: **salpingostomy**
2. Ectopic with rupture: **salpingectomy**
3. Selective cases: **methotrexate**. See criteria to the right

Ectopic Treatment Methotrexate if:

- a. B-HCG  $< 8000$
- b.  $< 3\text{cm}$
- c. No fetal heart tones
- d. No Folate Supplementation

Ectopic Treatment Operative Decision

Risk of Ectopic: ~1%

Risk of Ectopic after Ectopic: 15%

Risk of Ectopic after Salpingectomy: 15%

Risk of Ectopic after Salpingostomy: 15%

**Abortion**

One type of reproductive age bleeding is an abortion. Here, mom was pregnant (so the UPT was positive) and there was a baby inside. Mom CAN have an abortion without knowing she is pregnant and a spontaneous abortion can present with passing of clots. But, a vignette on the test is going to mention three things to help make the diagnosis: passage of contents, state of the os, and what is found on ultrasound.

Spontaneous Abortion progresses in a definable, predictable pattern as shown to the right. A normal **Intrauterine Pregnancy** becomes **Threatened**. That is, if no intervention is made the baby dies. Threatened abortions can be rescued with strict bed rest.

But after that, once the baby dies it becomes **inevitable**. It hasn't happened yet, but it will. Nothing will stop it. In this state, mom is ready (the **os is open**) but there's been **no passage of contents** and so an ultrasound will identify a **dead baby**.

Inevitable becomes **incomplete** as the contents begin to pass. In this case, mom is ready (the **os is open**) and there has been **passage of clots**. But mom is not through the abortion yet, so an ultrasound will show **retained parts**.

The process finishes with a **complete abortion**; mom finishes the process of expelling fetal contents. There will be **passage of clots**, but now mom is done (the **os is closed**) and an ultrasound will show **no parts**.

A **missed** abortion is one in which mom doesn't realize baby is dead. There has been **NO passage of clots**, a **dead baby** appears on ultrasound, but the **os is closed**. A missed abortion will need to be induced into labor (>24 weeks) or have the baby removed with suction curettage (<24 weeks).

**NEVER** give tocolytics to an abortion – let the contents pass.

**DO** get an ultrasound to make sure there are no fetal parts remaining. If there are, get them out with a D&C.

**DO** track the Beta-Quant to 0, putting mom on OCPs so she can't get pregnant. She has a high risk of developing a gestational trophoblastic disease. See Gyn, trophoblastic disease.

**DO** give an Rh – mom IVIG (Rhogam) to prevent isoimmunization (see isoimmunization lectures).

IUP → Threatened → Inevitable → incomplete → Complete

Diagnosis	Passage of Contents	Cervical OS	Ultrasound
IUP	None	Closed	Live Baby
Threatened	None	Closed	Live Baby
Inevitable	None	Open	Dead Baby
Incomplete	+	Open	Retained Parts
Complete	+	Closed	No Baby
Missed	None	Closed	Dead Baby

Do an ultrasound after the contents pass

Do track Beta-Quant to 0 to screen for trophoblastic disease

Do give IVIG to an Rh- mom at the time of abortion unless baby is absolutely known to be Rh –

Do induce a missed abortion (>24 weeks)

Do remove a missed abortion (<24 weeks)

DON'T give tocolytics

### Systemic Causes and Coagulopathy

Not relevant to this discussion of Anatomy, DUB, and PCOS, but important to mention none-the-less - uterine bleeding may have nothing to do with an abnormal uterus at all. If the woman has normal cycles but some other reason to bleed, she may bleed too much or too often. These include coagulopathies, thrombocytopenia, von Willebrand, liver, or renal diseases. We'll stay focused on the uterus for this discussion.

### Structural Abnormalities

Structural lesions are a common cause of uterine bleeding. Of them, Fibroids are by far the most common. While there's much to know about each disease, focus on three: adenomyosis, fibroids, and polyps.

#### Fibroids

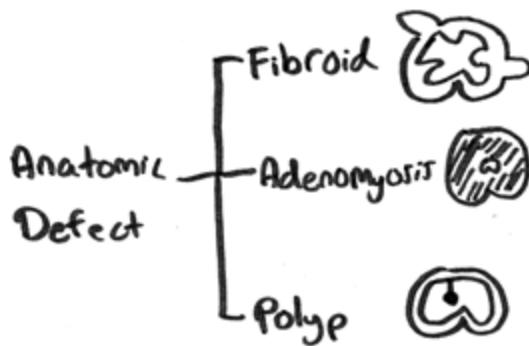
Leiomyoma, better known as fibroids, are benign growths of the myometrium. They're **estrogen-responsive** and **non-malignant**. The patient may present as an **asymptomatic mass** on physical exam, they may **bleed** and cause anemia, they may cause **infertility** (implantation compromised), or they may present with **pain**. Make the diagnosis first with **transvaginal ultrasound**. The best radiographic test is an **MRI**, though routine cases don't require an MRI. DON'T biopsy fibroids. Treatment is dependent on what mom wants. If mom wants children, a **myomectomy** is performed (scoop out the fibroid). If she doesn't, then perform a **total abdominal hysterectomy**. If the fibroid is too large for surgery, give **leuprolide** (continuous) until the fibroids shrink, then go to surgery.

#### Adenomyosis

Adenomyosis is a **symmetrical smoothed** uterus that's filled with normal uterine tissue; generally stromal and glandular epithelium. The classic form of adenomyosis, **diffuse adenomyosis**, is the one most often tested. The physical exam will reveal an enlarged **smooth uterus**. The diagnostic test and treatment are essentially identical to Fibroids, the goal being reduction in bleeding and pain. The only difference is that they don't have a layer of connective tissue that easily defines the plane of adenomyosis (unlike fibroids, which does), making residual disease the cause of most treatment failure.

#### Polyps

These structural causes of vaginal bleeding do not present with an abnormal physical exam. They present very similarly to Adenomyosis and Leiomyomas, but have a normal exam. Diagnostic tools involve the transvaginal **ultrasound**, saline infusion sonography, and **hysteroscopy**. Polyps should be surgically excised (DON'T treat with NSAIDs, OCPs) via hysteroscopic polypectomy.



*Focal Adenomyosis and Leiomyoma are essentially indistinguishable except on pathology of surgical specimens.*

Dysfunctional Uterine Bleeding

This is the **diagnosis of exclusion**. Once all organic causes have been ruled out, the woman can be diagnosed with DUB. Most of DUB is caused by **anovulation**. If ovulation doesn't occur, progesterone isn't produced, and the proliferative endometrium continues to grow until it outgrows its blood supply. Endometrial vessels become markedly dilated and unstable. Since they're dilated (prostaglandin effect), the bleeding can be severe.

Abnormal periods - whether meno, metro, or menometrorrhagia - are **normal** near **menarche and menopause**.

Even if there isn't diagnosed DUB, if there is **life-threatening bleeding** use **IV estrogen** (and taper to OCPs). If the bleeding continues despite estrogen, surgical ligation or embolization of arteries may be required. Ultimately, a hysterectomy is curative.

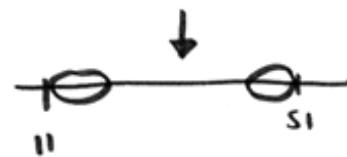
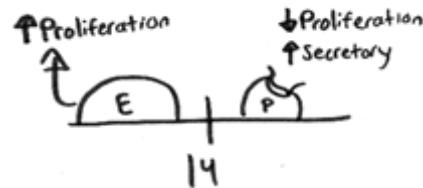
For most cases of DUB, treatment centers on **NSAIDs** and **OCPs**. NSAIDs is a bit of a weird one because generally you should consider NSAIDs to worsen bleeding by inhibiting platelets. And yet, NSAIDs can adequately treat DUB - especially if started at the onset of menses. For more chronic control, **OCPs** are the drug of choice. They provide contraception, reduction in dysmenorrhea, and control bleeding. There are also procedures that can control bleeding such as **endometrial ablation** or elective TAH (even if the bleeding isn't severe).

Polycystic Ovarian Syndrome

One particular cause of anovulation is PCOS, whereby the ovary is replaced by **thousands of atretic follicles**. These follicles can't produce progesterone, so they produce large amounts of estrogen. That's then converted to testosterone, which makes these women **hirsute**. Look for the woman who is **fat and hairy**, maybe with a deep voice, who has **irregular menses** and **trouble getting pregnant**. This is an endocrine diagnosis; an ultrasound ISN'T required. Even still, often the test will show an **ovarian ultrasound** with lots of little black circles, representing cysts. To make the diagnosis, instead use the **LH/FSH > 3**, and make a metabolic diagnosis of diabetes (with the **2-hour glucose tolerance test**) and dyslipidemia. Levels of testosterone (elevated in PCOS) and DHEAS (normal in PCOS) aren't necessary if there's no evidence of virilization, but are often obtained to rule out other causes of hirsutism.

Once diagnosed, the mainstay of therapy is **OCPs** to reset the axis and to reduce anovulation. **Metformin** treats the diabetes but also reduces circulating androgens, making the effects of PCOS less severe. You may also see patients on **Spironolactone** for its androgen-receptor antagonism, further reducing the symptoms of hirsutism. Finally, if the woman wants to become pregnant, facilitation with **clomiphene** or **pergonal** can induce ovulation. The risk is multiple pregnancies.

*Ovulatory DUB is a thing, but is rare. Don't learn about it*



*Levonorgestrel-releasing intrauterine system (Mirena®) is essentially equivocal to OCPs in all ways.*

Introduction and Age Differential

Vaginal bleeding should occur in **reproductive aged females** and should be at regular intervals - **21-35 days** between cycles. Menarche occurs around age 11 and has some trouble getting started (normal). Menopause is around 51 and has some trouble turning off (normal). When bleeding is heavy (**menorrhagia**), irregular (**metrorrhagia**), or occurs in either **premenarchal** or **postmenopausal** females there may be a problem.

Bleeding exists along an age spectrum, with the most common causes of bleeding differing in each age group.

In **premenarchal** girls who are bleeding suspect **foreign bodies** (most common) and **sexual abuse**. These girls need a **speculum exam**, often **under anesthesia**.

In a **post menopausal** woman bleeding is **cancer** until proven otherwise, ruled out with **endometrial sampling**. It's usually NOT cancer - simple **atrophy** is the most common. Hormone replacement therapy can also induce bleeding.

For the **reproductive aged female** with meno, metro, or menometrorrhagia it is far more complicated; we will follow the mnemonic "PAD": **P**regnancy, **A**natomy, **D**ysfunctional Uterine Bleeding. Start by ruling out pregnancy with a **UPT**.

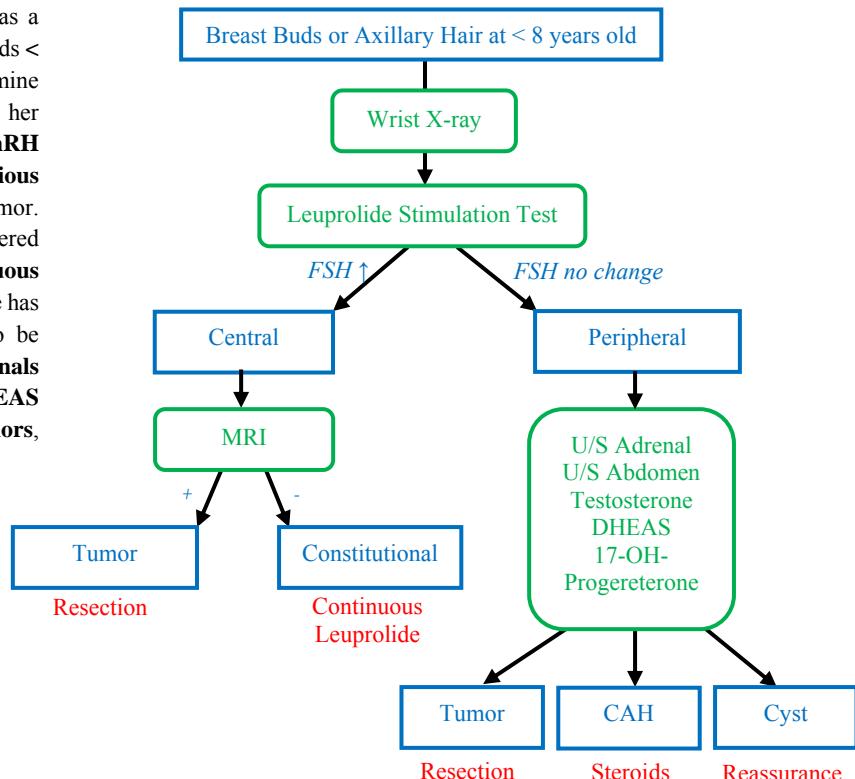
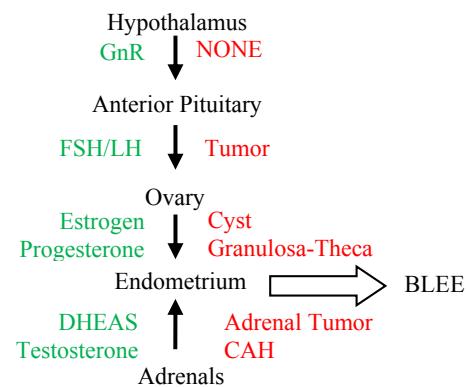
Precocious Puberty

Puberty is a series of events that culminates with menarche. This signifies the maturation of the HPA axis and termination of growth, **fusion of the growth plates**. If she bleeds she's done growing. It's a good thing to catch that condition before it happens then. Therefore, since secondary sex characteristics develop first (before the growth plates fuse), we use that as a marker for disease. Development of axillary hair or breast buds < **8 years old** warrants investigation. The first step is to determine bone age with a **Wrist X-ray**. If it's 2 years greater than her chronological age it's positive. The next step is a **GnRH stimulation test**. If it stimulates LH, she has **central precocious puberty** and needs to be evaluated with **MRI** to rule out a tumor. If there's a tumor, remove it. If no tumor, it's considered **constitutional** (i.e. idiopathic) and she gets **continuous leuprolide** for 2-4 years. But if the stim test was negative, she has estrogen coming from somewhere else; the source has to be found. Get an **ultrasound** of the **ovaries** (cysts) and **adrenals** (CAH, Tumor) while getting **estradiol** (ovarian), **DHEAS** (adrenal), and **17-OH-Progesterone** (CAH). **Resect tumors**, treat CAH with **corticosteroids**, and leave **cysts alone**.

11

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Premenstrual	Reproductive	Postmenopausal
Foreign Body (MC)	Pregnancy (MC)	Atrophy (MC)
Sexual Abuse	Anatomy	Endometrial Ca
Precocious Puberty	DUB	HRT
Sarcoma Botyroides		
Speculum Exam	UPT	Endometrial Sampling
Development	Normal Age	
Breast	8 years	
Axillary Hair	9 years	
Growth Spurt	10 years	
Menarche	11 years	



Vulvar Cancer

While the **most common** type (**squamous cell carcinoma**) follows the same pathogenesis as cervical cancer (that is, **HPV exposure**), there are two kinds of vulvar cancer that are a bit different. The diagnosis and treatment of SCC of the vulva is identical to melanoma - both tend to metastasize. Here's a brief review of melanoma and Paget's disease.

- Melanoma** presents as a **black** lesion in rather sun unexposed areas. If a lesion is found it gets **biopsied**. Because of its tendency to metastasize and its general resistance to chemotherapy (see surgery videos), it's essential to perform a **vulvectomy** and **inguinal lymph nodeectomy**. This results in sexual dysfunction and lower leg lymphedema.
- Paget's disease** is a **red** lesion that's usually confined to the epithelium (that is, **not invasive**). After a biopsy to diagnose, local resection is usually curative.

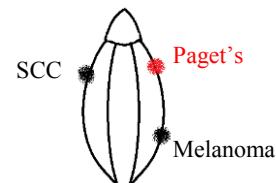
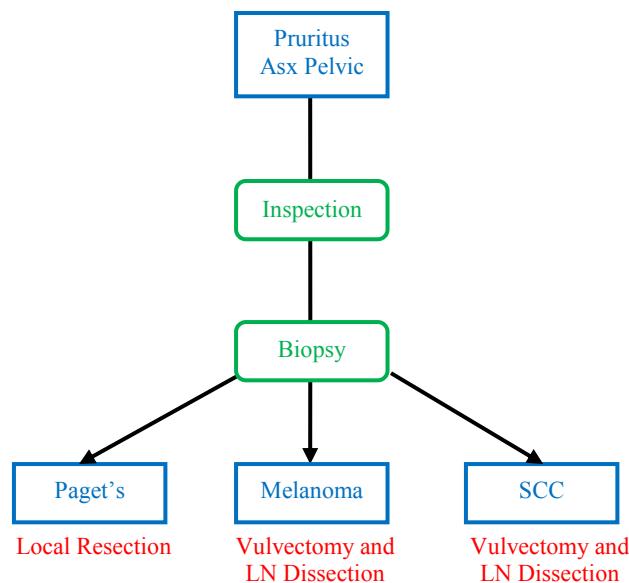
All vulvar cancers present with **pruritis**. If there's a lesion do a **biopsy** and treat the tumor with some sort of resection. Note that Paget's disease of the breast portends a terrible diagnosis, while Paget's disease of the vulva is often benign. A side note - **Lichen Sclerosis** is a low-yield topic that's premalignant SCC and intensely pruritic. It's diagnosed by biopsy.

Again, vulvar cancers are itchy; all get a biopsy and then some sort of resection. Recognize the black one (melanoma), the red one (Paget's) and the other one (SCC).

Vaginal Cancer

While the **most common** type (again **squamous cell carcinoma**) follows the identical pathogenesis to cervical cancer (**HPV exposure**) you must also know about **adenocarcinoma** and **DES exposure**. If adenocarcinoma is ever found, look for a history of DES use in the woman's mother while she was pregnant with this current patient. Since DES hasn't been used for 50 years this is getting rarer and rarer, but it's a good board/pimp question. This, not to be confused with a molar pregnancy, will be described as a **grape-like lesion** protruding through the vaginal opening.

Not surprisingly, **biopsy** and **resect** vaginal cancers.



	Cancer	Lesion	Diagnosis	Symptoms	Treatment
Vulvar	SCC	Black Lesion	Biopsy	Pruritis	Vulvectomy and lymph node dissection
	Melanoma	Black Lesion	Biopsy	Pruritis	Vulvectomy and lymph node dissection
	Paget's	Red Lesion	Biopsy	Pruritis	Local Resection
Vaginal	SCC Adenocarcinoma	HPV DES			

**Hirsutism**

Hirsutism is the process of masculinization. It is the mild version of the process (the more severe form being virilization). It is caused by excess androgens. The classic presentation is going to be **fat and hairy** – development of obesity and excessive body hair.

There will NOT be any changes in voice, clitoris, or muscle mass.

**Virilization**

Virilization is a more severe form of testosterone influence. It includes Hirsutism, but also the physiologic consequences of testosterone in med. The clitoris will enlarge, the voice will deepen, and she may suffer amenorrhea. Muscle mass may increase.

**Testosterone and DHEA**

The **ovaries** make **testosterone** (well, estrogen, which is converted to testosterone). Testosterone has the direct effect of hirsutism and virilization. A little bit does nothing, too much causes hirsutism, and way too much causes virilization.

The **adrenals** make **DHEA** in response to ACTH. DHEA is effectively testosterone. A little bit does nothing, too much causes hirsutism, and way too much causes virilization.

In terms of DIAGNOSIS, it matters. But for her body, it doesn't matter from where or in which form the testosterone is in, only how much her body sees that determines the symptoms: a little makes her hirsute, a lot makes her virilized.

**Diagnosis**

**Pelvic Ultrasound** is the test of choice to identify **ovarian tumors** (granulosa-theca being the most common).

**CT scan of the abdomen** is the preferred method to identify **adrenal tumors** or disorders.

**Differential**

	PCOS	Sertoli-Leydig	Adrenal Tumor	CAH	Familial Hirsutism
<b>Exam:</b>	Hirsute	Virilization	Virilization	Hirsute	Hirsute
<b>Testosterone:</b>	↑	↑↑	Normal	Normal	Normal
<b>DHEAS:</b>	Normal	Normal	↑↑	↑	Normal
<b>Imaging:</b>	Bilateral Ovary	Unilateral Ovary	Unilateral Adrenal	Bilateral Adrenal	Normal
	Ultrasound	Ultrasound	CT Scan	CT Scan	Normal
<b>Dx:</b>	LH/FSH 3:1	-	Adrenal vein sampling	17, OH, Progesterone	Normal
<b>Tx:</b>	OCP	Resection	Resection	Cortisol	Normal
	Metformin			Fludrocortisone	
	Spironolactone				

<b>Hirsute</b>	<b>Virilization</b>
Fat	Hirsutism and
Hairy	Amenorrhea
Excessive Coarse body hair	Clitoromegaly
Male distribution of body hair	↑ Muscle Mass
	Deepened Voice

<b>Ovaries</b>	<b>Adrenals</b>
Testosterone	DHEAS
Ultrasound	CT Scan
	(17-OH-Progesterone)

*PCOS: The not-a-tumor (Hirsute) of the ovary (testosterone, ultrasound)*

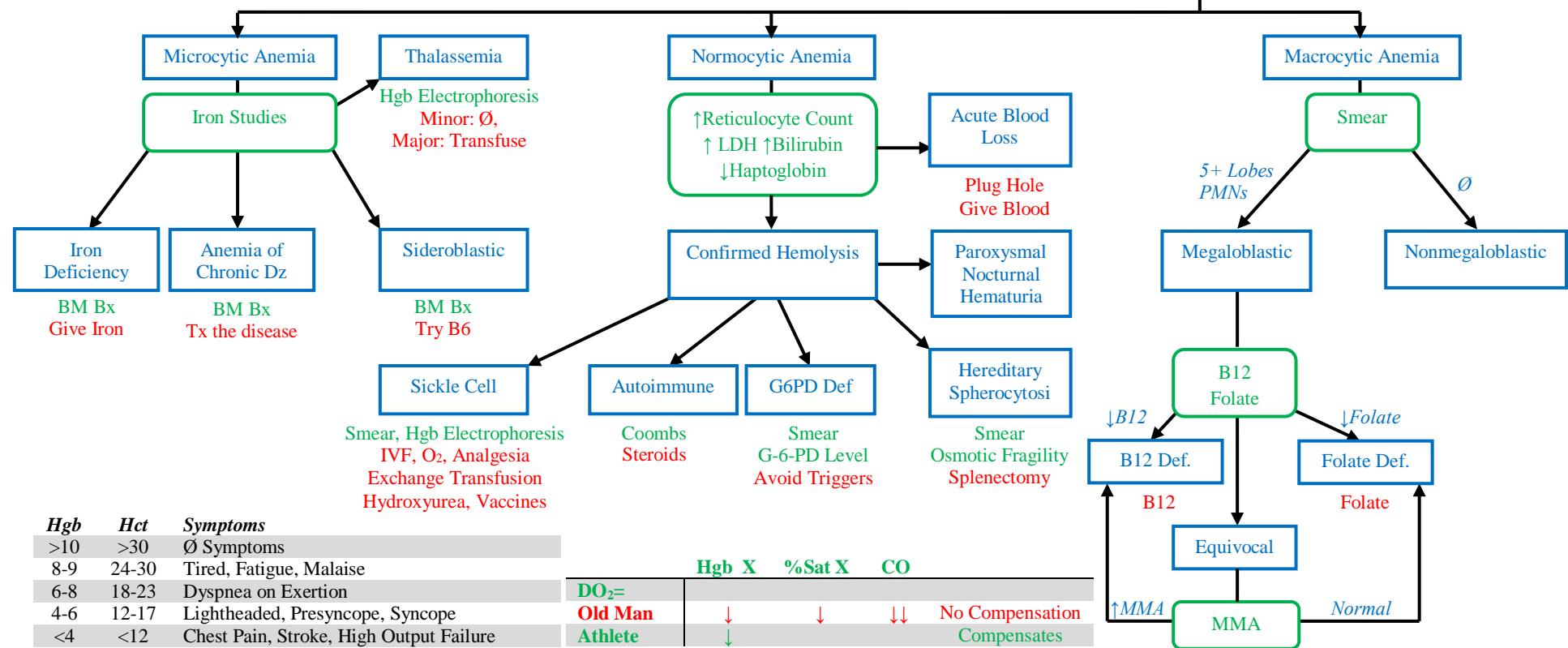
*Sertoli-Leydig: the tumor (virilization) of the ovary (testosterone, ultrasound)*

*Adrenal tumor: a tumor (virilization) of the adrenal gland (DHEAS, CT scan)*

*Congenital Adrenal Hyperplasia: a not-a-tumor (Hirsute) of the adrenals (DHEAS, CT Scan).*

All causes of anemia have the **same presentation** that's based on the **severity** and **Ø etiology**. There's Ø point in saying over and over again for each disease the symptomatology. Instead, knowing what's **unique in the history** and then the specific **best diagnostic test** for each one becomes most important.

The symptoms are listed in the chart at the bottom. The symptoms of anemia are vast - everything from a little fatigue, a **stroke** acutely, **high output cardiac failure** chronically, even **death** as a result of **myocardial infarction**. While I have them in a nice chart, remember that the symptoms are dependent on the **severity** and the patient's **tolerance**. It all comes down to the **oxygen delivery**. Oxygen delivery is based on three things: **Hgb**, **%Saturation**, and **Cardiac Output**. An **old man** with COPD ( $\downarrow\%$ sat), MI and HF ( $\downarrow$ CO), and on a Beta Blocker has a limited supply as is - any drop in the Hgb significantly compromises him. Even a drop from 10 to 9 can be fatal. On the other hand, the 25 year old athlete can tolerate Hgb that falls from 13 down to 7. He'll experience only a little fatigue and will compensate with tachycardia.



Introduction

Understanding bleeding can be complex. You probably memorized the entire clotting cascade and PT/PTT values for every disease for Step 1. Let's go over the essentials of hemostasis instead of all the complexities.

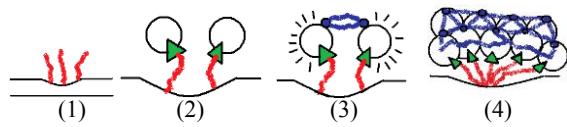
**Primary Hemostasis** is a function of **platelets** that starts with **endothelial injury**. From the endothelium, **von Willebrand factor (vWF)** is released like sticky Velcro tentacles, snatching on to platelets via **Glyc-Ib** via a process called **adhesion**. Adhesion activates platelets (release of granules and rearrangement of protein surface). This allows **fibrinogen** to link platelets via **glycoprotein IIb/IIIa** through a process called **aggregation**. The end product is a **platelet plug** that stops the bleeding initially, with a **fibrinogen mesh** ready to start the heavy duty clotting.

**Secondary Hemostasis** ends with fibrinogen mesh turning into **fibrin**. Along the way multiple clotting factors need to be activated. **Factor 7** is by its lonesome in the **extrinsic pathway** (measured by **PT**). Factors **8-12** (except 10) are in the **intrinsic pathway** (measured by **PTT**). The two pathways converge with the activation of **Factor 10**, which together with **Factor 5**, turns prothrombin to thrombin (**Factor 2**). Thrombin activates the fibrinogen mesh into Fibrin (**Factor 1**) on those platelets to activate clotting. The body is not stupid, and if that were the end, there would be clots everywhere. So that backup plan is plasminogen gets turned into plasmin by **tPA**. **Plasmin** dissolves the clot into **split products** (also called D-Dimer). You'll see how easy all the diseases are to understand if you can just follow the pictures.

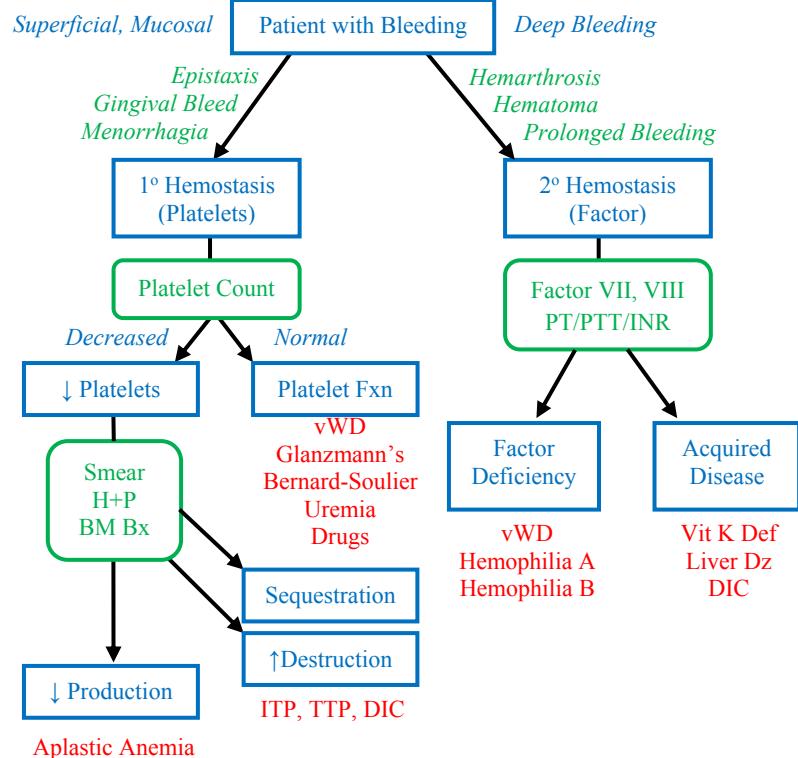
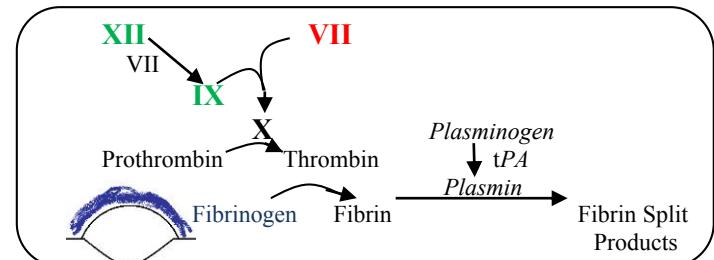
Differential

People like to jump to **coagulation studies** with bleeding. For the most part that's ok. Got a bleed? Get a **CBC** and **Coags**. But if interested in determining the best test for the patient in front of you, ask if they have **platelet bleeding** (superficial bleeding secondary to platelet dysfunction) or **factor bleeding** (deep bleeding secondary to hemostasis dysfunction). Then, if it's a problem with platelets use **platelet count** and **platelet function** (only if count is normal as a ↓count or ↓function) to get near a diagnosis. If it's factor bleeding use **PT**, **PTT**, **INR**, + **Factor Levels** to narrow the differential. From there each disease has its own detail, confirmatory test, and treatment.

We're going to discuss only highlighted diseases in the coming section - those commonly tested on the Step2. Check the "intern section" for more.



**Primary hemostasis** begins with **endothelial injury**, releasing **von Willebrand factor (1)**, sticking to platelets via **Glyc-Ib**, adhesion (2). This activates the platelets and allow for aggregation through **fibrinogen** and **Glyc-IIb/IIIa**. The end result is a **fibrinogen mesh** plug of platelets, ripe to be activated to fibrin in **secondary hemostasis** (shown below).



Test	Measuring What?	Diagnosis / Diseases
PT	Extrinsic Pathway	Warfarin, Vit K, Factor 7
PTT	Intrinsic Pathway	Heparin, Lupus Anticoagulant
Bleeding Time (Platelet Fxn)	Formation of Plug	Platelet Disorder Thrombocytopenia
Factor Levels	Direct Measure	Factor Deficiency
Mixing Study	Difference Between Inhibitors	Factor Deficiency
vWF	Direct Measure	vWD
D-Dimer	Indirect Measure of fibrinolysis	DIC
Fibrinogen		
Fibrin Split		

1) Von Willebrand's Disease

A person with a **platelet type bleeding** and a **normal platelet count** likely has vWD. If there's ↓vWF platelets can't adhere. Ø Adhesion = Ø Aggregation = Ø Plug. Start by testing for dysfunction of platelets with a **bleeding time** (archaic) or the newer **platelet function test** then get a **vWF assay**. Because vWF stabilizes Factor VIII there might also be **factor type bleeding**. Treat with **desmopressin** to ↑vWF. If severe, give **cryoprecipitate** or **Factor VII** acutely.

2) Thrombocytopenia

This is a topic all on its own. Get the general idea of each potential cause and learn what to look for. If **all cell lines are decreased** then it's an **aplastic anemia** (a production problem). If the **spleen is really big** then it's **sequestration** (a sequestration problem). The other forms of thrombocytopenia all involve **destruction** of platelets. **Heparin Induced Thrombocytopenia** (HIT) occurs in patients on Heparin (usually on day 5-7 of heparin). To alleviate **stop the heparin** and get **HIT-Antibodies**. If the patient has the classic **pentad** (**↓platelets, fever, altered mental status, renal failure, Microangiopathic hemolytic anemia**) then he/she has TTP. Do a **plasma exchange** and absolutely **avoid platelet transfusion**. Finally, if she has a thrombocytopenia and **all the others have been ruled out** assume she has ITP - an autoimmune "hemolysis" of platelets. Fight with **IVIg** or **Rhogam** right now, **steroids** chronically, and **splenectomy** if refractory.

3) Hemophilia

An X-linked recessive (**boys only**) disorder that affects **Factor 8** (type A) or **Factor 9** (type B). It's a deep factor type bleeding in **children** (hemarthrosis is classic). vWD should be ruled out. Since Factor VIII doesn't last very long **transfuse** only when the patient's **actively bleeding**.

4) Liver Disease + Vitamin K Deficiency

The liver needs vitamin K and Vitamin K needs a liver. Either way, factors **2, 7, 9, and 10** (also protein C+S) are broken, messing up both the **intrinsic** and **extrinsic** pathways and producing a factor type bleeding. If the patient's **cirrhotic**, antibiotics killed intestinal **K-producing bacteria**, or iatrogenically we blocked the effect with **warfarin** there could be a bleed. The move should be to test for factor levels. Ultimately, however, **K will have to be given**. If there's no improvement after K it's **liver disease**. If it improves they were just lacking vitamin K.

5) Disseminated Intravascular Coagulation (DIC)

Occurs in significant systemic disease (**sepsis, shock, malignancy**) where clotting goes crazy; many clots form where there should be none. This leaves **Ø platelets** and **Ø clotting factors** for where the holes actually are. This person bleeds from everywhere. There isn't one single test, but together an **↑PT** **↑PTT** (factors), **↓ Fibrinogen** (except in early disease), a **⊕D-Dimer / Fibrin Split Products** and the clinical history give a strong argument. Treat by giving everything back (**platelets, cryoprecipitate, blood**) and fix the underlying disease.

Von Willebrand's...But What about?

Glanzmann's Thrombasthenia	Deficiency of GlycIIb/IIIa
Bernard-Soulier	Deficiency of Glyc-Ib
Uremia	Seen in Renal Failure
Drugs	We give patients medications to limit clotting ASA, Clopidogrel, NSAIDs, Abciximab

Thrombocytopenia					
TTP	↓ Platelets + Fever + <b>AMS + RF + MAHA</b>	↓Plt+ ↓RBC	Exchange Transfusion	Never give platelets	
HIT	On Heparin 5-7d Ø hx 3-4 d with h/o HIT	↓Plt <b>only</b>	Stop Heparin	<b>Argatroban</b>	Lepirudin
DIC	Any systemic or severe dz, s/p OB, s/p trauma oozing from every hole	↓Plt ↑PT ↑PTT	Tx Underlying Disease	<b>Plts</b> cryo whole blood	
ITP	Female with ↓platelets but nothing else	↓Plt	Plt<20 or bleeding Plt >20 Steroids		Refractory: <b>Splenectomy</b>

A tidbit about inhibitors:

We purposefully didn't talk about them in this section, but they've been encountered by enough people to be worth mentioning.

Factor deficiency will either be factor deficiency or inhibitors. Tell the difference with a mixing study. If the bad blood gets corrected when mixing with good blood, it's a factor deficiency (everything we have listed in the flow chart on the first page). If the bad blood does NOT get corrected with good blood, it's an inhibitor. Learning more about inhibitors is way beyond the scope of this course.

TTP	DIC
F ever	Fibrinogen ↓
A nemia	D-Dimer ↑
T thrombocytopenia	Platelets ↓
R enal failure	Hemoglobin ↓
N eurologic Sxs	

Schistocytes +      Schistocytes +

This is an odd comparison chart. The point is that TTP and DIC can look an awful lot alike if you pay attention to the wrong things (like a blood smear).

	<b>Disease</b>	<b>Patient</b>	<b>PT</b>	<b>PTT</b>	<b>Bleeding Time</b>	<b>Diagnosis</b>	<b>Treatment</b>
<b>Primary Hemostasis (Platelets)</b>	vWD	Platelet Bleeding Normal Count	-	-	↑	vWF Assay	DDAVP
	BS					Glyc Ib Assay	Factor VII
	GT					Glyc IIb/IIIa	
	Uremia	+ Renal Failure				CMP / E-Lytes	Dialysis
	Drugs	Clopidogrel, ASA, NSAIDS				Med List	Stop
	Aplastic	↓ in all cell lines	-	-		BM Bx (hypocellular)	Fix Cause Underlying
	Anemia					Splenomegaly	?
	Splenic	↓platelet and a big spleen				U/S of Spleen	
	Sequestration					HIT-Ab	Stop Heparin, start Tirofiban
	HIT	↓platelets + Heparin (day 5-7)	-	-		Clinical	Plasma Exchange, NEVER plts
<b>Secondary Hemostasis (Factors)</b>	TPP	Fever, RF, ↓plt, MAHA, AMS	-	-		Clinical	Plasma Exchange, NEVER plts
	HUS	Fever, RF, ↓plt, diarrhea	-	-		Diagnosis of Exclusion	IVIG or Rhogam (acute)
	ITP	↓platelets in a female, everything else ruled out	-	-			Steroids (Chronic) Splenectomy (refractory)
	Hemophilia	Boys with Hemarthrosis	-		-	Factor Levels, r/o vWD	Factors only with Bleeding
	Vit K Deficiency	Antibiotics for gut or ↓Leafy Greens	↑		-	Vit K levels or just give Vit K	Vitamin K
	Liver Dz	Older, EtOH, cirrhosis, Hep B/C	↑		-	Vit K, if Ø correction, diagnosis is Liver Dz	Stop Drinking, Manage chronic disease, Manage Complications
	Warfarin	Pt with Afib, DVT, PE or other need for anticoagulation	↑		-	Patient Med List, INR	Vit K, Blood is Needed
	DIC	Sepsis, Trauma, Malignancy, Bleeding from everywhere	↑		-	Fibrinogen ↓ D-Dimer ↓	Fix underlying disease Cryo, FFP, Blood

Introduction

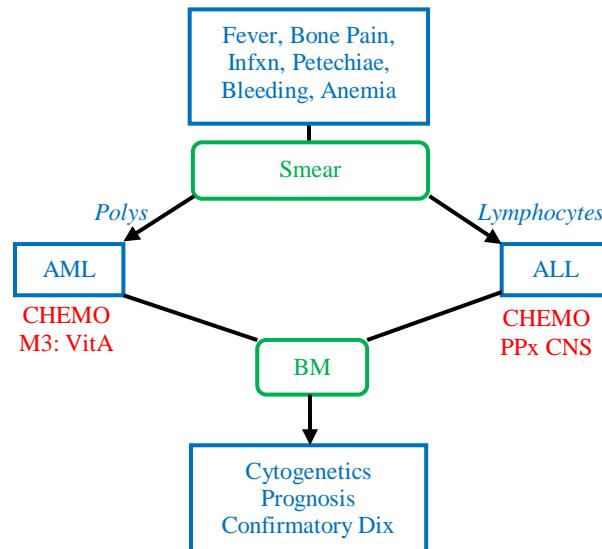
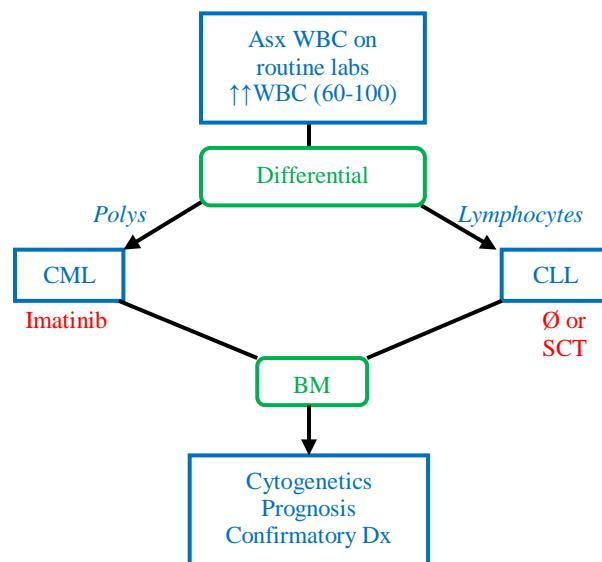
In dealing with Leukemias we must consider whether they are **acute** (undifferentiated, aggressive) or **chronic** (differentiated, indolent). The **acute** leukemia patients are going to be SICK (**fever, night sweats, bleeding, and infection**). It's a product of useless, immature cells crowding out effective cell lines, creating a **pancytopenia**. On the other hand, **Chronic** leukemia will be **asymptomatic** and found on a routine screen for something else (unless very late stage). Patients present with an **enormous** number of **leukocytes**. Which line gets elevated is dependent on the type of cancer. **Myelogenous** is **Neutrophils**, while **Lymphocytic** is **Lymphocytes**. In all cases the first test will be a **smear** to rule out acute disease (the presence of blasts). Then, a **differential** to rule out chronic disease. Definitive diagnosis is made with a **bone marrow biopsy**.

1. Acute Myelogenous Leukemia

This is a disease of **immature** (acute) **neutrophils** (myelogenous) **cancer in the blood** (leukemia). It can arise de novo after exposure to **radiation, benzene, or chemo**, or be a transformation (so-called "**blast crisis**") from other marrow cancers (CML, MDS). The symptoms of **bleeding, bruising, petechiae, pallor** and **fever** set in rapidly. CBC is of no use as all values could be ↑ or ↓. What gives the diagnosis away is seeing **blasts** on a **peripheral smear**. To confirm the diagnosis a **Bone Marrow Biopsy** showing **>20% Blasts** is required, as well as **cytogenetic analysis** showing neutrophils. A special form of AML, the **M3 type (Promyelocytic)**, is diagnosed by the presence of **Auer Rods**. Treatment with chemotherapy (**idarubicin + Ara-C**) can push AML into remission. **M3** is treated with **Vitamin A**, which induces development out of the blast phase by **all-trans retinoic acid** aka tretinoin.

2. Acute Lymphoid Leukemia

This is a disease of **immature** (acute) **lymphocytes** (lymphoid) **cancer in the blood** (Leukemia). It's often found in the **pediatric patient** who presents with **bleeding** and **bone pain**. As in AML, look at the **smear** for **blasts** then get a **Bone Marrow Biopsy** to confirm **>20% blasts** and cytogenetics. Like AML, it's treated with chemo (**cyclophosphamide, doxorubicin, vincristine, and methotrexate**) with a fairly decent sustained remission (90%) and poor cure rate (50%). Consider doing **intrathecal ppx chemo-radiation** with Ara-C or **Methotrexate** because the CNS is a sheltered region for ALL to hide while undergoing therapy for systemic blood and marrow cancer.



**3. Chronic Myelogenous Leukemia**

This is a disease of **matured** (chronic) **neutrophils** (Myelogenous) **cancer in the blood** (leukemia). It's associated with the **Philadelphia chromosome** - a translocation with overactive activity of a tyrosine kinase. It presents as an **elevated white count** with an abnormal percentage of **neutrophils** ( $>60\text{WBC}$ ,  $>90\%$  PMNs). Once the diagnosis is made confirm with a **Bone Marrow Biopsy** and cytology. Revolutionary therapy with the **tyrosine-kinase inhibitor Imatinib** has prolonged survival and delayed the **blast crisis**. However, inevitably this cancer becomes resistant, progresses to AML, and the patient ultimately succumbs.

**4. Chronic Lymphoid Leukemia**

This is a disease of **mature** (chronic) **lymphocytes** (lymphoid) **cancer in the blood** (leukemia). It occurs in **old men** most commonly presenting as an **asymptomatic ↑ in WBC**. A **diff** will show an absolute lymphocyte count **>50**. You might see **smudge cells** (artificial rupture of fragile cells during smear preparation) on **smear**, but it's the diff and subsequent **bone marrow biopsy** that defines the disease. The average survival is about **ten years**. If they're old **do nothing**. If they are younger (as in the 50s) try **fludarabine** or **rituximab** before **stem cell transplant**.

Disease	Patient	Age	Cell	1 <sup>st</sup> Test	Best Test	Treatment	Special
Acute	Fever, Bleeding, Petechiae, Infection, Pallor Bruising Bone Pain	7	Lymphoid	Smear	BM Bx >20% Blasts	Ara-C MTX Cyclophosphamide Doxorubicin	CNS PPx
		27	Myelogenous (Neutrophils)	Smear	BM Bx >20% Blasts	Auer Rods/M3 = Vit A Idarubicin + Ara-C	Auer Rods
Chronic	↑White Count, Found on routine screen	47	Myelogenous (Neutrophils)	Diff	BM Bx Philadelphia Chromosome	Imatinib	Blast Crisis
		77	Lymphoid	Diff	BM Bx	If old or Ø Donor = Ø If young: Chemo → BM Transplant	

Introduction

Lymphoma is a malignancy of lymphocytes within lymph nodes. A lot of this was covered in step I: translocations, cell types, histologic subtypes, etc. That's good information to impress your attending with. It's used for determining severity of disease, prognosis, and targeted therapy when typical chemotherapy fails. However, that level of specificity is better left up to the hematology oncology boards. Let's focus more on the diagnosis and treatment of lymphomas.

Presentation and Diagnosis

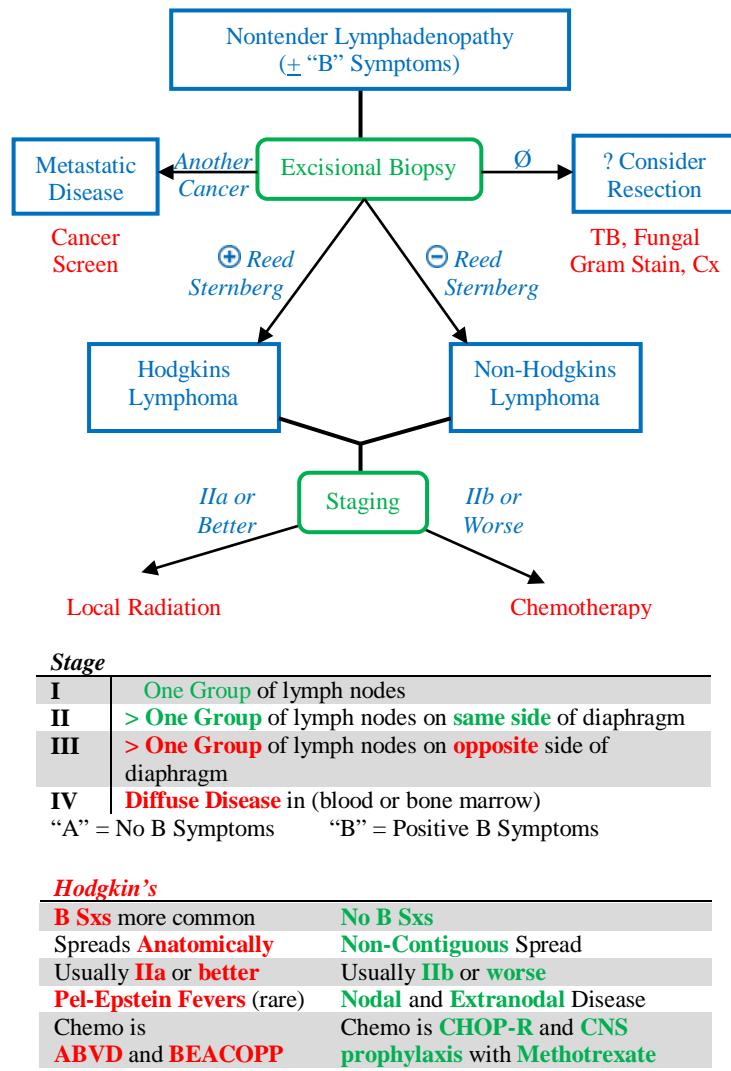
Lymphoma presents as **nontender lymphadenopathy**. The presence of "**B symptoms**" (fever, night sweats, weight loss) is used only for staging designation. While it's true that B symptoms are more common in Hodgkin's than Non-Hodgkin's, it can be present in either disease and shouldn't be used to change the diagnosis. Other non-specific or uncommon findings are **Pel-Epstein fevers** that come and go over weeks or the **painful lymphadenopathy** with **EtOH** and **HSM**. These can be additive clues for a Hodgkin's lymphoma but aren't required for diagnosis or suspicion of diagnosis. The first step when you encounter a painless lymph node is to get an **excisional biopsy** (an **FNA** is **insufficient** and often equivocal). The excisional biopsy is required to see the lymph node architecture, giving evidence of the type of lymphoma as well as for detecting **Reed-Sternberg Cells**. The presence of these abnormal B cells defines Hodgkin's lymphoma versus Non-Hodgkin's lymphoma. The excisional biopsy also allows for cytogenetic testing but is beyond our scope. If it's negative for lymphoma consider mets and infection.

Staging

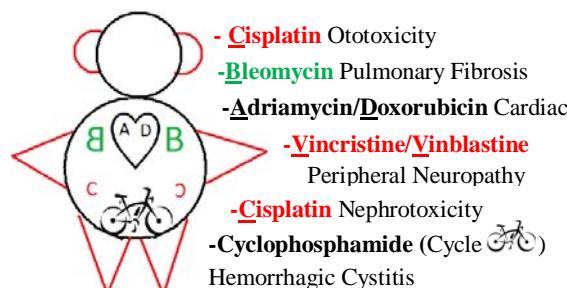
Once you have the diagnosis of "**any lymphoma**" the next step is to **stage** the disease. For simplicity, once you have reached **≥ Stage IIa**, you can stop staging; everything Stage 2b and up gets **chemo**. Start with a **Chest Xray** then perform either a **Pet/Ct** or a **CT of Chest/Abd/Pelvis**. If everything is negative a **Bone Marrow Biopsy** must be performed to exclude bone marrow involvement.

Treatment

Any lymphoma  $\leq$  **IIa** gets **local radiation**. Any lymphoma that's  $\geq$  **IIb** gets **chemo**. This is where the diagnosis of Hodgkin's (**ABVD** or **BEACOPP**, formerly **MOPP**) and non-Hodgkin's (**CHOP-R**) becomes important. While any heme-onc doc will tell you that every lymphoma gets chemo and radiation – and indeed this general rule is simple for learning – it's a little outdated. Know the side effects through "chemo man."

**Hodgkin's**

<b>B Sxs</b> more common	<b>No B Sxs</b>
Spreads <b>Anatomically</b>	<b>Non-Contiguous</b> Spread
Usually <b>IIa or better</b>	Usually <b>IIb or worse</b>
<b>Pel-Epstein Fevers</b> (rare)	<b>Nodal and Extranodal</b> Disease
Chemo is <b>ABVD</b> and <b>BEACOPP</b>	Chemo is <b>CHOP-R</b> and <b>CNS prophylaxis</b> with <b>Methotrexate</b>



**ABVD** =  
**A**driamycin/**D**oxorubicin  
**B**leomycin  
**V**inblastine  
**D**acarbazine

**BEACOPP** =  
**B**leomycin  
**E**toposide  
**A**driamycin/**D**oxorubicin  
**C**yclophosphamide  
**O**ncovorin / **V**incristine  
**P**rocarbazine  
**P**rednisone

**CHOP-R** =  
**C**yclophosphamide  
**H**ydroxydoxorubicin  
**O**ncovorin / **V**incristine  
**P**rednisone  
**R**ituximab

Introduction

Many people find heme confusing yet simplicity is key. In the basic sciences most people assume that **macrocytic** (a large MCV) is the same as **megaloblastic** (Hypersegmented neutrophils). One implies big cells only while the other implies **impaired nuclear development**. The first step in analyzing a macrocytic anemia is to therefore view a **smear** looking for Hypersegmented (5 or more lobes) neutrophils. In real life you'd get a smear and a **B12 & Folate** level at the same time, but if you had to say which came first it's the smear.

Megaloblastic Anemia

Both **Folate** and **B12 deficiencies** look the same and present the same way except for one major difference: **neuro symptoms** (B12 only). Look for both deficiencies at the same time, but learning the specifics of each and how to tell them apart is important.

i. Folate Deficiency

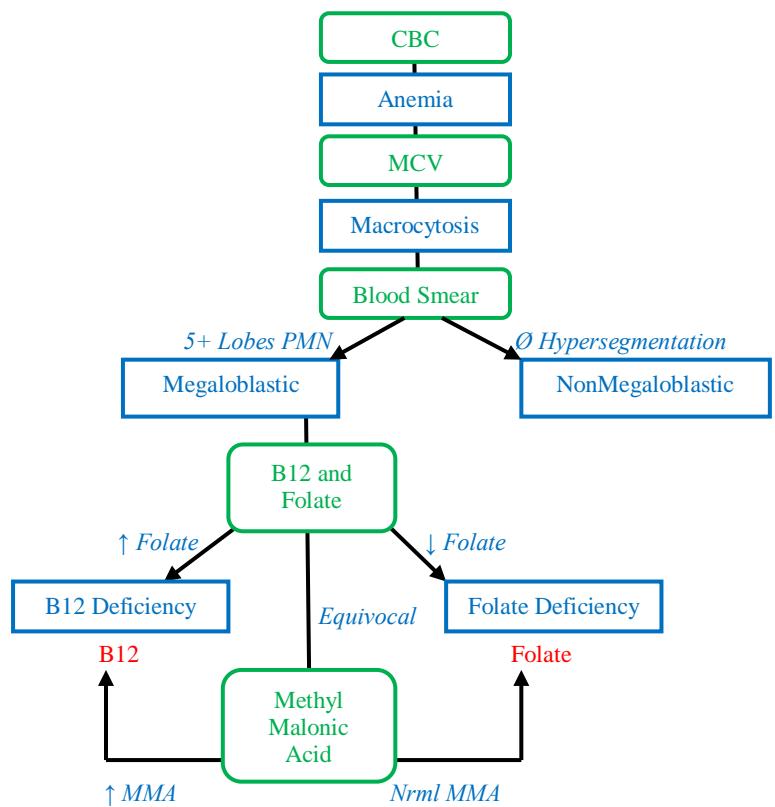
Folate comes from **leafy greens** and has **Ø storage forms** in the body. Thus, it often presents with higher acuity than B12. Malnutrition (**Alcoholics**) is the strongest risk factor. It presents as an **isolated megaloblastic anemia** without any symptoms other than anemia. A **folate level** will diagnose it and **folate supplementation** is usually sufficient for treatment. On rare occasions you may need to know that ↑ **homocysteine** and **normal methyl malonic acid** levels separate Folate from B12 deficiency.

ii. B12 Deficiency

B12 comes from **animal products** and requires an intact **gastric mucosa** (secretes **Intrinsic Factor**) to be absorbed. There are **3-10 years of stores** in the body so B12 takes a long time to develop. It occurs in **strict vegans** and in **pernicious anemia** (↓ Intrinsic Factor). It presents first with a **megaloblastic anemia** and then, if left untreated, with **subacute combined degeneration of the cord**. Diagnose it with a **B12 level**, and **supplement B12**. Be cautious with Folate administration. Throwing a lot of Folate at a B12 deficiency can overcome the anemia but the **irreversible neuro symptoms** will set in. In B12 deficiency the **homocysteine is elevated** (just like Folate), but in B12 deficiency only **Methylmalonic Acid** is also elevated. The only time a **Schilling's test** is done is when there's uncertainty about the etiology; it's a test that is rarely used.

Nonmegaloblastic Dz

This isn't that interesting. There's just a list of things that cause it. It's important to first rule out a **B12/Folate** deficiency then look for: **Liver Disease**, **EtOH**, **Hypothyroid**, **Medications** (AZT, 5-FU, ARA-C) and **metabolic conditions** (Lesch-Nyhan, Hereditary Orotic Aciduria).



**Subacute Combined Degeneration of the cord.** The dorsal columns (marked in red) are affected in B12 deficiency, resulting in loss of proprioception and two point discriminatory touch. The symptoms are permanent. Eventually any and all neuro symptoms may present, but it's peripheral neuropathy that's most common.

Dx	Presentation	Pathology	Best Test	Homocysteine	MMA	Tx	Follow-up	
Folate Deficiency	Megaloblastic Anemia Only	<b>Alcoholic Malnutrition</b> Leafy Greens, 3 week stores	↓ Folate Normal B12	Elevated	Normal	<b>Folate</b>	r/o B12	
B12 Deficiency	Megaloblastic Anemia and Neuro Sxs (any), <b>peripheral neuropathy</b> (most common)	<b>Pernicious Anemia</b> , vegans Animal Products 3-10 year stores	Normal Folate ↓ B12	Elevated	<b>Elevated</b>	<b>B12</b>	Schilling's	
Nonmegaloblastic		after ruling out B12 and Folate look for Liver Dz / EtOH / Drugs / Metabolic						

Brief Introduction

So we know the patient is anemic; we saw the MCV was low. If they were **unstable** we'd **transfuse** them. But we ought to get some labs first because after transfusion the labs will be based on the transfused blood only. The first step is to get **Iron Studies** and go from there.

Iron Deficiency Anemia

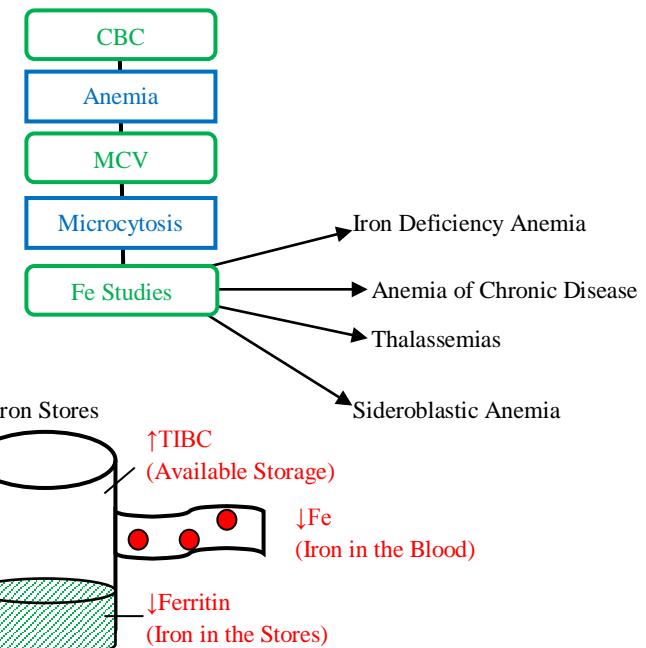
The **most common** form of microcytic anemia is iron deficiency. The normal requirement of iron is **1mg/day** with a maximum of **3mg/day**. If the body starts to lose blood it may begin using iron (to replace the lost hemoglobin) at a greater rate than it can be absorbed. But this also means that it must be a **chronic** source of blood loss. Potential causes are **GI Bleeds** (slow, polyps, hemorrhoids, etc) or **Gynecologic losses** (menorrhagia, cancer). Alternatively, decreased uptake of iron in a non-bleeding person (as in a **gastrectomy**) is possible. In any male or postmenopausal female with iron deficiency anemia follow up with a **colonoscopy** to rule out cancer. The **best** test to diagnose iron deficiency anemia is a **Bone Marrow Biopsy**. But it's rarely done because Iron studies are so good at diagnosing Iron Deficiency Anemia. The most sensitive part of the Iron studies is a **low Ferritin** (if Ferritin is low, it's iron deficiency anemia, period). That is, the **iron stores** are small. Low stores means high capacity to bind, so there'll be an **elevated TIBC**. The low stores also means **low serum iron**. Stop the bleeding then **give iron**. It takes **6 weeks** to replace the **serum iron** and **6 months** to replace **iron stores**.

Anemia of Chronic Disease

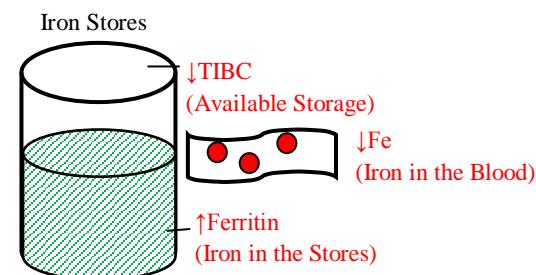
When there's **inflammation** the body is trying to prevent whatever it's fighting from getting the iron it needs. If it's only an acute process, that helps fight infection. A side effect is that it makes the iron unavailable even to the host! Great in fighting an infection; awful in a **chronic disease**. Essentially, what happens is the connection between the Iron stores and the blood is severed. The body has **a lot of iron stored** so a **low capacity to bind** but still has a **low serum iron**. Treating the underlying disease will fix the anemia (the inflammation goes away, the iron stores can be reconnected to the blood). Sometimes, that's not possible (Lupus, Rheumatoid Arthritis) so help the body utilize iron stores with **EPO**.

Thalassemia

Something different is going on in thalassemia. It's not the iron stores that are the problem - it's the **hemoglobin**. There's a genetic disease ( $\alpha$ , chromosome 16, frameshift and  $\beta$ , chromosome 11, deletion) that leads to  $\downarrow$  production of the normal hemoglobin with  $2\alpha$  and  $2\beta$ ; **HgbA1  $\alpha_2\beta_2$** . It doesn't matter which portion is broken - the patient is going to have **anemia with normal iron studies**. The way to definitively diagnose thalassemia is with a



**Iron Deficiency Anemia.** Iron stores are depleted, plenty of storage availability. Iron is low.  $\uparrow$ TIBC,  $\downarrow$ Ferritin,  $\downarrow$ Fe.



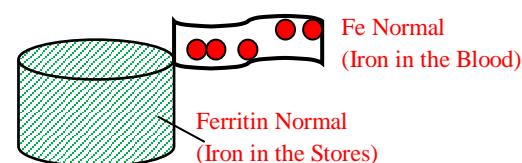
**Anemia of Chronic Disease.** There's a disconnect between the blood and the iron stores, but iron absorption is intact.  $\downarrow$ TIBC,  $\uparrow$ Ferritin,  $\downarrow$ Fe

	<b><math>\beta</math>-Thal</b>	<b><math>\alpha</math>-Thal</b>		
Asx	N/A	1 Gene Deleted	HgbA1	$\alpha_2\beta_2$
Minor	1 Gene Deleted	2 Gene Deleted	HgbA2	$\alpha_2\delta_2$
Major	2 Gene Deleted	3 Gene Deleted	HgbF	$\alpha_2\gamma_2$
Dead	N/A	4 Gene Deleted	Barts	$\gamma_4$
			HgbH	$\beta_4$

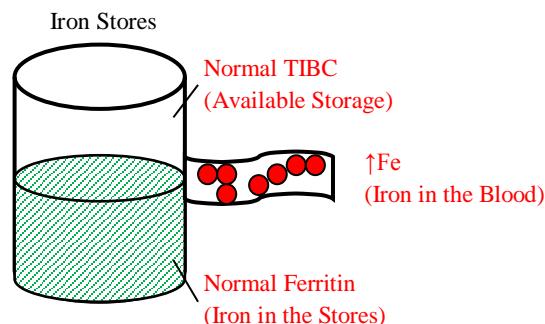
**Hemoglobin Electrophoresis** ( $\alpha$ -thal is ‘normal’). Here’s the kicker; because anemia is based on severity, not etiology, definitive diagnosis is not required except for genetic counseling. Think of ALL thalassemia patients as **minor** (do nothing) and **major** (routine transfusion). The deal with which hemoglobin it is, 1, 2, 3, 4 gene deleted is unnecessary and bogus for the clinical rotations. Recognize the hemoglobins (A1, A2, Fetal, Barts, HbH) but realize it’s either **do nothing** (minor) vs **transfuse** (major). Each bag of blood has **350mg Fe** - enough supply for one year. Frequent transfusion leads to **iron overload** treated with **deferoxamine** to prevent Hemosiderosis. Deferasirox is an oral medication that might pop up on a test or on the wards.

#### Sideroblastic Anemia

Nobody likes Sideroblastic anemia because it’s “hard.” Really it’s because it sounds terrifying and is named from what it **looks like on Bone Marrow Biopsy**. It’s the only microcytic anemia with **elevated iron**. Definitively diagnose it with a **bone marrow biopsy**, which will show the **ringed sideroblasts**. It has a number of causes (**Lead, EtOH, Isoniazid**, a pyridoxine metabolic disease of **B6**, and **Myelodysplasia / AML**). Get the pt away from lead, give him/her B6, and do a **BM Bx** for the cancer (which, coincidentally, you just did for the diagnosis).



**Thalassemia.** The iron stories are normal. The more genes deleted, the more severe the disease. Consider Thalassemias as either minor or major only.



**Sideroblastic.** Diagnosis of Exclusion confirmed on bone marrow biopsy. The tipoff is an **elevated iron** despite an anemia with small cells

Anemia	Pathology	Ferritin	TIBC	Iron	Best Test	Tx	f/u
Iron Deficiency	Blood Loss (Chronic) GI, GYN	↓Ferritin	↑TIBC	↓ Fe	BM Bx	Iron	Colonoscopy
Anemia of Chronic Disease	Any chronic inflammatory disease	↑Ferritin	↓TIBC	↓ Fe	BM Bx	Treat the Dz (Steroids) Try Epo	-
Thalassemia	Chr 16, $\alpha$ , Frameshift Chr 11, $\beta$ , Deletion	Normal Ferritin	Normal TIBC	Normal Iron	Hgb Electrophoresis	Minor: Ø Major: Transfuse	Deferoxamine (transfusions)
Sideroblastic	Lead, B6, genetic Dz, Myelodysplasia, EtOH, ↓ Copper	Normal Ferritin	Normal TIBC	↑ Fe	BM Bx (Ringed Sideroblasts)	Give B6, Look for Cancer	-



Introduction

When it comes to normal sized anemia there are generally two things to consider: **hemorrhage** and **hemolysis**.

Anemia of Acute Blood Loss

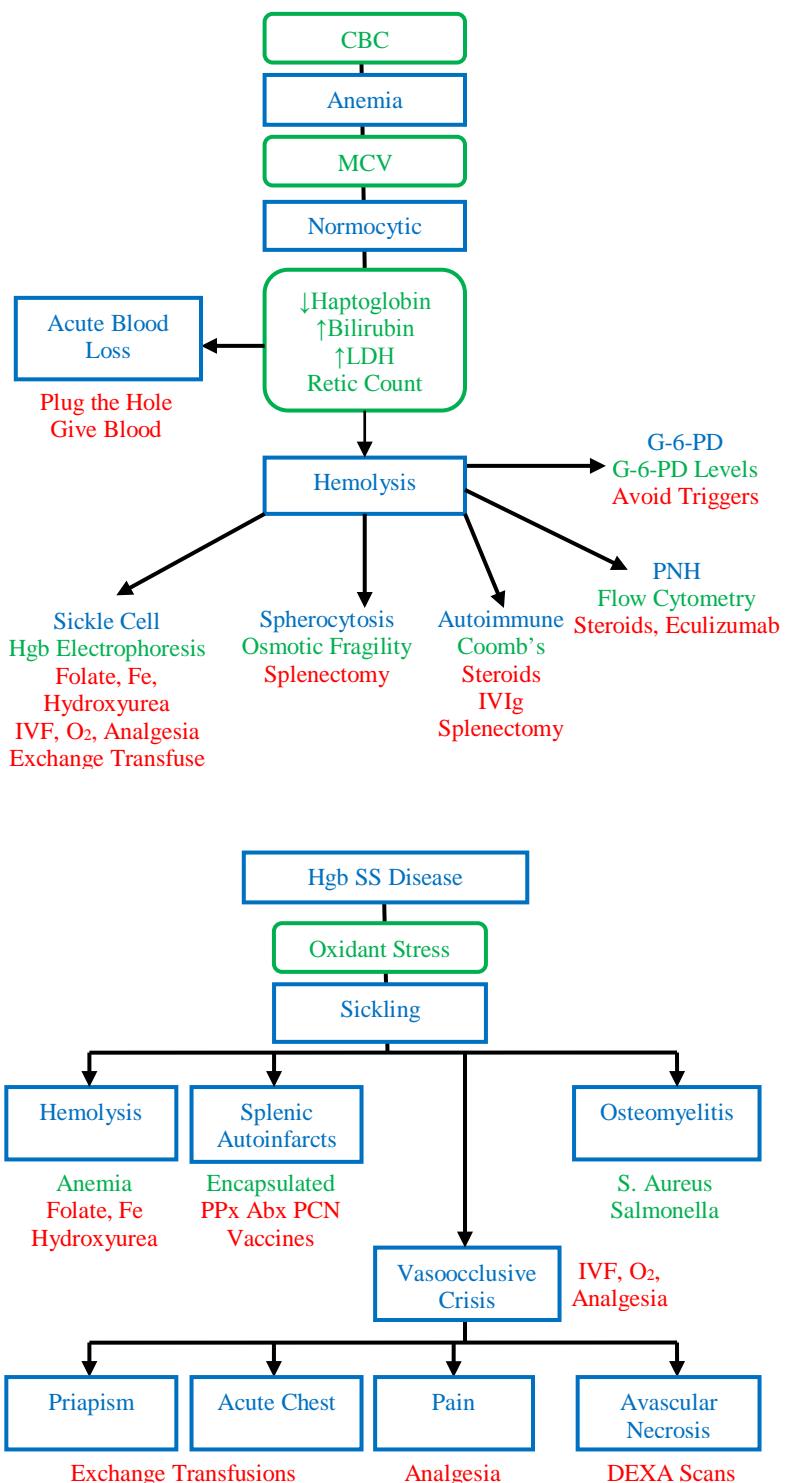
When the blood loss is acute there's an **acute drop in H/H**. This generally has an obvious source (**trauma, GI, GYN**) and is not the slow chronic onset iron deficiency stuff. An underlying anemia **can be exposed** with dilution, but you **can't dilute a normal person's H/H** to anemia. If a Normocytic anemia is revealed, look for the source of the loss. Fix this by **plugging the hole** and/or **giving blood**.

Hemolytic Anemia

Red blood cells last 120 days. When they die they release iron and hemoglobin into the blood. **Haptoglobin** binds up hemoglobin for transport to the liver. Because it's bound to hemoglobin ("used up") it'll be ↓ in hemolysis. There will be an overwhelming of the conjugation system so there will also be an **indirect hyperbilirubinemia** causing **jaundice, icterus**, and **pruritus**. There can be a lot of talk of intravascular vs extravascular hemolysis but let's focus on identifying the diagnosis and management rather than the basic science details.

i. Sickle Cell Anemia

This is a long one with plenty of details - all of which are important. It's caused by an **Autosomal Recessive** mutation in the  **$\beta$ -Globin** and commonly seen in **African Americans**. When the patient undergoes an oxidant stress (**hypoxia, infection, DKA, or dehydration**) the hemoglobin, termed **Hemoglobin S**, polymerizes inducing **sickling**. This creates a non-deforming cell that gets trapped in capillaries causing **hemolysis** and **microvascular occlusion**. There are many consequences of this. One is a **chronic anemia**, usually with sufficient reticulocytosis. If the retic is low, consider either an **acute aplastic crisis** (parvovirus 19) or a **folate deficiency**. For this reason HbSS patients should be on **daily folate + Fe**. Another is the **vasoocclusive crisis**. Microvascular occlusion causes infarction. Infarction hurts. These people will be on **chronic pain management** because their joints hurt all the time. Occasionally, they'll suffer an acute crisis where they need **IVF, O<sub>2</sub>, and Analgesia** to ride out the attack. If the patient develops an acute chest (ARDS picture) or priapism, he/she needs an **exchange transfusion** to get over the severe crisis. But infarction costs him/her more than that. **Splenic Autoinfarction** increases risk for **infection** by **encapsulated organisms**, requiring **annual vaccinations** (PCV, Meningococcus, H. Flu, HBV). **Aseptic Necrosis** of the hip/femur requires **dexa scan** screening. Finally, these patients are at ↑Risk for **salmonella osteomyelitis**. Decrease the amount of bad hemoglobin (HbSS) by giving **Hydroxyurea** (induces fetal hemoglobin, which does not sickle). Prevent sickling by avoiding stressors and staying hydrated. Control the pain with **analgesia** chronically and reduce the anemia with Iron and Folate. But how do we know who has sickle cell disease? Seeing **sickled cells** on a **blood smear** is sufficient for the diagnosis. Definitive diagnosis of the disease or of the carrier state may be confirmed by **Hemoglobin Electrophoresis**. Finally, the carrier state



almost never sickles unless under extreme conditions (such as climbing mount Everest) and in the **renal vein** ( $\uparrow$  risk for renal vein thrombosis).

#### ii. G6PD Deficiency

An X-linked genetic disorder prevalent in **Mediterranean ancestry** presenting with a hemolytic anemia after exposure to oxidant stress: **drugs** (dapsone, primaquine), **infection**, **DKA**, or **foods** (fava beans). Diagnose it with a **smear** showing **Heinz Bodies** and **Bite Cells**. Confirm the diagnosis with a **G-6-PD level** but do it weeks after the attack (doing so too soon may be artificially normal).

*The Greek man eating dapsone for breakfast, primaquine for a lunch, fava beans for dinner, and a bucket of sugar for dessert (to go into DKA) might have a G6PD deficiency*

#### iii. Hereditary Spherocytosis

The cytoskeleton of the RBC is missing a piece (usually **spectrin** or **ankyrin**, band 3.1 or pallidin). This presents just like a hemolytic anemia. The **spherocytes** can be seen on a **smear**, though they are not pathognomonic. Confirm the diagnosis with an **osmotic fragility** test. Because the big bad spleen beats up on the little spherocytes a **splenectomy** will stop the anemia. However, the cells will persist as spheres. Splenectomy has its own problems so stick with **Folate** supplements unless it's really severe.

#### iv Autoimmune Hemolytic Anemia

As the name implies, it's an **autoimmune disease** that attacks RBC. There can be **cold AIHA** caused by **Mycoplasma** and **Mono**, which produces **IgM** against RBC at cold temperatures. Avoid the cold and it's not a problem. **Warm AIHA** is caused by **autoimmune disease** (any Rheum disease), **drugs** (PCN, Sulfa, Rifampin), and **Cancer**, producing **IgG** against RBC @ warm temps. Treat this like any autoimmune disease by giving **steroids**, **IVIg** when acute, and **splenectomy** if refractory. The **smear** is non-diagnostic while the **Coomb's test** is diagnostic.

*Smear = Schistocytes, Helmet cells (not pathognomonic)*

#### v. Paroxysmal Nocturnal Hematuria

Caused by a mutation in the **PIG-A gene** the red blood cells have no **GPI-Anchor**, so cannot inhibit complement fixation. Fixation occurs all the time, but is accelerated by **hypoxia** (when you sleep). So, while these patients sleep complement fixes, cells **lyse**, and they **wake up with hematuria**. They can also get **venous thrombosis** in intra-abdominal veins causing **abdominal pain**. Confirm the diagnosis with a **flow cytometry** and treat with **Anti-Ab Drugs** (eculizumab).

*Flow cytometry shows absence of CD55 + CD59*

Disease	Patient	Path	1 <sup>st</sup> Test	Best Test	Treatment
G-6-PD Deficiency	Mediterranean man who eats dapsone, primaquine, fava beans, and goes DKA	G6PD Deficiency, cannot tolerate oxidative stress X-Linked	Smear <b>Heinz Bodies</b> <b>Bite Cells</b>	<b>G-6-PD Levels</b> weeks after the attack	Avoid Oxidant Stress
Hereditary Spherocytosis	Enlarged Spleen	Defective RBC structural proteins, Splenic Destruction	Smear (Spherocytes)	<b>Osmotic Fragility</b>	<b>Splenectomy</b> (Spherocytes Remain)
Autoimmune Hemolysis	IgG: Drugs, Cancer, Rheum IgM: Mycoplasma, Mono	Autoimmune Antibodies	Smear (Spherocytes)	<b>Coomb's Test</b>	Steroids, IVIg, <b>Splenectomy</b>
Paroxysmal Nocturnal Hematuria	Irregular bouts of morning hematuria and abdominal pain	PIG-A gene mutation, failure to inhibit compliment on RBC	-	<b>Flow Cytometry</b>	Steroids, Eculizumab
Sickle Cell Disease	African American, chronic pain, acute chest, priapism	Hgb S polymerizes in response to stress	Smear (Sickles)	Hgb Electrophoresis	IVF, O <sub>2</sub> , Analgesia, Exchange Transfusion

Multiple Myeloma

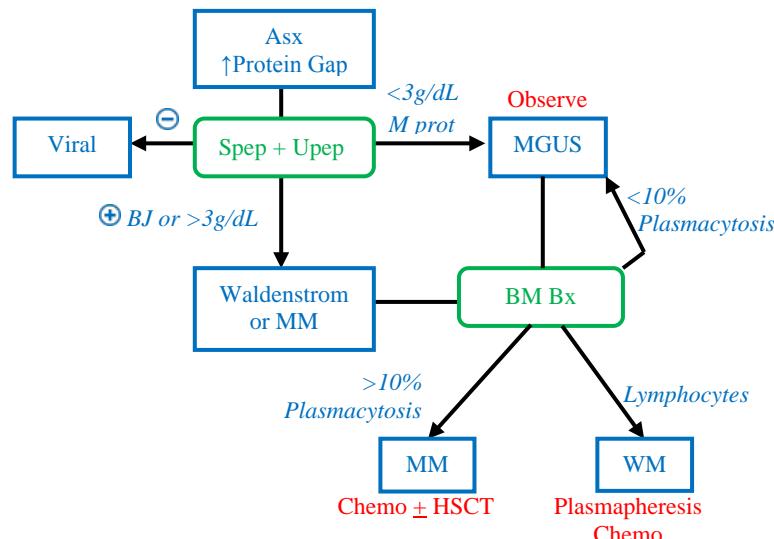
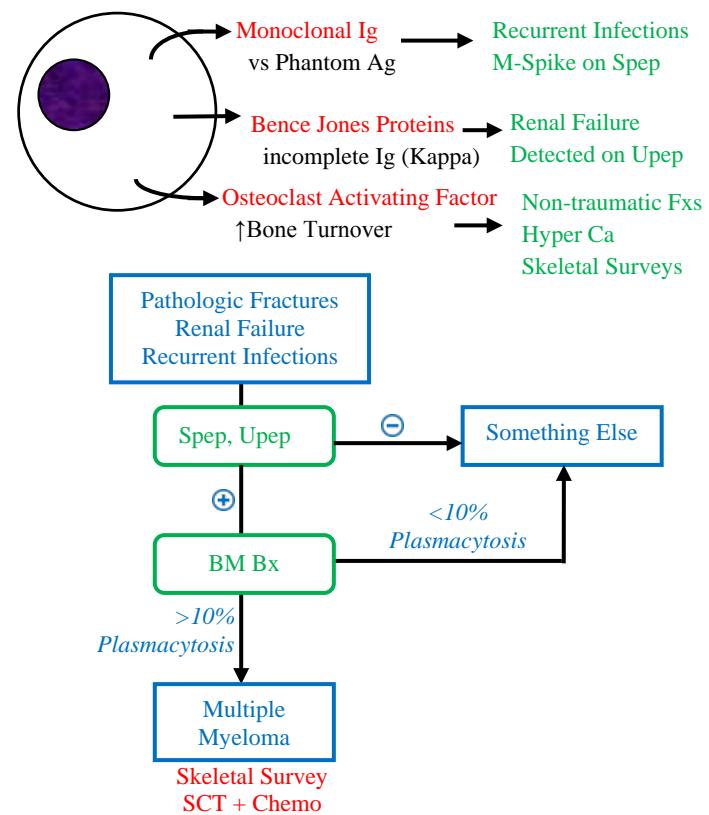
Multiple Myeloma is a dysfunction of plasma cells. Plasma cells secrete **Immunoglobulins** in response to antigen presentation. In multiple myeloma the plasma cells secrete one antibody against some phantom antigen. This dedicates the entire immune system to fighting something that doesn't exist. There are multiple consequences. The first is the **monoclonal antibody** produces overwhelming concentration of useless antibody. It can be detected by **Hgb Electrophoresis (Spes)** as an **M spike**. The consequence is when real infection comes there's Ø antibodies to fight infection; these patients develop **recurrent infections**. Sometimes complete Ig aren't made, but rather only pieces. These get deposited in the kidneys and can be detected on **Urine Electrophoresis (Upep)**. The fact that there are these proteins in the blood (both intact Ig + Bence-Jones) means there will be an **elevated protein gap**. Any time there are antibodies being made (HIV, Viral, bacterial infection) the protein gap can increase, but a sustained elevation on routine labs may be a tipoff. Plasma cells also secrete **osteoclast activating factor** which causes the bone resorption to go crazy. This results in **hypercalcemia** and frail bones = **pathologic non-traumatic fractures** - especially in the **elderly**. So patients will be **old**, with **weird fractures, renal failure, hyper Ca**, and an **↑Protein Gap**. The first thing to do is an **Spes** for the **Mspike** and a **Upep** for Bence-Jones. A **Bone Marrow Biopsy** must show a **>10% Plasmacytosis**. Now, diagnosis is more complicated than that but this is sufficient for a medical student. After diagnosis, perform a **skeletal survey** to assess for lytic lesions. Treatment options are dependent on the age; If **<70 + Donor** do a **stem-cell transplant** after chemo. For **>70** or **No Donor** do chemo only.

Monoclonal Gammopathy of Uncertain Significance

**MGUS** is when there's a ØSpes but with ØBence Jones, ØLytic Lesions, ØRenal Failure, ØHyperCa and a **plasmacytosis < 10%**. Do everything to rule out multiple myeloma, but then just monitor for conversion to multiple myeloma (~2% / year).

Waldenstrom's Macroglobulinemia

It's another **IgM secreting disease** that looks and feels like multiple myeloma but presents with a **peripheral neuropathy** and **hyperviscosity syndrome** rather than renal failure and bone fractures. The difference is really in the **Bone Marrow Biopsy** showing **Lymphocytes**. Treat with **plasmapheresis** and chemo.



Disease	Minor Sxs	Major Sxs	1 <sup>st</sup>	Best	Follow Up	Treatment
Multiple Myeloma	Hyper Ca Renal Failure Anemia ↑ Protein Gap	Nontraumatic Fx in the elderly	Spes & Upep	BM Bx >10% plasma	Skeletal Survey	<70 + Donor = Chemo + HSCT >70 or Ø Donor = Chemo
MGUS	Ø	Ø	Ø Spes Ø Upep	BM Bx <10% plasma	Annual Screen for MM	Observe
Waldenstrom's Macroglobulinemia	Peripheral Neuropathy	Hyperviscosity Syndrome	Ø Spes Ø Upep	BM Bx Lymphocytes	Serum Viscosity Nrm = 1.8, Abnormal >5-6	Plasmapheresis for Hyperviscosity Chemotherapy ± HSCT

[Disseminated Intravascular Coagulation](#)

At its core, DIC is the function of **fibrin** clots that consume both **platelets** and **factors**, causing both a factor and platelet type bleeding. Blood shearing across those fibrin clots produces **microangiopathic hemolytic anemia (MAHA)** and **Schistocytes** on smear. Clots and inflammation in general can produce a **fever**. Clots occur everywhere they shouldn't be and then can't form where they should. Thus, the patient bleeds (not where they should be), but also get thrombosis (from where they should not be). Thrombosis occurs anywhere, including the kidneys (**Renal Failure**) and brain (**neuro symptoms**). Comparing this description to TTP, it's evident both can mimic each other. However, since there are **fibrin clots**, it inherently means that **fibrinogen** will be consumed (and thus be **low**). Also, all clotting factors are consumed. This yields a **rise in PT and PTT**. These two findings (low fibrinogen and elevated PT/PTT) separate DIC from TTP; they're included in the **DIC panel**. Likewise, DIC usually occurs in a very sick patient i.e. one suffering from **sepsis**, **trauma**, or **massive hemorrhage**. The underlying condition must be corrected to reverse DIC. In the meantime, give the patient what is missing – **Blood, platelets, and FFP**.

[Thrombotic Thrombocytopenic Purpura](#)

TTP is an **autoimmune** disease where clots form - just like in DIC. But these clots are **hyaline** clots that **don't** consume factors, fibrinogen, or platelets. Instead, **ADAMTS-13** is deficient. It fails to cleave vWF multimers, which persist and **swallow platelets**. The thrombocytopenia has nothing to do with the clots, but with these large vWF multimers (at least we think). There's a classic **pentad** for TT, with the mnemonic **FAT RN**. There's **Fever**, **Anemia**, **Thrombocytopenia**, **Renal Failure**, and **Neurologic symptoms** that wax and wane. Diagnosis is based on a **normal DIC panel despite thrombocytopenia and anemia**. Schistocytes may be present. As discussed above, "FAT RN" may be present in both. The Laboratory diagnosis separates them. For TTP, **NEVER** give platelets (it'll worsen the MAHA). Instead, do a **plasma exchange** (take out the antibodies and give back plasma with a lot of ADAMTS-13), or a **plasma transfuse** (give ADAMTS-13 only).

[Idiopathic Thrombocytopenic Purpura](#)

ITP is an **autoimmune** disease of an unknown etiology that's the **diagnosis of exclusion**. Look at every other cause first, including **bone marrow biopsy**. Once exhausted, this is the diagnosis. The treatment is **steroids** (long term low dose better than short term high dose as the patient remains sensitive to treatment), though **IVIg** or **Anti-D** can be started at the same time to get platelets up faster. If steroids fail, a **splenectomy** is definitive. If splenectomy fails or is **contraindicated**, the remaining options are either **Rituximab** (immunocompromised and PML) or **thrombopoietin-receptor agonists**.

[Heparin Induced Thrombocytopenia](#)

If the patient is on **any heparin** there may be an **autoimmune destruction** of platelets, typically occurring at day 4-10 (earlier if second exposure). Stop the heparin, get an **HIT panel**, and start **Argatroban**.

<u>Platelets</u>	<u>Factors</u>	<u>Fibrin Clot</u>
↓ Platelets	↑ PT ↑ PTT	↓ Fibrinogen

<u>MAHA</u>	<u>Sxs</u>
↓ HgB	Fever
Schistocytes	Renal Failure
	Neuro

<u>Sxs</u>
Fever
Renal Failure
Neuro

Liver makes: Factors 2, 7, 9, and 10; Proteins C and S

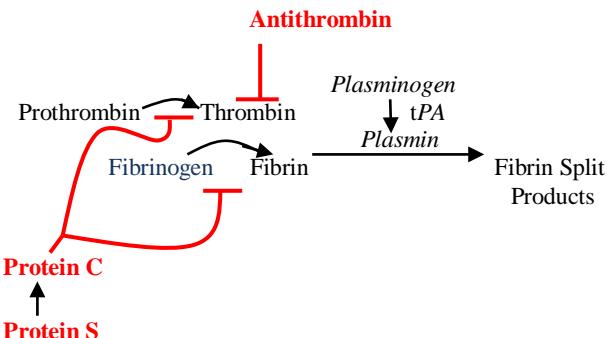
The (Anti) Clotting Cascade

Don't worry about memorizing the clotting cascade; don't even memorize this picture. Just recognize that there are forces in action trying to prevent the formation of a clot. **Protein S** activates **Protein C**. **Protein C** binds to **Factor V** to inactivate it, reducing the production of Thrombin from Prothrombin. **Antithrombin** prevents thrombin from turning the fibrinogen mesh into fibrin. Easy breezy, right?

So, is it so hard to imagine if there's a **deficiency** in **Protein C**, **Protein S**, or **Antithrombin** that there'd be an unusual amount of clotting? What if factor V just didn't get the Protein C message? Say there was a mutation of Factor V that made it resistant to the activity of protein C. That's **Factor V Leiden** - the most common thrombophilia. And of course, because everything can be lupus it can make the **antiphospholipid antibody** aka the lupus anticoagulant (horribly named since it causes clotting).

These are all genetic diseases that require genetic testing; they can almost all be treated with **coumadin**. It all has to do with factor clotting so induce an anti-clotting with coumadin to counteract the deficient anti-clotting of the endogenous system. Read that again to make sure you got it. But wait! Coumadin inhibits the production of clotting factors and proteins from the liver. Coumadin first **inhibits protein C and S**, actually INCREASING clotting when it's begun. That's why you must always start with a **Heparin Bridge**. Heparin is going to prevent the whole thing from getting started. Once proteins C, S, and all the liver clotting factors are depleted heparin can then be removed (with Coumadin being left on).

But what's the right time to go after these tests and to treat with Coumadin? Look for people who **are clotting** that **shouldn't be clotting**. That means things like people who have recurrent DVTs, get clots at a young age, or have a family history of clots. Generally, "everyone gets one," especially if there's a good reason for getting one (i.e. orthopedic surgery without prophylactic heparin in the hospital). Only work someone up for hypercoagulability, for thrombophilia, or when it's just a weird case you can't figure out.



Liver makes: Factors 2, 7, 9, and 10; Proteins C and S

For the resident, order:

- Protein C Levels
- Protein S Levels
- Antithrombin Mutation
- Factor V Leiden Mutation
- Antiphospholipid Assay

Intro

Bugs that cause disease stay the same while the antibiotics that treat them change. **Staph aureus** was the most common cause of osteomyelitis 50 years ago and still is today. Abx Resistance means the drugs to treat are in regular flux.

In general, **start with penicillin**. It's a cidal (kills bacteria) and typically successful.

There are two pathways from there - those that cover **staph** and those that cover **gram negative rods**.

Staph

The Methicillins (oxacillin, cloxacillin, dicloxacillin, nafcillin) are very good at killing staph. Unfortunately they're also really good at **making MRSA**. When sensitive to Methicillin any of the cillins should be used. In general, this is **not empiric**.

**Vancomycin** is the typical drug used for empiric coverage of Staph. It covers **MRSA**. However, just because it's a "big gun" does not imply broad coverage. It's weak against everything else.

**Linezolid** is top of the line. For Vancomycin-resistant Enterococcus (VRE) or Staph (VSA) the last resort is linezolid. Use this sparingly as resistance to this means there's nothing left.

Gram Negatives

To obtain gram negative coverage start with **Amoxicillin** or **Ampicillin** together with or without a **beta-lactamase inhibitor**. They don't cover pseudomonas.

If **pseudomonas coverage** is needed step up to **Ticarcillin** or **Piperacillin** with a **Beta-Lactamase Inhibitor**. These also cover gram positives (not staph) and anaerobes. Use should be restricted to pseudomonas to prevent resistance.

**Carbapenems** (imipenem, meropenem, ertapenem) are the uber drugs. They're best for polymicrobial infections but are reserved for gram negative infections of the most severe forms (like neutropenic fever). They DO cover pseudomonas

The **Quinolones** (cipro, levo, gatti, and moxifloxacin) are oral medications that kill a little bit of this and a little bit of that. Ciprofloxacin covers gram negatives (UTIs) and has the same bioavailability PO or IV. Moxi has the gram negative coverage but also gets some gram positives (Pneumonia).

The **Aminoglycosides** (gentamicin, amikacin) are synergistic with penicillins but almost **exclusively gram negative**. This is rarely the first choice for empiric treatment.

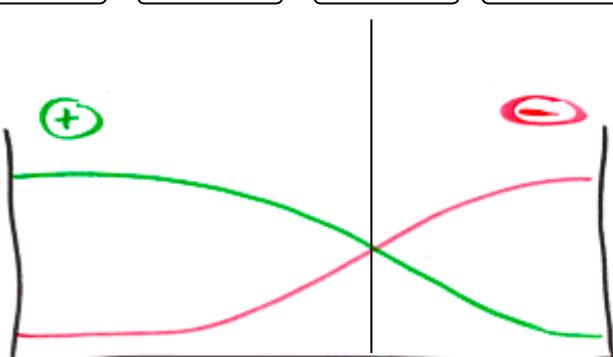
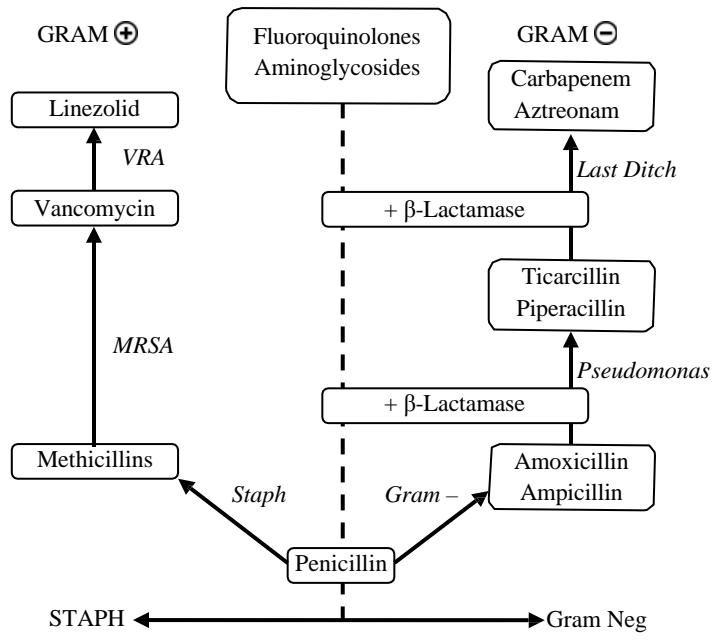
Cephalosporins

The earlier generations of cephalosporins (the **1<sup>st</sup> Generation Cephalosporins**) were designed to cover **strep** and **staph**. As you move up the generation ladder the amount of **gram negative coverage increases** but the **staph coverage decreases**.

**1<sup>st</sup> Generation Cephalosporins** are used to cover skin infections such as regular ol' cellulitis. Cefazolin.

**3<sup>rd</sup> Generation Cephalosporins** have sufficient gram negative and gram positive coverage. They also cross the blood brain barrier. They're chosen first for meningitis and inpatient pneumonia. Ceftriaxone.

**4<sup>th</sup> Generation Cephalosporins** means only cefepime; it kills pseudomonas. Like carbapenems, they're reserved for neutropenic fever or similarly immunosuppressed or severe conditions.



Anaerobes

Anaerobic coverage comes in many forms. Zosyn has anaerobic coverage, as do the penems. But when the focus is strictly anaerobes there are two options: **metronidazole** (gut and vagina) and **clindamycin** (everywhere else).

Understanding Quinolones

The more advanced a generation of quinolone, the more coverage it obtains. That is to say, first generation ciprofloxacin has gram negative coverage only; it's used to treat gram negative infections. The third generation moxifloxacin has more gram positive coverage but it DOESN'T LOSE gram negative coverage. This makes moxi a highly attractive medication to use (single-agent, covers everything) – but it also breeds resistance. Stay away from medications like this because they're rarely the right answer. No Quinolone covers Staph or Pseudomonas, though Cipro can be used in "double-coverage" of pseudomonas.

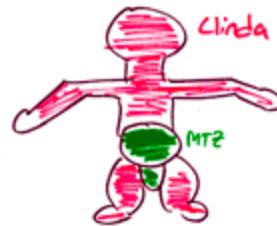
Pulling the trigger and going broad

In general, the goal is to narrow the antibiotics to exactly what's being treated. For a staph infection, pick Nafcillin. For MRSA infection, pick Vanc. For a UTI, pick Ampicillin or Cipro. For pseudomonas, pick Zosyn.

But there will be a time that a person is just ill. They're super sick. Missing the bug is fatal. When the person is **sick as shit** (think septic shock) it's ok to just "go broad"- make sure you get it all. This is why Vanc + Zosyn is so popular in the hospital. It's also why it will be the wrong answer on the test. Once **cultures and sensitivities** come back, you're then able to narrow your antibiotics. You can also **deescalate**, one antibiotic at a time, and assess the clinical response.

Real Life Antibiotics

Memorize the prevalence and patterns of infections at your institutions and use empirically derived data for empiric coverage. This is the list to the right.



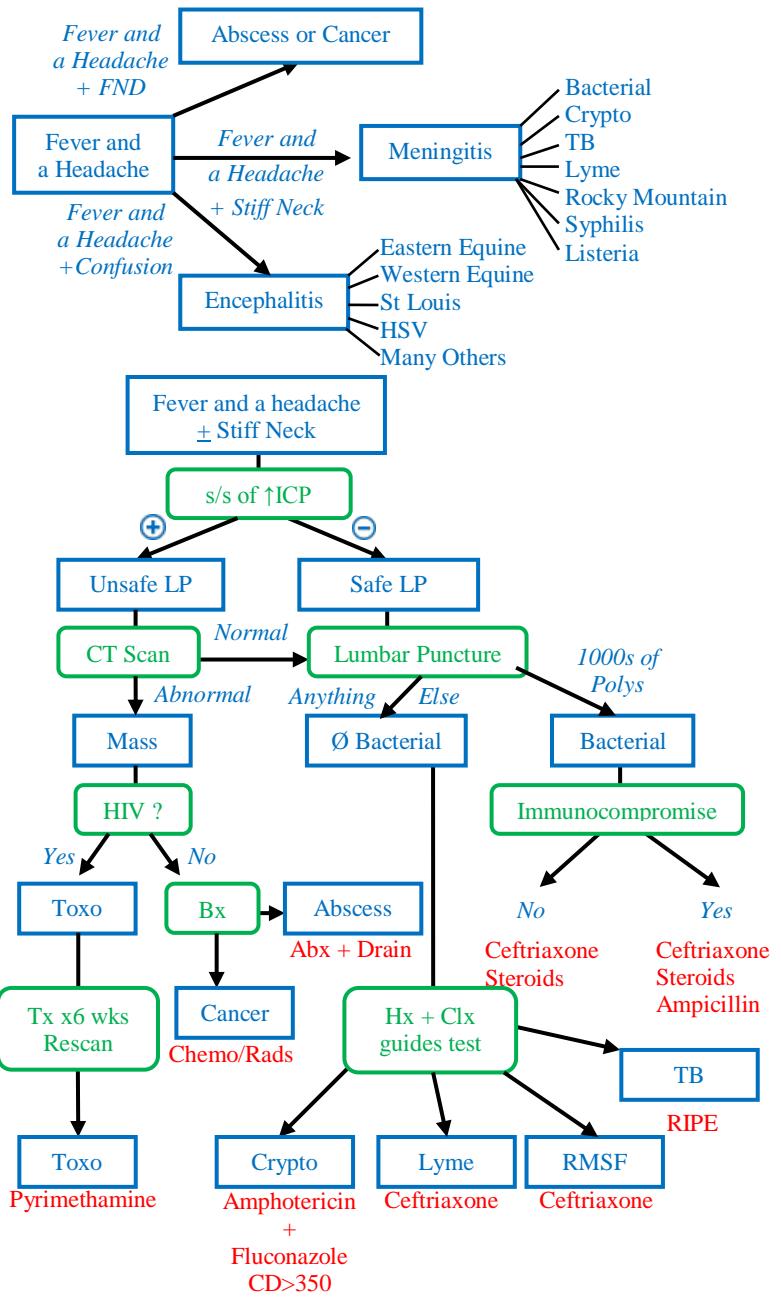
Condition	Drugs
Penicillin	Rash: Cephalosporins OK
Allergic	Anaphylaxis: Cephalosporins NOT ok
MRSA	Vancomycin, Linezolid
Pseudomonas	Pip/Tazo (Zosyn), Carbapenems, Cefepime Moxifloxacin, Azithromycin
Pneumonia	3 <sup>rd</sup> Gen Cephalosporin + Azithromycin
Inpatient	(Community) Vancomycin + Zosyn (Hospital)
Pneumonia	4 <sup>th</sup> Gen Cephalosporin (Cefepime)
Neutropenic	Carbapenems
Fever	Cipro, Bactrim, Nitrofurantoin, Ceftriaxone
UTI	Vanc, Ceftriaxone, +/- Steroids, +/- Ampicillin
Meningitis	Cefazolin, Bactrim, Clindamycin
Cellulitis	IV Vancomycin

Presentation and Differential

Any brain inflammation will present with a backbone of **fever + a headache**. This is nonspecific for a particular diagnosis but antennae should go up for “problem in the brain.” Other signs and symptoms that help (**photophobia**, N/V, and **seizures**) may be present but are likewise nonspecific. There are 3 categories of disease - each with their own unique findings. 1) **Meningitis** will have a **stiff neck** (Kernig and Brudzinski’s Signs). 2) **Abscesses** will present with **Focal Neurological Deficits**. 3) **Encephalitis** will present with encephalopathy (aka **confusion**).

Meningitis

Meningitis is inflammation of the meninges caused by any # of etiologies. The challenge is to identify which organism is most likely, confirm it, then treat it. The definitive test is the **Lumbar Puncture**. It gives a wealth of information (glucose, protein, cells) of the CSF as well as a body fluid for **Gram Stain** and **Culture**. It should be done before treatment is started. However, if the patient presents with signs and symptoms of ↑ICP a **CT scan** must be done 1<sup>st</sup>. That is: 1) **Papilledema**, 2) **Focal Neurological Deficits**, or 3) **Confusion**. If a CT scan is required empiric antibiotics should be given before the LP. This is the ONE time where you’ll **treat before a culture** (this decreases the sensitivity of the culture but it saves lives). Once the LP/Tap is done CSF is analyzed. **Glucose / Protein / # cells** are useful but are Ø sensitive enough for treatment. One value can tell **bacterial (1000s of PMNs)** or not. If bacterial, treat empirically while cultures grow. For **immunocompetent** patients give **ceftriaxone**. If immunosuppressed, **add Ampicillin** for **Listeria**. This will be the **elderly neonate on steroids for the organ transplant with HIV**. No matter their state, all patients get **IV steroids for bacterial meningitis**. If the tap comes back “Ø bacterial” we’re forced with a dilemma. The disease it is easy to diagnose if you know it’s there. To know it’s there look at history and risk factors. 1) **HIV/AIDS** point towards a potential **Cryptococcus** infection. Though India Ink is specific it’s not sensitive. Get a **Cryptococcus Antigen**. 2) A **targetoid rash** on a **hiker** from the **North East** points towards **Lyme disease**. Get the **Lyme Antibody** and treat with **ceftriaxone** (not the doxycycline used for arthralgias). 3) A **peripheral rash** that develops proximally from the hands indicates **Rocky Mountain Spotted Fever**. Look for the **RMSF Antibody** and treat with **ceftriaxone**. 4) A history of **homelessness or prison** with **fever/night sweats/weight loss/hemoptysis** looks like **TB**. Get an **AFB** and treat with **RIPE**. 5) **STDs/Chancre/2<sup>o</sup>Rash/DCMLS** point towards **syphilis**. Get an **RPR** on the CSF. They get **14 days of penicillin**. 6) **Viral** is a diagnosis of exclusion and nothing can be done for it.



Lumbar Puncture Findings					
Bug	Cell Count	Glucose	Protein	WBC	Tx
Bacterial	↑↑↑	↓↓	↑	PMNs	Ceftriaxone
Viral	↑	-	↑	Lymph	
Fungal	↑	↓	↑	Lymph	
TB	↑	↓	↑	Lymph	RIPE

Bug	Suspicious Hx	Test	Tx
RMSF	Rash on hands, Spread Proximal	Antibody	Ceftriaxone
Lyme	Targetoid Rash, Hiker, Ticks	Antibody	Ceftriaxone
Crypto	HIV/AIDS	Antigen	Amphotericin
TB	Pulmonary TB	AFB	RIPE
Syphilis	STD, Palmar Rash, DCMLS	RPR	Penicillin
Listeria	Elderly Neonate on Steroids	-	Ampicillin
Viral	Diagnosis of Exclusion	-	-

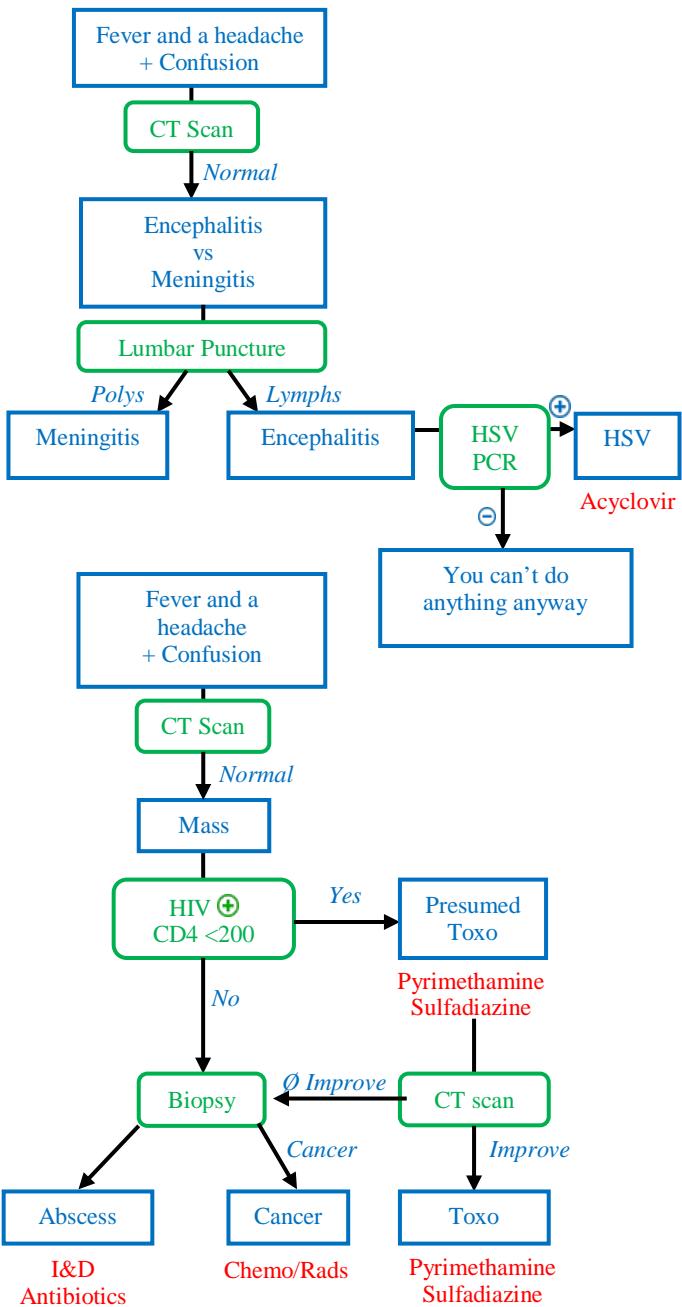
Encephalitis

Encephalitis presents as a **fever** and a **headache** with **confusion**. Because there is confusion a **CT scan** is performed 1<sup>st</sup> (usually with a dose of ceftriaxone). The CT will be **normal**. A **Lumbar puncture** will follow. Unless some bizarre travel has occurred or the person was bit by a fox (rabies), the only thing to be concerned with is **Herpes Simplex Virus**. The tap will have both **WBC** ("it is", separating it from a SAH or traumatic tap) and **RBC**. When normal CT + WBC/RBC is seen in LP, do **HSV PCR** to confirm the diagnosis while treating with **acyclovir**. The diagnosis of HSV may be suspected if there's any information about "**temporal lobe**" or "**anosmia**".

Abscess vs Cancer (Mass Lesions)

Since mass lesions present as a **fever** and a **headache** with **Focal Neurological Deficits**, this will also require a **CT scan** before the LP - usually with a dose of ceftriaxone. The CT will come back  $\oplus$  for a **ring enhancing lesion**; it'll be contraindicating with the lumbar puncture. Instead, additional investigation of the mass must take place (i.e. a **Biopsy**). This will tell us if there's an **abscess** requiring drainage and investigation of a primary source, ( $\oplus$  **organisms**) or if it's a **cancer** requiring radiation and chemo. Antibiotics won't work for a cancer and chemo/radiation won't work for an abscess.

There's one exception to jumping to a biopsy - an **HIV/AIDS** patient. In a patient with a CD4 count  $< 200$ , the mass is **Toxoplasmosis** **90%** of the time. For this patient **treat empirically with pyrimethamine** for **6 weeks**. If there's improvement keep it going. If not, go to biopsy. If "treat empirically" isn't an option look for Toxoplasmosis-Ab.



Introduction

A lot of things go on in the head. Children need to be exposed to bugs to develop an immune system. That means orifices become potential sites for problems to develop, which is why this topic is in pediatrics. Each disease has its own unique presentation so it's usually not a differential - just know what to do.

1) Otitis Media

Otitis media is an infection of the middle ear caused by the **respiratory bugs**. The child is going to be in pain. **Unilateral ear pain** in a child, with or without fever, leukocytosis, etc. is most likely to be otitis. Kids will pull on their ear (**no pain with pinna manipulation**) to relieve the sensation. The diagnosis is confirmed by **pneumatic insufflation** (a little puff of air reveals a **tense immobile membrane**). Things like a **bulging red angry membrane with loss of light reflex** are indicative of fluid behind the ear but aren't pathognomonic. Don't get tests but definitely treat with **amoxicillin**. Failure to treat can cause spread of the infection to the **mastoid, inner ear, and brain**. If the infection does not clear give **amoxicillin and clavulanate**. If the infections recur do **tubes** to equalize pressure and allow drainage - especially if there's residual fluid behind the ear.

2) Otitis Externa

Otitis Externa presents as **unilateral ear pain** (like media), but there's **pain on palpation of pinna** (unlike media). Caused by frequent contact with water ("swimmer's ear"), it's commonly caused by **pseudomonas** (a bug associated with water). It can also be caused by repeated trauma or an infection by **Staph aureus**. On physical exam an **angry erythematous canal** can be seen. It usually improves spontaneously. It becomes important to educate patients not to put anything in their ear and to dry ears after swimming and showering.

3) Sinusitis

An infection of the **nose and sinuses** that occurs in both kids and adults. **Purulent bilateral nasal discharge** is a giveaway something's wrong nearby. Adults and older kids may complain of a congested, stuffed feeling with **sinus tenderness**. The **facial tap** is a sensitive physical finding (tapping an inflamed sinus hurts). Radiographs are **not necessary** but will show **air-fluid levels** and **opacification** (XR + CT). They're expensive and usually reserved for refractory or recurrent sinusitis to make sure there's no congenital defect. But before doing anything make sure this isn't just a cold - a regular viral illness. If it's been **>7 days** or there's also a **cough**, simply **presume bacterial infection**. This is an URI so treat the URI bugs with **amoxicillin**.

4) Cold – Viral Nasal

Typically caused by **rhinovirus** and transmitted between people by **large droplets**. It's also gives "boogers", **rhinorrhea, congestion, and low-grade fever** so it looks like sinusitis. **Nasopharyngeal washes with culture** (to rule out bacterial infection) and **Immunofluorescence** (to rule out viral infection) could be gotten but it's better to **not do anything** because this will just get better on its own. If it's **<7 days AND no cough** it's likely viral and the patients should wait it out.

*This is a replica of PEDS – ENT and included for completeness if only studying ID.*

URI Bugs

		<b>Amoxicillin</b>
Most	Strep Pneumo	
Common	H. Influenza	± clavulanate
	Moraxella	
	Catarrhalis	
Otitis	Pseudomonas	Spontaneous Resolution
Externa		

Ear Pain

<b>Otitis Media</b>	Visual Inspection
Otitis Externa	Pinna Manipulation
Foreign Body	Lidocaine / Retrieval

Rhinorrhea

Viral Sinusitis	Ø Cough and < 7 days
Bacterial Sinusitis	Culture
Foreign Body	Inspection

Sore Throat

Bacterial	Rapid Strep → Culture
Viral	
Mono	Monospot

Bloody Nose

Digital Trauma	Cold compress, lean forward, humidified air, ablation
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Is it **viral (wait)**

Short Duration  
Low-Grade Fever  
Mild Symptoms

**bacterial (amoxicillin)?**

Longer Duration  
High Fever  
Worse Sxs

Culture

**5) Pharyngitis**

Much like sinusitis, **viral** pathogens are the most common cause occurring in kids and adults. The primary complaint will be **sore throat** with **pain on swallowing**. Like otitis, physical exam findings are nonspecific for viral versus bacterial (**erythematous pharynx, swollen tonsils, purulent exudates**). Because a bacterial infection with **Group A Strep** can cause rheumatic heart disease and poststreptococcal glomerulonephritis, we must find out if it's bacterial or viral. However, those physical findings are not specific. Instead, we use the **Centor Criteria** to help direct our decision making, keeping in mind the risk of mimicry (PSGN and Rheumatic Heart) are higher in kids, so we are more likely to treat (most doctors don't). The treatment is **amoxicillin-clavulanate** if there is strep, but to do nothing if it's viral. Using the Centor Criteria (right) we can make our decision. Doing a **Rapid Strep Test** is **specific** (if  $\oplus$  start treatment) but **not sensitive** (if  $\ominus$  move onto **culture**). Cultures take 2-3 days to come back; treatment does not need to be started until cultures confirm bacterial infection.

**Calculating the score**

+1	Fever
+1	Exudates
+1	Adenopathy
+1	ABSENCE of cough
+1	< 15 years old
-1	>44 years old

**Interpreting the Score**

< 1	No treatment (viral)
2-3	Throat Culture (Rapid Strep acceptable)
> 4	Empiric Treatment, no testing needed

**6) Foreign Body**

Children: Kids like to stick things places. Things can go into the **nose** (producing **foul-smelling unilateral rhinorrhea**), **ear** (pain), and sometimes down their **throat** (aspiration, covered in the pulmonary videos). Essentially, the object has to be **retrieved** with a **rigid bronchoscope** and the **infection treated**.

Adults: One particular foreign body are **insects**; homeless are aware of this and sometimes sleep with coins in their ears. Bugs present with a **unilateral scratching** or **buzzing** and should be treated with **lidocaine** and retrieval, but **never light** (they just burrow deeper).

**7) Epistaxis**

Whether out of habit or because the nose itches, epistaxis is most commonly caused by **digital trauma** (nose-picking). Normal nosebleeds are **unilateral** and last **<30 minutes**. Applying a cold compress (vasoconstriction) and leaning **forward** (backwards is just drinking the blood causing a cough breaking the clot) can cause an active bleed to stop. Look inside the nose to make sure there isn't anything **anatomical** or **foreign** inside. Treat recurrent bleeds with **humidified air**. Ultimately, **ablation** is used to prevent bleeding.

**Posterior epistaxis** may require **packing** (essentially a tampon inserted into the posterior of the oropharynx with prophylactic antibiotics to prevent toxic shock syndrome).

**8) Choanal Atresia**

Finally, something isolated to pediatrics. This is an **atretic** or **anatomically stenosed** (i.e. really big tonsils) connection between the nose and mouth. In severe cases the baby will be **blue at rest** (nasal breathing is insufficient) and then **pink up with crying** (as he/she uses his/her mouth). If it's just partially obstructed there might be a **childhood snore**; kids shouldn't snore. If there's complete atresia a **catheter will fail to pass**. If it's incomplete a **fiber-optic scope** will identify the lesion. **Surgery** is required to remove the tonsils or open the atretic passage.

Intro

Genital Ulcers always make it onto a shelf or board exam. You'll be unlikely to deal with these complaints unless you're an **Ob/GYN** or **Family Practice**. Knowing how each is **described** will help decide what the **causal organism** is, what **test** to do next, and then how to **treat**. Each of the four ulcer-causing diseases has its own descriptors - descriptors that overlap. So it becomes an overall picture without freebies based on a buzz word. Even though molluscum contagiosum technically isn't an ulcer disease, it's commonly tested against the other three so it's included in this section.

1. Primary Syphilis

Primary Syphilis presents as a **painless ulcer** called a **chancre**. It represents the entry point of the **Treponema Pallidum** organism, a **spirochete**. There may be associated **lymphadenopathy**. It's too early to use serology (chancre arises from 0-4 weeks, serology is useful only after 4 weeks) so we have to look for the organisms themselves with a **Darkfield Microscopy**. At this point **IM PenG** will be curative. If missed, a rash may return (**secondary syphilis**); it's described as **Targetoid** or **maculopapular** that **involves the palms and soles**. The rash is **infectious**. By this time serology is positive. Screen for syphilis with an **RPR** (or **VDRL**) and confirm with **FTA-Abs**. If FTA-Abs **⊕**, treat with PenG and IM. Finally, **tertiary syphilis** involves the CNS - typically taking the DCMLS - but can present with any neuro symptom. Again, do serology (**LP** with **CSF serology** may be required if index of suspicion high but serum antibodies are negative). In tertiary syphilis the patient need **IV Penicillin x 7-14 days**. If the patient is **penicillin allergic** doxy can be used instead of penicillin. If allergic AND pregnant they have to be **desensitized** and given the penicillin anyway; doxy is contraindicated.

2. Haemophilus Ducreyi

You "do cry with Ducreyi" presenting as a syphilitic chancre **that hurts**. It will have the ulcer, erythematous base, and inguinal lymphadenopathy of syphilis, but this **will hurt** - syphilis does not. Do a simple **gram stain** and **culture**, then treat with antibiotics with Gram **⊖** coverage - **Doxy** or **Azithromycin**.

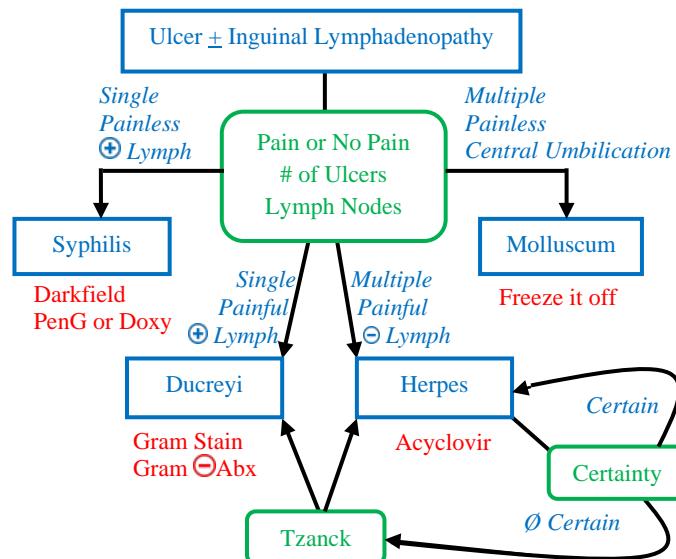
3. Herpes

**Herpes Hurts** like ducreyi, but are often **multiple roofed vesicles**, each on an **erythematous base**, whose eruption is preceded by a **painful prodrome**. If this classic picture is seen just treat with **acyclovir** as the diagnosis is clinical. At times, however, vesicles can **unroof** and become **confluent**. This makes it difficult to diagnosis clinically. If herpes is suspected get a **Tzanck Prep** to see the **perinuclear halos** and **nuclear molding**.

4. Molluscum Contagiosum

Molluscum can be anywhere on the skin. The lesions are often raised vesicles with **central umbilication**. While usually **Ø** confused for the others, test questions often ask you to differentiate this from them. These can just be **frozen off**.

1. Syphilis
2. Haemophilus Ducreyi
3. Herpes Zoster
4. Molluscum Contagiosum

Tests for Syphilis

RPR	Good <b>sensitivity</b> requires > 1 month to be positive
VDRL	Decent sensitivity, False <b>⊕</b> with Lupus
FTA-ABS	Good <b>specificity</b> , confirmatory for RPR <b>⊕</b>
Darkfield Microscopy	Excellent <b>specificity</b> , only means of diagnosis for <b>primary chancre</b>
<b>Treatment for Syphilis</b>	

Pen G IM	Mainstay of therapy, x1 time <b>primary</b> and <b>secondary</b>
Doxy	If <b>Pen Allergic</b> x7 days for <b>primary</b> and <b>secondary</b>
PenV IV	Best treatment for <b>3º disease</b> x 14 days, or for <b>penicillin allergic pregnant patients</b> (desensitize)

Types of Syphilis

Primary	Painless chancre with Inguinal Lymphadenopathy
Secondary	Maculopapular Rash on <b>hands</b> and <b>soles</b> (infectious)
Tertiary	Any neurologic complaint (Argyll-Robertson Pupil)

Dz	Presentation	Test	Treatment
Syphilis	Painless but firm ulcer (singular) + Lymphadenopathy	1º=Dark Field 2º RPR 3º FTA-ABS	PenGIM or Doxy
Ducreyi	Painful but soft ulcer (singular) + Lymphadenopathy	Gram Stain culture	Gram ⊖ Abx: Either Doxy or Azithromycin
Herpes	Roofed vesicle on an erythematous base after a painful prodrome	Ø needed	Acyclovir
Herpes (atl)	Confluent painful ulcer ("singular")	Tzanck	Acyclovir
Mollus Contagi	Vesicle with central umbilication	Ø needed	Freeze them off

**Pathology and Diagnosis**

HIV is an **RNA Virus** that enters **CD4** cells via **gp120** and **gp41** (CCR5, CXCR4 chemokine receptor bearing cells). Once infected, reverse transcriptase turns the RNA virus into host DNA, hijacking the nucleus to produce HIV RNA. After replication, new virions are packaged by **proteases** and are released into the blood stream by **exocytosis**. CD8 responses cause death/loss of CD4 cells resulting in a major decline. **Diagnosis** is based on **Oraquick** or **ELISA** confirmed with **Western Blot** or **Viral Load**. A window period exists from infection to antibodies, (**6 weeks**) where only viral load can be used.

**Prophylaxis**

As the **CD4 count** falls the patient becomes vulnerable to **opportunistic infections**. We look for the opportunistic diseases and treat them. However, we can also **prophylax** against two diseases: <sup>1</sup>**PCP pneumonia** at a **CD4 <200** with **Bactrim** and <sup>2</sup>**MAC** at a **CD<50** with **Azithromycin**. If for some reason the patient is allergic to Bactrim, give **Dapsone** instead.

**Opportunistic Infections and Therapy**

In spite of limited prophylaxis many patients do get infected with opportunistic infections. Knowing what to look for and what to treat based on CD4 count is critical. Be aggressive in the treatment of opportunistic infections. It comes down to simple memorization (the chart to the right) and recognition of symptoms.

Note that **AIDS** is defined by a **CD4<200 OR Opportunistic Infection**. Since it can't currently be cured the patient will always have the label - even if the infection clears or CD4 counts rise to normal levels.

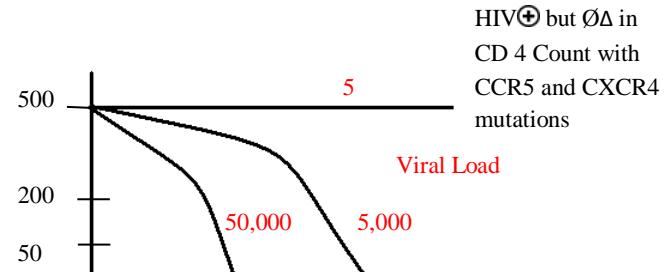
HIV is a blood borne illness and is a sexually transmitted disease. Be sure to **screen for possible coinfections** at high risk. It's the infections seen with the same risky behavior (IVDA and sex) such as **cervical cancer, Hep B and Hep C**.

**Antiviral Therapy = HAART**

Treatment with HAART is based on either **CD<350** or **viral load > 55,000**, typical therapy involves the **2+1 approach**. That means 2 Nucleoside Reverse Transcriptase Inhibitors and 1 Protease Inhibitor. This therapy is highly effective at reducing viral load and as exposure prophylaxis. It should take a viral load to **<50 copies in 4-6 months**. Failure to do so is indicative of poor adherence or viral resistance. One "quick fix" is to ↑efficacy of the protease inhibitor by **boosting** it with low dose **ritonavir**, which is synergistic. As soon as medication is stopped the viral load will return.

If someone has risk exposure (**needle stick, rape, or condom failure**), treat him/her with **2+1 x 4 weeks** and check a viral load. Also note that if on medication vertical transmission during birth should be prevented.

CD4 Count	What's <u>Right Now</u> = Infection Risk
Viral Load	What's <u>to come</u> = CD4 change soon



CD4 Count	Vulnerability	Prophylaxis
>350	Ø	Ø
>200	Thrush, TB, Leukoplakia	Ø
<200	PCP Pneumonia	Bactrim or Dapsone
<50	MAC	Azithromycin

The only prophylaxis we have is Bactrim and Azithromycin against PCP Pneumonia and MAC (above). Everything else has to be actively sought and treated (below).

CD4 Count	Infection	Treatment
>500	Normal Person with normal infections	Normal
200-500	Oral Leukoplakia Pulmonary TB (>5mm) Pneumococcal PNA Thrush	INH (PPx), R.I.P.E (Tx) 3 <sup>rd</sup> Gen Ceph + Macrolide Nystatin S+S
<200	PCP Pneumonia Crypto/Coccidio Miliary TB Candida Thrush	Bactrim, Pentamidine Amphotericin, Fluconazole R.I.P.E Nystatin S+S
<100	HSV/CMV Esophagitis Toxoplasmosis	Acyclovir/Ganciclovir Pyrimethamine Sulfadoxine
<50	Disseminated MAC CMV Retinitis	R.I.P.E Valaciclovir, Foscarnet

NRTIs	Protease Inhibitor
AZT	BM suppression
DDI	Peripheral
DDT	Neuropathy
DDC	pancreatitis
3TC	

The "Vudines"

The "avir"

HAART Therapy	
When to Start	CD<350 or Viral Load > 55,000
What to Start	2+1
When to Stop	Never (now questionable)
PPx with Risk	2+1 x 4 weeks

Pathogenesis

Infective Endocarditis (IE) is an infection on the heart valves. To get infected there must be introduction of bacteria into the blood stream AND a bad valve. Thus, some risk factors are **intravenous drug use** (most common in the US) or a patient with repeated access (like dialysis). Others are **valvular damage** (rheumatic heart worldwide, congenital defects in the US) and a **history of endocarditis** (100 fold increase in risk). Once the infection sets up shop on the valve, embolic, vascular and rheumatologic manifestations are possible.

Presentation

The Duke's criteria (presented to the right) is a useful means of building a table you can memorize. However, it was created for study inclusion and isn't a diagnostic tool. Instead, note there are two types of endocarditis: Acute and Subacute.

**Acute Endocarditis** is going to be from virulent organisms (Staph, Strep Pneumo) that will infect normal, native valves. These patients will be sick: persistent bacteremia, valve destruction, **new murmur**; we order a bunch of cultures to watch it clear (or not) and start antibiotics right away. Since the presentation is obvious it doesn't take long for the patient to seek medical attention. Thus, there's no time for the rheumatologic manifestations to start.

**Subacute Endocarditis** is caused by less virulent organisms (S. bovis, S. viridans, HACEK) infecting abnormal native valves. It's the endocarditis people learn about in second year – **Roth Spots** (eyes), **Janeway lesions** (painless hands), **Splinter Hemorrhages** (nail beds), **Osler nodes** (painful distal digit pulp) etc - subtle clues pointing to endocarditis because the patient is not sick enough to warrant attention. This one requires multiple cultures to make a diagnosis; antibiotics should not be started right away.

Diagnosis

The **echocardiogram** and **blood cultures** are the cornerstone of diagnosis. The TTE is often used first (usually to identify a valvular abnormality rather than a vegetation) followed by a **Transesophageal Echocardiogram** to make the final diagnosis by identifying the vegetation. The TEE is the best test.

**Acute endocarditis:** hey, the bacteremia won't clear. Keep getting cultures until they do. OH NOES! A MURMUR!!! Get a TEE.

**Subacute endocarditis:** my my, look at these interesting rashes. This one is painless on their hands, their nail beds have these small splinter like splotches, and their RF is up. I wonder if this is rheumatoid arthritis? Doesn't sound like RA - get 3 cultures and wait. AHA! BACTEREMIA! GET A TEE!!!!!!

**Major Criteria**

**Sustained Bacteremia** by organism known to cause IE  
(Strep, Staph, HACEK)

**Endocardial Evidence** by Echo

**New valvular regurgitation** (increase or change of pre-existing not adequate)

**Minor Criteria**

**Predisposing Risk Factor** (valve disease or IVDA)

**Fever**  $\geq 38\text{ C}$

**Vascular Phenomena** (septic emboli arterial, pulmonary, and Janeway lesions)

**Immunologic Phenomena** (glomerulonephritis, Osler nodes, Roth spots, RF)

**Definite**

Two major criteria (Blood Culture and Echo)

One major and 3 minor

5 minor

**Possible**

1 major and 1 minor (almost every bacteremic patient, btw)

3 minor

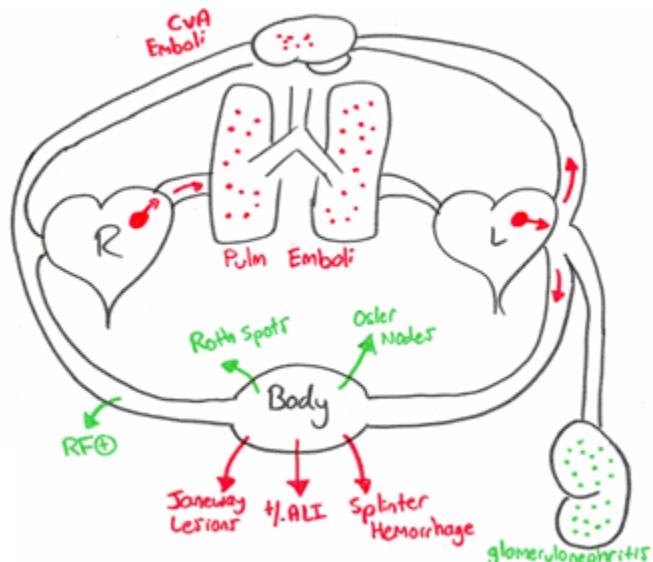
**Rejected**

Firm alternative diagnosis explaining evidence for IE

Resolution of everything in 4 days

No pathologic evidence (a BIOPSY!) at surgery or death

Failure to meet criteria as above

**Diagnostic Steps**

Blood cultures x 3, one hour apart, NO abx	Subacute Endocarditis
--	-----------------------

Blood cultures x 2 now, start empiric abx, follow-up cultures	Acute Endocarditis
---	--------------------

Trans Thoracic Echo	If you aren't sure
---------------------	--------------------

Trans Esophageal Echo	If you are sure
-----------------------	-----------------

Treatment

There are two elements to the treatment of Endocarditis: **antibiotics** and **surgery**.

Antibiotics will be required for a **minimum of 6 weeks**. Which antibiotic is chosen will be dependent on the culture and sensitivity of the organism. But when treatment is begun we must use **empiric coverage**. That changes not on the endocarditis, but on the patient. See to the right.

Surgery is designed to prevent CHF and embolization. Acute endocarditis can cause valvular insufficiency. The worse the valve or the worse the CHF the sooner the surgery (someone in cardiogenic shock goes right away while someone who is compensated but has severe insufficiency can wait a few days). This is a clinical judgment: how sick the patient is.

But embolization is not clinical. There are fairly well described criteria for who goes to surgery for a vegetation that could embolize. Note that a stroke or MI would be a contraindication to any surgery EXCEPT for IE, since failing to go to surgery will result in further embolization. See to the right.

Prophylaxis

There is a long list of people that need to be prophylaxed against IE. But if you instead remember, “bad valve” and “mouth and throat” you’ll get it right most of the time.

**Bad Valve** means they have a congenital heart defect, previous endocarditis or a prosthetic valve.

**Mouth and throat** means they’re having a dental procedure or a procedure that would involve bronchoscopy and biopsy of the respiratory flora.

If you see both, give **amoxicillin**. If they can’t tolerate a penicillin, use ceftaz. If that doesn’t work go to clinda, but you won’t be drilling down to this level of detail as a medical student.

Unique Association for Bonus Points

**Strep bovis** comes from the colon. If Strep bovi endocarditis, do **colonoscopy** for occult cancer.

**Staph aureus** comes from the skin. IVDA and tricuspid valve most often.

**Strep Anything Else** comes from the mouth. Look for dental disease.

Antibiotics

Native Valve			
All Native	Vancomycin		
<b>Prosthetic Valve</b>			
<60 Days	Vancomycin	Gentamycin	Cefepime
60-365 days	Vancomycin	Gentamycin	
>365 days	Vancomycin	Gentamycin	Ceftriaxone

Surgery

Go to surgery if
>15mm even without embolization
>10 mm + embolization
Abscess
Valve destruction or CHF

**Bad Valve**

Bad Valve		Mouth and Throat
Congenital Heart Disease		Dental Procedures
Prosthetic Valve		Biopsy of the Airway
History of Endocarditis		

Antibiotics

Amoxicillin (1 <sup>st</sup> line)
Ceftaz (back up)
Clinda (last line)

Organisms and Disease Typing

Whenever there's a **fever and a cough** consider a lung infection. There are three lung infections: (1) **Abscess**, (2) **Bronchitis**, and (3) **Pneumonia**. When learning about **Typical Pneumonias** and **Atypical Pneumonias** for Step 1, the symptoms and CXR findings may be misleading (neither is specific enough), and "Pneumonia" is treated on its severity - not by which "type" it is. Instead use: exposure, the history, and risk factors to orient the treatment goals. That means the Step 1 studying you did (this organism leads to that presentation) should be ignored. Instead, the thinking should be along the lines of "given the patients risk-factors, what bug could this be?" If there's **no association with healthcare** the community bugs (not virulent or resistant) are more likely (**Community Acquired Pneumonia**). Within CAP there are bugs more likely to cause disease based on risk. **Strep Pneumo** is always the most common; the #2 disease is based on risk (see the table). If the patient has been **near healthcare** the virulence and resistance increase; the bugs are more virulent. Treat for HAP (**Hospital Acquired Pneumonia**). If the patient is **Immunocompromised** the weird bugs can cause infections (TB, Fungus, MAC, and the most feared PCP in an AIDS). Finally, if there's a risk for **aspiration** (MS, Stroke, Diabetic, Alcoholic, Intubated, Seizures) then the oral flora /anaerobes are at ↑ risk.

Workup

Everybody will get a **CXR** who presents with a **fever** and a **cough**. Everybody will get an **SpO<sub>2</sub>**. Even though the best test is a culture, sometimes in the lung it doesn't work out. So beyond CXR + SpO<sub>2</sub>, there's no clear algorithm. **Sputum Gram Stain and Culture** may be useless (contaminated by floral organisms, useful only when <10 Squamous and >25 Polys /lpf). **Blood Cultures** rarely yield anything, and if positive represent septicemia, but should be obtained on any patient being admitted to the hospital. **Bronchoalveolar lavage** is reserved for acutely ill patients with HIV/AIDS to rule out a rapidly fatal PCP. Instead, **empiric treatment** is often sufficient when relying on history and risk factors to direct us. Finally, if a diagnosis is required, **serum or urine antigen / PCR** can be used to identify the organism. A **history** and a **CXR** are the two major hinge points for evaluation. For details on organism ↔ history see the typical pneumonia section.

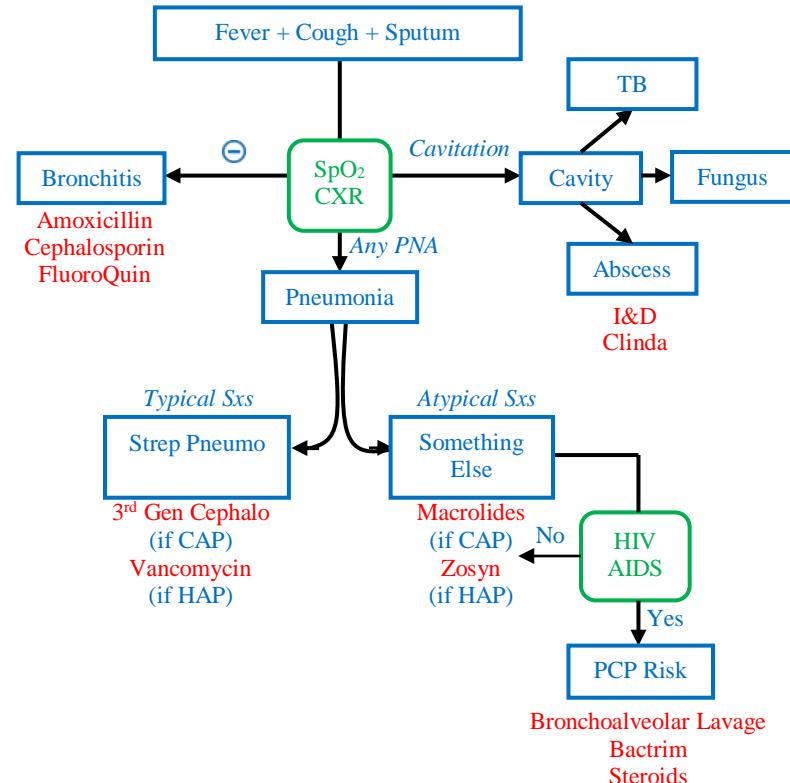
Abscess

An abscess is going to present as a **fever w/ a cough, cavitation, and foul breath**. The best way to rule out fungus and TB is with an **Incision and Drainage with Culture**. At this point treat empirically with **Clindamycin**. Abscesses don't just form so there's usually a history of **aspiration risk** (most pulmonary abscesses are anaerobes). Aspiration risk essentially means the **seizure, alcoholic, and MS/CVA** patients. Once the dx is determined (TB, Fungus, Abscess) treat accordingly.

<b>Bugs to Risk</b>	
CAP	Strep Pneumo most common Mycoplasma/Chlamydia in "Atypical" Picture Legionella in "Atypical" and Smoking H. Influenza in COPD/Smokers Klebsiella in Drunks Staph Aureus after a viral UTI
HAP	GNR, Pseudomonas, E. Coli, Enterobacter MRSA, Klebsiella
Immuno↓ Aspiration	Fungus, TB, MAC, PCP, CMV, HSV GNR, S. Aureus, S. Pneumo

Fever + Cough.....with

<b>Bronchitis</b>	Sputum Production, NrmL CXR
<b>Abscess</b>	Foul Breath, Cavitation CXR
<b>Pneumonia</b>	Any CXR finding that's not the others. Typical = Lobar Infiltrates Atypical = Bilateral Infiltrates

Bottom Line

<b>Bottom Line</b>	<b>Alternative</b>
CAP = 3 <sup>rd</sup> Generation Cephalosporin + Macrolide	FQ
HAP = Vancomycin + Zosyn	
HIV = Bactrim + Steroids + CAP coverage	
Outpatient Tx < 65 yo, Macrolide only	

Bronchitis

Bronchitis presents as a **fever** and a **cough** with a **Normal CXR**. This presentation might be a viral pneumonia or an extrapulmonary process, but with a **sputum production** that can be treated. Treat it like an URI: treat with amoxicillin, 3<sup>rd</sup> generation cephalosporins and a macrolide, or fluoroquinolones. It's typically not necessary to admit a patient with bronchitis unless there's COPD exacerbation as a result of infection. Chronic Bronchitis is a productive cough for 2-3 months in 2 consecutive years.

Typical Pneumonia

Typical Pneumonia presents as an **acute onset fever** and a **cough with lobar infiltrates** on CXR; typically with **productive sputum**. This has been historically associated with typical URI bugs: **S. Pneumoniae**, **M. Catarrhalis**, and **H. Influenza**. The most common bug in all patients is Strep Pneumo. However, typical pneumonia patterns will come up in other patients at high risk. With risk factors, a stain and culture might not show the organism. The good news is that almost **all organisms** are treated with the same antibiotics; only the risk has to be identified. Use **1<sup>3</sup>rd generation cephalosporin plus a macrolide** for CAP that gets admitted, **2<sup>Macrolide only</sup>** for CAP that goes home, and **3<sup>Vancomycin + Zosyn</sup>** when HAP. Most of the time, determining a diagnosis is likely an academic exercise.

Atypical Pneumonia

Atypical pneumonia presents as an **insidious onset fever** and a **cough with bilateral infiltrates** on CXR. These patients typically do not present as acutely ill - the so called "walking pneumonia." The diagnosis and treatment is the same as typical pneumonia; macrolide covers for the typical organisms. Microbiology loves the association with **Mycoplasma Pneumonia** and IgM cold agglutinin disease.

HIV

Do a **bronchoalveolar lavage** with a **silver stain** ASAP. **PCP** has to be ruled out immediately. If it's PCP the patient will progress to ARDS fast. Treat with **Bactrim** and **STEROIDS**. Steroids will ↓ inflammation and ↑O<sub>2</sub> exchange across capillaries.

PORT Score and CURB-65

This is way out of scope for a medical student but I'll include it here because pneumonia is SO COMMON that you might hear about this on the wards or in the ER. A PORT score is a long and complicated list of conditions - each with their own score - that can grade the severity of the infection and the need for outpatient, inpatient, or ICU care. Since the PORT score is so rigorous an easier screen has been developed for the ER. The CURB-65 is a 5 point system - the more positive findings the more likely the patient is in need of admission. It's a very rough approximation but has become routine in training ERs.

Other Bugs to consider

<b>S. Pneumoniae</b>	Most Common	
Legionella	GI + CNS Sxs	Urine Ag
Klebsiella	<b>EtOH</b>	
Chlamydia	Placenta/Sheep	Serum Ab
Haemophilus	COPD/Smoker	

<b>Conditions</b>	<b>Typical</b>	<b>Atypical</b>
Outpatient CAP	None	Macrolide
Inpatient CAP	3 <sup>rd</sup> Gen Ceph	Macrolide
Any HAP	Vancomycin	Zosyn

*Fluoroquinolones MAY be used single agent outpatient*

CURB-65

**Confusion of new Onset**

**Urea > 7 (BUN > 19)**

**Respiratory Rate ≥ 30**

**Blood pressure <90/<60**

**65 years or older**

A 5-point system, the more

points, the more severe the

patient's condition, and the

more fatal the condition.

Determines Admit Potential

and ICU necessity.

Introduction

An infection usually causes a local inflammatory response with symptoms. Lung infections cause a cough while UTIs cause dysuria. But when an infection becomes systemic - that is, the **effects are felt systemically** - start thinking of sepsis. Sepsis itself does not require **septicemia** (bacteria in the blood) and therefore may be **culture negative**, but the systemic effects of **inflammatory mediators** can wreak havoc on the body.

SIRS Criteria

The **Systemic Inflammatory Response Syndrome** (SIRS) must meet **2 of 4 criteria** that signal physiologic responses to inflammation. Inflammatory mediators will cause ↑CO (**↑HR**) either directly on the heart or reflexively from vasodilation. **Tachypnea** follows. **Fever** is a product of IL-6 + TNF- $\alpha$ . Finally, the response to infection is ↑WBC (leukocytosis). But, because some infections may ↓ WBC or a person can have sepsis in the presence of HIV, both count. Evaluation beyond sepsis involves looking for **end organ damage**: (1) **Renal Failure** (↑Cr and BUN), (2) **liver** failure with coags and an LFT (3) **Blood Vessels** with a blood pressure, (4) **Brain** with mental status checks, and (5) **Heart** with an ECG or Tropionins. Still further, one needs to evaluate for tissue hypoxemia with a **lactic acid level**. Depending on the number and severity of organ dysfunction, the patient is stratified into a sepsis "type." (SIRS, Sepsis, Severe Sepsis, Septic Shock, MODS).

Therapy

Regardless of "type," the treatment is the same: **Early Goal Directed Therapy**. This takes place in the first six hours of hospitalization (**early**) designed to **↑Tissue Perfusion, ↓ Tissue Hypoxia, and control the source**. Controlling the source begins by eliminating sources of infection (**IV sites, Abscess Drainage, and Wound Debridement**) and starting **empiric antibiotics** for the suspected source. **Blood Cultures** should be drawn prior to antibiotics, but do NOT delay the treatment with broad-spectrum antibiotics. In order to meet tissue perfusion demands certain criteria should be monitored. To maintain **perfusion** (MAP >65, CVP 8-16) a **500-1000cc fluid challenge** is the first requirement. If responsive, nothing more needs be done. Failure of the fluid challenge will require the need for **pressors**. To maintain **oxygenation** (oxygen deliver > oxygen consumption, or  $SvO_2 > 70\%$ ) both **oxygen** and **blood** (if Hgb ≤ 7) should be given.

**SIRS Criteria**

<b>Temperature</b>	>38 or <36
<b>Tachycardia</b>	>100
<b>Respiratory</b>	RR >20 or $PCO_2 < 32$
<b>WBC</b>	>12 or <4

**SIRS "Types"**

<b>SIRS</b>	2 or more criteria met, Ø source
<b>Sepsis</b>	2 or more criteria met, ⊕ source
<b>Severe Sepsis</b>	2 or more criteria met, ⊕ source ≥ 1 organ failure
<b>Septic Shock</b>	2 or more criteria met, ⊕ Source, Hypotension refractory to fluid resuscitation or requiring pressors
<b>MODS</b>	Multiple Organ Dysfunction Syndrome, the patient is circling the drain with septic shock and multiple organs failing

**Early Goal Directed Therapy**

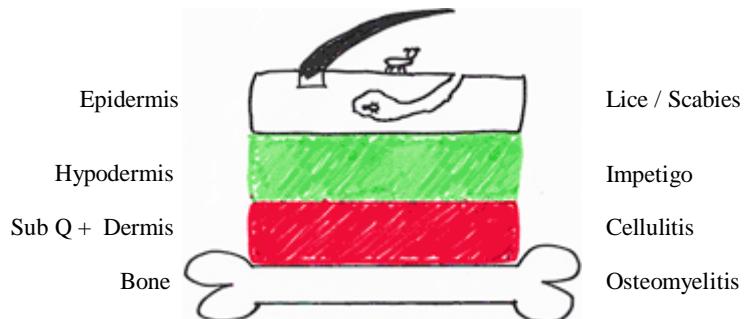
<b>CVP</b>	8-12mmHg
<b>MAP</b>	>65mmHg
<b>U<sub>output</sub></b>	>0.5cc/kg/hr
<b>Svo<sub>2</sub></b>	>70%
(1)	Give 500-1000cc IV Bolus
(2)	Remove all source of infection
(3)	O <sub>2</sub> as needed
(4)	Pressors if fluid bolus fails
(5)	Empiric abx while waiting for cultures

Introduction

While many things can infect the skin, most conversation will be about **cellulitis** and **osteomyelitis**. However, common skin infections may arise and you should be able to identify them. This image will serve as a visual queue to remember the “weird” bugs and fungus and conceptualize what they infect. Then we’ll go on to talk about higher yield items.

(1) Lice

As is shown in the diagram, the louse is a **large bug** that lives on top of the skin **near hair**. Diagnose Lice simply with **visual inspection**. Louse or their eggs, the nits, can be seen with the eye. The farther out the nit the longer the infection has been present. These bugs **itch** and are common in children and people with poor hygiene. Treat with topical **promethin**.

(2) Scabies

The “scaby baby” is shown **burrowing** through the skin and is small so you can’t see it. This infection will also **itch** because of a **contact dermatitis** to the eggs and feces. You’ll see **furrows** especially **between fingers and toes**. Because they are **highly contagious** multiple household members will be affected. A “pruritic rash” on “multiple family members” gives a major clue to scabies. People scratch so much they might actually get **excoriations** or **lichenifications**. Because they are deep in the skin, you will need to **scrape** the **furrows** for diagnosis. Treat with **promethin**.

(3) Impetigo

An infection with **β-Hemolytic Strep Pyogenes**. It infects the hypodermis causing a rise and swelling of the overlying skin. This causes a **honey colored crusted lesion**. It’s important to treat the infection with **amoxicillin** to prevent glomerulonephritis. Infection with **Staph Aureus** is also problem so it’s better to treat with a **2nd generation cephalosporin** while cultures are pending. It may be a consequence of other skin lesions - particularly itchy ones.

(4) Fungus in General

Fungus will present as either **itching burning feet**, a **patchy discoloration** of the skin, or **patchy alopecia**. If asked to diagnose a fungal infection, always do a **KOH prep** then a **culture**. For treatment, it comes down to **nail or hair involvement**. If there’s **no hair** and **no nail involvement** it’s ok to use topical ointments (**Terbinafine**). If there’s **nail or hair involvement** **systemic antibiotics** are needed.

Tinea Corporis is described as **annular erythematous lesion** with **scaly vesiculated border** and **central areas of clearing**. They’re usually multiple and may become confluent.

*Lice*

Patient	Itchy scalp, Eggs and Nits in hair
Dx	Visualize, lives near hair
Tx	Promethin, avoid contagion

*Scabies*

Patient	Itchy skin, between toes, fingers, furrows on skin
Dx	Scrape and see
Tx	Promethin

*Impetigo*

Patient	Honey Colored Crusted Lesions
Dx	Clinical, Culture (S. Aureus, S. Pyogenes)
Tx	Amoxicillin or 2nd Generation Cephalosporin

*Fungus*

Patient	Discoloration of hair, skin, or nails, itching
Dx	KOH prep → Culture
Tx	Ø Hair Involvement = Topical ⊕ Hair Involvement = Systemic

### Cellulitis

An infection of soft tissue that's usually associated with some breakdown of the skin barrier (**laceration/DM/Stasis Ulcers**). The typical signs of local inflammation (**erythema, edema, warm**) are present around a site of infection. The choice is between **erysipeloid cellulitis** (streaks of red representing **ascending lymphadenitis** caused by **strep**) and a **typical cellulitis** (generally expanding erythema caused by **staph**). The goal is to essentially **rule out Osteomyelitis** because cellulitis is a clinical diagnosis. Get an **X-ray** on everyone with cellulitis. **Never culture** (polymicrobial) or **bone scan** (false  $\oplus$ ). The treatment is generally against **Gram  $\oplus$  cocci** so either **penicillinase-resistant PCN** or **1<sup>st</sup> Gen Ceph**. If MRSA is suspected start **Vancomycin IV** + follow up with **Bactrim po**. Track the  $\downarrow$  in erythema to see if cellulitis is resolving.

### Osteomyelitis

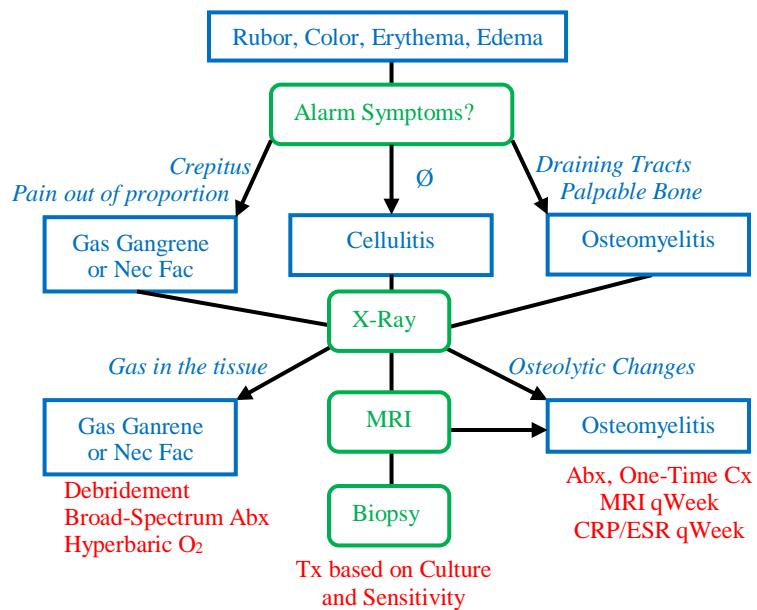
An infection of the bone caused either by **hematogenous spread** or by **direct inoculation**. If it seems to be cellulitis it might be osteomyelitis. Suspect osteomyelitis with a **sinus draining tract** over a bony structure or any wound where **bone can be probed**. Do an **X-ray** on basically any skin infection. While Osteolytic changes may take 4-6 weeks to develop, a  $\oplus$  X-ray is  $\oplus$  osteomyelitis. A **bone scan** can detect early changes but has a large **false  $\oplus$**  with any overlying soft tissue infection. The absolute best test is a **bone biopsy** for culture and sensitivity but should only be done once at diagnosis. An **MRI** is the best radiographic test and can be repeated to track resolution. Along with MRI, track **ESR** and **CRP** over time. Treat empirically with **Vanc** and **Zosyn** until cultures return. Tx for at least **4-6 weeks**.

### Gas Gangrene

One of the reasons why every cellulitis gets an X-ray is for this. It's caused by **Clostridium Perfringens**, an aerobic infection that is gas producing and is rapidly destructive. **Crepitus** is highly specific but poorly sensitive; an infection may appear as cellulitis only. The **X-ray** will show **gas dissecting tissue**. The definitive diagnosis is usually made during **emergency debridement** for which **PCN + Clinda** should be started immediately. **Hyperbaric O<sub>2</sub>** is toxic to C. Perfringens and is an ancillary treatment.

### Necrotizing Fasciitis

The worst case scenario is a **rapidly spreading cellulitis** with **pain out of proportion** to the physical exam. This represents infection and necrosis of deep fat and SubQ fascia. It usually occurs on the extremities and abdominal pannus. Look for **bluish-gray cutaneous gangrene**. Do rapid, broad **surgical debridement** and **broad spectrum antibiotics**. Here, **hyperbaric O<sub>2</sub>** has shown to  $\downarrow$ mortality but should  $\emptyset$  delay definitive therapy. It's definitively diagnosed by **pathology of surgical specimen** but CT/MRI/X-ray can be gotten. **Highest Risk in Diabetics**.



### Osteomyelitis

Risk Factors	Bug
Most Common	S. Aureus
Penetrating Sneakers	Pseudomonas
Sickle Cell	Salmonella (Osteo)
Erysipeloid	S. Pyogenes
DM/PVD	Polymicrobial

### Bugs involved in Nec Fac

E. Coli, Pseudomonas, Strep Pneumo
Vibrio, Staph
Bacteroides, Clostridium, Enterococcus

Microbiology and Epidemiology

TB is an **acid-fast bacillus** that stains poorly on Gram stain. TB is spread through the **aerosolized** respiratory droplets and infects the lungs. **Primary TB** presents like a pneumonia and localizes in the **middle or bottom lobe**. Unable to kill the bacteria, the body forms **cavitory lesions** (aka **caseating granulomas**) to wall off bacteria. **Reactivation TB** occurs in the apices - where oxygen tension is highest. Cavitation results in lung fragmentation and **hemoptysis**. Major risk for the spread of TB is a place where there are too many people in too small a space (**military barracks, prison, and cities**). Being **immunocompromised** ↑ risk of contracting and reactivating chronic disease.

Patient Presentation

There are two types of patients: those who are **asymptomatic** but exposed and those with cavitory pneumonia presenting with **night sweats / fever / weight loss / Hemoptysis /** and cough. These patients are going to follow a diagnostic algorithm separate from each other.

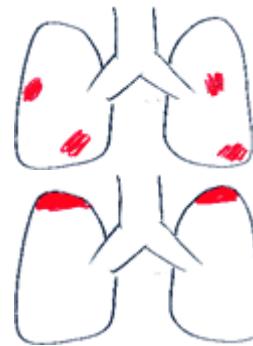
Diagnosis

For the **asymptomatic patient with risk factors** screening is recommended as needed. Screening is performed with the **PPD** test. Placed under the skin, TB antigens will summon an immune reaction to fight antigens in patients who **have been exposed**. After **48-72 hrs** the level of **induration** (NOT erythema) is assessed and compared to a standard. Those who are **negative** have **Ø been exposed** and screening can stop. Those who are positive require a **CXR** to assess for active infection vs exposure. If the **CXR** **⊖** it's ok to stop but **PPx with INH x 9 months**. If **CXR** **⊕** you must rule out active infection with **AFB smears**. This is a good time to isolate the individual. If the **AFB Smear** **⊕** there's an active infection; treat with **RIPE**. If the **AFB Smear** **⊖** then the patient has latent TB; treat with **INH x 9 months**.

For the **acutely ill patient** there's no need (or time) to wait the **48-72 hrs** of the PPD. First do a **CXR** looking for **apical lesions**. However, there's a **⊖ CXR** it's insufficient to rule out active disease; an **AFB Smear** and **Culture** must also be done. If the disease is suspected you want a positive confirmation. Send out **early morning** sputum and at least a **total of 3** cultures 8 hours apart. It's essential to be sure it's negative so also send out **3 early morning sputums 24hrs apart**. For AFB smear culture **⊕ (active disease)** treat with **RIPE**. If AFB smear **⊖** look for another diagnosis such as malignancy; it isn't TB that's causing the symptoms.

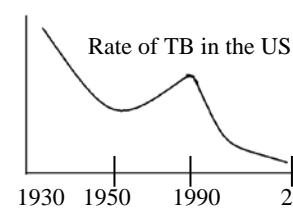
Treatment

Anyone with a **PPD** **⊕** or **⊕ CXR** is going to get at least **9 months Isoniazid PPx**. For **active disease** we get a trial of **Rifampin, Isoniazid, Pyridoxine, Ethambutol (RIPE)**. It's a good idea to know the side effects of these drugs. **ALL 4** cause **hepatotoxicity**.

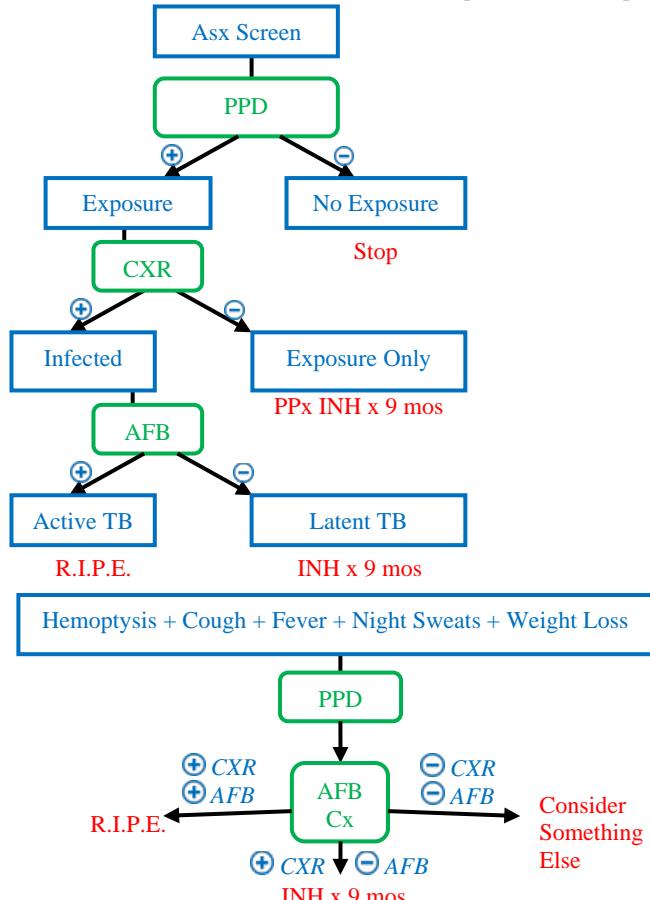


Primary Lesions are usually in middle and lower lobes

Reactivation Lesions are in the apices



<b>⊕ PPD screen if:</b>
>5mm "the Really Sick" HIV, Close Contacts of TB, Organ Transplant, Steroids
>10mm "Normal People" Incarcerated, Military, Health Care, Homeless, Crowded City
>15mm "Shouldn't Be Screened" People from Wyoming who's exposure is soccer practice

**RIPE Side Effects**

Rifampin INH Pyridoxine Ethambutol	Red Urine Neuropathy (Give B6 Ppx) Hyperuricemia Eye Disturbance
---	---

Presentation and Background

UTIs are infections involving anything from the kidneys to the urethra. It's most common in **women aged 18-24** because of their relatively **shorter urethra** (women) and **frequency of sex** (age group). **Sex, OCP, and Anal** intercourse all ↑ risk of infections. The UTI is most often caused by fecal flora coming into contact with the urethra. This means that **E.Coli** is likely to be the causative organism. Klebsiella, Proteus, and Strep/Staph are common as well.

Asymptomatic Bacteriuria

This is a bacterial infection found in the urine on screening. Only a few people (**pregnancy / cystoscopy / biopsy**) require screening. If found to be **⊕** and there's a reason to treat, treat it. In most cases, an asymptomatic bacteriuria does not need treatment. Asymptomatic bacteriuria is treated in **pregnancy** to prevent **progression to pyelonephritis** with **nitrofurantoin**.

Cystitis

Presenting with **frequency / urgency / dysuria**, cystitis ("bladder infection") is the most common of the UTIs. Systemic symptoms like N/V, Fever, and Chills are **absent**. Diagnose cystitis with a **Urinalysis** and **Urine Culture + Gram Stain**, then treat as an **uncomplicated UTI**: either **FQ or Bactrim x 3 days**. If cystitis occurs in a male or a pregnant female, treat as if it's **complicated cystitis**: the same drugs for **10-14 days**.

Urethritis

Urethritis is Cystitis + **Urethral Discharge** - especially in a **sexually active** person. Either culture the discharge or get **Gonorrhea / Chlamydia DNA** to confirm the diagnosis. How do you tell the difference between urethritis and cystitis? The urethral discharge is usually more disconcerting to the patient. The cause? Usually **STDs**. Treat **Neisseria** with **Ceftriaxone IM x1** and treat **Chlamydia** with **Doxycycline 100 x 7days**.

Pyelonephritis

Pyelonephritis is a **systemic disease** that most likely presents with **sepsis**. These will be sick-looking people with **Frequency, Urgency, Dysuria** of cystitis plus **⊕N/V + Fever and Chills + CVA Tenderness**. All pyelo requires admission and IV antibiotics - treating it like sepsis. A **Urinalysis** and **Urine culture** gives organism sensitivities. A **blood culture** is used to assess for septicemia. Treat patients with **3<sup>rd</sup> Gen Ceph IV, Amp+Gen, or FQ** until afebrile x24-48 hrs (inpatient) followed by a total of **14d FQ outpatient**. If there's **Ø** inpatient improvement get a **CT scan** to rule out **abscess**.

Abscess

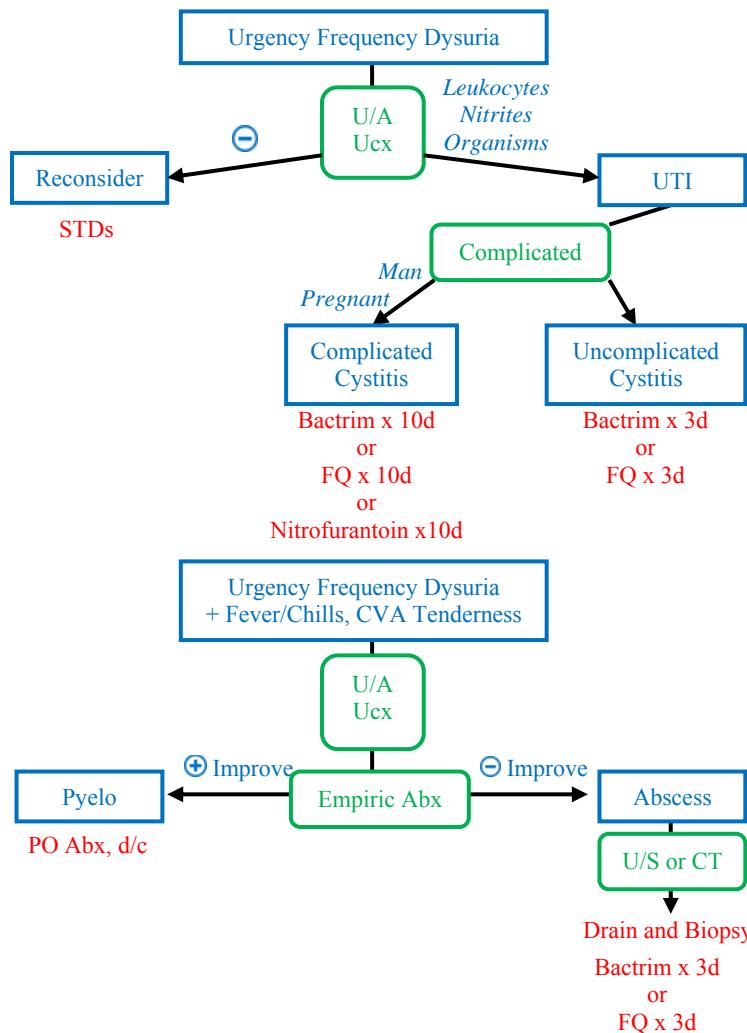
The person who comes in with pyelonephritis who does **not improve** probably has an abscess. Either an **Ultrasound** or a **CT scan** will reveal it. **Drain it** and continue IV antibiotics. CT scan is best but avoided in patients with **renal failure** or **pregnancy**. In those scenarios an ultrasound is an acceptable alternative.

Bactrim = Trimethoprim-Sulfamethoxazole

<b>Disease</b>	<b>Symptoms</b>	<b>Test</b>	<b>Treatment</b>
Asx	Ø	U/A Ucx	Pregnant: Nitrofurantoin
Bacteriuria			
Cystitis	Frequency Urgency Dysuria	U/A Ucx	3d Bactrim / FQ Pregnant: Nitrofurantoin
Urethritis	Frequency Urgency Dysuria + Discharge	U/A Ucx + DNA	Ceftriaxone 125mg IM Doxy 100 x 7 days
Pyelo	Frequency Urgency Dysuria + Fever	U/A Ucx Bcx	IV ceph or FQ (inpt) to PO Ceph or FQ (outpt)
Abscess	Pyelo that does not improve	CT or U/S	Drainage + Abx

Pregnant Side Note

Confirmation of eradication is required only in pregnancy, and is justified by being "another screen," ≥ 2 infections means PPx Abx in pregnancies thereafter.



Gas interpretation of acid-base disturbances is difficult. There will be one on your shelf. You're guaranteed at least one on the Step 2 as well. Unfortunately, being able to appropriately interpret a blood gas doesn't always prove incredibly useful in actual practice. But being able to master acid base disturbances can lead to an impressive evaluation (and can impress all your friends since they won't be able to do it). But in reality, if this stuff just takes too long and you still don't get it, take the hit on the test and move on. Better to randomly guess and get it wrong than spend 15 minutes on a question you may not get right (thereby wasting precious minutes that could have been used on other questions). With that in mind, let's get started.

### Follow the Steps

#### Step 1: Acidemia or Alkalemia. Use 7.4

- Is the pH < 7.4 (acidemia)
- Is the pH > 7.4 (alkalemia)

#### Step 2: Respiratory or Metabolic

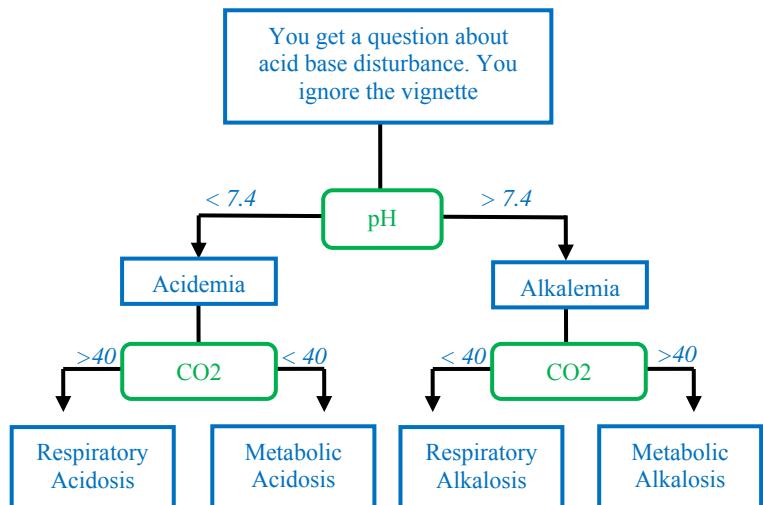
See CO<sub>2</sub> as respiratory and acid. CO<sub>2</sub> is the respiratory acid. If you get rid of CO<sub>2</sub> you get rid of respiratory acid; this should create an alkalotic environment. If you retain CO<sub>2</sub> you hold onto more respiratory acid; it should create an acidotic environment.

After deciding if there's an Acidemia or Alkalemia ask, "What do I expect the CO<sub>2</sub> to be - high or low?"

If there's a pH < 7.4, expect the CO<sub>2</sub> to be higher than normal - that is >40. If it is, the acidemia is caused by a respiratory acidosis. If it isn't, the acidemia is caused by a metabolic acidosis.

If there's a pH > 7.4, expect the CO<sub>2</sub> to be lower than normal (loss of respiratory acid). If it is, the alkalemia is caused by a respiratory acidosis. If it isn't, the alkalemia is caused by a metabolic alkalosis.

This step is SUPER important because it decides what Step 3 is going to be. Once the primary disturbance is determined you then go through that disturbance start to finish.



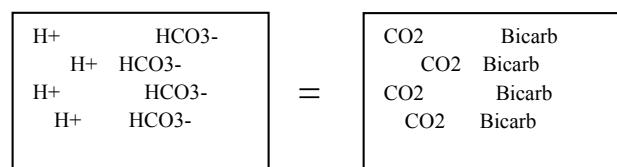
#### *Determining the Primary Disturbance*

Step 1: Acidemia or Alkalemia

Step 2: Respiratory or Metabolic

....

Step 3: is there something else wrong?



$H^+$  = "Respiratory Acid" = pCO<sub>2</sub>

$HCO_3^-$  = "Metabolic Base" = Bicarb

More  $H^+$  = More pCO<sub>2</sub> = Low pH

Less  $H^+$  = Less pCO<sub>2</sub> = High pH

More  $HCO_3^-$  = More Bicarb = High pH

Less  $HCO_3^-$  = Less Bicarb = Low pH

**Step 3a: Check the anion gap.**

Always check the anion gap. It's normally 12. It's actually about  $3 \times$  Albumin, normal albumin being 4, so this may change in real life. When handling acid-base problems, view them w/ the assumption of a normal anion gap = 12. The reason to always check the anion gap is because if present (regardless of other findings), there must also be an anion gap metabolic acidosis. That's true even if it isn't the primary disturbance.

**Respiratory Acidosis****Step 3b: Acute or Chronic**

If the respiratory acidosis is acute then for every dime change (every 10 points) of CO<sub>2</sub> the pH should change by 0.08. If the respiratory acidosis is chronic, then for every dime change of CO<sub>2</sub> the pH should change by 0.04. Step 3b is to find out which it is: acute or chronic.

To do that, find out how many dimes from normal the CO<sub>2</sub> is. Multiply that by 0.08 and subtract from the normal pH of 7.4. Do it again multiplying by 0.04 and subtracting that from the normal pH of 7.4. Compare both scores to whatever the pH actually is. Whichever is closer determines the chronicity.

**Step 3c: Is there a Metabolic Derangement**

For respiratory acidosis the bicarbonate should change as well. For every dime change in CO<sub>2</sub> the bicarb should change by 1 point if acute or 3 points if chronic. Bicarb should change to compensate for the CO<sub>2</sub>; in a respiratory acidosis the bicarb should go up.

Multiply the number of dime change of CO<sub>2</sub> by 1 (if acute) and by 3 (if chronic). Add that to a normal bicarb of 24. Compare to the bicarb you have. If there are more bicarbs than expected, there's also a metabolic alkalosis. If there are too few bicarbs, however, it's an additional metabolic acidosis.

Note that in the example the CO<sub>2</sub>s don't change. When exploring Step3c the only care is the bicarb number (too few, enough, too many). The CO<sub>2</sub> doesn't matter except to the extent that we use it to determine how much the bicarb should have changed.

$$\text{Anion Gap} = \text{Na} - \text{Cl} - \text{Bicarb}$$

$$\text{Normal Anion Gap} = 12 \dots \text{or } \text{Albumin} \times 3$$

If the calculated anion gap (Na-Cl-Bicarb) is greater than the normal anion gap there is an anion gap metabolic acidosis

***REGARDLESS*** of whatever else is going on

For Every "Dime" Change in CO <sub>2</sub>			
<i>Δ pH</i>	<i>Δ Bicarb</i>		
If Acute	0.08	If Acute	1
If Chronic	0.04	If Chronic	3

Formula for memorizers:

$$7.4 - (\text{Dimes} * 0.08) = \text{pH if acute}$$

$$7.4 - (\text{Dimes} * 0.04) = \text{pH if chronic}$$

Pick the one closest to the actual pH

Formula for memorizers:

$$24 - (\text{dimes} * 1) = \text{Expected bicarb if acute}$$

$$24 - (\text{dimes} * 3) = \text{Expected bicarb if chronic}$$

If actual bicarb > expected bicarb: too many bicarbs = Metabolic Alkalosis

CO <sub>2</sub>	Bicarb
Bicarb	Bicarb

If actual bicarb < expected bicarb: not enough bicarbs = Metabolic Acidosis

CO <sub>2</sub>	Bicarb
CO <sub>2</sub>	Bicarb
CO <sub>2</sub>	
CO <sub>2</sub>	

### Respiratory Alkalosis

It's literally the same for respiratory acidosis, except that the bicarb changes by 2 (if acute) or 4 (if chronic) for every dime change. Let's spell it out here.

#### Step 3a: Acute or Chronic

If the respiratory alkalosis is acute then for every dime change (every 10 points) of CO<sub>2</sub> the pH should change by 0.08. If the respiratory acidosis is chronic, then for every dime change of CO<sub>2</sub> the pH should change by 0.04. Step 3b is to find out which it is: acute or chronic.

To do that, find out how many dimes from normal the CO<sub>2</sub> is. Multiply that by 0.08 and subtract from the normal pH of 7.4. Do it again multiplying by 0.04 and subtracting that from the normal pH of 7.4. Compare both scores to whatever the pH actually is. Whichever is closer determines the chronicity.

#### Step 3c: Is there a Metabolic Derangement

For respiratory alkalosis the bicarbonate should change as well. For every dime change in CO<sub>2</sub> the bicarb should change by 2 point if acute or 4 points if chronic. Bicarb should change to compensate for the CO<sub>2</sub>; in a respiratory acidosis the bicarb should go up.

Multiply the number of dime change of CO<sub>2</sub> by 2 (if acute) and by 4 (if chronic). Add that to a normal bicarb of 24. Compare to the bicarb you have. If there are more bicarbs than expected, there's also a metabolic alkalosis. If there are too few bicarbs, however, it's an additional metabolic acidosis.

### Metabolic Alkalosis

The only way this will happen is if the aldosterone is up. Don't care about the gas interpretation, but instead whether it's "salt sensitive," which always means, "volume responsive," which also asks, "are they volume deplete?" To figure that out simply give the patient volume.

The way Metabolic Alkalosis will appear on an acid-base interpretation question is as a secondary disturbance to a respiratory problem or on its own. That's it.

For Every "Dime" Change in CO <sub>2</sub>			
$\Delta$ pH	$\Delta$ Bicarb		
If Acute	0.08	If Acute	2
If Chronic	0.04	If Chronic	4

Formula for memorizers:

$$7.4 - (\text{Dimes} * 0.08) = \text{pH if acute}$$

$$7.4 - (\text{Dimes} * 0.04) = \text{pH if chronic}$$

Pick the one closest to the actual pH

Formula for memorizers:

$$24 - (\text{dimes} * 2) = \text{Expected bicarb if acute}$$

$$24 - (\text{dimes} * 4) = \text{Expected bicarb if chronic}$$

If actual bicarb > expected bicarb:

too many bicarbs = Metabolic Alkalosis

CO <sub>2</sub>	Bicarb
Bicarb	Bicarb

If actual bicarb < expected bicarb:

not enough bicarbs = Metabolic Acidosis

CO <sub>2</sub>	Bicarb
CO <sub>2</sub>	Bicarb
CO <sub>2</sub>	
CO <sub>2</sub>	

**Metabolic Acidosis**

Step 3a: Check the anion gap. See above.

Step 3b: is the CO<sub>2</sub> appropriate for this bicarb?

Assess if the pCO<sub>2</sub> on the ABG is appropriate for the bicarbonate. To do this, multiply the bicarb by 1.5 then add eight to that total. There is some fudge factor here. An acceptable range of pCO<sub>2</sub> is that number plus/minus 2.

If the pCO<sub>2</sub> is in that range then there's no respiratory disturbance.

If the pCO<sub>2</sub> is higher than that range, then there are too many respiratory acids, which means an additional respiratory acidosis.

If the pCO<sub>2</sub> is lower than that range, there are too few respiratory acids, which means an additional respiratory alkalosis.

Step 3c: is there another metabolic derangement (anion gap only)

You'll read about the delta-delta. Stop reading about the delta-delta. It's simple to calculate but requires memorization to interpret. So we use the add-back method instead.

A normal anion gap is 12. Take whatever the anion gap is right now and find out how many extra acids were needed to get there. Current Anion Gap - Normal Anion Gap. That number is the number of acids added to solution / the number of bicarbs that came out of solution. To find out how many bicarbs we started with before the anion gap business, add that number to the current bicarb.

That value is how many bicarbs we started off with. Normal is 24.

If there are too many bicarbs (>24) there are too many metabolic bases – there's an additional metabolic alkalosis.

If there are too few bicarbs (<24) there are too few metabolic bases – there's an additional metabolic acidosis. Because we started with an anion-gap acidosis, this must mean we have an additional non-gap metabolic acidosis.

**The Expected CO<sub>2</sub> for Bicarb is Winter's Formula**

$$\text{Expected CO}_2 = \text{Winters} = (\text{Bicarb} * 1.5) + 8 \pm 2$$

Bicarb you have      constant      fudge  
factor

If actual CO<sub>2</sub> > expected CO<sub>2</sub>:  
too many CO<sub>2</sub>s = Respiratory Acidosis

CO <sub>2</sub>	Bicarb

If actual CO<sub>2</sub> < expected CO<sub>2</sub>:  
not enough CO<sub>2</sub>s = Respiratory Alkalosis

CO <sub>2</sub>	Bicarb
CO <sub>2</sub>	Bicarb
	Bicarb
	Bicarb

**Add Back Method**

$$\text{Actual Anion Gap} - \text{Normal Anion Gap} = \Delta$$

Given to you      12 (Alb x 3)      = Calculated

Then...

Delta + given bicarb = expected bicarb

If actual bicarb > expected bicarb:  
too many bicarbs = Metabolic Alkalosis

CO <sub>2</sub>	Bicarb
Bicarb	bicarb

If actual bicarb < expected bicarb:  
not enough bicarbs = Metabolic Acidosis

CO <sub>2</sub>	Bicarb
CO <sub>2</sub>	Bicarb
CO <sub>2</sub>	
CO <sub>2</sub>	

You'll be asked to do two things: interpret a blood gas (which comes later) and decide what to do next. We first handle "what to do next," the potential diagnoses that might be encountered and how to spot them on a vignette.

The first step is to determine what the primary disturbance is. It's discussed in greater detail in gas interpretation, but basically  $<7.4$  is acidic while  $>7.4$  is basic. Then use the CO<sub>2</sub> (with a cutoff of 40) to separate into respiratory or metabolic.

### Respiratory Acidosis

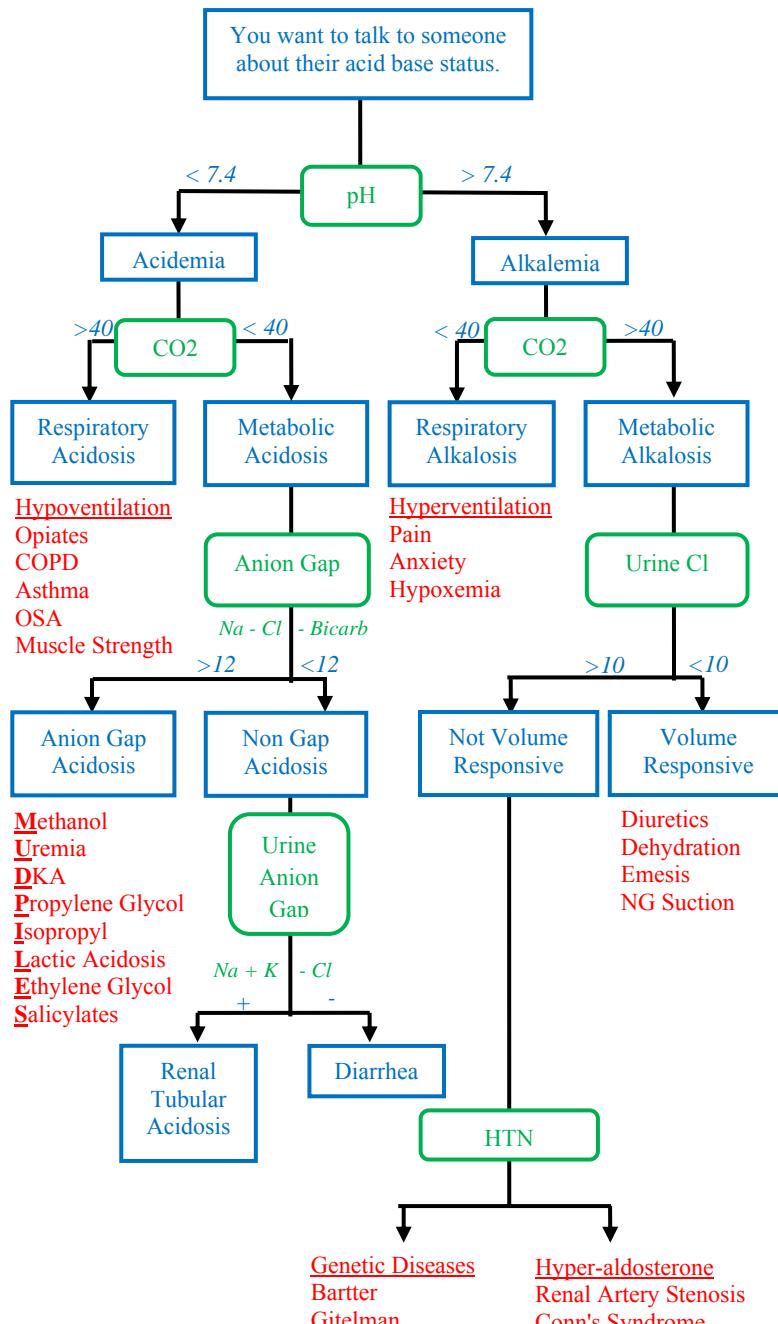
This is a product of hypoventilation. The less ventilation the more CO<sub>2</sub> will accumulate. Whether it's a low tidal volume (COPD) or a low respiratory rate (opiate overdose), if either falls the CO<sub>2</sub> rises. Look for things like wheezing (Obstructive Lung Disease), obesity (OSA), cyanosis and pinpoint pupils ( opiates), or signs of muscle weakness (like paralysis from Guillain–Barré)

### Respiratory Alkalosis

Conversely, respiratory alkalosis is from hyperventilation. Very few things will do that as a primary disturbance. It'll either be pain, anxiety or hypoxemia. Lots of things cause hypoxemia (pneumonia, PE, ARDS) so the patient can get complex, but in terms of acid-base respiratory alkalosis means hyperventilation.

### Metabolic Alkalosis

The only thing that causes this is a high aldosterone. The decision is if the person is volume responsive - that is, will giving him/her volume improve their alkalosis? This is done in one of two ways: using the history to say he/she is volume down and give fluids, then recheck the bicarb OR by checking the **urine chloride**. The test loves the urine chloride. If it's low ( $<10$ ) the patient is salt-sensitive, or volume responsive, and giving him/her volume will improve his/her condition. Look for the use of diuretics, emesis or NG suction, or another reason for them to be dehydrated (looking for insensible water losses like sepsis, fever, tachypnea, or tachycardia).



Test	When To Use It
pH	Start here
pCO <sub>2</sub>	After pH to get primary disturbance
Anion Gap	Metabolic Acidosis
Urine Anion Gap	Non-Gap Acidosis
Urine Chloride	Metabolic Alkalosis

If the Urine Chloride is high (**>10**) it's a condition that has nothing to do with volume. It's then time to assess for the presence of **hypertension**.

If there is + **HTN**, consider diseases of too much aldosterone; inappropriate elevations in aldosterone levels. It's most likely to be renal artery stenosis or Conn's syndrome (primary hyperaldosteronism). Keep in mind that the aldosterone was up in volume depletion to keep the pressure up. In this case it's up inappropriately, so it causes a rise in blood pressure.

If the patient is - **HTN**, think of Bartter and Gitelman syndromes - genetic, always present forms of HCTZ and Furosemide, respectively.

#### Metabolic Acidosis

Metabolic Acidosis is the hardest to handle; it's the most complex by far in gas interpretation. But it's pretty easy to get the answer right when trying to make a diagnosis based on the clinical scenario.

First, calculate the **anion gap** (Na - Cl - Bicarb). A normal gap is 12, or Albumin x 3. If greater, there's an anion gap acidosis, which can be reminded by a number of mnemonics. We've chosen MUDPILES in this section (just don't forget about Toluene). In an **anion gap metabolic acidosis** the diagnosis is made by the rest of clinical picture. Highlights of the ones you must know are to the right.

For **non-gap acidosis** the next step is the **urine anion gap**. The urine anion gap is calculated from similar but not the same electrolytes as the regular anion gap (frustrating), so be careful. If **positive** the answer is renal tubular acidosis. If **negative** the answer is diarrhea.

UCl < 10 = Volume Responsive

UCl > 10 = Not Volume Responsive

UCl > 10 and HTN = Inappropriate Aldosterone

UCl > 10 and no HTN = genetic diseases

**ANION GAP:** Na - Cl - Bicarb  
(NO POTASSIUM)

#### *Highlights to MUDPILES Diagnoses*

DKA	Diabetic who is acidotic. Look for ketones. Treat with insulin, fluids, and replete potassium
Methanol	Homemade liquor (moonshine), causes blindness, no cure
Ethylene Glycol	Crystals in the urine, urine turns color under Wood's Lamp. Give either ethanol or fomepizole
Lactic Acidosis	Either Metformin + Acute Kidney Injury or... Patient in shock (fix the shock)

**URINE ANION GAP:** Na + K - Cl  
(No Bicarb)

Introduction and Physiology

Calcium is regulated by **Calcitonin** ("calci-tone-down") and by **parathyroid hormone**. The main level of function is at the parathyroid gland via PTH. Calcium's detected by **calcium sensing receptors** on secretory cells of the parathyroid. **Increased Calcium inhibits PTH release.** Thus, decreased levels permit release. PTH has three effects: it (1) activates **osteoclasts** to clear bone, ↑ Ca and ↑ P, (2) directly **reabsorbs Ca** and **excretes P** in the kidney, and (3) indirectly **absorbs Ca** and **P** from the gut via **Vitamin D**. Calcium in the blood travels mostly as **bound calcium** (inactive) with a small proportion as **ionized calcium**. We measure **total calcium** routinely so it must be adjusted for **albumin levels** and **alkalotic states**. For every one point of albumin below four correct the calcium by 0.8.

**For every disease you'll use the PTH, Ca, and P levels to make a diagnosis.**

**1) Hypercalcemia**

A high calcium may be nothing. If increased on ambulatory screening and asymptomatic, redraw it. Further investigation's required if it's still increased on the redraw or there are symptoms. **Symptoms** of hypercalcemia are **bones** (fracture, osteopenia), **stones** (calcium Nephrolithiasis), **abdominal groans** (nausea vomiting, abdominal pain), and **psychic moans** (altered mental, severe hypercalcemia only, Calcium of 13-15). Diagnosis is less important if there are symptoms, so treat first. **Intravenous Fluid** is always the first line therapy. **Furosemide** is added to increase naturesis and calcium excretion, but only **AFTER** volume status is corrected (dehydration from early administration of furosemide is actually HARMFUL). If more aggressive therapy is required (because symptoms are severe) start **Calcitonin** (acts fast, fades fast) and **Bisphosphonates** (long term therapy).

**i. 1° Hyperparathyroidism**

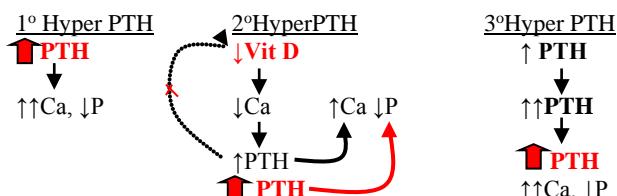
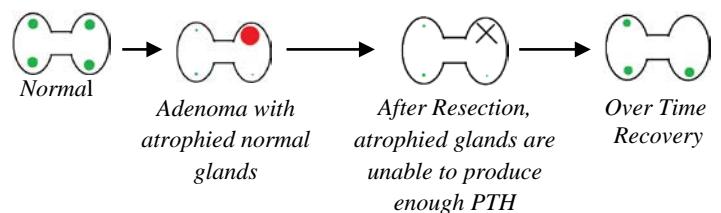
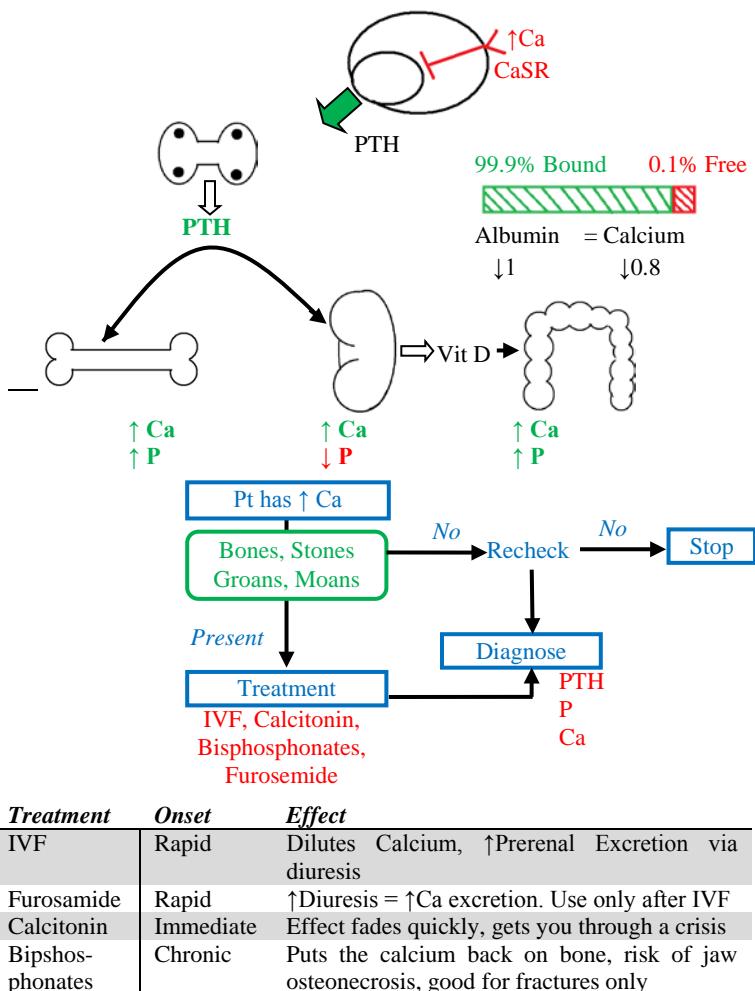
A **single autonomous gland** secretes PTH without effective feedback. Calcium is absorbed (↑ Ca) while Phos is lost (↓P). An additional bone finding is found here - **fibrosa cystica** (aka "brown tumor") - from overstimulated osteoclasts creating large bone lesions. The treatment is **resection**. Use a **radionuclide scan** to identify which gland is autonomous / hypertrophied. Monitor for signs of **hypocalcemia** after surgery (**hungry bone syndrome**).

**ii. 2° Hyperparathyroid**

While we're here let's talk about some other PTH diseases. In **early renal failure** Vit D isn't made. This produces a **hypocalcemia** that then causes ↑PTH and **parathyroid gland hypertrophy**. PTH increases in order to maintain a normal calcium.

**iii. 3° Hyperparathyroid**

If renal failure continues, eventually **parathyroid glands** become **autonomous** just like in primary hyperparathyroidism. This is an autonomous gland in the **presence of existing renal disease**. Although **resection** is required, there's no risk of cancer.



iv. Familial Hypocalciuric Hypercalcemia

Caused by an **abnormal calcium sensing receptor**, there is a new “set point.” There is an ↑Ca and ↑PTH but the body is just maintaining its “normal.” They are **asymptomatic** and require **no treatment**. Caution with stenotic aortic disease as they age.

v. Malignancy

Cancer can cause hypercalcemia. It can do it in either of two ways. Either **metastasis** go to the bone and actively destroy bone (releasing Ca and P) or a cancer can produce **PTH-rp** (parathyroid like hormone) turning the cancer into a <sup>10</sup> hyperparathyroidism but with a “low” blood PTH (our tests only captures the real PTH, special tests are required to measure levels of PTH-rp). Treat the cancer and the condition goes away.

vi. Immobilization

For some reason (we think it's ↓ **impact stress**) patients who are **bed-ridden** have an **asymptomatic increase** in **calcium** secondary to bone turn over. Get them out of bed and walking - the condition will improve.

vii. Vitamin D excess

**Granulomatous** disease (Sarcoid, TB) can turn on **Vitamin D** independently of kidneys, which increases calcium, turning off PTH, and so P cannot be renally excreted. Use **steroids** to treat the underlying disease.

**2) Hypocalcemia**

**Albumin** plays a bigger role in Hypocalcemia. Poor nutrition, cirrhosis, or nephrosis will cause a ↓ **Albumin**. Adjustment for albumin usually reveals a **normal calcium**. Potentially, checking for **signs and symptoms** is important as it could lead to catching a life threatening emergency before it gets there. Look for perioral tingling (usually comes first) then signs of **tetany** (both **Chvostek's** and **Trousseau's sign**). Treatment is to replace the calcium. Use **PO Calcium** and **Vitamin D** for **nonemergent, IV if emergent**.

i. Hypoparathyroidism

Typically **iatrogenic**, either from an “oops” Thyroidectomy or from a parathyroidectomy of an adenoma (**hungry bone syndrome**) secondary to decreased PTH production of atrophied glands.

ii. Vitamin D Deficiency

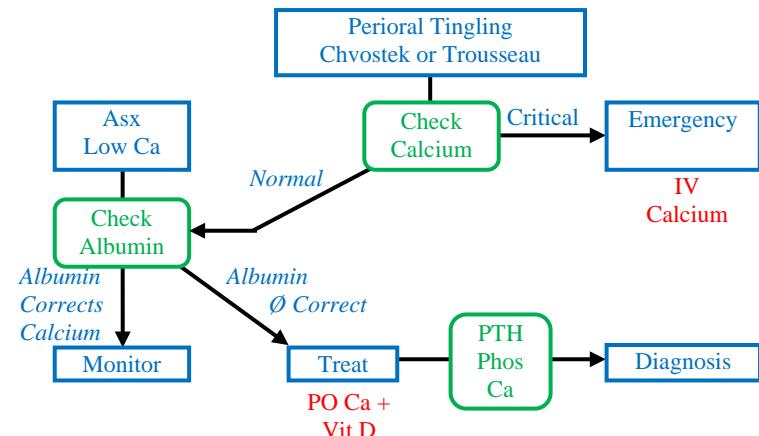
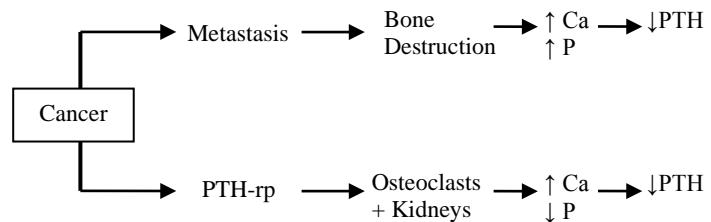
Whether it's from **renal failure** or **sunlight / diet deprivation**, having too little Vitamin D leads to secondary hyperparathyroidism. Initially, there's decreased calcium.

iii. Calcium Sequestration

A condition that is acute and often in the setting of **pancreatitis**.

iv. Pseudohypoparathyroidism

An awfully named disease that means **PTH-end organ resistance**. There is a high PTH but everything works normally. Ignore it.



	Ca	PTH	Disease	PO <sub>4</sub>	Path
	↑↑		Hyperparathyroidism	↓	↑ PTH = ↑ Ca
	↑	FHH		↓	↑ PTH = ↑ Ca
		Malignancy Mets	↑	↑Ca = ↓ PTH	
	↓	Malignancy PTH-rp	↓	↑Ca = ↓ PTH	
		Immobilization	↑	↑Ca = ↓ PTH	
	↑↑	Vit D Excess	↑	↑Ca = ↓ PTH	
	↑↑	Pseudohypoparathyroidism	↑	"Ø PTH"	
	↓	Vit D Deficiency	↓	↓ Ca = ↑ PTH	
	↑	Chronic Renal Failure	↑	↓ Ca = ↑ PTH	
	↓	Pancreatitis	↓	↓ Ca = ↑ PTH	
	Hypoparathyroidism	↓	↓ PTH = ↓ Ca		

**Polycystic Kidney Disease**

A common disease in the population, it's responsible for **5-10%** of **ESRD** (end stage renal disease) and **Dialysis**. It's an **autosomal dominant** genetic disease that insidiously converts the renal parenchyma to cysts. These cysts have **no orientation** and can be any **size**. Eventually, functional nephrons are obliterated and replaced. Along the way the cysts can **bleed** (producing **pain** and **hematuria**, commonly mistaken for stones), get **infected** (pyelo), or actually form **stones**. These cysts also retain the ability to activate the **RAS** and can produce **malignant hypertension**. A symptomatic patient can be diagnosed with an **Ultrasound**. There's no treatment, but **manage complications** then do **dialysis / transplant** when they finally fail. What's critical in this disease is to identify the **Extrarenal manifestations**. Cysts can form in the **liver** (cirrhosis), **pancreas** (pancreatitis) and in the **cerebral vasculature**; they predispose the patient to **subarachnoid hemorrhage**.

**Simple Cysts**

Sometimes an ultrasound or CT will reveal a cyst. If it's simple - **no echoes** and just **one continuous mass** (like a smooth balloon) – there's no need to worry about it. If symptoms develop (see below) **biopsy** and then **excise**.

**Complex Cysts**

If that ultrasound or CT reveals a **large or septated** cyst it must be biopsied to **rule out malignancy**. Do a needle-guided biopsy and treat if it's a cancer or for symptomatology.

**Renal Cell Carcinoma**

A Renal Cell Carcinoma can be detected from the ultrasound or CT, which is why the biopsy's done for complex cysts. However, if the classic triad of **flank pain**, **hematuria**, and a **flank mass** is seen it's almost guaranteed to be cancer (though it may not always be present). Patients are at increased risk with **smoking**, **ESRD**, and with **Von Hippel-Lindau**. If a hematuria comes up on a U/A, go ahead and get an **ultrasound** or **CT** the flank to visualize the kidneys. **Biopsy** the lesions and **resect**. Since the renal cell carcinoma spreads **hematogenously** disseminated spread may have already occurred. **Renal vein thrombosis** is a real problem with this cancer. Finally, there can also be either **anemia** or **Polycythemia**. Either the cancer is stealing the blood (anemia) or it's actually producing an **epo paraneoplastic syndrome**.

Dz	Gene	Associations
<b>Polycystic Kidney Disease</b>	ASD	SAH, Liver, Pancreas Hematuria, Flank Pain, Infxn, Stones, HTN Ultrasound or CT to see cysts
<b>Polycystic Kidney Disease</b>	ASR	Radially aligned cysts at birth Barely compatible with life (peds only)
<b>Simple Cyst</b>		Incidental finding do... nothing
<b>Complex Cyst</b>		Biopsy to rule out malignancy
<b>Renal Cell Carcinoma</b>		Smoking, ESRD, VHL Flank Pain, Flank Mass, Hematuria Ultrasound or CT scan to find it Needle to biopsy it Excision, Ø Rads / Chemo available Epo Paraneoplastic Syndrome or Anemia



Polycystic Kidney Disease



Simple Cyst



Septated Complex Cyst



Renal Cell Carcinoma

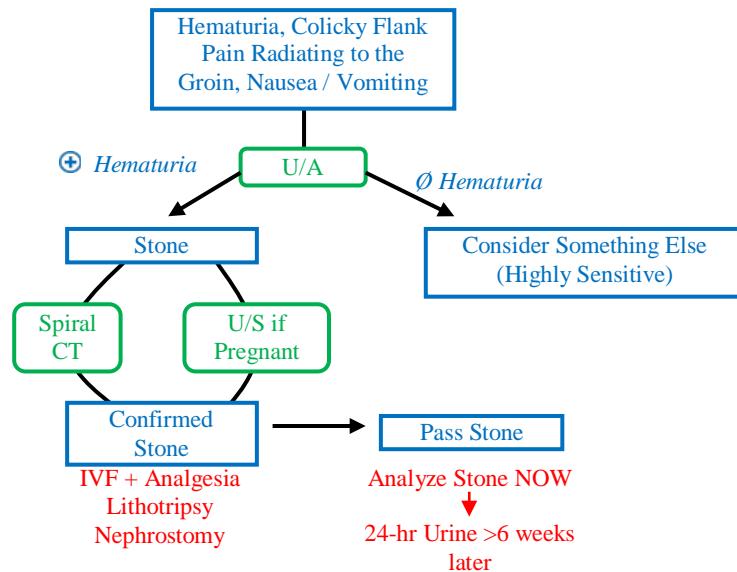
Kidney stones come in a variety of forms. They're caused by the **precipitation** of something - either because their **quantity is large** or due to **decreased intravascular volume**. Each type has its own risk factor which is why, after a stone passes, there needs to be a **close analysis** of both the stone and the urine.

The typical patient will present with **colicky flank pain** that **radiates to the groin** and with **nausea / vomiting**. There won't be chills or fever which helps rule out pyelonephritis, which may present similarly. Still, start with a **Urinalysis** just in case. Urinalysis should show **hematuria WITHOUT casts**. Confirm the diagnosis with a **Spiral CT** (best test) which will show the actual stone. Other tests that can be done are things like **KUB**, **IVP**. Or, if **pregnant** use an **ultrasound** to see hydroureter, hydronephrosis, or even the stone itself.

Once diagnosed there are a couple of options on how to treat the stone. **Hydration** and **pain management** are always first. If the stone is **<5mm** just let the stone pass. If the stone is **< 3cm** a **lithotripsy** can be done to break up a big stone and wait for it to pass. If it's bigger than that, or there's evidence of **obstruction**, go in and take it out. That means relieving the pressure with a **nephrostomy** and maybe even **surgery** to remove it.

Regardless of the way the stone's taken out, it **needs to be analyzed**. See the chart on the top of the page for composition of different stones. Then, **6 weeks later** analyze a **24-hr urine**. Correct the risk factors and bam! good as new.

<b>Types of Stones</b>	<b>Radio-</b>	<b>Risk Factors</b>
Calcium Oxalate	Opaque	↑ Ca absorption (Vit D Excess, PTH, FHH) ↑ Oxalate (fat malabsorption, Vit C excess) ↑ Animal Protein in the diet ↓ Fruits / Vegetables in the diet
Magnesium Ammonium Phosphate (Struvite)	Opaque	Alkaline Urine secondary to frequent UTIs with Urea-Splitting bacteria (Proteus)
Uric Acid	Lucent	Creates Massively large stones ↑ Uric Acid (Gout, Tumor Lysis Syndrome)
Cysteine	Lucent	Rare inherited renal tubular defect

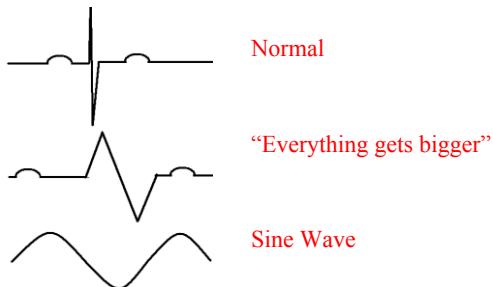


**Path:** Precipitates form stone in tubules or ureters  
**Px:** Hematuria, Colicky Flank Pain that Radiates to the Groin, no fever or leukocytosis  
**Dx:** 1<sup>st</sup>: U/A  
 Best: Spiral CT Scan  
 Other: U/S, KUB, IVP  
**Tx:** <5mm: IVF + Analgesia  
 <3cm : Lithotripsy  
 >3cm : Nephrostomy, Surgery  
**F/U** Strain and Analyze Stone  
 24-hr urine for Ca, PO<sub>4</sub>, Urate, Oxalate

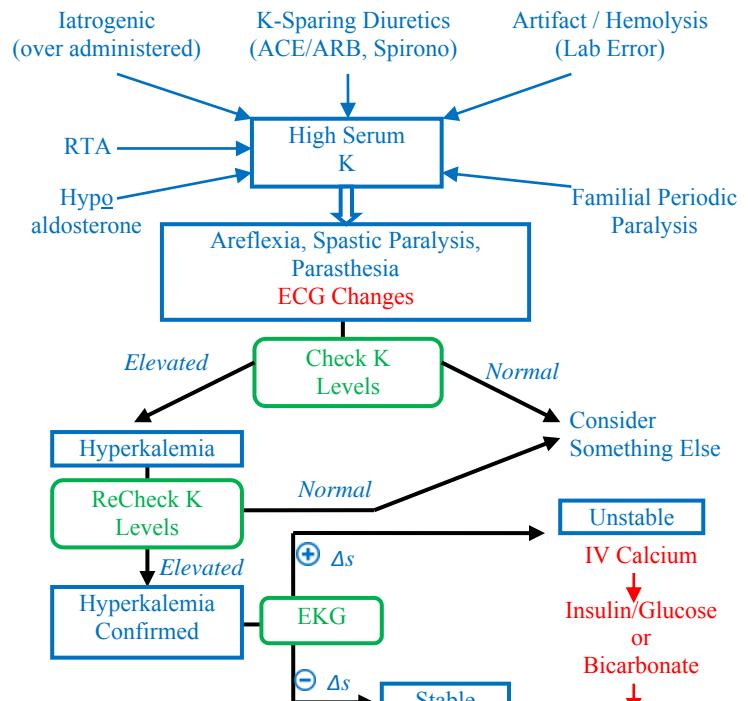
**Hyperkalemia**

Extracellular potassium is tightly regulated. It doesn't take that much extra potassium in a syringe to kill someone (**death penalty**). The range is typically **3.5 – 5.0** ( $>4.0$  is normal in cardiac patients). There are many causes of hyperkalemia, some rare, some common. They all lead to the same symptoms: **areflexia, flaccid paralysis, paresthesias** (aka decrease motor and sensation) and the **ECG Changes**. Whenever you get an abnormal potassium level, the first thing to do is **repeat the lab** (the sample could be busted or the cells could have hemolyzed). Yet, the crucial evaluation is the **ECG 12-Lead**. Remember that “everything gets bigger...” as the **K goes up the PR prolongs, the QRS widens, and the T waves peak**. Treatment is dependent on severity and ECG changes. There are 3 phases of treatment.

Phase I is to stabilize the myocardium with **IV calcium gluconate**. Phase II is to **decrease serum K** by sequestering it, hiding it, in the cells. Do that with **Insulin and glucose** (the insulin shifts the K, the glucose prevents hypoglycemia) or with **Bicarbonate**. Phase III is to actually **decrease total body K** with either K-wasting **diuretics** or more commonly with **Kayexalate**. If in Renal Failure or the K is extreme, use **Dialysis**.

**Hypokalemia**

Less exciting than hyperkalemia but just as deadly, a **low potassium** has multiple potential causes. Usually, it's going to be either through **GI losses** (diarrhea, laxatives, vomiting) or **Renal Losses** (Loop or Thiazide Diuretics). On a board exam look at <sup>1</sup>**Renal Tubular Acidosis** or <sup>2</sup>**Barter's** if isolated. If part of a syndrome, look for **hyperaldosteronism**. As with hyper K, if there's a low value **confirm it** by repeating the lab. If it's really low, slap on a **12-Lead ECG** and start **repleting potassium**. PO replacement is preferred over IV. IV administration burns but can be given when people can't tolerate PO. Regardless of the method chosen, make sure corrections are not faster than **10mEq/hr** (increasing K by 0.1 per hour). If they're on K-wasting diuretics add **K-Sparing** agents or **supplement the potassium** long term.

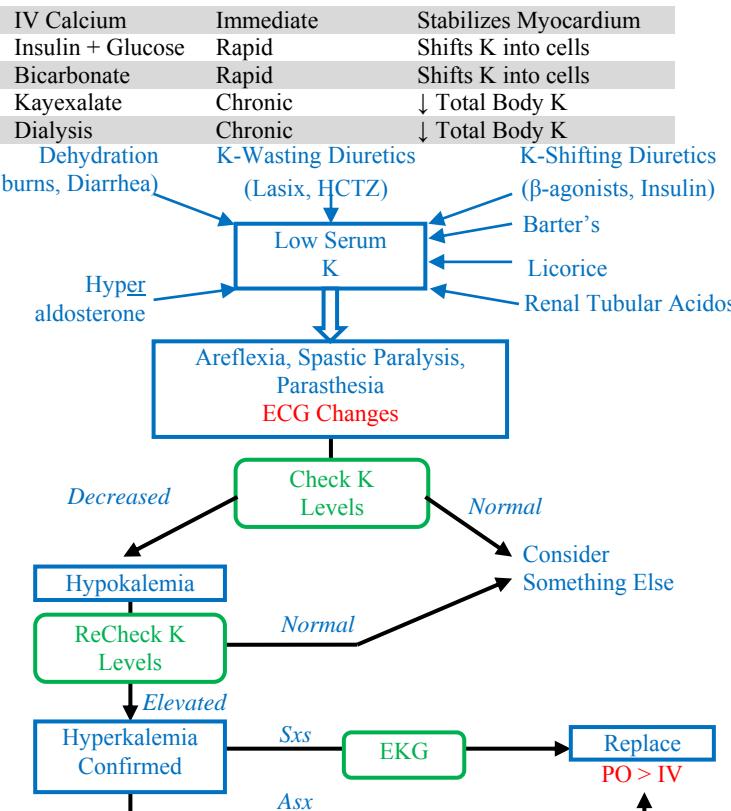


K comes back high on a lab draw      Repeat the draw

K comes back confirmed high but the patient is asx, Ø EKG Δ      Kayexalate, Stop K-Sparing drugs

Symptoms or EKG Δs With or without elevated K      IV Calcium, Insulin/Glucose, Kayexalate, Consider Dialysis

Renal Failure and any of the above      Dialysis



Introduction

When a patient presents with acute renal failure, better termed **acute kidney injury**, he/she will generally present with an ↑Creatinine or ↓Urinary Output. That is, until electrolytes get out of control the patient is going to be asymptomatic. It's usually on routine labs that it's encountered. It's important to differentiate between **prerenal**, **intrarenal**, and **post renal failure**. The list of potential diagnoses is epic so it becomes prudent to develop a system. **Prerenal** is the result of ↓perfusion - whether it be from ↓cardiac output, 3<sup>rd</sup> spacing of fluid, or ↓vessel diameter. In this case, the kidneys think they're dehydrated and **hold onto salt and urine**. Thus, the urinalysis will show a **low urine sodium ( $U_{Na} < 10$ ,  $FE_{Na} < 1\%$ )** and a **BUN/Cr ratio > 20** (use urea instead of Na if a patient is on a diuretic). This should also always be the **first step** because it's very easy to fix (**IVF** or **manage condition**). On the opposite side of the spectrum is **postrenal failure** from **obstruction to outflow**. Obstruction can be at any level. Thought to cause an ↑Creatinine, the ureters would have to be blocked bilaterally. Whether it's an **old man** with **BPH** or **Gout** causing uric acid crystal deposition, use a **sonogram** to look for **residual urine** and **hydroureter/hydronephrosis**. The goal's to **stent** the obstruction (urology) and/or **remove it**. It's easy to diagnose or rule out pre and post renal failure. It's difficult to diagnose **intrarenal** disease because the differential is even vaster. But at this point a **urinalysis** can give many clues for diagnosis and a **biopsy** will be definitive (though a history and urinalysis is usually sufficient). The kidney is broken; it can't reabsorb sodium or concentrate urine so the  **$U_{Na} > 20$**  and  **$FE_{Na} > 1\%$**  on U/A.

Intrarenal

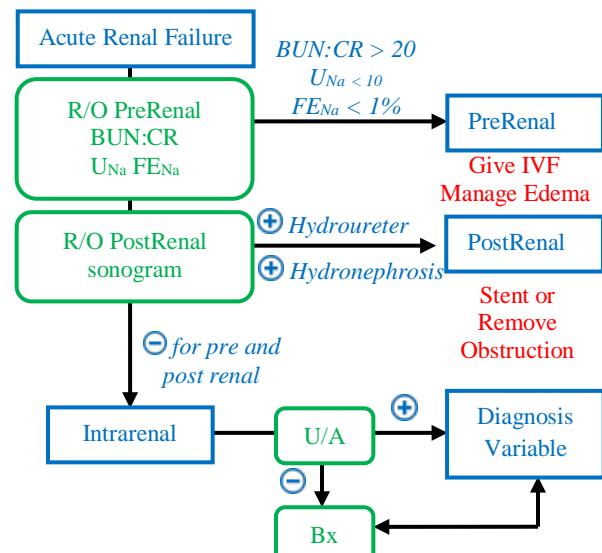
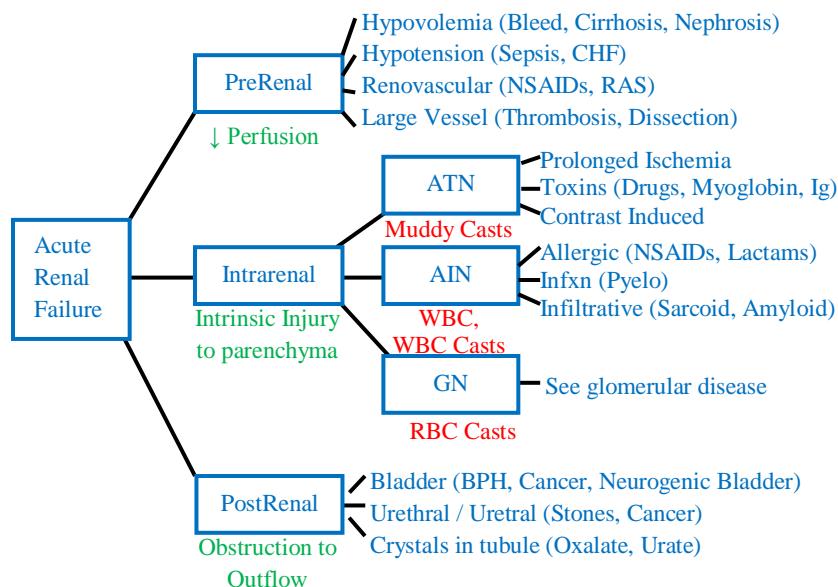
Once honed to Intrarenal, the damage can be thought of in 3 distinct regions.

i. Tubules (Acute Tubular Necrosis)

Considered to be from **prolonged ischemia** or **toxic exposure** the tubules necrose, die, and slough off. They form the shape of the tubules and present as **muddy brown casts** on urinalysis. They'll go through three phases: the **prodrome** where creatinine rises but urine output remains the same, an **oliguric phase** where creatinine rises and urine output plummets (caution fluid overload), and a **Polyuric phase** where the patient pees a lot. Through this time he/she needs supportive care.

a. Contrast Induced ATN

One special kind exists. If a patient has **preexisting renal damage** or is at increased risk, and he/she NEEDS contrast, give **vigorous hydration**, prophylactic **N-Acetyl-Cysteine**, and **Stop ACE/ARBs and Diuretics**.

Urinalysis Findings

Pre-Renal	BUN/CR > 20, $U_{Na} < 10$ ; $FE_{Na} < 1\%$	IVF, Manage Fluid Shifts
Post-Renal	⊕ Urinary Retention ⊕ Hydronephrosis /ureter	Stent and Remove obstruction
IntraRenal	BUN/CR <10, $U_{Na} > 20$ ; $FE_{Na} > 1\%$	
ATN	Muddy Brown Casts	Supportive Care
Allergic Nephritis	Eosinophilia	Remove Drug
Pyelonephritis	WBC Casts	Abx
Myoglobin Nephritis	⊕ Blood, Ø RBC	$NaHCO_3$ , IVF
Glomerulo-nephritis	RBC Casts	Disease Dependent
Gout	Uric Acid Crystals	Treat the Gout!

ii. Interstitial (Acute Interstitial Nephritis)

Here, something is **invading** the interstitium. That something is immune cells. **Drugs, Infections, and Deposition Disease** can cause AIN. The patient will typically present with **fever**, a **rash**, and **increased creatinine** while a urinalysis will show WBC or WBC casts indicative of those immune cells. Stopping the offending agent (remove the drug, treat the infection) may be insufficient - especially when deposition disease is being considered. **Steroids can also be tried.**

iii. Glomerulus (Glomerulonephritis)

A patient with **RBC casts** on urinalysis is indicative of glomerulonephritis. There are a crap-ton of diseases that can cause it. The way to tell them apart is with a **biopsy** - something not often done. Learning the typical histories should be enough (memorize the chart to the right). What becomes important is to **rule out Nephrotic Syndrome** ( $>3.5\text{g}/24\text{hr}$  urine, Edema, and Hyperlipidemia) with a **U/A Spot Test** or **24-hr urine**. This isn't step 1 stuff so don't worry about spending time memorizing biopsies, stains, or complement levels.

Chronic Kidney Disease (CKD)

When the creatinine remains elevated and won't come back down, you've got CKD. It's usually **>3 months of reduced GFR** ( $<60\text{mL/hr}$ , or a Creatinine~2). The stage of renal disease is based on the GFR. The goal is to stop it from progressing and to maintain lifestyle. Therapy is centered around blood pressure and control of comorbidities. **Blood Pressure Control** in renal disease is more intense than in an otherwise hypertensive patient. The goal is **<130 / <80** (versus 140/90). The preferred method is to start with an **ACE-inhibitor** and add therapies for comorbidities. But there are other goals as well: there must be **tight glucose control**, a better **diet** with **low Na low K**, and maintaining the **Hemoglobin at 11-12** with **Iron** and **Erythropoietin**. Keep an eye on the **calcium** and **phosphate** levels to avoid secondary hyperparathyroidism.

Of course, with **ANY KIDNEY DISEASE** consider the need for **dialysis**. The anuric patient of ATN may need dialysis once, whereas the end-stage renal patient may need it every other day. Indications can be remembered using the mnemonic **AEIOU** (the true vowels). Note that the decision to dialyze is NOT based on the Creatinine! **Transplant** is another definitive option.

<i>Glomerulonephritis</i>	<i>History</i>	<i>Blood Test</i>
IgA Nephropathy	Post-Viral	
Post-Streptococcal	Post Pharyngitis / Impetigo	ASO titer
Lupus	⊕ ANA, ⊕ dsDNA, Sxs	⊕ dsDNA
Wegner's	Sinus, Lung, Kidney	⊕ ANCA
Goodpasture's	Hemoptysis + Hematuria	⊕ Anti-GM
Churg-Strauss	Asthma + Hematuria	
Henoch-Schonlein	Post-Viral (IgA) and systemic vasculitis	

<i>Stage</i>	<i>Description</i>	<i>GFR</i>	<i>Tx Goals</i>
<b>I</b>	Ø GFR effect	>90	Comorbidities
<b>II</b>	Mild	60-89	Comorbidities
<b>III</b>	Moderate	30-59	Comorbidities / Complications
<b>IV</b>	Severe	15-29	Prepare Dialysis / Transplant
<b>V</b>	Kidney Failure	<15	Dialysis required for survival

<i>Intervention</i>	<i>Goal</i>	<i>Reasoning</i>
<b>ACE-inhibitor</b>	BP <130 / <80	Delay progression
<b>Insulin</b>	bG 80-110	Delay progression
<b>Erythropoietin</b>	Hgb 11-12	Lifestyle
<b>Iron</b>	Hgb 11-12	Lifestyle
<b>Diet</b>	Low Na, Low K	HTN + Electrolytes
<b>Calcium and Vitamin D</b>	Prevents secondary hyperparathyroidism	Osteoporosis and fractures

*Indications for Dialysis:*

<b>A</b>	Acidosis
<b>E</b>	Electrolytes (Na/K)
<b>I</b>	Ingestion (toxins)
<b>O</b>	Overload (CHF, Edema)
<b>U</b>	Uremia (pericarditis)

Introduction

Disorders of sodium are really disorders of water balance. Normally, there are two compartments - the blood and the brain. These two compartments are in equilibrium. If there's a disturbance in how much "stuff" is in the blood the water will shift. If there's too much "stuff" in the blood water will shift out of the cells and into the blood (**Hypernatremia**), dehydrating the cells. If there's too much water ("less stuff") in the blood (**hyponatremia**) there's relatively more in the cells, so water will move into the cells and cause them to **swell**. Either way, that's bad news for the cells. It's the dehydrating and swelling that leads to symptoms.

The treatment for any sodium disorder is to give back what the patient is missing. If he/she's missing "stuff" (HypoNa) give sodium. If he/she's missing water (HyperNa), give fluid. But how much to give and how to give it is dependent on the severity of symptoms. The severity of symptoms is dependent on **how much** the sodium changes relative to **how fast it happens**. Check out the chart to the right. Give **Hypertonic Saline** for **Severe HypoNa** only (doing so in a normal patient will result in **central pontine myelinolysis**) or **dilute saline** (1/2 NS) for **Severe HyperNa**. If you can give PO fluids / PO Salt, give it. If the patient's disoriented or confused, give IV fluids instead.

In order to make a diagnosis the serum osmoles must be determined. Then, adjust based on clinical picture.

(2) Pseudohyponatremia

Whenever encountering a patient with hyponatremia think first about the serum osmoles. If his/her serum osmoles are high - that is, the "stuff" in the blood is something other than Na - it may not be a true hyponatremia. The sodium is low on the lab but there's no disorder of water. This can be in the case of **hyperglycemia** or **fat/protein**. In fact, for every **100mg/dL** of glucose above 100 adjust for the Na by 1.6. If there is in fact a pseudohyponatremia just fix the glucose and move on.

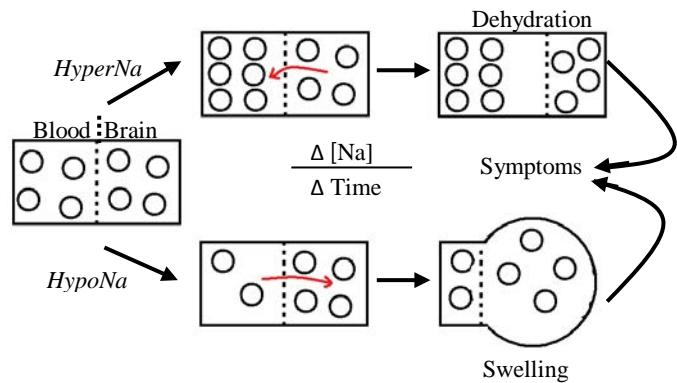
(3) True Hypovolemia

Three things to think about here.

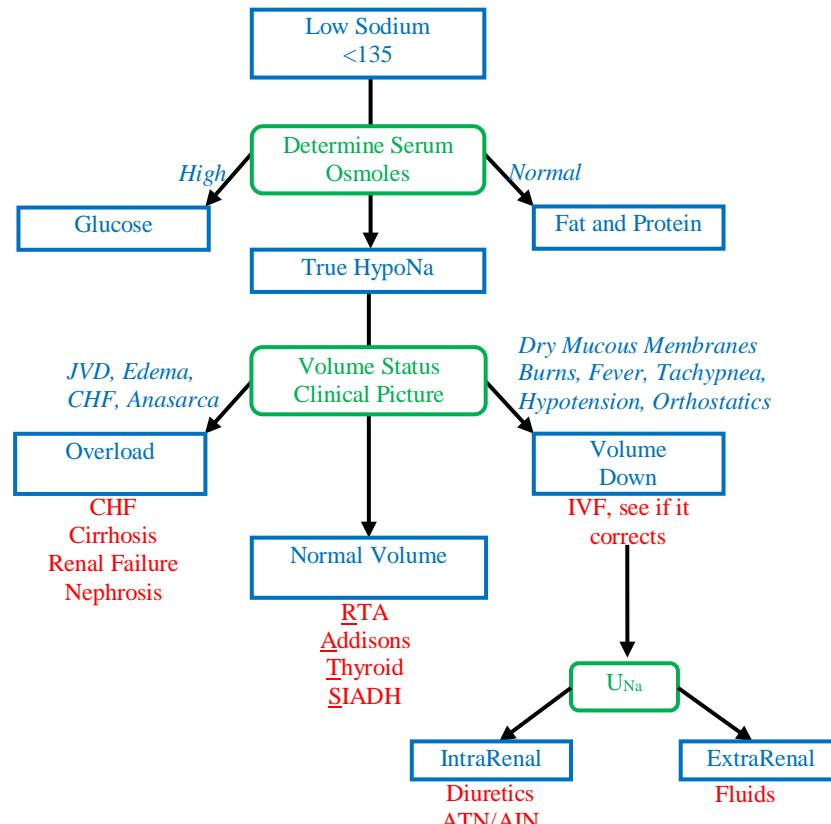
<sup>1</sup>If the patient is **wet** (i.e. JVD/Edema/CHF/Anasarca) then he/she's **overloaded**. The fluid is in the third space and needs to be mobilized. Treat with **diuretics**.

<sup>2</sup>If the patient is **volume down** (dry mucous membranes, burns, fevers, tachypnea, hypotension), then all the patient needs is **IVF**. The sodium should correct with IVF. If there's no time for that get a  $U_{Na}$  to distinguish if it's just the volume status or actually an intrarenal disease. See Renal Failure video.

<sup>3</sup>If the patient is **euvolemic** we're left with **RATS**. Rule out each disease one at a time. Realize that **SIADH** is a diagnosis of exclusion. Check out the endocrine videos for details.



Onset	Symptoms	Treatment
Slow + Gradual	Asymptomatic	PO intake HypoNa: Salt HyperNa: Fluid
Rapid (Hours to Days)	Confusion, Disorientation	Hypo Na: IV NS HyperNa: IV NS NOT Hypertonic
Acute or Severe (Na<110, Hours)	Coma, Seizures, Death	HypoNa: IV Hypertonic HyperNa: IV ½ NS



$$\text{Serum Osmoles} = (2 \times \text{Na}) + \frac{\text{Glucose}}{18} + \frac{\text{BUN}}{2.8}$$

Introduction

The spinal cord runs through the vertebrae of the spine, protected from external injury. Muscles attach to the spine on the outside. Any disruption to **muscle**, **bone**, or **cord** can produce back pain. Since musculoskeletal pain is the most common cause of back pain, finding reasons to look for deeper problems becomes critical. Awareness of both surgical and nonsurgical disease producing **back pain** and/or **neurologic symptoms** is crucial.

1. Cord Compression

Irrespective of the underlying condition, any **warning symptoms** of cord compression (see the chart to the right) warrant immediate investigation. This is a **neurologic emergency**. Intervention significantly improves morbidity (increased ambulation after treatment) - especially when started early. If any alarm symptoms are found the thing to give is **dexamethasone** (immediately). Since symptoms have already manifested themselves look for something big and obvious with an **X-ray**. If positive, it's positive. If negative, follow up with an **MRI**. Most things will respond to **radiation** or **surgery**.

2. Musculoskeletal

This is the **most common** cause of back pain. It typically has an **inciting event** (heavy lifting, straining) though none may be found on questioning. The pain is **symmetric**, in a **belt-like fashion**, and described as an **ache**. In the absence of neurologic or systemic symptoms do nothing. Just give **analgesia**, **exercise**, and **stretching**. If symptoms do not improve, follow up with an **XR** then **MRI**. Give the patients 4-6 weeks before returning. It typically occurs in people **> 30**.

3. Herniation

In the patient where musculoskeletal pain is being considered, one must **rule out herniated disk**. The age group and exacerbating factors are the same. However, people with herniation will have a **lightning or shooting pain** down the leg ("sciatica"), exacerbated by **hip flexion, movement, cough, or activity**. Assess **plantar flexion** (L4) and **Dorsiflexion** (L5), the common nerves impinged by a bulging disk. Here's the deal: **neurosurgery** is better than conservative at 6 months, but they're the same at 1 year.

4. Osteophyte

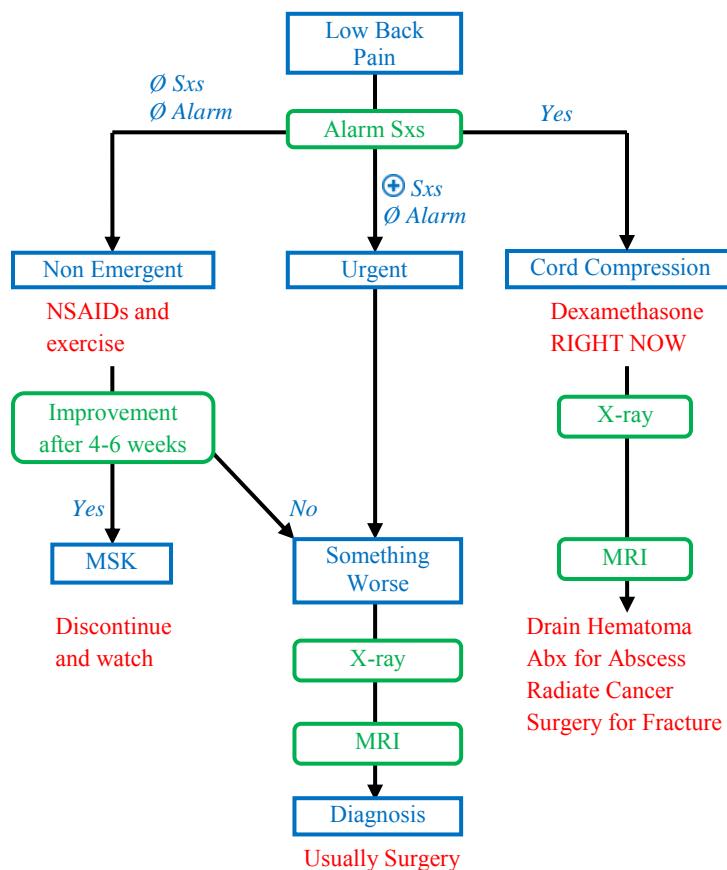
If you've found a patient that might have a herniation (they have that shooting lightning pain) but is an **elderly male** think **osteophyte**, a simple bone growth into the exit of the nerve route. Get an **XR** then **MRI** to rule out a compression fracture. Here, **neurosurgery** is better than waiting.

5. Compression Fracture

In an **elderly patient** with back pain and a **history of osteoporosis** suspect a fracture. Do an **X-ray**, see the fracture, and get a neurosurgeon or orthopedist to fix it. There is usually **point tenderness** or a **vertebral step off** and warning symptoms may be present. These may occur with trauma, but only in the frail old ladies who fall on their butt (coccyx).

Warning Symptoms

History of Cancer
Urinary Symptoms (Incontinence or Retention)
Sexual Dysfunction (ED or Priapism)
Bilateral Lower Extremity Weakness
Sensory Deficits in a Dermatome
Fever



**6. Spinal Stenosis**

Typically found in an **elderly patient** presenting with a unique form of “sciatica.” There’s often **leg and butt pain** that sounds like **claudication** but is positional (when upright with exercise  $\oplus$  symptoms, when hunched over  $\ominus$  symptoms). Do an **MRI** to confirm it and **Surgery** to fix it.

From here on we can talk about other non-traumatic causes of neurologic symptoms or back pain. You can turn your eyes off if you’re reading this for surgery.

**7. Syringomyelia**

A pocket of CSF bulges into the anterior cord that produces back **pain** and **loss of pain/temperature sensation**, sparing proprioception. As it expands motor and sensation will be compromised. **MRI** diagnosis it, **surgery corrects** it.

**8. Abdominal Aortic Aneurysm**

If a patient has a history of **HTN, CAD**, and **Smoking**, he/she might have an AAA. With AAA, the **anterior spinal artery** can be affected producing a **spastic paralysis** and a loss of **pain and temperature**. The back pain is from visceral compression (i.e. an aneurysm that is about to pop). It can be screened via an ultrasound. If there are neurologic symptoms it also requires an **MRI** and **Surgery**.

**9. Visceral Organs**

Finally, visceral organs can **refer** to the back. In particular, **diarrhea/constipation** and **GYN** issues can cause back pain. Ask about neurologic symptoms. When negative, send them home on NSAIDs. If in the clinic and patients explain of **intermittent low back pressure**, especially relieved by flatulence or passing stool, you’ve got your answer.

	<b>Age</b>	<b>Risk Factors</b>	<b>First</b>	<b>Best</b>	<b>Tx</b>
Cord Compression	>50	Cancer, IVDA	XR	MRI	Dx Dependent
Musculoskeletal	20-50	Heavy Lifting, Straining	None	Unless no Improvement	NSAIDs
Herniation	20-50	Heavy Lifting, Straining	XR	MRI	Bed Rest, NSAIDs
Osteophyte	>50	Aging	XR	MRI	Surgery
Compression Fx	>50	Osteoporosis	XR	$\emptyset$	Surgery
Spinal Stenosis	>50	Aging	XR	MRI	Surgery
Visceral Organs	Any Age	Anything	XR	-	-
AAA	>50	Smoking, HTN< Atherosclerosis	-	-	-
Syrinx	Any Age	Trauma	-	-	-

Introduction

Producing **unconsciousness** - a depression of brain function that extends beyond executive function - requires significant CNS compromise. In each of the conditions we're going to discuss the patient is mostly **unaware** and **unable to be aroused**. The degree of arousal (response to external stimuli, brainstem function) determines what the diagnosis is. **Cerebral function** is the most sophisticated, the most human, and the least required for survival, so it is sacrificed first, meaning that relatively **small insults** can induce **coma**. **Brainstem function** is vital and can persist despite the absence of awareness (breathing, sleep/wake cycles), leaving the patient in a **persistent vegetative state**. In the absence of cerebral function and brainstem function there's nothing left -- **brain death**. Watch out for **locked-in** syndrome which can look like any of the above, but the person is still fully alive, awake, and alert.

Coma

Coma is a state of unconsciousness of **depressed cerebral function** such that there is **no response to internal or external stimuli**. Literally anything can produce coma: **Toxins** (EtOH, Benzos, Opiates), **Electrolytes** (all), and **Endocrine** (Hypothyroid, Thiamine) are potential reversible causes. However, to knock out all arousal there must be significant/catastrophic cerebral damage. It can occur via **hypoxic/ischemic encephalopathy** (drowning, cardiac arrest), trauma (**diffuse axonal injury**) or **brainstem pathology** (hemorrhage or infarction). By definition, coma is reversible. Do a comprehensive workup (**CMP, CT scan, LP, EEG**), give the **coma cocktail** (Thiamine, D<sub>50</sub>, Oxygen, Naloxone), and reverse underlying causes. A full recovery from comas is possible.

Persistent Vegetative State

The patient has a **flat EEG** but **opens her eyes** or has a **positive caloric test**. The patient has no arousal but can move, display pain, and have sleep wake cycles. Nonetheless, the personality is gone; he/she's in a **persistent vegetative state**. He/she will never recover and will require tube feeds/institutionalized care for life.

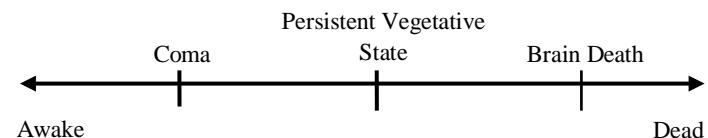
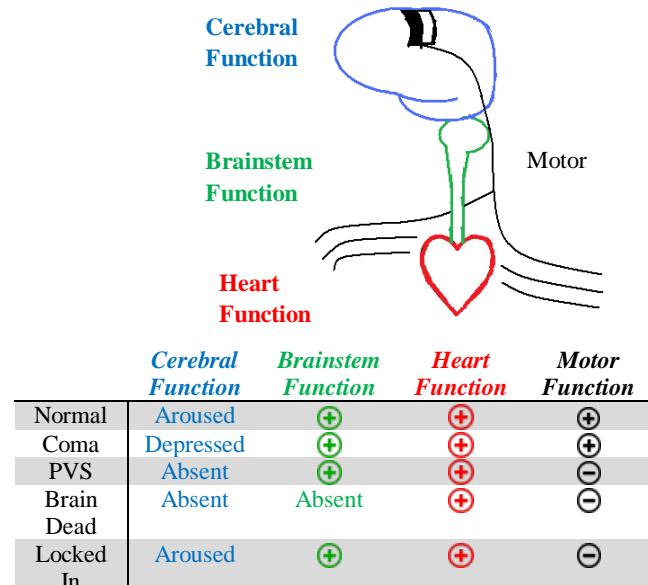
Brain Death

If someone goes down and stays out despite resuscitative efforts, and attempts at reversal fail you must consider brain death. In brain death the **cerebral EEG** shows nothing: there's **no arousal, sleep wake cycle, or drive to breathe** (life is ventilatory dependent). Before confirming brain death rule out intact neural reflexes with a **caloric test (COWS)** and a **corneal reflex**. If there's no response brain death is in place and the patient should be removed from life support. **Two** doctors must confirm death.

Locked-In Syndrome

The pons is the site where both **motor and sensory tracts** pass. If there's a **basilar artery infarct** or **central pontine myelinolysis** these tracts are severed. The patient LOOKS LIKE he/she's in a Persistent Vegetative State but they have **full awareness**. He/she's able to communicate via **eye movements**. There's no recovery from this. **MRI** should confirm the diagnosis; make the patient comfortable.

- (1) True Coma
- (2) Persistent Vegetative State
- (3) Brain Death
- (4) Locked-in Syndrome



Introduction

Dementia is a combination of **memory loss** and an alteration of **cognitive function**. Having trouble finding your keys or losing spans of time is insufficient for the diagnosis of dementia. As such, the **MMSE** was created to assess if there are changes in **attention, concentration, or executive function** in addition to memory. Once dementia is established there are a variety of diagnoses. The most important thing to do is rule out all **reversible causes**, or identify a reversible cause and fix it. The possible reversible causes, their history, diagnosis, and treatment are listed to the right. If no reversible cause is identified, **organic dementia** must be entertained, differentiating based on the **history**, the **time course**, and **associated symptoms**.

Alzheimer's Disease (AD)

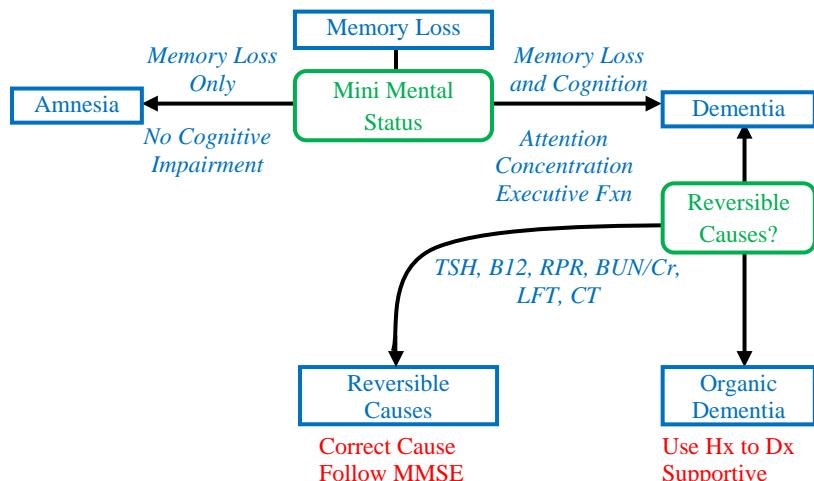
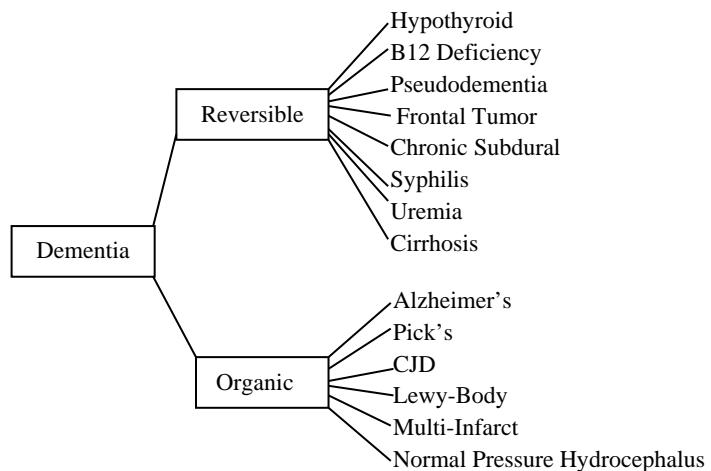
This is the **most common** cause of organic dementia. Linked with **neurofibrillary tangles**, **neurotic plaques**, and **amyloid deposition**, a definitive diagnosis is only made on brain biopsy at **autopsy**. However, AD has a very classic presentation of an **insidious** (slowly progressive) onset dementia taking **memory first** (short term then long term) **sparing social graces** until late in the disease. A CT scan will show **diffuse cortical atrophy**. There is a link to chromosome 21 (all **Down syndrome > 40 years old** develop AD). Once reversible causes have been ruled out treat with **cholinesterase inhibitors** such as tacrine or **donepezil** (Aricept). These will **slow progression** but don't reverse disease. Death usually occurs within 5-10 years; it's often from a secondary cause like pneumonia.

Pick's Disease

In contrast to AD, the **Personality goes first** in Pick's disease. Social graces are lost (violence, hypersexual) but **memory remains intact**. Whereas AD has diffuse cortical atrophy, Pick's has **frontal** and **hypothalamic** degeneration. Diagnosis is clinical and there's no treatment.

CJD

This disease is caused by an abnormal protein called a **prion**. Prions evade denaturation even with cooking so can be transmitted in infected meat, by eating human brains with the disease (Kuru, and zombies), or with corneal transplant. While eating infected meat is certainly a scary thought, the most common means of acquiring prion disease is a **sporadic mutation**. In a patient that's **too young** to have dementia and displaying a **rapid decline** (within a year) of memory, consider CJD. There may be the associated symptoms of **myoclonus**. Treatment is palliative and death occurs in years from infection but usually months from diagnosis.



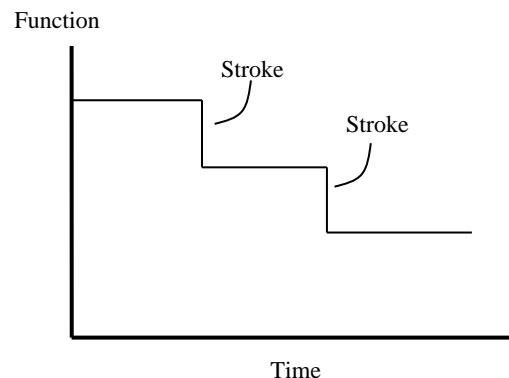
Condition	Clinical Picture	Test	Treatment
Hypothyroid	Weight Gain, Heat Intolerance, Constipation, Malaise, ↓DTRs	TSH	Synthroid
B12 Def	Megaloblastic Anemia and Neuro sx's	B12	B12
Subdural Hematoma	Focal Neurologic Deficit, Headache, Trauma	CT	Surgery
Syphilis	Sexually Active, Any Neuro, Screen endemic areas	RPR	Penicillin
Uremia	Renal Failure, Uremic Frost	Cr	Dialysis
Cirrhosis	Asterixis, Ascites, Hepatomegaly	NH <sub>4</sub>	Transplant Lactulose
Pseudo-dementia	Depression, Loss of Loved One	Psych	SSRI

Lewy Body Dementia

**Lewy Bodies** are the pathognomonic finding on biopsy for Parkinson's. Dementia with Lewy Bodies without the stigmata of Parkinson's is Lewy Body Dementia. This will present as an **acute onset delirium** picture in an **elderly male**. Difficult to diagnose, unable to treat, just know it exists.

Multi-Infarct Dementia (Vascular)

When someone has a stroke his/her memory and cognitive function may become impaired. The problem is a person with Alzheimer Disease often has Risk Factors for stroke (**HTN, DM, CVA**), but without a focal neurologic deficit the stroke may not be diagnosed. However, if a patient has a stroke and gets **abruptly demented or abruptly worse** and you can tie the stroke temporally to the decline in cognitive function, call it vascular dementia (Multi-Infarct Dementia). An **MRI** may show old infarcts, but these may be coincidental rather than causative. If there's a question treat it as Alzheimer's but of course control risk factors for stroke.

Normal Pressure Hydrocephalus

This is both an **organic** and **reversible** cause of dementia. In an elderly patient with an **ataxic gait, urinary incontinence, and dementia**, get a CT or **MRI** to evaluate for hydrocephalus. The pressures are normal so there are no signs and symptoms of ↑ICP. Since it's ↑CSF causing the problem, it's possible to do **serial LPs** to take off extra fluid (if it improves it's also diagnostic) and eventually fit them for a **VP Shunt**. Be carefully calling cortical atrophy with subsequent volume expansion "Normal Pressure Hydrocephalus" (NPH is a specific diagnosis with specific criteria).

- Wet (urinary incontinence)
- Wobbly (ataxic gait)
- Weird (Dementia)

	<i>History</i>	<i>Location</i>	<i>Diagnosis</i>	<i>Treatment</i>
<b>Alzheimer's</b>	Short Term Memory, Long Term Memory, then Social Graces, Chronic & Insidious Dz	Diffuse Cortical Atrophy	CT	Donepezil
<b>Pick's Disease</b>	Personality 1 <sup>st</sup> Memory Later	Frontal-Temporal Degeneration	CT to r/o Clinical Diagnosis	None
<b>CJD</b>	Myoclonus Rapid Decline	Diffuse Cortical Atrophy	Clinical Diagnosis	None
<b>Lewy Body</b>	Delirium	N/A	Lewy Bodies on Stain	Donepezil maybe None
<b>Multi-Infarct</b>	Acute exacerbation with CVA	Anywhere	Clinical Correlation of dementia with CVA	Control CVA risk
<b>Normal Pressure Hydrocephalus</b>	Ataxic Gait, Urinary Incontinence Dementia	Nowhere	LPs Dx and Tx	Serial LPs, VP Shunt

Introduction

“Dizzy” is a very vague complaint that needs further investigation. The first question needs to be what does the patient mean: **presyncope** or **vertigo**? In **presyncope** the patient will complain of blacking out, lightheadedness, or cardiac symptoms. This is covered in the cardiology lectures. In **vertigo** a patient will sense movement where none exists. This will present as either the **room spinning** or being **unsteady on his/her feet**. Once vertigo is established it's critical to differentiate between **central** (usually a structural lesion requiring **MRI** of the **posterior fossa**) and **peripheral** (sparing the need for costly **MRI**, focusing more on **symptom control**). Lesions that are **central** are generally **chronic and progressive**; they occur in the posterior fossa (i.e. away from ears, sparing aural symptoms) where the cranial nerves are. This produces **cranial nerve deficits**. Get an **MRI** and correct as needed. **Peripheral** lesions are essentially **in the ear**, away from cranial nerves, but **acute with ear symptoms** (hearing loss and tinnitus).

Posterior Fossa Lesions

Whether it's **vertebrobasilar insufficiency** or a **posterior fossa tumor**, the main problem is a structural lesion compressing on or eating away at the **cerebellum** and **brainstem**. If there are **focal neurologic deficits** and **vertigo** it's almost pathognomonic for a central lesion. Get an **MRI**. If normal, follow with **MRA**.

Benign Paroxysmal Positional Vertigo

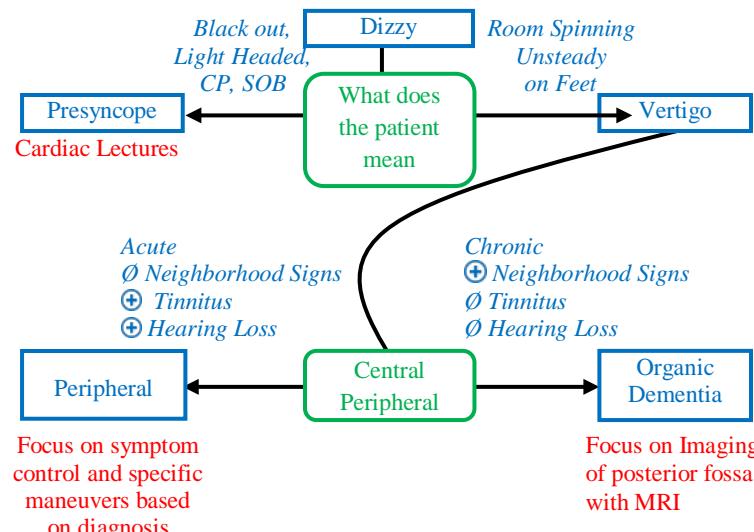
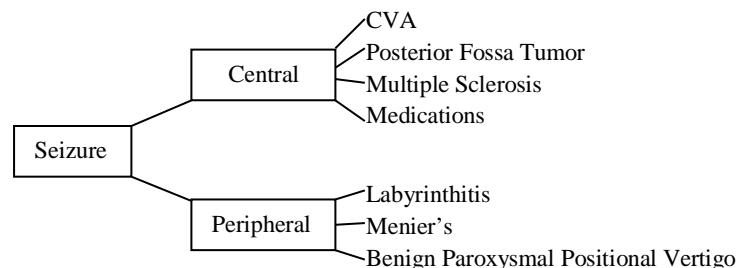
This disease is caused by an **otolith** within the semicircular canals. It moves with head movements and settles randomly producing **vertigo** and **rotary nystagmus** on **head movement** that's **transient** (<1 minutes). This occurs every time the head moves (easily reproducible). Sensation can be reproduced by the **Dix-Hallpike maneuver**. **Movement Exercises** dislodge and break up the stone, curing the patient of disease. An **Epley Maneuver** can be done in the office and is often curative.

Menier's Disease

A peripheral cause of vertigo presenting with a triad of **vertigo**, and **hearing loss**, **fullness**, or **tinnitus** that's **unrelated to movement**. Like BPPV, it's acute but the vertigo persists - lasting ~**30 minutes**. This also occurs repeatedly, but not every time the head moves, and may be separated by long periods of time. Treat with **diuretics** and **low salt diet**.

Labyrinthitis/Vestibular Neuritis

A diagnosis of exclusion. Suspect this disease in a patient with **vertigo**, **Nausea/Vomiting** **hearing symptoms** for weeks after a **URI** (pharyngitis, otitis, sinusitis). It's a diagnosis of exclusion because pontine strokes and tumors mimic the chronic nature of vertigo and the URI often goes unnoticed. If diagnosed early give **steroids** within 72 hrs. The disease will resolve in months, but balance and hearing may be compromised for those months.



Disease	Onset	Duration	Diagnosis	Treatment
BPPV	With Movement, Acute, Reproducible	<1 min	Dix-Hallpike Rotary Nystagmus	Movement Exercise
Menier	Without Movement, Acute, Repetitive	30 mins	Clinical	Diuretic and Low Salt
Labyrinthitis	1-3 weeks after an URI, N/V, vertigo, deafness	Persistent, sxs may occur or and off for months	Diagnosis of Exclusion	Steroids
Posterior Fossa Lesions	Chronic and Progressive	Persistent	MRI	Surgery Steroids CVA control

Introduction

A headache may seem like a trivial complaint, but it might be the symptom of a significant underlying disease. When a patient presents with a headache you need to be able to 1) **identify red flags** (separating headache into primary or emergent conditions), 2) **recognize the typical features**, and 3) **know when to image**. Alarm symptoms tip off a secondary disease - requiring a CT or LP - while their absence allows for focus on the primary headache disorders.

Tension Headache

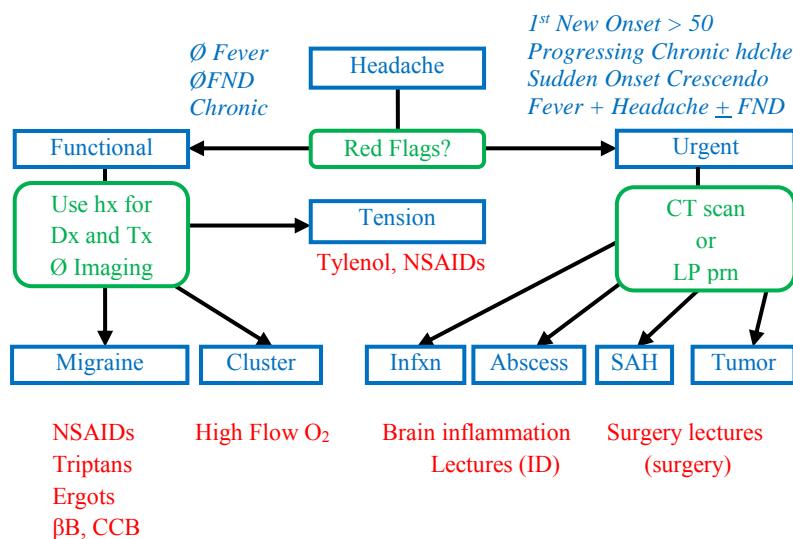
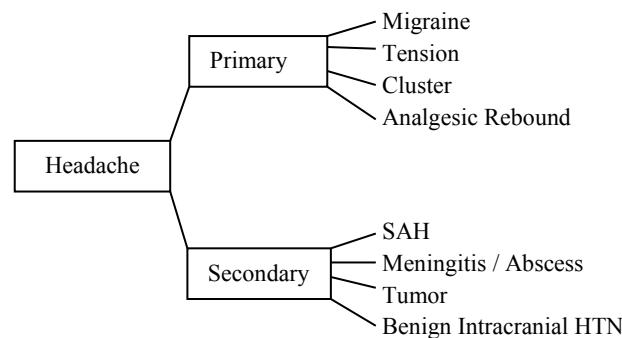
This is the most **common** headache in the US. It presents as a **bilateral, vice-like** pain that starts in front and **radiates** to the back / neck. It's **aggravated** by exercise and has **no Nausea / Vomiting**. It's really the typical everyday headache. Treat it with OTC analgesia; patients usually don't come to the doctor for this. Use **acetaminophen** or **NSAIDs** when they occur.

Cluster Headache

Named for the sporadic and grouped presentation, cluster headaches are **sudden onset, unilateral** headaches that occur **multiple times a day for many weeks** but then go **months to years without symptoms**. The pain is described as "boring" and is often **periorbital "eye pain"** with associated eye symptoms: **rhinorrhea, lacrimation, conjunctival injection**, and **Horner's**. In an acute attack give the patient **High-Flow O<sub>2</sub>** to abort the headache. If that fails give **triptans** (like a migraine, cluster headaches are vascular in nature). For the same reason, if it's really bad it can be prophylaxed with **CCB**.

Migraines

Migraines are generally poorly understood; they're thought to have a **vascular pathogenesis** (arterial vasodilation). A patient with a migraine may present in multiple ways with no one symptom especially sensitive or specific. Migraines have **triggers** (nitrites, caffeine, chocolate, menstrual cycle, stress, etc) that incite a **unilateral pounding headache**. The pain is usually **disabling** causing **photophobia, nausea / vomiting**, and a lingering malaise even after the headache is aborted ("hangover"). If the patient manages to fall asleep it's sufficient to abort the migraine, otherwise, the pain may last for **4-72 hrs** without intervention. For an active dynamic migraine decide if it's **mild** (use NSAIDs) or **severe**. If severe, initiate therapy immediately (early intervention decreases the need for back up medications). Start with a **Triptan** or an **Ergot** (caution if **CAD** as these drugs cause vasospasm). For a patient that has chronic migraines use cognitive feedback, trigger avoidance, and **prophylax** with **Beta Blockers (propranolol is best)**, Calcium Channel Blockers (verapamil or diltiazem), or Anticonvulsants.



**Analgesic Rebound**

Analgesic rebound can be any type of pain that occurs in a patient on chronic analgesics (**opiates, ergots, triptans, OTC**, taken **2-3 times / week**) who suffers from frequent headaches (**15x/month**). Withdrawing the offending medication may initially make the headaches worse, but this is simply a withdrawal symptom it'll pass if drugs are withheld.

**Secondary Headaches**

Red flags and alarm symptoms are unique for each diagnosis. Knowing what test to do for which scenario is critical. The first step is to identify the alarm symptom. Follow it with the confirmatory test.

- For **meningitis** look for **fever and a headache**. Do an **LP** with **Cx**, give **Abx (CT?)**. See ID lectures
- For **abscess** look for **fever, headache, and Focal neurologic Defect**. Do a **CT scan** then **drain**, give **Abx**. See ID lectures.
- For **tumor** look for a **progressively worsening headache worse in the AM**. Do a **CT / Bx**, give **Radiation/Chemo/Surgery**. See cancer lectures.
- For **SAH** look for a patient with a **sudden onset** head ache that's the **worst headache of his/her life**. Do a **CT**, get **Neurosurgery, control BP and HTN**.

**Benign Intracranial HTN**

Finally, pseudotumor cerebri (benign intracranial HTN) usually occurs in **women**. It's aptly named as it presents just like a **tumor: nausea/vomiting, signs/symptoms of ↑ICP, and exacerbation with coughing**, except the **CT scan is normal**. An **LP** is diagnostic and a shunt/LP will be curative. Think of this as a mass lesion effect but without any masses! **LP** shows an **↑opening pressure only**, all other findings are negative. If a **woman**, take her **off OCPs**; otherwise, it's shunts and/or serial LPs.

Patient	Presumed Diagnosis	Test	Tx
Fever + Headache	Meningitis	LP	Ceftriaxone
Fever + Headache + FND	Abscess	CT	Drain, Abx
Worse in the morning and with cough or progressively worsening	Tumor	CT	Rads/Chemo
1 <sup>st</sup> Time New Severe Headache	-	CT	-
Worst headache of their life or thunderclap headache	SAH	CT	Surgery

Dz	Danger	History and Associated Sxs	Laterality	Quality	Duration	Aggravation	Dx	Treatment	PPx
Tension	Low	Vicelike headache, radiating to back and neck	Unilateral	Vicelike		Exercise	Clinical	Acetaminophen NSAIDs	N/A
Cluster	Low	Periorbital pain, rhinorrhea, lacrimation, Horner's	Unilateral	Boring	5-90 minutes many/day	Ø	Clinical	100% O <sub>2</sub> , Triptan	CCB
Migraine	Low	⊕Triggers, photophobia, ⊕N/V, ⊕Aura, Disabling sxs, hangover	Bilateral	Pulsating	4-72 Hrs	Ø	Clinical	Mild: NSAID Mod: Triptan / Ergot	βB, CCB,
Analgesic	Low	Pt uses pain meds >2-3 times per week	Any	Any		Ø	Clinical	STOP Analgesic	N/A
SAH	High	Worst headache of their life, thunderclap headache	Bilateral	Tearing	Peaks in Seconds	Ø	CT Scan	Surgery	N/A
Meningitis	High	Fever + Headache	Bilateral	Any	Acute	Ø	LP	Ceftriaxone	N/A
Abscess	High	Fever + Headache + FND	Any	Any	Acute	Waking, Cough	CT scan	Ceftriaxone	N/A
Tumor	High	Worsening chronic HA, worse in AM, exacerbated by cough or Valsalva	Any	Any	Months	Waking, Cough	CT Scan	Rads/Chemo	N/A
Benign Intracranial HTN	Low	Abrupt onset N/V, s/s ↑ICP, Looks like a tumor, but isn't	Bilateral	Dull	Rapid Onset	Waking, Cough	LP	Serial LPs, Shunts	N/A

Introduction

Seizures are **uncontrolled synchronous firing of neurons** in the brain. There are many different types of seizures with many different presentations. As such, they should be considered a **symptom** of an underlying disease. For the disease and appropriate intervention consider **epilepsy** (usually only with a history of this disease) and the **VITAMINS** mnemonic. Generally, go through the Section marked "Seizure/Vitamins" for a 1<sup>st</sup> time seizure, and then the section marked "Epilepsy" for repeat offenders.

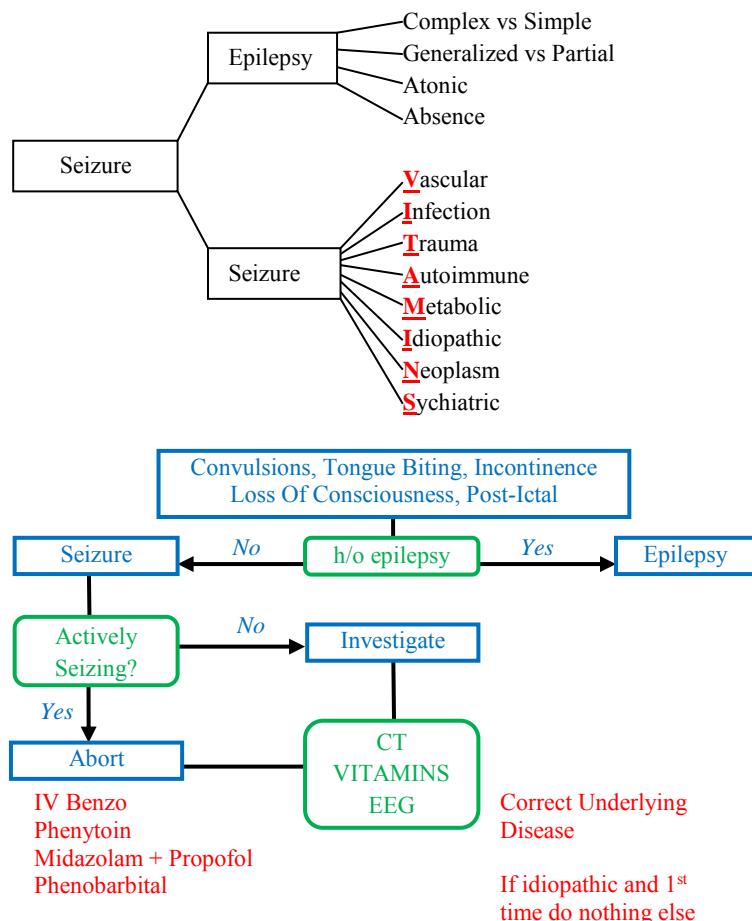
Seizure/Vitamins

On the boards, a new onset seizure will classically present as a grand mal. A grand mal seizure presents with **tonic clonic convulsions, bowel/bladder incontinence, and tongue biting**. Yet, all of these are very nonspecific. There's a **loss of consciousness**, but it's the **post-ictal confusion** that separates a seizure from alternative causes of loss of consciousness. A patient who has a seizure but is now normal requires observation, VITAMINS workup, and an **EEG**. However, when patients are actively seizing, are post-ictal, or have entered **Status Epilepticus**, they need to be treated as a **medical emergency**. The goal of treating a seizure acutely is to **reverse the underlying cause**. To do that the patient has to be alive - so the #1 priority is to **control ABCs** (Intubation, oxygenation, ventilation, IVF). Before drawing labs to investigate VITAMINS the **seizure must be aborted**. Do so by following this cascade: (1) **IV/IM Benzos** (lorazepam / diazepam) → (2) **Phenytoin** → (3) **Midazolam** and **Propofol** → (4) **Phenobarbital**. Then **draw labs** and reverse any underlying defects.

Epilepsy

A patient with **epilepsy** (any history of seizure, repeat seizure in an idiopathic cause, etc) is treated a little different. If he/she's **actively seizing** treat him/her as above - **ABCs** and **Abort Seizure**. But an epileptic also requires chronic therapy to decrease the risk of another seizure. What to give is dependent on the type of seizure. **Valproate/Depakote** is the most common medication, but you need to know when to start something else (see the chart to the right). As you dose patients it's important to reach **therapeutic levels** and **switch** if they **seize while therapeutic**. Diagnose the seizure and the location of origination with **EEG** by looking for **spike and waves** indicative of organized neuronal firing (abnormal for an awake adult). **24hr video monitoring + EEG** may be required to catch the seizure and its manifestations.

Many new patients will be put on the "wonder drug" levetiracetam (Keppra) in clinical practice. This usually does not show up on the Boards but often does on the Wards. Likewise, being able to describe a particular type of seizure is Step 1 stuff, but reviewed to the right.



VITAMINS		
<b>V</b> ascular	Stroke, AVM, Hemorrhage	FND + Risk Factors
<b>I</b> nfxn	Encephalitis, Meningitis	Seizure + Fever
<b>T</b> rauma	MVA, TBI	h/o Trauma
<b>A</b> utoimmune	Lupus, Vasculitis, Arthritis	Rash, Purpura, ANA
<b>M</b> etabolic	Na, Ca, Mg, O <sub>2</sub> , Glucose	CMP, ABG, Mg, Phos
<b>I</b> diopathic	"Everybody Gets One"	1 <sup>st</sup> Time Seize
<b>N</b> eoplasm	Mets vs Primary	h/o Cancer, headache
<b>S</b> ychiatric	Faking it, Iatrogenic	Faking it / Hand Drop

Partial vs Generalized

Partial = Part of the Brain

Generalized = Total Brain Involvement

**Carbamazepine** **Phenytoin**

**Valproate** or **Lamotrigine**

Complex Vs Partial

Complex =  $\oplus$  LOC

Partial =  $\ominus$  LOC

Specific Types

Atonic =  $\ominus$  Loss of Tone,  $\ominus$  LOC

Absence =  $\oplus$  Loss of Tone,  $\oplus$  LOC

Myoclonic = Jerky Muscle

**Valproate**

**Ethosuximide**

**Valproate**

Intro

Stroke is a high impact disease; it's the **3<sup>rd</sup> leading Cause of Death** and a leader in lingering **morbidity**. Not only that, but it's a **preventable** and largely **time-sensitive** disease.

Etiologies

Stroke is a **brain attack** - that is, an ischemic injury to the brain parenchyma. This can happen in three ways. 1) **Emboli** may form on diseased valves, in the left atrial appendage during Afib, or on a carotid dissection/stenosis. The emboli will then travel to a smaller vessel where it gets lodged in the lungs and occludes flow. 2) **Thrombi** may form in a vessel. This is the same pathogenesis as atherosclerotic plaque in the heart, predisposed by CAD/PVD/HTN/Atherosclerosis. Of the etiologies, 3) **Hemorrhage** has the worst prognosis. Both **subarachnoid** and **intracerebral hemorrhage** (discussed elsewhere) are considered "brain bleeds" - usually a product of hypertension. In this case blood does flow, just into the parenchyma. It's an irritant, decreases perfusion to the distal brain, and is a potential mass effect.

Presentation

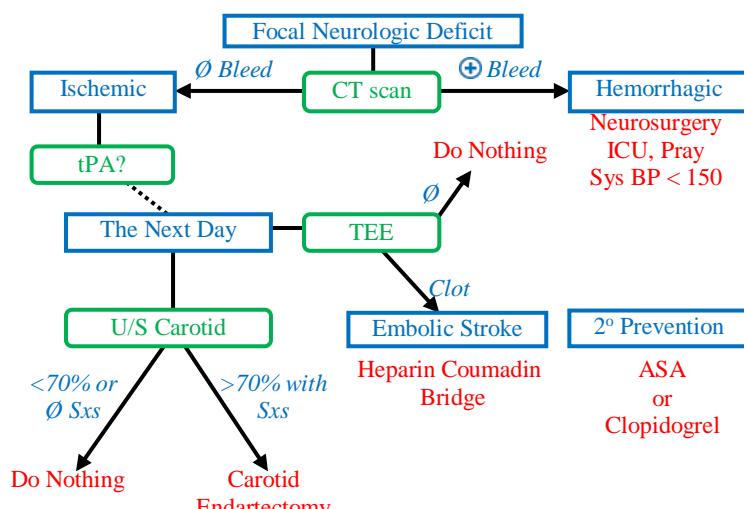
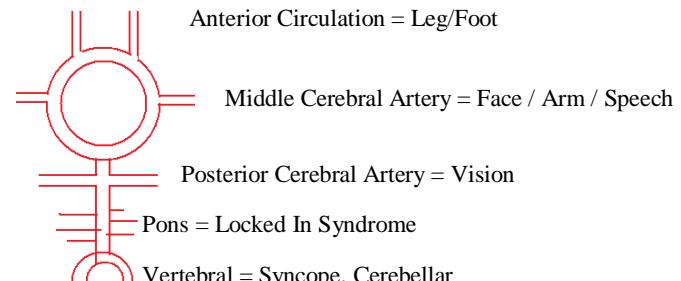
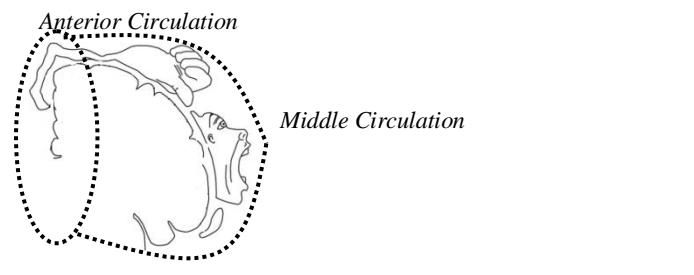
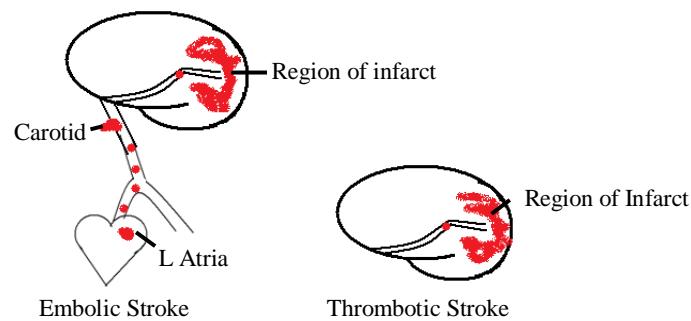
The clinical presentation does not correlate with etiology. The tell-tale sign of any stroke is **Focal Neurologic Deficit of Acute Onset**. The location of infarct correlates to the defect. Thus a sudden onset loss of **motor, speech, sensation, or level of consciousness** prompts investigation. It becomes important to revisit arterial supply and vascular distribution. The **posterior circulation** is made of the **vertebral arteries** that come to form the **basilar artery**. Lesions here cause **cerebellar dysfunction, Δ in Mental Status, and blindness**. The **anterior circulation** is comprised of the **anterior and middle cerebral arteries**. These feed the speech centers, motor strips, and sensory strips. Recall the homunculus.

Certain elements of presentation may help beyond simply location. For example, the patient with **Afib** has an increased likelihood of embolism. **Painful neck pulsations** and a patient who **grabs her neck** are indicative of a carotid dissection. Patients who experienced **TIA**s (FND < 24hrs) in the past likely have a thrombotic event.

Diagnosis and Workup

Regardless of presentation, in the **acute phase** of a stroke (**within 30 minutes** of presentation and **within 6 hrs of symptoms**) the goal is **rapid identification** and intervention if possible. The first thing to do is a **CT scan without contrast** to rule out hemorrhage. At this point therapeutic intervention is considered. After the initial presentation (usually on day 2), additional testing may be done. **Transesophageal Echo** assesses the cardiac valves, **carotid duplex** for carotid stenosis, **MRI** to look at areas of ischemia (CT scan is not to diagnose CVA, but to rule out hemorrhage), and **CT angiogram** for blood vessels of the brain.

Etiology	Type	Examples
Ischemic	Embolus	Afib, Carotid Stenosis
	Thrombotic	CAD/PVD, Atherosclerosis, HTN
Hemorrhagic	Hemorrhagic	SAH, Intracerebral, HTN



Treatment Options

Treatment is broken into the “treat right now” and “secondary prevention.” Most strokes occur and it’s too late - nothing can be done for them - so preventing the next one becomes crucial.

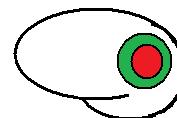
**Aspirin** is the mainstay treatment unless the patient gets/has (1) **ASA Allergy**, (2) **GI Bleed**, or (3) **Strokes while on ASA**. At that point ASA is switched to **clopidogrel**. If the stroke's embolic from Afib a **Heparin to Coumadin Bridge** is considered, given the patient's **CHADS2 score**.

The big to-do for stroke is **tPA**, the **clot buster**. It has greatly restricted use but can actually rescue ischemic tissue and preserve the **penumbra**. The risk of transforming an ischemic stroke into a hemorrhagic one is high so caution must be used. Even if tPA isn't used the stroked brain will die. However, optimally controlling **oxygen >95%, tight glucose control 60-100**, and **Blood Pressure** (permissive hypertension) will allow the at-risk penumbra to recover.

For future stroke prevention, control dyslipidemia with **statins** with **HDL >40** and **LDL <100**, control diabetes with **Insulin, bG <125** ( $\text{HgbA1C} <7\%$ ), continue cardiovascular exercise, and daily ASA. These will decrease the risk of stroke.

In the condition where there's a **carotid dissection** or **carotid stenosis >70%** and **symptoms**, a carotid endarterectomy may be performed.

If there's Afib perform a Heparin to Coumadin Bridge. Rate control is equivalent cardioversion. Anticoagulation is not required if the rhythm is converted, though the tendency is to leave them in afib with anticoagulation.



Penumbra (can be saved)

Infarct (cannot be saved)

<b>tPA</b>	<b>ASA</b>
Thrombotic / Embolic only Never if Brain Bleed Ever Sxs onset < 3 hrs Ø if surgery in 21 days Ø if head trauma	Primary med for secondary prevention
<b>Heparin / Coumadin</b>	<b>Clopidogrel</b>
Embotic Stroke Prevention <u>CHF</u> <u>HTN</u> <u>Age &gt; 65</u> <u>DM</u> Stroke (worth 2)	Used when the patient cannot tolerate ASA or when ASA fails. Caution thrombocytopenia

<b>Test</b>	<b>Notes</b>	<b>Timing</b>
CT scan	Do it at presentation, rule out hemorrhage but is Ø useful to diagnosis CVA until days later	<30 min
MRI	Visualize areas of ischemia, track resolution, confirm diagnosis if unsure	24 hrs
U/S Carotid	Carotid Visualization to rule out or rule in carotid artery stenosis and dissection	2 <sup>nd</sup> Day
TTE TEE	Visualize heart valves, especially in Afib, r/o source of embolism. TTE ↓Se, Easy TEE ↑Se, Difficult	2 <sup>nd</sup> Day
CTA, MRA	Visualize blood vessels, Ø require angiogram	2 <sup>nd</sup> Day

<b>Treatment</b>	<b>Notes</b>	<b>Timing</b>
tPA	Rescue ischemic tissue, recover penumbra, only if symptoms start <3 hrs ago. High risk of hemorrhagic transformation, Mainstay of acute therapy	One time
Heparin	If actively worsening stroke or suspected embolic disease. Bridge to Coumadin for embolic stroke only	X 6 months
ASA	Mainstay of secondary prevention. Almost as good as clopidogrel and it's cheap.	Forever
Clopidogrel	ASA Allergy or stroke while on aspirin. Risk of TTP and Thrombocytopenia	Forever

Tremor is an uncontrolled, uncoordinated, and unwanted movement of the extremities or trunk. It may be caused by many things (medications and diseases alike) and each tremor generally has a unique history and presentation.

### 1) Parkinson's

Parkinson's is one of those diseases that's very well studied with a lot of information attached to it. It's also a disease unlikely to be misdiagnosed. It's caused by a **Loss of Dopaminergic Neurons** within the **substantia nigra**. This essentially eliminates the "go" signal, prevents **initiation of movement**, and manifests as a pill-rolling tremor. There will also be signs of **bradykinesia** (difficulty initiating movement) such a **cog-wheel rigidity**, **shuffling steps**, **unsteady gait**, and/or an **expressionless face**. Parkinson's is a clinical diagnosis (though an MRI can be used to visualize the substantia Nigra). Treatment is based on **removing Ach** (lifting the brakes) and **supplying dopamine** (increasing the gas). There are many treatment options but they're chosen is based on **functional status** and **age**. It's presented in the algorithm to the right. Learning details about the medications is useful to get step 2 questions right, but you generally don't fool around with these meds.

### 2) Essential Tremor

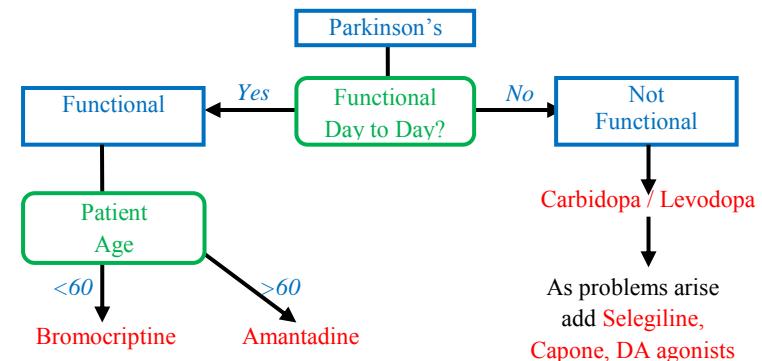
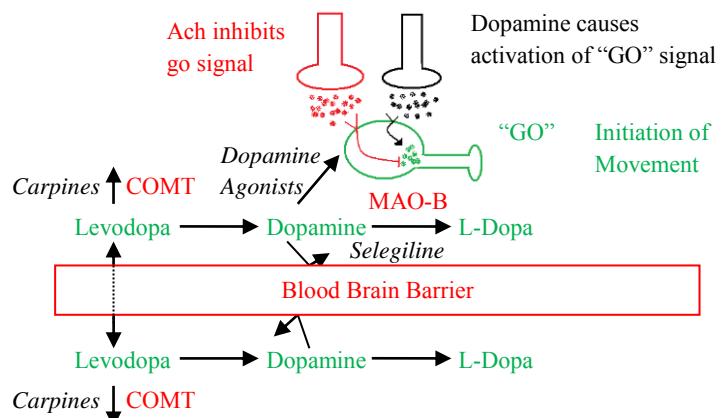
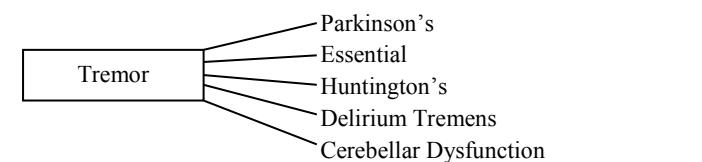
The essential tremor, also known as a **familial** tremor, is one that's **absent at rest** but **worsens with movement**. There's typically a family history of a tremor. It unfortunately doesn't have a treatment. Consider this when other causes have been ruled out already. For control of symptoms try **beta blockers**.

### 3) Cerebellar Dysfunction

A tremor that's **absent at rest** and gets **worse the closer to the target** the finger gets. This is also called an **intention tremor** because it arises as the patient attempts (intends) to do something. Since there's a physical lesion (stroke, atrophy) of the cerebellum there's no therapy.

### 4) Delirium Tremens

Occurring during times of **EtOH (or Benzo) withdrawal**, a patient may have a pronounced tremor with hands **outstretched** and **dorsiflexed**. When monitoring patients for withdrawal, elevations in **BP** or **HR** are used for early detection. A patient that's now **seizing** or who is frankly **psychotic** is in acute withdrawal. Give benzos, NOW. Ideally the patient would be on a **long acting benzo before the seizure**, preventing this event. The recommended drug, Lorazepam, has gained a lead on chlordiazepoxide. You shouldn't have to choose between the two benzos.



Drug	Mechanism	Indications	Side Effects
Amantadine		Functional >60 years old	
Carbidopa Levodopa	Dopamine Agonists	Nonfunctional	HoTN, Psychosis
Selegiline	MAO-B Antagonist	Nonfunctional Exacerbate	Delays Progression
Capones	COMT Antagonist	Nonfunctional Exacerbation	Delays Progression
Bromocriptine	Dopamine Agonist	Functional <60 years old	-

Disease	Rest	Moving	Other	Tx
Parkinson's	⊕	Improves	Old (>60)	Complex
Essential	⊖	Worsens	Middle (>30)	Propranolol
Cerebellar	⊖	Intention Tremor	Cerebellar Lesion	Ø
DTs	⊖	⊖	↑HR, ↑BP Delirium	Benzos

Intro

**Weakness** is a complicated complaint with a broad differential. Diseases can be broken down to demyelinating diseases, diseases of the neuromuscular junction, spinal cord lesions, lesions of the peripheral nerve, and lesions of the muscle itself. In this section we'll tackle classic diseases most commonly tested. See the Intern Content for a more advanced discussion of weakness.

- ALS – spinal cord
- Lambert-Eaton / Myasthenia = neuromuscular junction
- Multiple Sclerosis / Guillain-Barré = Demyelinating

Amyotrophic Lateral Sclerosis

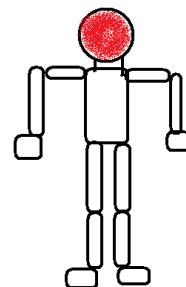
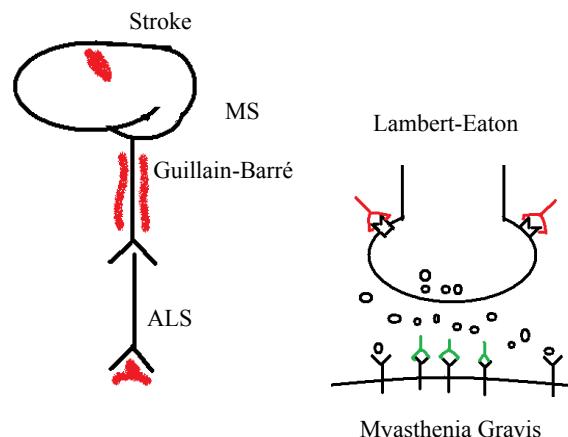
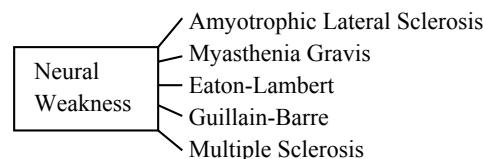
ALS is a **chronic, progressive** disease of **unknown etiology** that produces **asymmetric Upper Motor Neuron and Lower Motor Neuron lesions**, generally sparing the eyes. Look for **atrophy** and **fasciculations** of the tongue and extremities commingled with **upward Babinski** and **hyper-reflexia** of the extremities. In late stage, LMN symptoms predominate. Associated symptoms are **emotional lability** and **weight loss**, though sphincter tone is maintained. Rule out spinal lesions with a **CT/MRI/Spinal X-ray** and confirm the diagnosis with an **EMG**. There's no treatment. The association with **superoxide dismutase** learned in step 1 is present in only 10% of cases; most are idiopathic.

Myasthenia Gravis

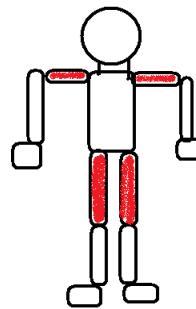
An **autoimmune** disease targeting **post-synaptic Ach-R**. While the extremities may feel effect, the typical muscles affected are the **eyes** (Diplopia, Ptosis) and **throat** (swallowing). They're affected the most because the disease causes **fatigability** (Ach-blockade requires increased Ach concentrations to make the muscles work, depleting reserves). The fatigue is **relieved by rest**. On exam the patient will have **intact reflexes** and you may produce progressive weakness on repeated use. The initial test is the **Anti Ach-R Antibody** (nearly 100% specific with clinical symptoms). The best test is **EMG** showing decreased amplitude on repeated stimulation. **Pyridostigmine** is first-line therapy, thereby increasing **acetylcholine concentration**. If the disease is associated with a **thymoma** (diagnosed by **CT scan of the chest**), then a **thymectomy** may be curative. If the weakness compromises life functions (eating, breathing) then give either **IVIG** or **plasmapheresis** (you cannot choose between them). Finally, refractory disease is treated with **prednisone** or disease modifying agents such as azathioprine.

Lambert-Eaton

Lambert-Eaton is a **paraneoplastic syndrome** producing an **antibodies against presynaptic Calcium channels**. This inhibits the release of Ach-vesicles. It produces a **proximal muscle weakness that improves with repeated use**. The clinical diagnosis is sufficient. However, the **antibodies** could be checked. A **CT scan** of the chest should be done to identify the small cell cancer causing the disease. The best test is an **EMG** showing improvement with repetitive use. The cancer is treated with **chemotherapy, radiation, or resection** (small cell lung cancer responds well to chemo and radiation). If cure is not possible, then symptom control is achieved with **prednisone** (palliative measures).



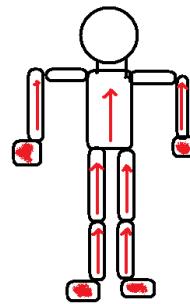
Acetylcholine receptor antibodies block the function of acetylcholine on nerve contraction. Muscles you use the most fatigue first (Eyes, Throat) and worsen with repetitive motion.



Antibodies against cancer cells also function against presynaptic calcium channels. With repetitive use these antibodies are overcome. Affects muscles that are used the least (the proximal muscles)

Guillain-Barré

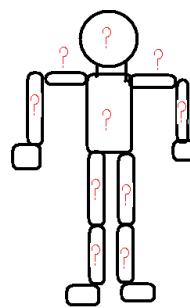
Guillain-Barré is a demyelinating **autoimmune disease** that produces an **ascending paralysis** (weakness begins in legs, starting **distally, moving proximally**) 1-3 weeks after **diarrhea** (campylobacter) or **flu vaccinations**. There's always a **hyporeflexia** while **paresthesia** and **autonomic dysregulation** may or may not be associated. Because the ascension may reach the diaphragm (causing death) the first step is always to ascertain the need for **intubation**. To test for the disease look for evidence of autoimmune processes in the CSF with an **LP = lots of proteins, very few cells**. Confirmation is made with **EMG** and **Nerve Conduction Velocity** showing decreased nerve conduction velocity. Treat with **IVIG** or do **plasmapheresis** to eliminate the causative IgG Ab response against myelin. While it looks and feels like autoimmune, **NEVER** give steroids.



Antibodies against myelin in the peripheral nerves begin most distally and work its way up. The demyelination is not permanent

Multiple Sclerosis

MS is a disease with a presumed **autoimmune etiology** occurring in patients with a genetic susceptibility AND exposure to environmental triggers, creating antibodies against **myelin** (a **demyelinating disease**). It's difficult to diagnose MS based on only one presentation because it's defined by **neurologic symptoms separated by time and space** (blurry vision two years ago and now tingling in the arm for example). The primary complaint is often **blurry vision / diplopia** (from **optic neuritis**). If suspected, get an **MRI** looking for **periventricular plaques, multiple lesions, or lesions on corpus callosum**. Active lesions are easy to spot but older healed lesions may not be. Because it's often a **relapsing-remitting** disease (other forms are beyond the scope of a medical student) an MRI may be non-diagnostic. In this case, an **LP** with **pleocytosis** and **oligoclonal IgG** or **evoked potentials** may be done. These are ancient - like the Tensilon test - and aren't done. Because MS can linger there needs to be **chronic management (Interferon-B1b)**, drugs for **acute flares (steroids)** and because it can cause any type of lesion in the cord, **symptomatic relief** for urinary retention (**Bethanechol**), incontinence (**Amitriptyline**), and spasticity (**Baclofen**).



Any nerve, motor, or sensory can be affected anywhere at any time then go back to normal just as suddenly.

	<b>History</b>	<b>Associated Sxs</b>	<b>Repeated</b>	<b>Diagnosis</b>	<b>Tx</b>	<b>Path</b>
ALS		Emotional Lability Weight Loss	N/A	XR Spine (normal) EMG	Ø	?
Myasthenia Gravis	Chronic Fatigability of eyes and throat worse in PM or with use	Intact Reflexes Thymoma	Fatigue Worsens	1 <sup>st</sup> Anti-Ach-R-Ab f/u with CT Chest Best EMG = Fatigue	Chronic: Prednisone Acute: IVIG Plasma Surg: Thymectomy Sx: Stigmynes	Anti-AChR Post Synaptic
Lambert-Eaton	Proximal Muscle Weakness in a patient with Cancer	Cancer Symptoms (weight loss, hemoptysis)	Improves	CT Scan	Tx cancer, Prednisone Azathioprine	Anti-Calcium presynaptic antibodies
Guillain-Barré	Ascending Paralysis 1-3 weeks after diarrhea	Hyporeflexia, Paresthesia Autonomic Dysregulation	N/A	1 <sup>st</sup> = LP = ↑Prot, ↓Cells Best = EMG	IVIG Plasmapheresis Ventilator	Autoimmune
Multiple Sclerosis	Neurologic symptoms separated in space and by time with a relapsing and remitting course in a female. Diplopia is most common	Any neurologic Symptoms	N/A	MRI (1 <sup>st</sup> and best) LP (oligoclonal IgG) and Evoked Potentials only if MRI equivocal	Chronic: Interferon Acute: Steroids Incontinence: Amytript Retention: Bethanechol Spasticity: Baclofen	Autoimmune

Introduction

Bleeding in the third trimester is usually benign but can also be an ominous sign. The most common causes of bleeding are **polyps** and **cervical lesions**; they have nothing to do with the pregnancy itself. Both are no big deal and can be dealt with after pregnancy. Specifically, **NO** procedure would be performed for the diagnosis or treatment of a cervical cancer until after the baby is born. When contractions are starting or the cervix ripening, there might be a **bloody show** - a signal of impending delivery. Since it can be normal or pathological, it must be determined which one it is. So, check **mom (vital signs)**, the **vagina (speculum exam)**, **baby (non stress test)**, and the **placenta (ultrasound)** for clues. If the bleeding is impressive it's also worth checking her "blood status" with CBC, Coags, and a DIC panel.

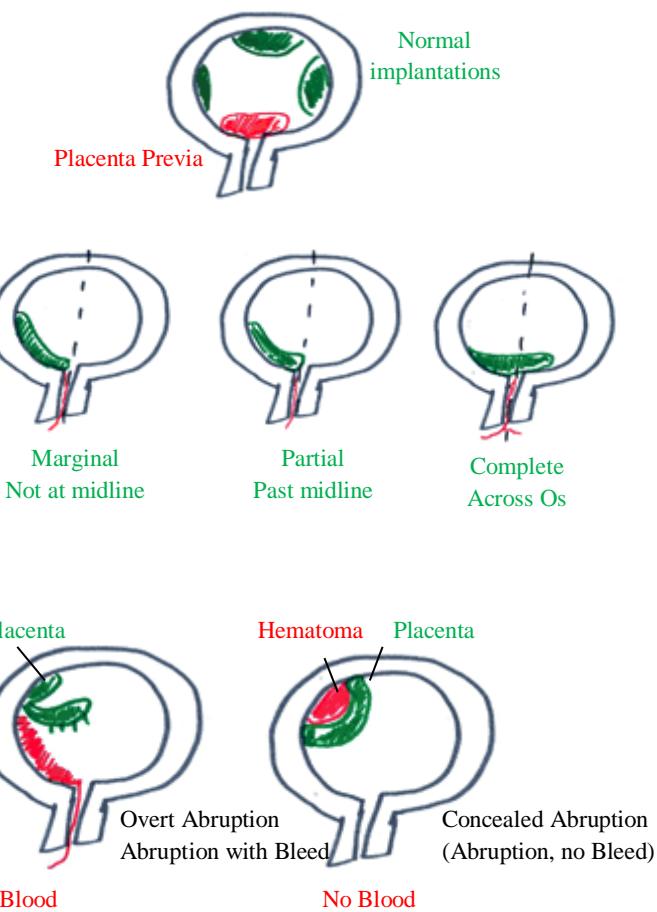
Presented here are the four diseases commonly tested against each other.

Placenta Previa

Mom presents with a **painless 3rd trimester bleeding**. "Previa" means, "implanted across the os." In this case, the placenta has implanted across the cervical os. That's not the normal spot of implantation. The placenta looks for a good place to drill; it wants a rich vascular supply. In a woman who has had multiple pregnancies (**multiparity**) the uterus may be dried up; the placenta must reach **out** rather than deep to find blood. The other way this happens is in **multiple gestations** where competing placentas push each other to implant over the cervical os. A routine **ultrasound** early in pregnancy can predict this disease by revealing a **transverse lie** rather than cephalic. Even if diagnosed early, the placenta may **migrate** so that it's no longer over the os. But if it doesn't, when the cervix opens it stretches the placenta and tears it. The blood is **baby's blood** so mom won't notice, but baby is losing its blood supply and will present with **fetal distress** indicating a **C-section**.

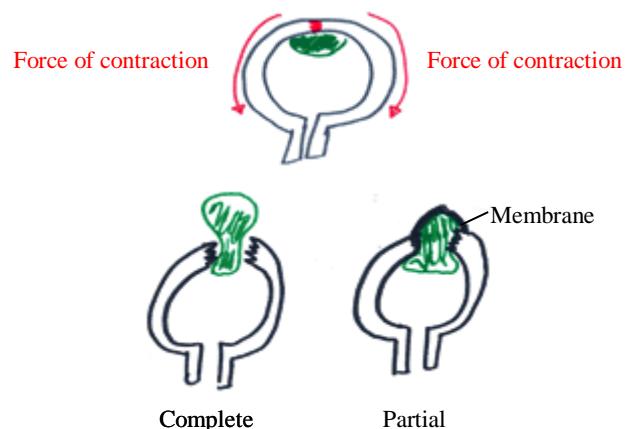
Abruption

Mom presents with a **sudden onset painful 3rd trimester bleed**. The placenta literally tears off the uterus. This **tearing** hurts. The placenta would have been in a normal position on routine ultrasound. But after it's **blown off (hypertension, cocaine)** or **ripped off (MVC)**, an **ultrasound** can confirm that the placenta is no longer properly attached. A non-stress test will show how bad the damage is to baby. Little abruptions can be delivered, but on the test it's likely to be a big, bad abruption, which necessitates **cesarean section**.

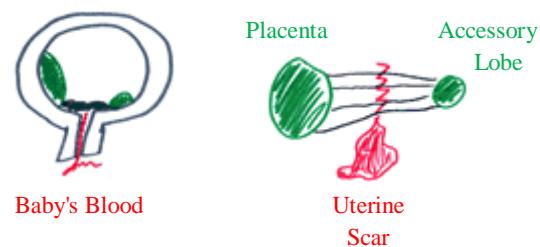


Uterine Rupture

Mom presents with a **painful bleed**. However, the diagnosis does not require bleeding and it often presents **without bleeding**. As the uterus contracts, baby should be pushed out the path of least resistance: the vagina. But if the uterus **ruptures** under its own force (risk is increased with **vaginal birth after cesarean**) baby will follow the path of least resistance into the **peritoneum**. There's no air in there so the baby will die. What to look for is **contractions** and sudden **fetal distress** followed by **loss of contractions** - these have a high index of suspicion. There isn't time to make the diagnosis so there are **NO TESTS**. Go to **crash section**.

Vasa previa

Previa means "across the os." Vasa means blood vessels. This is a rare cause of **painless 3rd trimester bleeding**. In the same way as placenta previa, it's caused by tearing of the **connecting vessels** that lay across the cervical os, connecting the placenta to an **accessory lobe**. During cervical dilation and during the **rupture of membranes**, the vessels break and bleed. Mom's losing **baby's blood** so it's painless. Baby is going to notice, however, and there will be obvious **fetal distress**. It's commonly manifested as **fetal bradycardia**.



	<b>Disease</b>	<b>Risk Factors</b>	<b>Diagnostics</b>	<b>Treatment</b>
<b>Painless Bleeding</b>	Placenta Previa	Multiparity Multiple Gestations	Ultrasound shows transverse lie	C-section
	Vasa Previa	Succinate Lobe Velamentous insertion of placenta	This triad: <b>ROM</b> <b>Bleeding</b> <b>Fetal bradycardia</b>	C-section
<b>Painful Bleeding</b>	Abruption	<b>Trauma (MVA)</b> <b>Cocaine</b> <b>HTN</b>	Ultrasound NST	C-section
	Uterine Rupture	<b>Previous C-section</b> Use of oxytocin	<b>Fetal stress + Loss of contractions</b>	Crash C-section

Gestational Diabetes

**Everyone** gets tested for gestational diabetes. Risk factors include **advanced maternal age**, preconception **obesity**, and being "fat for pregnancy" which is **>1 pound / week gestational gain**. This is important, because there are crucial differences in screening patients for diabetes in medicine and in obstetrics.

**NO** screening with **hemoglobin A1c**. The A1c is an average of the past 3 months' sugar level. In order to be diagnosed with gestational diabetes, the diabetes must occur **after week 20**, and therefore, the preceding 12 weeks would have normal sugars, and a normal A1c.

**NO** screening with the **2 hour glucose tolerance test**

**NO** screening with **fasting glucose**.

In obstetrics you use the **1 Hour Glucose Tolerance Test** (1-GTT) followed by the **3 hour Glucose Tolerance Test** (3-GTT). The first step is to feed the woman a 50g oral glucose load, check her sugar at 1 hour. If it is  $\geq 140$  she has screened positive and gets the **3-GTT**. If it is  $< 140$ , she has no gestational diabetes, and she is good to go.

If positive on any two values, treat with **insulin**.

Anemia

Both the protein and the serum component of mom's blood increases. It happens that the plasma increases more than the protein. Which means that, since hemoglobin is a concentration, there is more water and less stuff. Women are expected to become anemic. That is, the hemoglobin is low. However, they actually have an INCREASED oxygen carrying capacity and a RESERVE of red blood cells. And so it is not surprising then, that a woman's hemoglobin falls. The **nadir is at 28-30 weeks** and should **never go below 10**. If it is below 10, something is the matter. Most often it is an **iron deficiency anemia**. If found to be abnormal a more thorough evaluation of anemia is required. See the medicine lectures for the workup of anemia.

Abnormal Antibody Screen, Rh typing

This topic comes up in greater detail in its own dedicated lecture. What we want to do is prevent an Rh negative mom from identifying Rh positive babies as foreign. We do this on **all Rh-negative mom's**. What we test for is the **Rh-IgG-Antibody**. If it is **positive**, it is **too late**, and mom's immune system has already been primed to attack Rh-Antigen-Positive baby. If **negative AND dad is Rh+ or Unknown**, we protect mom from developing antibodies against the Rhesus Antigen by giving **Rhogam**.

Screen: 1 hour glucose tolerance test

- Positive  $\geq 140$  = go to 3-GTT
- Negative  $< 140$  = stop screen

Confirm: 3 hour glucose tolerance test positive if:

- Fasting  $> 95$
- 1 hour  $> 180$
- 2 hour  $> 155$
- 3 Hour  $> 140$

BUT... if fasting  $> 95$ , that's good enough and no 3-GTT needs to be performed.

Nadir at 28-30 weeks

Abnormal  $< 10$

*Screen Rh-Antigen-Negative Moms for Rh-Antibody*

*If dad is Rh-Antigen-Unknown OR Rh-Antigen-Positive  
AND  
Mom is Rh-Antigen-Negative and Rh-Antibody-Negative  
THEN  
Rhogam at 28 weeks and delivery*

Monitoring adequacy of contractions is crucial to identifying a cause of abnormal labor. To do so requires placement of an **Intrauterine Tocometer**. Placement of that device can only happen once the membranes are ruptured. What you will actually do is monitor Montevideo units. Look for a total of 200 Montevideo Units. In a 10 minute period the number and power of contractions are assimilated into one number. The cutoff is 200.

### 1) Prolonged Latent Phase

The latent phase begins with the onset of contractions and should last < 20 hours (in a first timer) or < 14 hours (in a repeat customer) but not longer. If it takes too long, it counts for "time" (see next sentence). Diagnose prolonged latent phase with **contractions, cervix < 4 cm, AND time**. The most common cause of prolonged latent phase is from **analgesic misuse** (usually being given too soon). Once diagnosed, it has to be decided if the contractions are adequate. **Adequate contractions** are defined as **3 contractions in 30 minutes** and **>40mmHg** on contractions (or 200 Montevideo units). Most of the time, a prolonged latent phase does not need much intervention. It's usually ok to **rest and wait**. Other alternatives are to hurry things along using a **balloon** to simulate baby's head engagement to facilitate cervical ripening or using **oxytocin**.

### 2) Prolonged and Arrested active phase

Expect a certain amount of cervical contraction per hour. Expect to see **1.2 cm / hour** changes in a first time mom, **1.5cm / hour** in a seasoned veteran. There are three causes of arrest of active phase: **Passenger, Pelvis, and Power**. Recognize there is not too much to do about the passenger (baby is as big as baby is and that's not going to change in a matter of hours). There's not much to do about the pelvis either (mom's anatomy is fixed). So the only thing we can do is augment the power. First, ascertain if there are **adequate contractions** (3 in 30, >40mmHg OR 200 Montevideo units). Second, see if there is **insufficient cervical change** (prolonged active phase) or **no cervical change** (arrest active phase).

If there are adequate contractions and still prolonged or arrest of active phase, consider **c-section**.

If there are **not adequate contractions** try **oxytocin** to improve contractions. If after **two hours** there's no improvement, go to **c-section**.

*Adequate Contractions:*

- 3 in 30, >40mmHg
- Montevideo 200 in 10 minutes

*Normal:*

- 20 hours for first timer
- 14 hours for repeat deliveries

*Analgesic misuse most common. NO OPIATES in latent phase!*

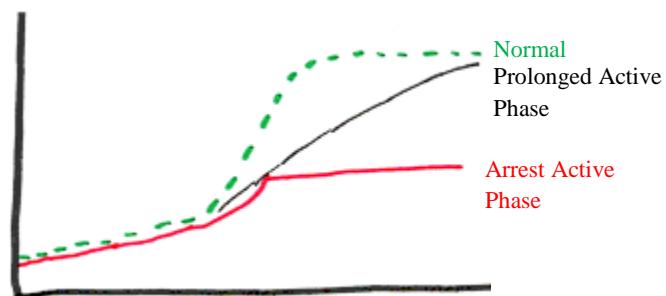
*Balloon to simulate engagement*

*Normal:*

- 1.2cm / hour change for first timer
- 1.5cm/ hour change for repeat delivery

*Oxytocin if adequacy is an issue*

*C-section if it isn't*

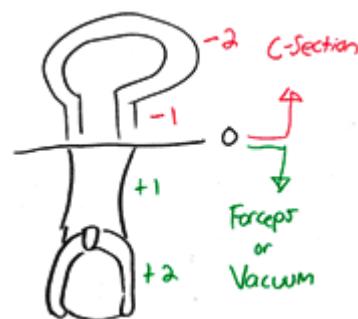


### 3) Prolonged Second Stage

The second stage of labor - the time where the cervix is fully dilated to the time baby comes out - should take **2 hours** if **no epidural** and **3 hours** if there's an **epidural**. Do the same thing as before. Since the only thing we can augment is the power of contractions, we assess for **adequacy of contractions** (3 in 30, >40mmHg OR 200 Montevideo units). Give **oxytocin** if inadequate, perform **ob operations** if adequate. Which operation is performed is dependent on the fetal station. If +1 or +2, use **Vacuum or Forceps Delivery**. If 0, -1, or -2, do a **C-section**.

#### 4) Prolonged Third Stage

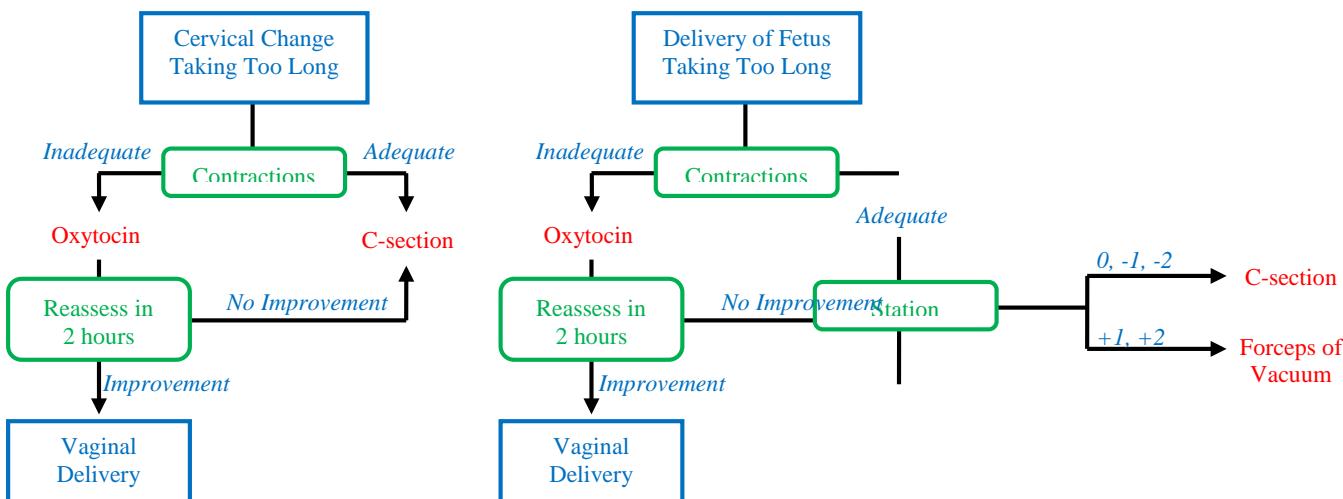
The third stage of labor begins with delivery of the baby and ends with the delivery of the placenta. Delivery of the placenta should occur within **30 minutes**. By this time the uterus is tired. The placenta will always fit (not passenger) through mom's pelvis (not pelvis). The only thing that can go wrong is an issue with power. This is especially true if oxytocin was needed to get baby out. To facilitate the placenta being delivered, perform **uterine massage** (external maneuver), then **oxytocin**, and if all else fails, reach into the uterus and perform **manual manipulation**.



*Can only be power*

*In order:*

1. Uterine Massage
2. Oxytocin
3. Manual Manipulation



Ultrasound

Ultrasound is a great tool. It provides noninvasive imaging of intrauterine contents. It's useful to identify **gestational age** with a degree of error in weeks equal to the trimester it's used (1st trimester is +/- one week, 3rd trimester is +/- 3 weeks). It's used primarily to **diagnose intrauterine pregnancy and fetal age**. It can be used later on to assess fetal wellbeing.

Transcranial Doppler

A specific use of the ultrasound is to assess for **fetal anemia**. After **20 weeks** an increased flow by intracranial doppler is indicative of fetal anemia. It has **no risk** as it's an ultrasound, but it also gives us **no access**. We can't know what the fetal hemoglobin is or provide the fetus any blood. It's a great screening tool for patients at risk for developing a fetal anemia - especially in the setting of **isoimmunization**. See that content for more details.

Chorionic Villous Sampling (CVS)

Certain moms will have trouble with pregnancy and may warrant genetic counseling. Two types of patients may want to consider invasive testing of her fetus. 1) **Advanced maternal age** (age >**35 years**) who have increased risk of **non-disjunction** (resulting in a Trisomy; 13 = Patau, 18 = Edwards, 21 = Down) 2) and those who have suffered from infants with **birth defects, fetal demise, and mental retardation**. The idea is if the fetus can be assessed early enough and significant disease is detected, we can abort it and try again so as not to end in heartbreak. Chorionic villous sampling can be done early - at **10-12 weeks** - but it's **invasive** and carries a significant risk of fetal demise. If the developing fetus is accidentally poked at 6 weeks, the piece taken may cause it to die. The sampling obtains a piece of the baby so direct genetic testing can be performed. Look for a **positive quad screen** and **gestational age < 12 week**.

Amniocentesis

Amniocentesis can serve a similar purpose to the chorionic villous sampling. It takes some of the fluid within the amniotic sac. Baby's cells are floating around in there, which provides the DNA to do genetic testing. It's not reliable until **16 weeks**. However, since it doesn't take a piece of the baby it's less dangerous. It's used to look at **amniocytes** (baby's genetic material) and the **AFP content**. Again, the wait is longer with CVS but it's a bit safer. Amniocentesis can also be used to assess fetal anemia using the Liley Graph (this has been abandoned given the noninvasive transcranial doppler) as well as to assess the **Lecithin: Sphingomyelin ratio**.

Percutaneous Umbilical Blood Sampling (PUBS)

This is a definitive means of **diagnosing and treating fetal anemia**. It's like putting an IV into baby while baby is still in the uterus. A blood sample to determine the exact hemoglobin can be obtained and there's access to transfuse **blood**. This is the last step in the evaluation of fetal anemia. The transcranial doppler will be positive, there will be risk for fetal anemia, and now the baby has to be transfused to survive. This is rarely the right answer; look for a very well-worked-up fetus that is not ready to deliver. It can be performed at >**20 weeks**.

<b>Procedure</b>	<b>Gestational Age</b>	<b>Goal</b>	<b>Risk of Loss</b>	<b>Bonus</b>
Ultrasound	Any	Intrauterine Pregnancy Fetal age Fetal Well-being	No risk	1st Trimester +/- 1 week 2nd Trimester +/- 2 weeks 3rd Trimester +/- 3 weeks
Transcranial Doppler	>20 weeks	Screen for fetal anemia	No risk	No access (compare to PUBS)
Amniocentesis	>16 weeks	AFP, Genetic Material	1/200	> 16 weeks: Genetics >24 weeks: Liley Graph > 36 weeks: L:S ratio
Chorionic Villous Sampling	10-12 weeks	Genetics, Karyotyping	1/150	None
Percutaneous Umbilical Cord Sampling	> 20 weeks	Confirm Fetal Anemia Treat Fetal Anemia	1/30	Access for transfusion

*Listed in order of risk ascending order of fetal demise*

These tests are usually in response to **decreased fetal movement** - that is, mom comes in worried. Note that it is decreased fetal movement; absent fetal movement should get an ultrasound to rule out fetal demise. These tests could also be ordered in **high risk patients** who need close monitoring. Finally, some tests, such as **contraction stress testing**, are done as delivery begins.

#### Non-Stress Test

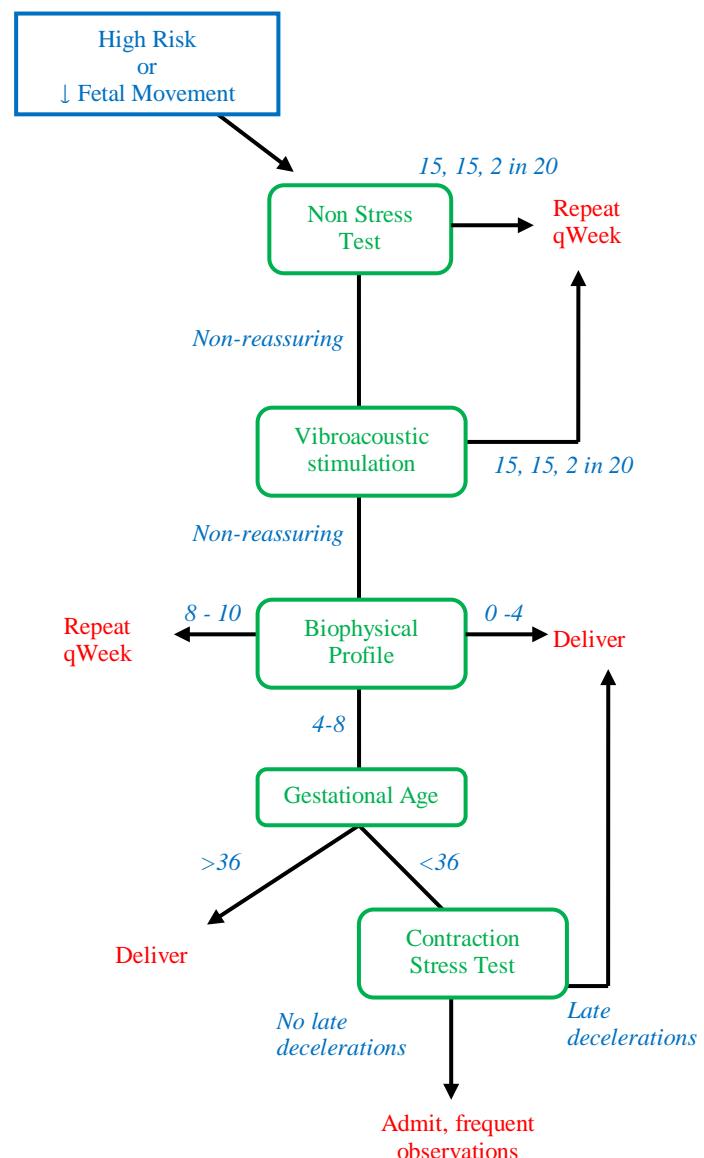
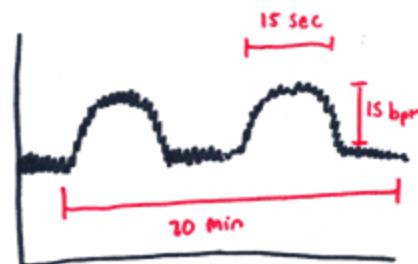
A non-stress test assesses the fetal heart rate for **accelerations** and **variability**. What's being looked for is, "15, 15, 2 in 20". The goal is an **increased heart rate of 15 bpm** sustained for **15 seconds** and occurring **twice in 20 minutes**. If we see a good non-stress test it's called a **reactive NST** (baby is doing well). If it was a test for **decreased fetal movement**, no further testing is required. If it was for a **high risk patient**, then continue **weekly until delivery**. Now, if the, "15, 15, 2 in 20", isn't seen it's called a **nonreassuring NST** and we go to the next step.

That next step is **vibroacoustic stimulation**. Baby may be non-reassuring because it's sleeping. If, "15, 15, 2 in 20," with vibroacoustic stimulation, then it's counted as though the NST was reassuring (see above). If it still isn't, "15, 15, 2 in 20," with stimulation, then it's on to the Biophysical Profile.

#### Biophysical Profile

This is similar to APGAR, but in utero. It's performed using information from the **NST** and an **Ultrasound**. There are 5 factors that go into a BPP: NST, Breathing, Body Movement, Tone, and **Amniotic Fluid Index (AFI)**. Each is worth **2 points**. Using the BPP is quite complicated in real life. Let's try to simplify it. If baby is in trouble (basically dead) it needs to be **delivered**; that is a score of **0-2**. If baby is doing great (basically, normal) then treat it just like a normal NST with **weekly assessments**; that is a score of **8-10**. If it's in between, a decision needs to be made: does the benefit of further development outweigh the risk of fetal death? If the bun is basically done, (**gestational age > 36 weeks**) just **deliver**; it's NOT worth the risk. If the baby is premature (**gestational age < 36 weeks**), go on to a **contraction stress test**; it probably is worth staying in but the risk needs to be assessed further.

If < 30 weeks, it's 10, 10, 2 in 20.



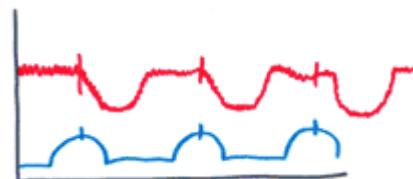
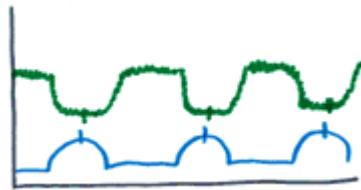
Contraction Stress Testing

When a woman is in active labor it transforms an NST (fetal monitoring) into a CST. An adequate test requires **3 contractions every 10 minutes**. An NST looks at accelerations. Conversely, **decelerations** are what matters in a CST. BUT – the test should not be performed if there are contraindications to induced contractions.

There are **early decelerations** which simply means **head compression**. The image you'll see is the decelerations mirroring the contractions: the nadir of deceleration is at the peak of contraction. This is **nonworrisome**.

There are **variable decelerations** which come from **cord compression**. The image you'll see will show decelerations completely unrelated to the contractions. These are also **nonworrisome**.

There are **late decelerations** which come from **uteroplacental insufficiency**. This is bad. This counts as fetal distress. It will look show the decelerations starting at maximum contraction and nadir after contractions end. This warrants **immediate delivery**.



There are a variety of contraception options available. It's easiest to just deliver them in a chart.

#### **Long-Term, High Efficacy, Very Invasive**

*Reserved for women who have completed child bearing, are ready to have no more children, and want to guarantee they don't get pregnant again*

Implanon	Implantable	3 years	
IUD - Mirena - Copper	Implantable	5 years	Intrauterine infections and atypical bleeding
Tubal Ligation	Surgical	Irreversible	CAN cause ectopic pregnancy
Vasectomy	Surgical	Irreversible	Male version of contraception

#### **High Efficacy, Non-Invasive**

Women who want temporary contraception and are highly compliant. Risk of failure is higher, but the invasiveness is far less. No restriction

Depo-provera	Injection	3 months	
Ortho Evra	Patch	month	Increased risk of DVT
NuvaRing	Inserted	month	Can fall out and she won't realize it
<b>OCPs</b> (estrogen, progesterone)	<b>Oral</b>	<b>daily</b>	<b>If this is an option on the test, pick it</b> <b>Requires daily compliance</b>
Mini-pill (progesterone)	Oral	daily	Must be taken religiously down to the hour

#### **Low Efficacy, Non-Invasive**

Are prn in usage. High risk of failure.

Condoms	Male controlled	prn	<b>STI protection</b>
Diaphragm	Female controlled	prn	With spermicidal, some STI protection
Female Condom	Female controlled	prn	

#### **DO NOT WORK**

Family Planning	More likely to get a woman pregnant than to prevent it. This is what counselors will do with women when they are having trouble conceiving
Withdrawal method	"Coitus Interruptus." Pre-ejaculate can have semen in it. Failure to pull out once can result in failure. No STI protection.

### Introduction

High blood pressure in a pregnant woman is neither good for baby or mom. Women of child bearing age should not be hypertensive. It can be simply the **changes of pregnancy** or it could be an ominous foreshadowing for the dreaded **Eclampsia**.

#### 1) Transient Hypertension (tHTN)

Just like normal patients, pregnant females can have a high blood pressure because they get nervous (**anxiety** or **white coat hypertension**) or due to **exercise** (running to the office because she was late). So, if a hypertensive patient is discovered ( $\geq 140 / \geq 90$ ) the first thing to do is just let her relax and **recheck it** (same visit). In a medicine patient we wait two weeks and recheck. However, hypertension in a pregnant female can be more than just hypertension, so we **SHOULD** get a **urinalysis** (rule out **proteinuria**) and have her **keep a log** (i.e ambulatory blood pressure monitoring). If it goes back to normal, great - don't worry about it.

#### 2) Chronic Hypertension (cHTN)

Hypertension before pregnancy is defined as a chronic (not transient) blood pressure of  $\geq 140 / \geq 90$  before 20 weeks. IE this is someone who had hypertension prior to the pregnancy. It can complicate things. Absolute pressures can no longer be used as markers for eclampsia. But the goal remains the same: prevent organ damage. Control the blood pressure with  **$\alpha$ -methyldopa**, the only anti-hypertensive safe in pregnancy (hydralazine and labetalol might also be on the test). Because blood pressure can no longer be used, a close follow-up (**urinalysis for protein** and **ultrasound for intrauterine growth restriction**) must be maintained.

#### 3) Mild Preeclampsia

When fetal proteins are released, they can cause a **diffuse vasospasm** (increase risk of thrombosis). If there's sustained hypertension with an onset **after 20 weeks**, it's within the realm of preeclampsia. MILD PreE is defined as a mildly high **blood pressure ( $\geq 140 / \geq 90$ )** and mild **proteinuria (5g/24 hrs)**. If an elevated BP is found it's time to actively look for alarm symptoms. There may be **edema of the hands** - the earliest sign of PreE turning bad. Do a CBC to look for **hemoconcentration** secondary to 3rd spacing of fluid. If there's hypertension after 20 weeks, reflex to Urinalysis and CBC, ask about edema and abdominal pain.

### Criteria to consider

1. **Blood Pressure:**  $\geq 140 / \geq 90$
2. **Timing:** whether before or after 20 weeks
3. **Urine:**  $>300\text{mg}/24\text{hrs}$  vs  $>5\text{g}/24\text{hrs}$
4. **Alarm symptoms:** any, either yes or no
5. **Seizures:** if yes, ignore all others

*Any nonsustained hypertension for any reason after 20 weeks, resolves after delivery*

*Any sustained hypertension for any reason before 20 weeks*

*Mildly elevated, Sustained BP, after 20 weeks, mild proteinuria*

4) Severe Preeclampsia

When PrE gets bad, there's going to be a high **blood pressure ( $\geq 160 / \geq 110$ )** and a **major proteinuria (5g/24 hours)** OR **any alarm symptom** (scotomata, headaches, blurry vision, epigastric pain). If these are found cover yourself by making sure it isn't going to full eclampsia. Get a **CBC**, a **DIC panel**, and **LFTs**. The goal is to **stabilize and deliver** regardless of gestational age. Eclampsia is around the corner. The answer is **magnesium**. It's prophylaxis for seizures. Then, control blood pressure with **metoprolol or hydralazine**. At the point of severe PreE, we need the baby out. Baby comes out with induced labor (**pitocin**).

*Severely elevated, Sustained BP, after 20 weeks, severe proteinuria, no seizures*

5) Eclampsia

When that vasospasm affects the brain ischemia results, followed by reperfusion edema, resulting in a **new onset seizure** - typically **tonic-clonic**. Make sure there is no HELPP syndrome with LFTs, DIC, U/A, etc. But the most important thing is to **stop the seizures with magnesium** and get the baby out. Either induce if she is already in active labor or **C-section**. The point is get the baby out or mom will die so c-section happens now, unless already in advanced labor. The test loves to give **abdominal pain** as a sign of impending eclampsia, caused by capsular stretch.

*Severely elevated, sustained BP, after 20 weeks, severe proteinuria,*

*WITH SEIZURES*

6) HELLP Syndrome

Defined as **Hemolysis Elevated Liver Enzymes and Low Platelets**. Treat it like Eclampsia.

	<b>Blood Pressure</b>	<b>Timing</b>	<b>Urine</b>	<b>Symptoms</b>	<b>Treatment</b>
Transient HTN	>140 / >90	<b>Unsustained</b> after 20 weeks	Ø	Ø	Conservative <b>Keep a Log</b>
Chronic HTN	>140 / >90	Sustained, Starting <b>before 20 weeks</b>	Ø	Ø	<b><math>\alpha</math>-methyldopa</b> close follow-up
Mild PreE	<b>&gt;140 / &gt;90</b>	Sustained, Starting <b>after 20 weeks</b>	<b>&gt;300mg</b> proteinuria	Ø	> 36 weeks <b>mag + deliver</b> urgently (induced) <36 weeks <b>bed rest</b>
Severe PreE	<b>&gt; 160 / &gt; 110</b>	Sustained, Starting <b>after 20 weeks</b>	<b>&gt;5 g</b> proteinuria	Positive*	<b>Mag + BP + deliver</b> urgently (Induced)
Eclampsia	Any	Any	Any	<b>Seizures</b>	<b>Mag + Deliver</b> emergently (Section)
HELLP	Hemolysis	Elevated LFTs	Low	Platelets	<b>Mag + Deliver</b> emergently (Section)

\*Positive = Abdominal Pain, Swelling, Blurry vision, scotomata, headaches, blurry vision, epigastric pain

### Process of Isoimmunization

Isoimmunization is an immunologic response to the Rhesus antigen - an antigen present on red blood cells. An Rh-Antigen-Negative mom encounters blood that is Rh-Antigen-Positive. On first exposure she develops an IgM response, which no one notices. Not the baby or mom - not anyone. IgM can't cross the placenta so it does nothing. On subsequent exposure, however, IgG is made and can cross the placenta. This then leads to fetal anemia.

### Who do we look for?

If mom has isoimmunization it can lead to fetal anemia. The goal's to assess if mom is even capable of attacking of baby's blood, if she's ready to attack, and then if she's already started.

To be capable of attacking baby's blood mom must be **Rh-Antigen-Negative** and have an **Rh-Antigen-Positive** baby. This happens only if mom is Rh-Antigen-Negative and dad is Rh-Antigen-Positive or unknown. Somewhere along the line mom would have had to develop **Rh-Positive-Antibodies**; the exposure to an Rh-antigen-positive baby on this pregnancy is insufficient to produce fetal anemia. That means this current pregnancy must have the perfect set-up of antigen and antibody AND mom's been exposed to Rh-antigen in the past.

**Exposure** to Rh-antigen comes from either a **blood transfusion** or a previous **delivery or abortion** to an Rh-Antigen-positive baby. The antigen does not cross the placenta, so it's only in the mixing of blood that this becomes a problem. But we don't know what's happened in the past. So, if we have the combination of Rh-Antigen-Negative Mom + Rh-Antigen-Positive/Unknown Dad we start the screening process; mom is at least capable of attacking baby's blood.

The screening process is with an **Rh-Antibody** screening of mom. This happens at **28 weeks**. If she has the antibody she is ready to attack baby's blood. But "being positive" isn't enough. There have to be the **right antibodies** (**Lewis Lives, Kal Kills, and Duffy Dies**) and they have to be in sufficient quantity (**titters >1:8**). If the antibodies are right, and there are enough of them, mom has probably already started the attack.

### Fetal Risk (All 5 positive)

1. Mom Rh-Antigen-Negative
2. Dad Rh-Antigen-Positive or Unknown
3. Mom is Rh-Antibody-Positive
4. Antibodies cause anemia (Kal or Duffy)
5. Titters > 1:8

Screening for fetal anemia

Now how bad is it? Assess for fetal anemia with a **transcranial doppler**. It's **non-invasive** and is a powerful screening tool. It doesn't provide access (anemia can't be confirmed), but it's a safe way to start the screening process. The concept is that an **increased flow** is indicative of some physiologic derangement, and, given the extensive thought process above, it's likely to be from fetal anemia.

Confirming fetal anemia

If the transcranial doppler is positive, now we ask if we NEED a **definitive diagnostic step**. Definitive diagnosis involves **percutaneous umbilical cord sampling**. We actually get a **fetal hemoglobin** and find out exactly how bad off the anemia is. But, it's dangerous for baby. If the risk of premature delivery outweighs the risk of performing PUBS (**age <34 weeks**) then it's best to obtain the hemoglobin and **transfuse** through the PUBS. If the risk of PUBS outweighs the risk of delivery (**age  $\geq 34$  weeks**), just **deliver**.

Amniocentesis and the Liley Graph is no longer used. It's always the wrong answer and is never the next step.

Treatment of fetal anemia

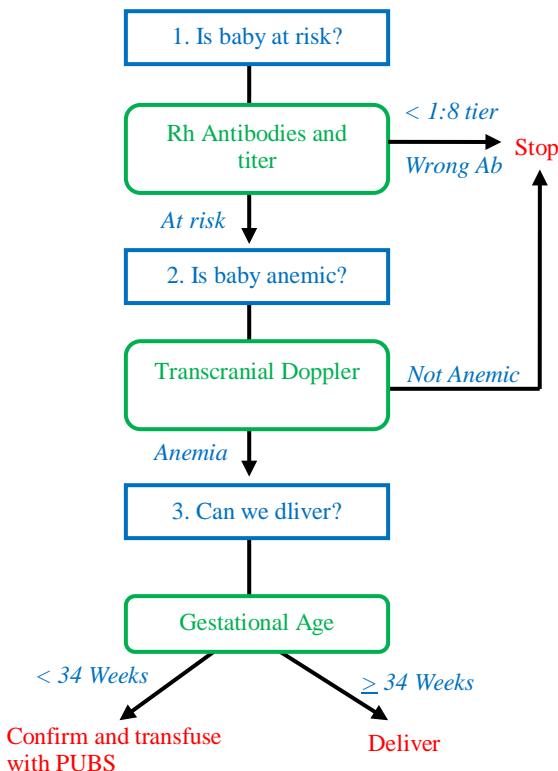
If we've committed to the PUBS and have a confirmed fetal anemia there's only one choice - **transfuse** through the pub.

Preventing Isoimmunization

Rather than respond to fetal anemia with a procedure that can result in fetal loss, it'd be much better to prevent isoimmunization in the first place. This can be done with **Rhogam-D**. An intravenous immunoglobulin binds to the Rhesus and hides it from mom's immune system. In this way she never develops the immune response and never identifies the Rhesus antigen as foreign.

Rhogam-D is never given to a mother who is already Rh-Antibody-Positive.

Rhogam-D is given to a mother who is Rh-Antibody-Negative, Rh-Antigen-Negative when pregnant with an Rh-Antigen-Positive baby (dad is positive or unknown) at both **28 weeks** and at the time of **fetal-maternal mixing of blood**, generally **within 72 hours**. Most important to identify is delivery, post-partum hemorrhage, abortion, previa, and dilation and curettage.



*Rhogam-D at 28 weeks and within 72 hours of fetal-maternal mixing in a mom who is Rh-Antigen-Negative and Rh-Antibody -Negative*

*D&C  
Placental Abruption  
Post-Partum Hemorrhage  
Abortion  
Delivery*

**1) Rupture of membranes**

Membranes can rupture **spontaneously** (<1 hr from the start of delivery is normal) or **artificially** (by us) to aid induction or to provide prenatal monitoring. The patient will feel a **rush of fluid**, either blood-tinged or not. Often it has the color of meconium. This is the amniotic sac rupturing and the amniotic cushion being released. Confirm rupture of membranes with a **speculum exam** looking for **pooling of fluid** in the posterior vagina. With that fluid perform either a **nitrazine test** (paper turns blue) or put it on a slide to look for a **fern sign**. Finally, it's essential to make sure that gush was from baby. Do an **ultrasound** which will reveal the now oligohydramnios (nothing is left). If this has progressed in a normal pregnancy, just continue delivery.

**1a) Premature Rupture of Membranes (pROM)**

In the **absence of uterine contraction** a rupture of membranes is pathologic. Typically caused by an **ascending infection**, it's time to treat for bacteria. Most commonly the bug is **E. coli** (gram negatives) and empiric coverage is with **ampicillin + gentamycin**.

**1b) Preterm Rupture of Membranes (ppROM)**

When rupture of membranes occurs, the decision of what to do is based on gestational age. If **>36 weeks (term)** just **deliver**. This is not preterm rupture of membranes, this is premature rupture. If it's really preterm (**<24 weeks**) the fetus is nonviable and induction or suction curettage is indicated. Between 24 weeks and 36 weeks is a preterm rupture of membranes and a viable fetus remains in mom. The goal here is to weigh the risk of infection (the membranes protect baby from infection) against the benefit of lung maturation. Give **corticosteroids** to mature the lungs before delivery and leave baby in as long as possible. This mom gets admitted for close observation. A **Lecithin-Sphingomyelin ratio of > 2** performed on the amniotic fluid indicates fetal lung maturity and a reduced risk of ARDS. That means deliver. An L:S ratio <2 means danger - keep baby in the oven longer if able.

**1c) Prolonged Rupture of Membranes**

If there's a prolonged time (**>18 hours**) between ROM and delivery, it's termed prolonged rupture of membranes. The risk of **Group B Strep** goes way up. Cover with amoxicillin even if no infection is seen. Preterm rupture is caused by an infection. Prolonged rupture puts baby and mom at risk for an infection. If preterm and no induction, it's likely there is a prolonged rupture. In any case, prolonged rupture can lead to Chorioamnionitis and Endometritis - as can simply preterm rupture without prolonged. Watch those ps!

**Chorioamnionitis and Endometritis**

Both diseases have the same diagnosis, presentation, and treatment - save one thing. It's **chorio** when there's a **baby still inside** and **endometritis** when **baby has come out**. This is an **ascending infection** that gets into the uterus. It's the risk of keeping baby in the oven longer. The same infection that caused damage to the membranes has now set up shop in mom. Mom is

*Rush of fluid*

*Speculum exam = pooling*

*Nitrazine test turns it blue*

*+ Fern sign*

*Ultrasound shows the rush of fluid was the amniotic fluid because now there is none ("oligohydramnios")*

*Rupture without contractions: Amp+Gent +/- Metro*

*Rupture before 36 weeks.*

*Generally is also premature (mom not contracting)*

*Can be preterm rupture, but not premature (preterm labor)*

*L:S ratio > 2, go, L:S < 2, Steroids*

*18 hours from rupture to delivery. Give amoxicillin*

*Mom is toxic: cover broadly*

*Chorio = baby inside*

*Endometrio = baby is out*

*IV Amp, Gent, Metro*

going to present with **pROM** and a **fever**. She's going to be septic (fever, leukocytosis, tachycardia, tachypneic) and there will be an absence of other infections (and you'll look for pneumonia, UTI, cellulitis, etc). Culture is NOT the answer; the vagina is not sterile. Vagina floral organisms are causing the infection. A culture will just show what we already know is there. Cover for gram negatives AND anaerobes with **intravenous broad spectrum antibiotics** (amp+gent+metronidazole). This is a sicker, worse version of the same process that causes preterm rupture.

#### Preterm Labor

Preterm labor is the leading cause of neonatal morbidity and mortality. Its cause is unknown, but it's associated with **smoking**, **young women**, **pROM**, and **uterine abnormalities**. It's defined as labor (**3 contractions in 30 minutes with cervical change**) of a fetus that is less than term (<36 weeks), but older than abortion (>20 weeks). That is, any delivery between **20-36 weeks** is preterm labor.

Once preterm labor has started, there is realistically very little that can be done. **Tocolytics** are used if not contraindicated, but in reality, they buy us two days at most. One isn't better than another, but options include **Magnesium** (pick this if you're asked to choose), **B-Agonists** (terbutaline), **Calcium Channel Blockers** (nifedipine) and **Prostaglandin-inhibitors** (indomethacin). Use tocolysis and administer **steroids** if the baby has immature lungs (**L:S <2**) to permit continued development. Tocolysis may allow for transport to an advanced neonatal facility.

Tocolytics are contraindicated in the setting of **(pre)Eclampsia** (maternal contraindications), **fetal demise/distress** (fetal contraindications), or in a high **OB risk** (pROM, abruption). Baby is headed to the NICU.

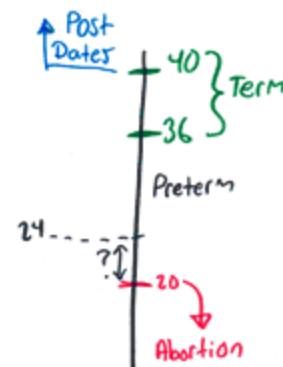
#### Post Dates

Baby coming too soon is a problem. Coming too late is not good either. A baby **>40 weeks by conception** or **>42 weeks by last menstrual period** is considered an old fetus. The dilemma usually occurs when mom is unsure on dates. The question is should we get the baby out or not? Here's how you decide.

It's imperative to determine how sure you are on the dates and what the cervix looks like to determine the treatment plan. See the grid to the right for details.

Post dates can cause a **macrosomic baby** (too big to come through the birth canal resulting in arrest of labor or shoulder dystocia) or a **dysmature baby** (small baby without subcutaneous tissue).

*Labor (3 in 30) but not yet term.*



Dates	Cervix	Treatment	Path
Certain	Favorable	Induction	Both ready
Certain	Unfavorable	C-Section	Baby ready, Mom's not
UNcertain	N/A	NST + AFI	C-Section when baby is ready or in trouble.

### Thyroid Disease

Both hypo and hyper thyroidism is not good for baby. In general, hypothyroidism is worse. **Congenital Hypothyroidism** presents with **cretinism**: a disfigured, mentally retarded baby. The good thing is that hypothyroid patients are often infertile secondary to anovulation. The pituitary is smart: if the hormones to keep you alive are lacking it isn't going to waste time on the hormones that allow reproduction (FSH, LH). All hypothyroid is treated the same way: **levothyroxine**. Remember that during pregnancy there are more proteins. There are more red blood cells, estrogen, and thyroglobulin binding protein. This means a euthyroid non-pregnant woman who becomes relatively hypothyroid as she gets more and more pregnant. This requires **increasing levothyroxine** in pregnancy and assessing the TSH regularly. DO NOT wait for the TSH to go up to increase the dose; by the time that happens there's been an entire trimester of low T4.

For hyperthyroidism there are a couple of options. If she's seen prior to the pregnancy, either a **surgical resection** or **radioactive iodine ablation** can be performed. BUT, if the hyperthyroidism is diagnosed during pregnancy **nothing** radioactive can be used. That means no RAIU scan to diagnose and no radioactive ablation. Surgery can still be performed, but that would be done in the second trimester (critical period of development is past and the uterus is not so large as to compromise the airway). **PTU** (propylthiouracil) is safe in **pregnancy** because it's **protein bound** and will not cross the placenta. Methimazole is the other drug.

### Seizures

This is hard. Essentially every anticonvulsant is a **teratogen**. That is bad. Mom seizing is also bad. Historically, **phenobarbital** is **protein bound** so it was safe in **pregnancy** (and you had to look out for folate). Now, the best bet is Lamotrigine. The key here is to recognize that it's a risk benefit analysis; few and infrequent seizures that are not grand mal don't get treated (risk of meds too high) whereas someone who is pregnant and has had 5 seizures already probably benefits from seizure control.

*Diagnosis of hypothyroid disease in pregnancy:*

1. *TSH and Free T4*
2. *Ultrasound*
3. *NO RAIU*

*Treatment hypothyroid disease in pregnancy:*

1. *Increased doses of levothyroxine*
2. *Frequent TSH assessment*

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2. *Surgery in 2nd trimester*
3. *PTU in pregnancy*

**Urinary Tract Infections**

Women get UTIs. They happen. They're usually not a big deal in the non-pregnant state and there are many options to treat. This is covered in the medicine infectious disease lecture in great detail. Know that in pregnancy they are **treated** and should be **rescreened** for **asymptomatic bacteriuria**. Pregnancy and post-instrumentation are the only time when we treat a positive urine but negative symptoms. The medication used to treat is most definitely **nitrofurantoin** for oral therapy and **ceftriaxone** for intravenous therapy.

Be able to identify three specific syndromes:

1. **Asymptomatic bacteriuria:** leukocyte esterase positive, nitrite positive, **no symptoms**. Treat with oral therapy.
2. **Cystitis:** urgency, frequency, and dysuria with leukocyte esterase positive, nitrite positive. Treat with oral therapy
3. **Pyelonephritis:** urgency, frequency, and dysuria, high fevers, and costovertebral angle tenderness. Leukocyte esterase positive, nitrite positive, **white blood cell casts** on urinalysis. Treat with **IV therapy** and admit to hospital. Obtain **ultrasound** to rule out abscess if no clinical improvement.

**Teratogens**

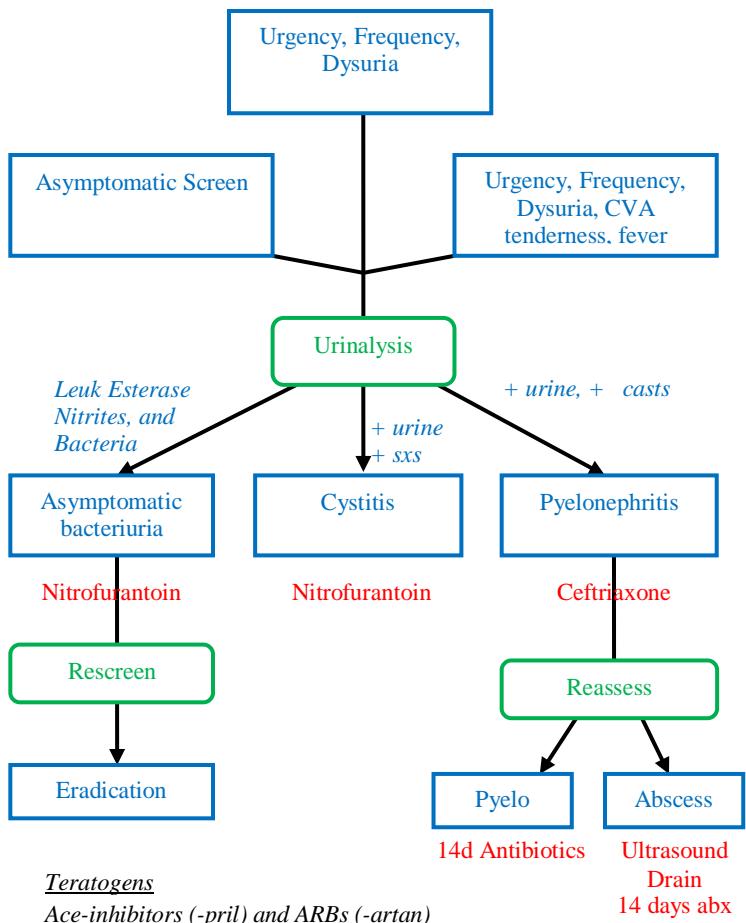
These are going to be medications that a woman is on that she needs to stop taking before she gets pregnant. There are many; memorizing them is not going to help. Instead, recognize the diseases in this section and know what **SHOULD** be used. If it's not on the approved list, know the medication is probably a no go. The list of commonly tested drugs are listed to the right.

**Hypertension**

See medical hypertension as well as the pre-eclampsia video. In pregnancy, select **alpha-methyl dopa** as the agent of choice. If unavailable, pick hydralazine or labetalol.

**Diabetes**

Covered in the third trimester lab video. Screen for gestational diabetes at 28 weeks with **1-hr glucose tolerance test** and confirm with **3-hr glucose tolerance test**. The only treatment is **insulin**. If she is planning on becoming pregnant and is a diabetic, transition off orals, onto insulin, and maintain strict control of her bG, <150.

**Teratogens**

*Ace-inhibitors (-pril) and ARBs (-artan)  
Any Oral Hyperglycemic control agent  
Any Seizure medication (phenytoin classic)  
Lithium  
Tetracyclines (doxycycline)  
Retinoic Acid (acne)  
Methotrexate*

*Alpha Methyl-Dopa.... Hydralazine, Labetalol*

*Insulin only for diabetic management*

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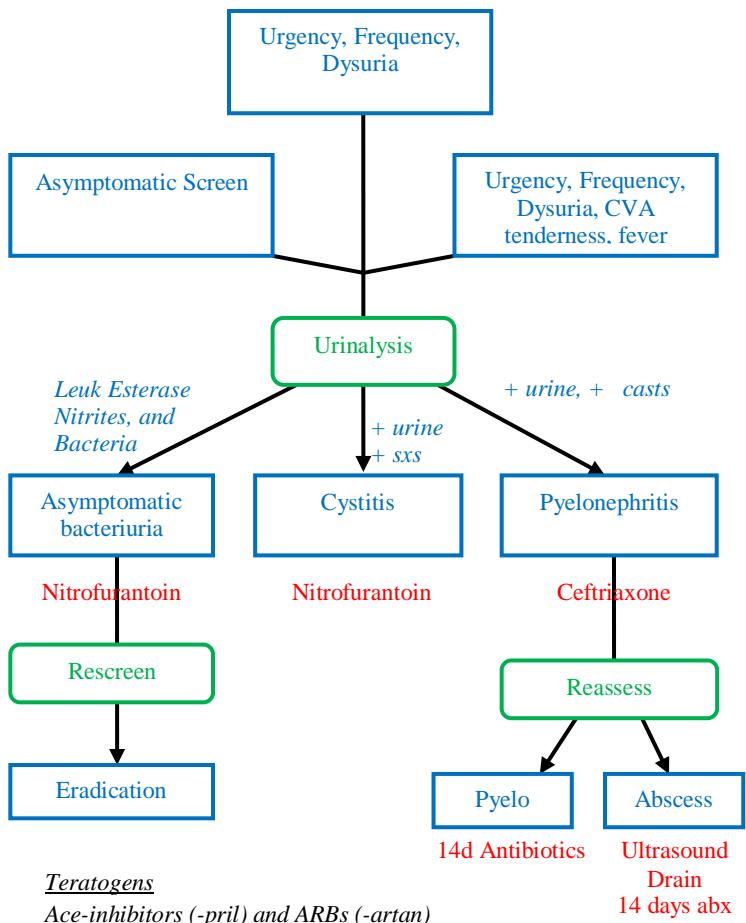
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Tetracyclines (doxycycline)  
Retinoic Acid (acne)  
Methotrexate*

*Alpha Methyl-Dopa.... Hydralazine, Labetalol*

*Insulin only for diabetic management*

The important thing to know about multiple gestations is how to identify what type of twinning we have AND what each type of twinning is at risk for.

#### Diagnosis of Twins

Suspect twins when there is a size-date discrepancy, that is the **uterus is large for dates** or when the **AFP is high** on quad screen. The idea is there's "too much baby" so both size and AFP production goes up. It's easy to think it might just be caught on a screening ultrasound, but often the second fetus is missed. If ever suspected, however, **ultrasound** is the method of diagnosing. The ultrasound also gives us clues to what type of twinning it is. We look for the number of genders, gestations, placentas, and sacs to help distinguish one from the other. See the algorithm to the right.

All twins are at risk for requiring **c-section** (they get in the way of each other being in cephalic position so go breech) and **prematurity** (4 weeks early for every extra gestation).

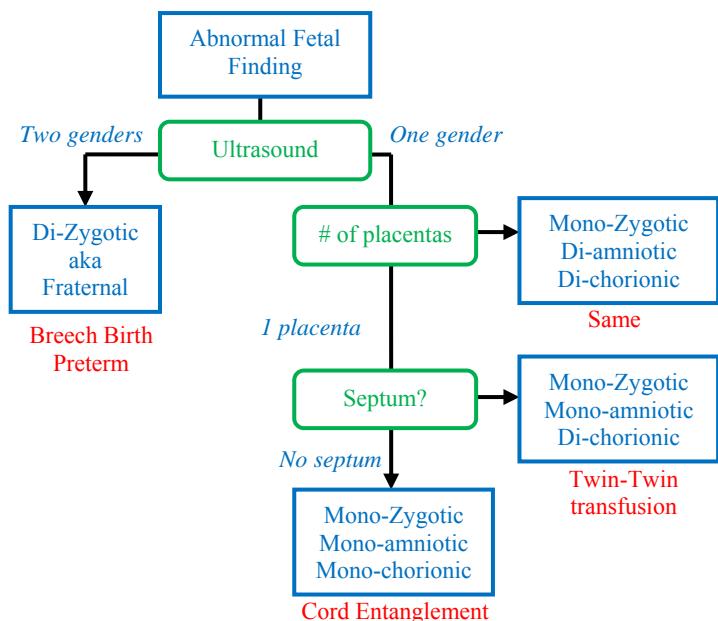
Identifying what type of twinning is present is done by looking at the number of sacs and placentas. Once the kids come out, we can then determine the number of eggs. Those three things: eggs, sacs, and placentas help separate all twin types.

#### Dizygotic Dichorionic Diamniotic

This is actually **two normal pregnancies** that happened to occur at the same time. **Two eggs, two fertilizations, two sacs, two placentas**. It's seen when mothers take hormones to induce ovulation (to increase chances of pregnancy) and release multiple eggs. This is the only set that can have **different genders**. So, if different genders are identified the diagnosis is done. Otherwise, it's impossible to separate it from the next form of twinning on ultrasound alone. These have the lowest pregnancy risk. Beware of the **vanishing twin** where the second twin disappears by the end of the 1st trimester.

#### Monozygotic Dichorionic Diamniotic

These twins are a product of the **same fertilization** (monozygotic); they have the same genetic material. These twins separate early, days 0-3. They're two completely separate organisms with the same genetic material. They'll be **identical twins** and will share only the complications of the Dizygotic Dichorionic Diamniotic twins. They have **two sacs, two placentas**, but come from **one egg** so they must be the **same gender**.



#### All multiple gestations are at risk for

1. Breech Birth
2. Pre-term delivery (due date 4 weeks less per fetus)
3. Placenta Previa

#### Delivery Decisions:

1. Cephalic - Cephalic = vaginal
2. Cephalic - Breech = "clinical judgment"
3. Breech - Breech = c-section



2 placentas  
2 sacs  
2 eggs = 1 or 2 genders

Two separate fetuses in two separate implantations derived from two separate eggs.

Added Risk = same as above



2 placentas  
2 sacs  
1 egg = 1 gender

Two separate fetuses in two separate implantations derived from the same fertilization.

Added Risk = same as above

Monozygotic Monochorionic Diamniotic

These twins are a product of the **same fertilization** (monozygotic); they have the same genetic material. They separate on days 4-8. Because they separate later, they now **share a placenta** (monochorionic). Since they share a placenta, they also **share a blood supply**. These twins have all the same characteristics of a Monozygotic-Dichorionic-Diamniotic, but are also at risk for **twin-twin transfusion**. This is where one twin (the smaller one) will donate its blood supply to the other (the larger baby). The **small twin does better** because of the reduced bilirubin load, despite the low birth weight.



1 placenta  
2 sacs  
1 egg = 1 gender

*Two fetuses drawing blood from the same placenta, made from the same egg*

*Blastocyst day 4-8*

*Added Risk = Twin-twin transfusion syndrome*

Monozygotic-Monochorionic-Monoamniotic

These twins are a product of the **same fertilization** (monozygotic); they have the same genetic material. They either separate late (**day 9-12**) for **nonconjoined** twins or fail to separate (**splitting >12 days**) for **conjoined twins**. There's only one placenta (monochorionic). In addition to all complications of the twins listed above, now they share the same sac. There are two cords within one sac (monoamniotic) that can become entangled, called **cord entanglement**, which puts both fetuses at risk for fetal demise. If **conjoined**, they can be separated in **staged surgeries**.



1 placenta  
1 sac  
1 egg = 1 gender

*Two fetuses drawing blood from the same placenta and sharing the same sac, may be conjoined.*

*Added Risk = Conjoined Twins, Cord Entanglement*

Stages of Labor

The different stages are based on **cervical dilation** and **quality of the contractions**.

**Stage I** is broken into two phases. It **begins with contractions and ends with cervical dilation of 10cm**.

The **latent phase** is from the start of contractions until the cervix  $\geq 4$  cm, and normally lasts **20 hours** for a first-time mom or **14 hours** for a seasoned veteran. That is, it's normal for a first time mom to take a little longer.

The **active phase** of stage I starts with the **cervix at 4 cm** and ends with **full dilation**. Once the cervix starts to dilate the rest should happen quickly. Reworded, the latent phase takes a long time, but once things get going it progresses quickly. The active phase, from 4 cm to 10 cm, should only take **4 hours**.

**Stage II** is from the **complete dilation** to **delivery of baby**. Again, once active phase ends from the time baby comes out is stage II.

**Stage III** is from **delivery of baby** to **delivery of the placenta**. So, baby comes out to placenta comes out. This requires the maintenance of **uterine contraction**.

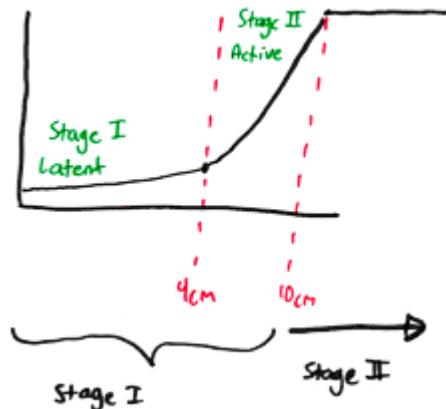
"Stage IV" isn't a real stage, but is the time after the placenta comes out.

Station

Baby's position is important. It helps determine how far along baby is and how easy it will be for him/her to come out. It's simply location and number. The furthest from the vaginal opening is the most negative. Station zero is basically out of the uterus and just in the vagina. +2 is head at the vaginal opening. See the diagram.

Cervical Changes

The cervix must change from a **thick and firm** structure that is **long** (feels like "your nose") to a **thin, floppy**, and **short structure** ("your lip"). This is achieved by **breaking disulfide bonds** between **collagen** and infusion of water. The process is called **cervical ripening** or **effacement**. It's stimulated by **fetal head engagement** (or artificially with a balloon) and by the production of **prostaglandin E2** which is why indomethacin can be a tocolytic. Questions about this topic will really be about pathology: disulfide bonds, prostaglandins, fetal head engagement.



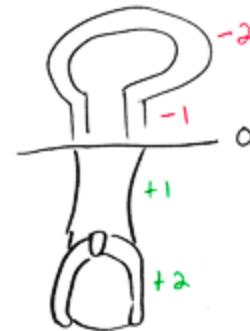
*Contractions begin: Latent phase 20 hours or 14 hours*

*Cervix at 4 cm: Active phase 4 hours*

*Cervix at 10 cm: Stage II until...*

*Baby delivered: Stage III until...*

*Placenta delivered: Finished*



Fetal Movements of Delivery

At the **pelvic inlet**, the largest diameter is **transverse** requiring the baby's head to turn transverse to engage. The pelvic inlet is the **pubic symphysis to sacral prominence**.

At the **mid pelvis**, it's a 90 degree change. The largest diameter is at the **anterior-posterior**. It again requires a corkscrewing of the baby to get through.

1. **Engagement**: head high above the pelvic inlet
2. **Engagement** and **descent** and **flexion** into the inlet
3. **Internal rotation** as the head moves deeper against the pelvic floor
4. **Extension** occurs as baby's head passes the symphysis pubis
5. **External rotation** to get shoulders lined right in the mid pelvis
6. **Anterior shoulder** is delivered
7. **Posterior shoulder** is delivered last

Fetal Position

The orientation of the baby in the uterus is important. There is only one "right way." That is **longitudinal cephalic**. Longitudinal means that baby's axial skeleton is parallel to mom's axial skeleton. But even if longitudinal, things could still be wrong. The baby is supposed to be head down - towards the vagina. This is longitudinal cephalic. The longitudinal axis can be backwards, with the head towards mom's head, and the legs toward the vagina. This a **breech position** - longitudinal breech.

**Breech** has a bit more of a breakdown.

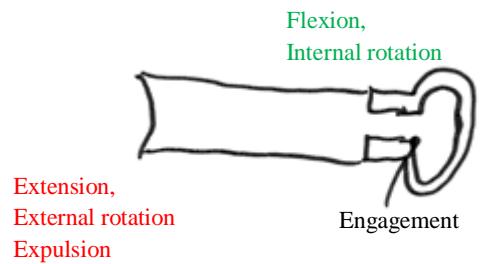
**Frank breech** has both **knees extended, hips flexed**

**Complete breech** has both **knees flexed, hips flexed**

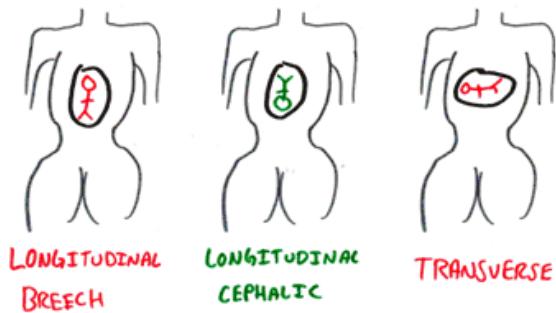
**Footling breech** has **hips extended**, knees in any

But what if baby isn't parallel to mom? If baby is **perpendicular** to mom's axial skeleton she is said to be in **transverse breech**.

If baby is in a breech position that isn't going to work. The options are either have a **C-section** if breech and delivering or trying to manipulate the baby before it comes out. **External version** is called the **Leopold maneuver** and is performed at 37 weeks. It involves literally pushing on the baby from the outside, trying to get baby into the right position. Sometimes it works and baby stays in the right position. Sometimes it doesn't and baby flips back. It's a simple procedure, has no cost, and a clear potential benefit. It's worth trying.



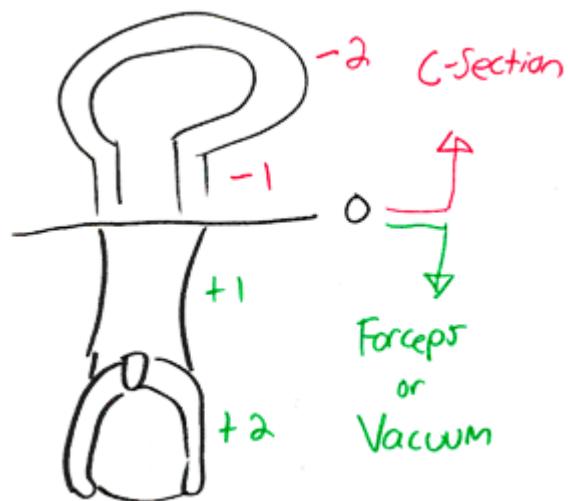
Frank Breech	Complete Breech	Footling Breech
Knees extended	Knees flexed	Knees in any position
Hips flexed	Hips flexed	Hips extended



## Operative OB

### Cesarean Section

This is actual surgery. A knife cuts open the skin and we go into the abdomen. An abdominal incision is made to get to the uterus. A **posterior uterine incision** is made to get into the uterus. Baby comes out. It can be **elective** - where a **bikini cut** is used or it can be emergent - a "**crash section**" where a vertical **midline incision** is made - also called a "classic cut." C-section has many indications; all of them are to get baby out when baby (or mom) is in trouble. These include but are not limited to, **breech birth**, **arrest of labor**, **nonreassuring contraction stress test**, and **previous c-section**. It's important to realize that it's often not the diagnosis that indicates C-section, but rather the hemodynamic response of baby (or mom). Those who have had C-sections before should have another C-section given the theoretical risk of uterine rupture. But, the uterus should also only be cut on **3 or 4 times**. This makes the dilemma of pregnancy #5 very tricky.



### Vaginal Birth After Cesarean (VBAC)

This is controversial; it will be a discussion on your OB rotation. In general, it should be avoided given the risk of **uterine rupture**. It's controversial because repeated cuts on the abdomen lead to adhesions and scarring (which are bad). Vaginal birth with a uterine scar can lead to uterine rupture (no good). But we don't know what's actually worse: the risk of uterine rupture or the risk of scarring and adhesions. So, after the 4th C-section careful conversation is needed with mom about contraception and the method of the next delivery.

### Vacuum Delivery and Forceps

If the baby is almost out (**station +1 or +2**), in trouble (**fetal distress**) AND mom is ready to deliver (**full effacement**) then these are operative methods to get the baby out faster. These two methods are equivocal; you won't have to decide between them.

In vacuum delivery a suction device is stuck onto baby's scalp. Then you pull. Mom pushes, you pull, and the baby comes out faster. It's a vacuum. If mom's vagina is accidentally stuck in the suction, when you pull you denude mom's vagina. That hurts. Sweep your finger around the edges of the suction to assure mom is free of the device.

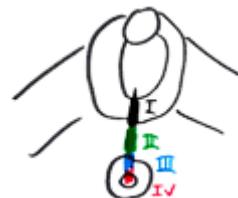
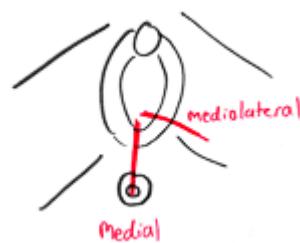
Forceps delivery is literally a pair of tongs used to grab baby's head. Then you pull. Mom pushes, you pull, and the baby comes out faster. Grabbing baby's face and pulling can produce a **facial palsy** or **cephalohematoma**, both of which will resolve spontaneously.

Cerclage

If mom has an **incompetent cervix** (look for a **cone biopsy** or **frequent gyn infections**) her cervix will fall open and the placenta will fall out. She'll present with repeated second trimester losses. There will be a **painless opening of the cervix before viability**. On the NEXT pregnancy, it's possible to help the baby stay in by literally tying the cervix shut using a **purse-string suture**. It's placed at the end of the second trimester - usually weeks **12-14**. We wait for two reasons. One, to be certain it's a **normal fetus**. Two, if the fetus is accidentally stabbed with the suture permanent damage or even death can occur. So we balance risk of incompetence against the risk of fetal demise. The sutures **must be removed** prior to cervical ripening. A failure to do so will result in the cervix opening anyway. This will tear the sutures, literally tearing mom's cervix to shreds.

Episiotomy

Episiotomy is generally never indicated and are, "done for resident education." If you read about them, they can be used to reduce **shoulder dystocia** or to speed along a **prolonged delivery**. It can also be done to prevent uncontrolled tears from **macrosomal babies** in **nulliparous moms**. The idea is that if baby is big and mom has never been stretched out, a big thing through a small opening might result in mom ripping (leading to lacerations). Episiotomies are done to control the direction and severity of the tear so it's known where to suture when she's done. Episiotomies and lacerations are **graded**. There can be **medial** episiotomies (hurts more, heals better, risk of grade IV) and **mediolateral** episiotomies (hurts less, heals worse, but no risk of grade IV). The big complication of these, other than bleeding and pain, is that a **grade 4 tear** can result in a **recto-vaginal fistula**. That sounds awful – it is.



Grade I: Vagina only

Grade II: Grade I + Perineum

Grade III: Grade II + Anal sphincter

Grade IV: Grade III + Anal Mucosa

Anesthesia

The pain of **Stage I** comes from **T10-T12** (visceral pain)

The pain of **Stage II** comes from **S2-S4** (somatic pain)

**Narcotics** can be given as the patient desires. But narcotics should only be started after **Active Labor** has begun. They're also the **most common cause of prolonged latent phase**. If given within **1 hour of birth**, have the antidote **naloxone** ready for baby, as they can cause profound respiratory depression in such a small person.

**Paracervical block** is basically never used. It can be used to block the pain of **cervical dilation** with **local lidocaine**. The way this comes up on the test is when a patient receives this therapy and then there is resultant **fetal bradycardia**. It's the only time where fetal bradycardia can be observed. The lidocaine got into baby and will wear off soon.

**Pudendal nerve block** is used to block the somatic pain of Stage II. It's performed by palpating the **ischial tuberosity** and the injection is made towards the **pudendal nerve** inside the **sacrospinous ligament**.

**Epidural** is the anesthesia of course. It goes into the **epidural space** (there should be no POP nor should there be any CSF return - that would be a lumbar puncture). The epidural comes at some cost, however. Since mom will not be able to feel her contractions at all, a **tocometer** must be placed to assess mom's contractions and she must be coached to push as her uterus contracts. Too much epidural or epidural anesthesia introduced too deeply can result in **vasodilation and hypotension** (neurogenic shock), or it may lead to **paralysis of the diaphragm**.

Method	Indication	Modifiers	Side Effects
C-Section	Fetal Distress	Os not @ 10cm	>3-4 contraindicated
	Elective	Station $\leq 0$	
		Contractions Irrelevant	↑ Risk of rupture with VBAC
Forceps	Fetal Distress	Os @ 10cm	Facial Palsy
	Prolonged Labor	Station $\geq +1$	Cephalohematoma
Vacuum	Fetal Distress	Os @ 10cm	Vaginal Bleeding
	Prolonged Labor	Station $\geq +1$	Denuding of Vagina
Episiotomy	Macrosomic babies in nulliparous moms	Medial	Heals, Hurts, Grade IV
	Prolonged labor	Mediolateral	No heals, no Hurts, no grade IV
Cerclage	Recurrent second trimester losses	Place week 12-14	ppROM (you nick baby)
	Incompetent Cervix	Remove week 36-38	Cervical Rupture (fail to remove)
Anesthesia	Narcotics	$\geq$ Active Labor	Naloxone for baby Prolonged Latent Phase for mom
	Paracervical block	Pain of cervical dilation Local Lidocaine	Fetal bradycardia (observe)
	Pudendal Block	Ischial tuberosity Sacroiliac Ligament	You can miss
	Epidural	Preferred method for delivery and C/S	Into CSF = shock Inability to feel = prolonged labor

Introduction

Pregnant women have an expanded vascular volume so can tolerate significant blood loss. You see a 1000cc blood loss in a gangbanger and he's probably going to die. You see a 1000cc in a delivery and mom will likely be fine. Post-partum hemorrhage, however, is defined as **500cc** for **vaginal delivery** and **1000cc** for **C-section**. Finding the cause of and stopping the bleeding is critical. Surgery is ultimately the option, but there will be more to do between blood loss and surgery.

1) Uterine Atony

The **most common** cause of post-partum hemorrhage. After delivery, the uterus should contract down and the bleeding should stop. But a **tired uterus** may **fail to contract**. Either the oxytocin was on too long, the woman was just contracting for too long, or tocolytics were onboard. If there's bleeding, most OBs just assume it is atony. The uterus will feel **boggy** and large. The treatment is to get the uterus contracting. It starts with uterine **massage**. Medications can also be used to contract the uterus. Start with **methylergometrine** (methergine). This is a smooth muscle constrictor that mostly acts on the uterus. If there was oxytocin on board and it's now off, turn the **oxytocin** back on. Before going to **surgery**, also try **hemabate** (though this is not the answer on the shelf).

2) Uterine Inversion

If there's a post-partum hemorrhage but the **uterus can't be felt**, it's likely an inversion. Caused by a defect in the myometrium, it's imperative to keep the uterus in place. The diagnosis can be made just by looking. **Tack the fornices** in place, then give **oxytocin** to contract the uterus back into the original position.

3) Retained Placenta

Products of conception can be left behind. The uterus will be **firm** and will **fail to progress**. This might also present as continued bleeding **weeks after delivery**. The degree in which the placenta has embedded defines the name of the disease. Obviously, the deeper it is the harder it is to get out. Forgive the analogy, but it helps to make the idea stick. The uterus is a vascular bed, much like an oil well. The placenta goes drilling for blood. Sometimes it goes wide and sometimes it goes deep. In a fresh uterus (no pregnancies) the vascular supply is rich and the placenta does not have to go deep or wide. When the uterus is used (multiple pregnancies) the placenta will go either wide (placenta previa) or deep (retained placenta). So **risk increases with increasing pregnancies**. The other way to get this disease is if an **accessory lobe** or **fractured placenta** embeds deeply. This will present with **vessels that run to the edge** of the placenta, which is why we always inspect the placenta after delivery. The first step is a **dilation and curettage** to get it out. Failure results in a **hysterectomy**. An **ultrasound** or **beta-quant** can be used to follow post-delivery regression and as a guide for treatment.

*Most common cause of post-partum bleeding*

*Large boggy uterus*

*Massage uterus --> methylergometrine --> oxytocin*

*Surgery is always the ultimate answer to all post-partum hemorrhage*

*Post-partum hemorrhage + No palpable uterus*

*Do a speculum exam*

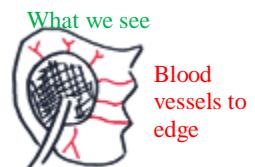
*Tack the fornices and oxytocin*



Normal placenta, blood vessels not out to surface



Comes out      Stays in



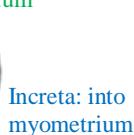
What we see

Blood vessels to edge

Accreta: endometrium not into myometrium



Percreta: to Serosa



Percreta: to Serosa  
Increta: into myometrium

4) Vaginal Lacerations

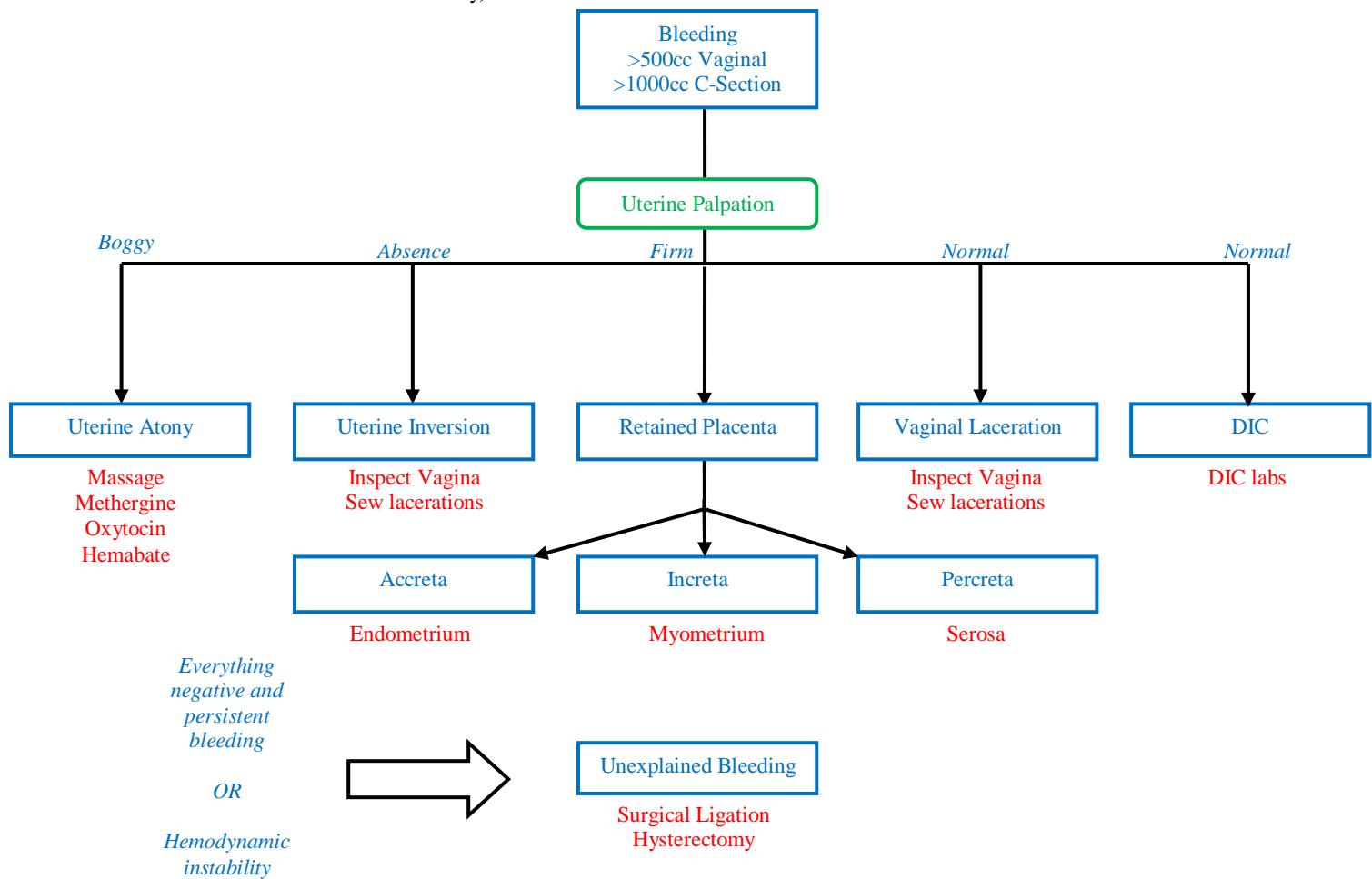
Every time there's a vaginal delivery check for lacerations of both the vagina and cervix. It's especially important to check during **precipitous deliveries** or **macrosomic babies**. The uterus is **normal** but there will be obvious and visible lacerations of the vagina. To fix, apply pressure to start. If they don't stop bleeding or they're obviously large (see the OB operations content on episiotomies) do **local anesthesia** and **suture them closed**. If an episiotomy has been done, you're going to know to sew it back up.

5) DIC

Placental contents getting into mom's blood can cause an embolism, but it can also cause DIC. If suspected, get a **DIC panel** (platelets, INR, fibrinogen) if bleeding continues.

6) Unexplained Bleeding

Blood loss is a bad thing. If the patient continues to bleed it's necessary to move to **operative control** after **all drugs fail**. Arterial ligation (**uterine arteries then hypogastric arteries**) followed ultimately by **hysterectomy** if everything else fails. Obviously, while she is losing blood monitor counts and transfuse as needed (physiology before the number, as acute blood loss will not be revealed on labs acutely).



### 1) Group B Strep

It's a **benign colonization** of the vagina by Group B strep. During **vaginal delivery** babies get exposed and infected. The goal is to **prophylax baby** against pneumonia and sepsis by giving mom **penicillin**. If allergic to penicillin, use **erythromycin**. This will present in one of two ways. Either it's a positive screening culture at week 35-38 (we did a good job) or it'll be a healthy baby that rapidly deteriorates in the first day of life, leading to aseptic baby (we missed the GBS screen or the vignette tells you mom didn't have prenatal screening). If you get a **sick baby** pick **ampicillin**. It's desirable to give penicillin to a lot of people. Treat any **asymptomatic bacteriuria**, any **GBS + ever, prolonged ROM**, and any **positive screen**.

### 2) Hepatitis B

Hepatitis B is a viral infection. The way baby gets Hep B is through vertical transmission. If mom is a chronic carrier she can pass it to baby. The biggest part of this is to diagnose mom with hepatitis B early. This is part of the first trimester labs screen. But it's not as simple as positive or negative. **Hep B surface antibody** implies **immunity**; the woman has either been exposed to Hep B or a vaccine. **Hep B core antibody** means that immunity was obtained through exposure. The presence of **antigen** now changes anything that's been found to mean that she's a **chronic carrier**. If she's antigen negative she's immune. It's the presence of the **antigen that makes baby at risk**. If baby is at risk, do a **c-section** to reduce the blood exposure. But c-section is not enough. Give baby **IVIg Hep B** as well as **Hep B Vaccine** on the day of delivery. This is far earlier than when the vaccine would normally be given.

### 3) HIV

Like Hep B, HIV is part of every woman's first trimester labs. The sooner HIV is detected the better because the sooner we get mom on **HAART** the better managed it will be. The **lower her CD4** the more opportunistic infections she's at risk for. The **higher her viral load** the more likely she is to transmit the virus to baby. HIV does NOT cross the placenta. That means the virus can only get into baby during blood-to-blood contact. The more virus, the higher the likelihood of transmission. So, two goals: get the viral load down and reduce blood-to-blood contact. Do that with a **C-section** (avoids bloody contact), get mom on **HAART early**, and if all else fails, give **AZT with delivery** if neither could be done before. The problem with diagnosis is that while the virus can't cross the placenta, HIV antibodies can. Thus, to be sure it wasn't passed on the HIV antibodies have to be waited out. They take around 6 months to disappear, after which the screen can occur. If positive, start treatment immediately.

*Newborn sepsis from an uncomplicated prenatal and crashes in hours*

*Prenatal screen*

*Vertical transmission*

*Hep B Surface Antibody = Immunity*

*Hep B core antibody = Exposed*

*Hep B ANY antigen = infected*

*Avoid blood to blood exposure with a C-section. Give baby IVIg Hep B and Hep B Vaccine*

*HIV mom:*

- ELISA: Rapid Antibody
- Confirm Western Blot
- Track CD4, Viral Load
- Treat HAART

*HIV baby:*

- C-section (though not necessary)
- HAART through pregnancy
- AZT at delivery if nothing else able
- Rescreen at 6 months

**4) Herpes Zoster**

Herpes hide in the **dorsal root ganglion** which can then descend to create the typical presentation. There will be a **painful prodrome** followed by **vesicles on an erythematous base**. It's an STD. There are two risks to baby. A **reactivation**, as described above, does NOT provoke a viremia; it can't get into the baby. But if baby comes out through the birth canal, baby can come into contact with the lesions and get infected. If mom has a lesion, perform **C-section** to avoid contact. The other way herpes can hurt baby is with a **primary viremia**. The first time mom gets infected there's a **viremia** and it can get into baby in utero. Herpes normally requires no diagnostic step if classic, but if there's a question on the test, you can perform a **Tzanck prep** to identify multinucleated giant cells. Give mom **acyclovir** to treat.

**5) Varicella Zoster**

Varicella is basically the same thing as herpes. The **primary viremia hurts baby** while **secondary reactivation** only hurts baby if it touches a lesion. Varicella Zoster is chicken pox. If mom had chicken pox then she can get a secondary reactivation as shingles. This is rare in a young woman. If it happens, give **acyclovir** to reduce symptoms and shorten the duration. Now there is a chicken pox vaccine - every child should get it. If mom wants to get pregnant and has not had chicken pox nor varicella titer antibodies, she should get the **vaccine PRIOR to pregnancy**. She should **NEVER get the vaccine while pregnant** as this will just induce a primary viremia. The most important thing about chicken pox, for the test, is that if mom is not exposed or vaccinated and is pregnant, she must be **isolated from children who could potentially get the virus and give it to her**. If baby gets zoster in utero, baby will present with zig-zag skin lesions, small eyes, and small extremities.

**6) Syphilis**

Every mom gets screened for syphilis at every time. Screening is made with an **RPR** and confirmed with **Treponema Antibodies**. But other diagnostic modalities may be necessary. If there's a **painless ulcer** it was a primary infection; **dark field microscopy** is required to make the diagnosis (there has not been sufficient time to develop antibodies). If mom has had it a long time and it's in her nervous system, she may need a **Lumbar Puncture** to get the diagnosis. How it effects baby depends on when mom gets infected. If mom gets infected with syphilis in the first trimester, baby won't survive and will present as a dead and macerated fetus. If mom gets infected in the **3rd trimester**, the kid will live and present with **saddle nose, saber shins, and Hutchinson's teeth**. Treatment is **always penicillin**. If she is penicillin allergic, **desensitize**.

*Primary = Viremia = Transplacental Crossing*

*Secondary = Lesion = Nontransplacenta*

*Treat mom with acyclovir*

*Treat baby with C-section if genital lesions*

*Isolate mom from children if she doesn't have exposure or vaccine*

*Vaccine prior to pregnancy*

*Primary Syphilis: Dark field Microscopy, Penicillin*

*Secondary Syphilis: RPR then FTA-antibodies*

*Tertiary Syphilis: Lumbar Puncture*

*Treatment:*

*Penicillin*

*Penicillin Allergic? Penicillin*

*Syndrome in baby:*

*1st trimester - death*

*3rd trimester - saddle nose, saber shins, Hutchinson's teeth*

**7) Toxoplasmosis**

Toxoplasmosis is a **parasite** that's transmitted through **cat feces**. Mom will experience a **mono-like** syndrome while baby gets **symmetric intrauterine growth restriction** and **brain calcifications**. The bug makes it into the baby only with a **primary infection** during the **1st trimester**. If mom had already been exposed she will be immune - baby will not be at risk. **Toxoplasmosis antibodies** are tested for on a pre-natal screen.

#### 8) Rubella (German measles)

German measles is transmitted by respiratory droplets. It can pass to baby only during a **primary viremia** - mom must be unvaccinated and exposed for the first time. This most commonly occurs in the first trimester presenting as **deafness, cataracts, and congenital heart defects**. Mom should get a vaccines at **least 3 months prior to pregnancy**, as it's a **live attenuated** virus.

*IUGR and Brain calcifications*

*Screen mom with Toxo Ab; if positive, nothing to worry about*

*Cat litter*

Intro

Allergies are all about IgE and mast cells. An antigen sensitizes the immune system to react. When exposed thereafter, IgE crosslinks with mast cells to release histamine. Histamine produces vasodilation and leaky capillaries. Dealing with allergies comes down to anti-histamines and avoidance.

1) Seasonal Allergies a.k.a. allergic rhinitis

“Allergies” affect kids like they do adults. They’re typically **seasonal** and are from the typical allergens (**dander/pollen**). Kids will have persistent **rhinorrhea** which they “**salute**,” producing a persistent **nasal crease**. Because of the release of histamine (the root of the allergies), they may get venous stasis under the eyes, leading to **allergic shiners**. It’s important to identify triggers so that they can be avoided (get rid of furry pets, carpets, parents should stop smoking, etc). If it’s not obvious what the allergen is, you can do skin patch testing (**Skin test**) and if the skin patch testing is inconclusive, you can do ImmunoCap blood testing. Giving prophylaxis of therapeutic **anti-histamines** may work. **Intranasal corticosteroids** may be useful for immediate relief.

2) Urticaria → Anaphylaxis

When exposed to an antigen (**bee stings, foods, pollen**) an urticarial wheal (hives) may develop. It’s an **IgE-mediated histamine-induced** vasodilation that causes leaky vessels. This produces a **raised, blanching wheal** that can be suppressed by **anti-histamines**. If a kid gets it that’s ok. Usually it means avoiding whatever food they just ate or whatever weed they just touched. It must be ensured there’s **no anaphylaxis (hypotension, dyspnea, wheezing)**. If there is, give them **1:1000 IM epi** to prevent death. Obviously, once an allergen has been identified (typically anaphylactic antigens are shellfish, peanuts, and eggs) they need to **avoid triggers**. Like seasonal allergies, triggers can be identified by **skin testing**.

3) Atopic Dermatitis (Eczema)

Eczema is a **rash** that occurs in response to **antigen triggers**. There’s a high association with **eczema, asthma, and seasonal allergies** - all of which may be present on family history. In very **young kids** it can appear on the **face** in response to a **new food exposure** (one reason why foods should be introduced once a week). In older kids it occurs on the **flexor surfaces**. In both cases it’s **pruritic** - leading first to **excoriations** and **potential infection** (strep/Impetigo, Staph), then continued scratching results in **lichenification in adulthood**. **Topical corticosteroids** or **non-drying soaps** can be tried, but generally nothing really works except to avoid the trigger.

4) Angioedema

Localized swelling that’s bradykinin mediated. If the swelling is in the airway it can cause respiratory compromise, so **intubate early**. Think about **C1 esterase deficiency**, but it’s often a drug reaction. Withhold the **Ace-inhibitor**. It has no treatment.

<b>H1 Blockers (Allergies)</b>	<b>H2 Blockers (GERD)</b>
Cetirizine	Ranitidine
Fexofenadine	Famotidine
Loratadine	Cimetidine
Diphenhydramine (drowsy-inducing)	

<b>Urticaria</b>	<b>Anaphylaxis</b>
A wheal = red raised area	Rash on body
NO hypotension	YES hypotension
NO wheezing	YES wheezing
NO treatment	IM EPI 1:1000
(topical anti-histamine)	

**Esophageal Atresia**

A **newborn** presenting with **choking with feeds** and **excessive salivation** should prompt the attempted passage of an NG tube, which will **coil on CXR**. There are four types (some with abnormal connections to the trachea, a tracheal-esophageal fistula), but knowing which (for you) is not important. Before **surgically correcting** look for other **VACTERL** anomalies - especially cardiac and renal.

**Imperforate-Anus**

**NEVER** take a 1<sup>st</sup> temp rectally. An imperforate anus will be found on visual inspection but where the pouch of the colon is must be identified. Turn the baby upside down and take a **babygram** (an x-ray of the entire baby) to see where the blind end of the colon is. If it's **near the anus**, simply correct it right now. If it's high in the abdomen, place a **colostomy** and repair when older. If **fistulas** are present, they can be left alone until toilet training (because the baby will be soiled in diapers regardless), but if you fix the pouch fix the fistula.

**Congenital Diaphragmatic Hernia**

If you hear **bowel sounds** over the lungs and there's a **scaphoid abdomen** in a **dyspneic baby**, get a **babygram** to see the loops of bowel in the thorax. A hole in the diaphragm, it's almost always on the **left** (the liver prevents right sided lesions) and most commonly **posterior** (Bochdalek most common), but can be anterolateral (Morgagni). The problem is not the hernia per se, which can be repaired easily, but the **hypoplastic lung** that requires intubation and ventilation for baby's survival.

**Gastroschisis + Omphalocele**

Extrusion of the bowel is both obvious and dangerous. If it's **to the Right of midline and without a membrane** then it's **gastroschisis** (an angry sounding word and angry looking dz) with an increased risk of infection. Conversely, if it's **midline with a membrane** it's **omphalocele**. Both conditions require the construction of a **siloh**, whereby contents are twisted in gradually overall time and the defect is repaired. Although it looks "better" at presentation, omphalocele is more likely to be associated with other congenital defects than gastroschisis.

**Extrophy of the Bladder**

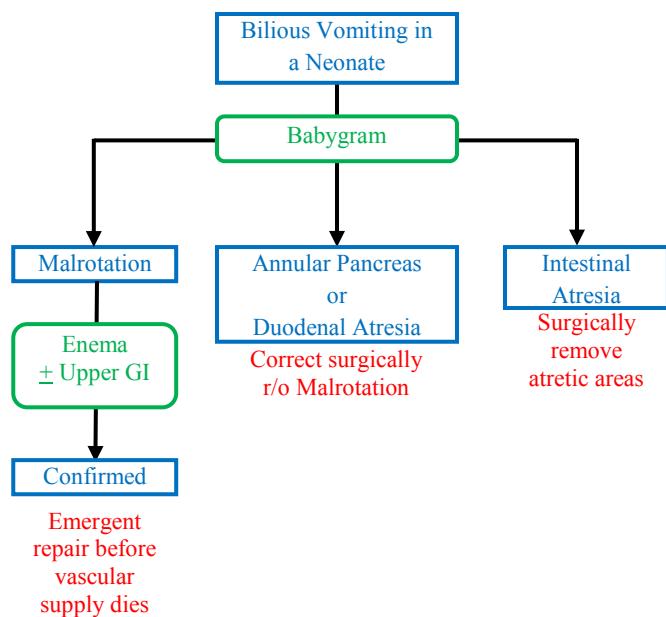
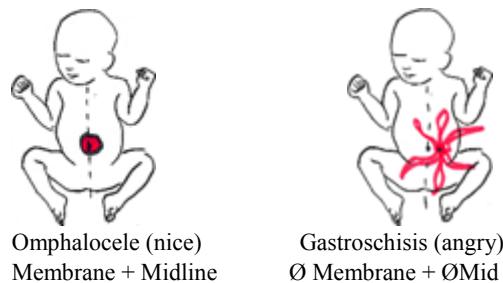
A **midline defect** might sound like gastroschisis, but if it's **red, shining, and wet with urine** it's no bowel – it's a bladder. This requires emergent surgery. Delayed corrections will fail.

**Bilious-Vomiting**

A **bilious vomit** is indicative of an obstruction distal to the ampulla of vater. Bile can get into the GI tract, but can't go "forward" so goes "backward" and comes out as vomiting. The first step in working up bilious vomiting is to get a **babygram**. What you get back is highly nonspecific, but there are clues. **Multiple Air-Fluid Levels or a triple bubble** is indicative of **intestinal atresia** (a vascular accident in utero, i.e. mom used cocaine). The **double-bubble sign** is associated with **duodenal atresia** (and Down's), **annular pancreas**, and **malrotation**. The chances are greater for malrotation if there are **normal gas patterns beyond** (gas had to get here before the obstruction arose). Do a **contrast enema** (safer) followed by an **Upper GI** series (better). Malrotation can cause ischemia and must be ruled out first.

**Y**ertebral (XR)  
**A**nal (imperforate)  
**C**ardiac (Echo)  
**T**racheal -  
**E**sophageal Fistula  
**R**enal (Ultrasound)  
**L**imbs (Thumbs in particular)

*This is a duplicate from the surgery videos. Use this only for shelf study and not for Step study. Go to the Surgery videos if step studying.*



Necrotizing Enterocolitis

Seen in **premature babies** after their first feeding. It produces a **bloody diarrhea**, abdominal distention, and a drop in platelet count. Stop all feedings and start **TPN**. Do a **babygram** that shows **pneumatosis intestinalis** (gas inside the bowel wall). If it's that bad do surgery.

*See peds, GI Bleeds for more details*

Meconium Ileus

In babies with **cystic fibrosis** (you know this because of routine neonatal screens) who develop **bilious vomiting** and **trouble passing their first bowel** suspect meconium ileus. An **X-ray** will show multiple **dilated loops** of small bowel and a "**ground glass**" appearance. Confirm the diagnosis with a **gastrografin enema** – you **may see microcolon on barium enema**. Because it's water soluble it draws fluid into the lumen, dissolving the meconium and **treating** while diagnosing.

*See peds, Constipation for more details*

Pyloric Stenosis

If baby has made it out of the nursery and starts to have **nonbilious projectile vomiting** occurring **after meals** (usually in **weeks** of life), suspect pyloric stenosis. Because nothing is really wrong with baby he/she's **hungry** and **eats** as such. Physical exam will reveal a palpable **olive-shaped mass**. An **ultrasound** will show the **donut sign**; it may be revealed with laboratories showing the classic **hypochloremic, hypokalemic, metabolic alkalosis**. Fix the electrolytes first then do a **myectomy**.

*See peds, vomiting for more details*

Biliary Atresia

If the baby gets a little bit older (**6-8 weeks**) and the neonatal **jaundice does not resolve**, it might be because of **biliary atresia**. It might also be due to an inborn error of metabolism or cystic fibrosis. Rule out the others, then do a **HIDA scan after phenobarbital x 1 wk**. Atresia is definitively diagnosed by failure of bile to reach the duodenum, even after the phenobarbital stimulation.

*See peds, vomiting for more details*

Hirschsprung's

Presenting either as a **failure to pass meconium** or **chronic constipation**. The bowel is usually distended - palpable through the abdomen. The **normal colon is dilated** and the **bad colon decompressed**. The bad colon has no innervation, and so has absent peristalsis. A **barium enema** reveals a dilated colon. Definitive diagnosis is made by **full-thickness biopsy** demonstrating **absent ganglia**. Take out the bad colon and reanastomose.

*See peds, constipation for more details*

Intussusception

In a **healthy** 6-12 month old baby who suddenly has **colicky abdominal pain** and then has **currant jelly stool**, do an **air enema** which is both diagnostic and therapeutic. Surgery may be done if the vascular supply was compromised and necrotic bowel occurred.

*See peds, GI bleed for more details*

Introduction

A lot of things go on in the head. Children need to be exposed to bugs to develop an immune system. That means orifices become potential sites for problems to develop, which is why this topic is in pediatrics. Each disease has its own unique presentation so it's usually not a differential - just know what to do.

1) Otitis Media

Otitis media is an infection of the middle ear caused by the **respiratory bugs**. The child is going to be in pain. **Unilateral ear pain** in a child, with or without fever, leukocytosis, etc. is most likely to be otitis. Kids will pull on their ear (**no pain with pinna manipulation**) to relieve the sensation. The diagnosis is confirmed by **pneumatic insufflation** (a little puff of air reveals a **tense immobile membrane**). Things like a **bulging red angry membrane with loss of light reflex** are indicative of fluid behind the ear but aren't pathognomonic. Treat with **amoxicillin** (first line), **azithromycin** (if pen allergic). If the infection doesn't clear give **amoxicillin and clavulanate**. If OM progresses from acute to chronic, this can lead to complications - spread of the infection to the **mastoid, inner ear, and brain**. If the infections recur do **tubes** to equalize pressure and allow drainage - especially if there's residual fluid behind the ear.

2) Otitis Externa

Otitis Externa presents as **unilateral ear pain** (like media), but there's **pain on palpation of pinna** (unlike media). Caused by frequent contact with water ("swimmer's ear"), it's commonly caused by **pseudomonas** (a bug associated with water). It can also be caused by repeated trauma and infection by **Staph aureus**. On physical exam an **angry erythematous canal** can be seen. It usually improves spontaneously but you can treat with ciprofloxacin drops. It becomes important to educate patients not to put anything in their ear and to dry ears after swimming and showering.

3) Sinusitis

An infection of the **nose** and **sinuses** that occurs in both kids and adults. **Purulent bilateral nasal discharge** is a giveaway something's wrong nearby. Adults and older kids may complain of a congested, stuffed feeling with **sinus tenderness**. The **facial tap** is a sensitive physical finding (tapping an inflamed sinus hurts). Radiographs are **not necessary** but will show **air-fluid levels and opacification** (XR + CT). They're expensive and are usually reserved for refractory or recurrent sinusitis to make sure there's no congenital defect. But before doing anything make sure this isn't just a cold - a regular viral illness. If it's been **> 10 days** or is getting worse over a week, simply **presume bacterial infection**. This is an URI so treat the URI bugs with **amoxicillin** (1st line) or **azithromycin** (if penicillin allergic).

4) Cold – Viral Nasal

Typically caused by **rhinovirus** and transmitted between people by **large droplets**. It's also gives "boogers", **rhinorrhea, congestion, and low-grade fever** so it looks like sinusitis. **Nasopharyngeal washes with culture** (to rule out bacterial infection) and **Immunofluorescence** (to rule out viral infection) could be gotten but it's better to **not do anything** because this will just get better on its own. If it's **< 7 days AND no cough** it's likely viral and the patients should wait it out.

URI Bugs

Most Common	Strep Pneumo H. Influenza Moraxella catarrhalis	<b>Amoxicillin</b> (1st line) <b>Azithromycin</b> (pen allergic) Amoxicillin + Clavulanate (refractory) 2 <sup>nd</sup> / 3 <sup>rd</sup> gen Cephalosporin (refractory)
Otitis Externa	Pseudomonas	Spontaneous Resolution (can use Cipro gtt)

Ear Pain

Otitis Media	Visual Inspection
Otitis Externa	Pinna Manipulation
Foreign Body	Lidocaine / Retrieval

Rhinorrhea

Viral Sinusitis	Ø Cough and < 7 days
Bacterial Sinusitis	Culture
Foreign Body	Inspection

Sore Throat

Bacterial	Rapid Strep → Culture
Viral	
Mono	Monospot

Bloody Nose

Digital Trauma	Cold compress, lean forward, humidified air, ablation
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Is it **viral** (wait)

Short Duration  
Low-Grade Fever  
Mild Symptoms

or is it **bacterial (amoxicillin)?**

Longer Duration  
High Fever  
Worse Sxs

Culture

5) Pharyngitis

Much like sinusitis, **viral** pathogens are the most common cause occurring in kids and adults. The primary complaint will be **sore throat** with **pain on swallowing**. The vignette may describe tonsillar erythema, exudates, etc., but those findings are neither sensitive nor specific. Instead, we use the **Centor Criteria** to help direct our decision making. The treatment is **amoxicillin-clavulanate** if there's strep, but do nothing if it's viral. Doing a **Rapid Strep Test** is **specific** (if  $\oplus$  start treatment) but **not sensitive** (if  $\ominus$  move onto **culture**). Cultures take 2-3 days to come back; treatment doesn't need to be started until cultures confirm bacterial infection. Group A Strep infections can lead to rheumatic fever and PSGN\*.

6) Foreign Body

**Children:** Kids like to stick things places. Things can go into the **nose** (producing **foul-smelling unilateral rhinorrhea**), **ear** (pain), and sometimes down their **throat** (aspiration, covered in the pulmonary videos). Essentially, the object has to be **retrieved** with something rigid and the **infection treated**.

**Adults:** One particular foreign body are **insects**; homeless are aware of this and sometimes sleep with coins in their ears. Bugs present with a **unilateral scratching** or **buzzing** and should be treated with **lidocaine** and retrieval, but **never light** (they just burrow deeper).

7) Epistaxis

Whether out of habit or because the nose itches, epistaxis is most commonly caused by **digital trauma** (nose-picking). Normal nosebleeds are **unilateral** and last **<30 minutes**. Applying a cold compress (vasoconstriction) and leaning **forward** (backwards is just drinking the blood causing a cough which can break the clot) can cause an active bleed to stop. Look inside the nose to make sure there isn't anything **anatomical** or **foreign** inside. Treat recurrent bleeds with **humidified air**. Ultimately, **ablation** is used to prevent bleeding.

**Posterior epistaxis** may require **packing** (essentially a tampon inserted into the posterior of the oropharynx with prophylactic antibiotics to prevent toxic shock syndrome).

Nasal polyps

Seen on physical exam, these usually do NOT cause epistaxis, and typically don't cause any problems unless they're huge (airway obstruction). Multiple nasal polyps can be a sign of **cystic fibrosis**; testing should be done even in the absence of other symptoms. Treat with **intranasal steroids** to shrink the polyps or **surgically remove** if they cause deformity or complete obstruction.

8) Choanal Atresia

Finally, something isolated to pediatrics. This is an **atretic** or **anatomically stenosed** (i.e. really big tonsils) connection between the nose and mouth. In severe cases the baby will be **blue at rest** (nasal breathing is insufficient) and **pink up with crying** (as they use their mouth). If it's just partially obstructed there might be a **childhood snore**; kids shouldn't snore. If there's complete atresia a **catheter will fail to pass**. If it's incomplete a **fiber-optic scope** will identify the lesion. **Surgery** is required to remove the tonsils or open the atretic passage.

\*PSGN = post-streptococcal glomerulonephritis

**Calculating the Centor score**

+1	Fever
+1	Exudates
+1	Adenopathy
+1	ABSENCE of cough
+1	< 15 years old
-1	>44 years old

**Interpreting the Score**

< 1	No treatment (viral)
2-3	Throat Culture (Rapid Strep acceptable)
> 4	Empiric Treatment, no testing needed

Site	Retrieval
Ear	Otoscope + Tweezers
Nose	Otoscope + Tweezers
Aspiration	Rigid Bronchoscope
Adult, Ear, Scratching	Lidocaine & Tweezers

Anterior Epistaxis	You Treat
- Nose picking	Compression
- Dry Air	Humidified Air
	Nasal Saline
	Ablation
Posterior Epistaxis	ENT Treats
- Look for HTN	Packing and abx x 72 hours
- Look for CHF	

Introduction

Constipation can present either as **failure to pass meconium** (FTPM) in the neonate or as **infrequent hard stools** in a child. Either one prompts investigation and there can be some overlap between presentations. It's peds - so stratify by age. Each disease has its own workup / presentation so there won't be a diagnostic dilemma.

1) Imperforate Anus

The **earliest and most obvious** of causes of **FTPM**. Just look at it - there's no hole. This is why you **NEVER** take a baby's first temp rectally. But there's a continuum of disease. To find out how bad it is and determine how much colon is missing do an **up-side-down babygram** (gas rises and shows how much distance between the end of colon and the baby's anus). If it's **close**, just **reanastomose**. If **far**, put a **colostomy** and correct before toilet training begins. However, because it's associated with **VACTERL** it's essential to look for **esophageal** and **cardiac** defects before going to surgery.

2) Hirschsprung's

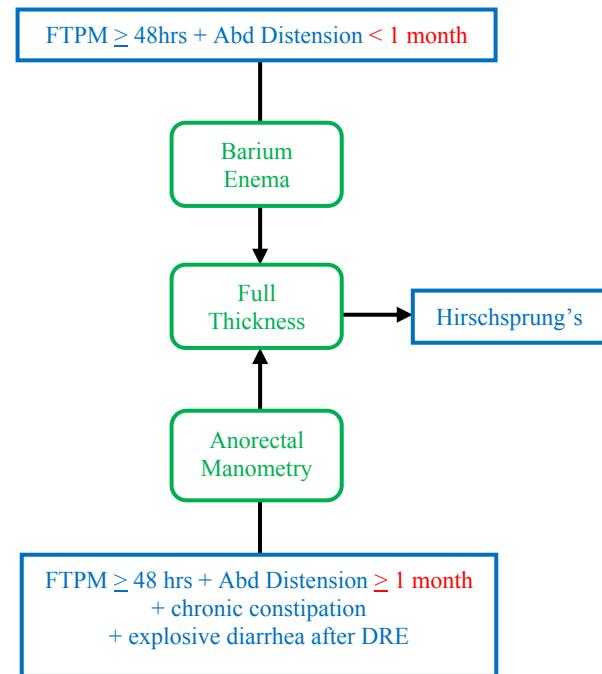
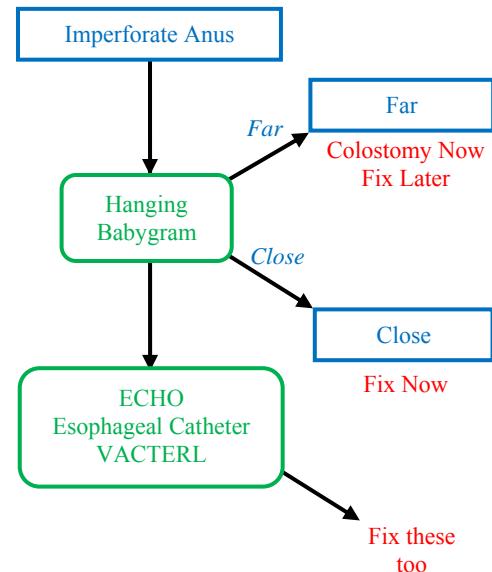
Hirschsprung's is caused by an absent **Auerbach's plexus** (ganglion cells) in the colon. No Auerbach's plexus means no motility. It just so happens that it's a migratory issue, which means only the **distal colon** is affected. This can present as either **FTPM** which persists for **> 48 hrs** or as a child with **chronic constipation** (less common). A highly specific finding is a kid with chronic constipation who has an **explosive bowel movement after DRE**. If mild, he/she can have bowel movements as pressure builds up and overcomes the **paralyzed bowels**. To diagnose, do a **KUB/Babygram** to see **dilated colon** (the normal colon) and distal **normal looking colon** (the defective colon). This causes obvious, palpable distention. The screening test is based on age. If **< 1 month** use **barium enema**; if **> 1 month** use **anorectal manometry**. If **⊕**, confirm with a **full thickness biopsy**. Remove the busted part and anastomose the ends. This is associated with Down syndrome.

3) Meconium Ileus

A child with **cystic fibrosis** (always get a prenatal screen) may have a big chunk of meconium plugging up the intestines. This presents either as **FTPM** or **bilious vomiting**. Even if there wasn't a prenatal screen (a red flag in a question stem), a **babygram** won't show the same picture as an imperforate anus or Hirschsprung's. Instead, it will show **dilated loops of bowel**. A **barium** swallow will show a **micro-colon** distal to obstruction. The best test is also therapeutic: performing a **gastrografin enema** causes water to be absorbed into the lumen dissolving the meconium plug and is **diagnostic** and **therapeutic**. If genetic testing was negative for CF, perform a **sweat chloride test** – it's crucially important to treat CF **pancreatic insufficiency** and **pulmonary toilet** as early as possible. If you see meconium plug, look for cystic fibrosis.

4) Voluntary Constipation

The most common cause of constipation is voluntary holding. Whether to **avoid pain** or simply **embarrassment**, kids may hold it in. The longer they hold it the more water gets taken out of it; the harder it gets. Because the colon is working, stool may sneak around and cause **intermittent diarrhea** or **encopresis**. To get the kid unplugged (voluntary may convert to involuntary) there may have to be a **disimpaction** in the **OR**. Make sure to teach the child that holding it in is dangerous!



Introduction

Blood in the stool and blood out of the rectum is generally a bad sign. It's actually a lengthy medicine discussion in the abdominal section. The good thing is there aren't vast etiologies for us to diagnose in kids, but rather only a few considerations. Once a child is older than 10 anything goes and you might as well treat them like adults.

1) Necrotizing Enterocolitis

If it's **premature baby** and **bloody diarrhea** the diagnosis can essentially be assumed. An **x-ray / babygram** will show **pneumatosis intestinalis** (air in the wall of the bowel) to confirm the diagnosis. The baby needs to go **NPO immediately** and get started on **TPN** and **IV antibiotics**. Hold off from surgery unless there's **no improvement** or **conditions worsen**. Also be on the lookout for other complications of prematurity (to the right).

2) Anal Fissure

A **tear in the anal mucosa** that can be seen on anal exam is an anal fissure. If severe they can be sutured, but since babies usually have diarrhea anyway incontinence isn't an issue and the fissure will heal on its own.

3) Intussusception

When part of the bowel **telescopes** into another the blood supply can be compromised. This causes an **abrupt onset of colicky abdominal pain** in an otherwise healthy baby. It occurs in kids 3 months to 6 years. Kids will find relief with the **knee-chest position** and there may be some **vomiting**. A late sign (ominous and an indication for surgery) is the **currant jelly diarrhea**, which is indicative of bowel necrosis. A **sausage-shaped mass** can be felt in the abdomen. While a KUB may show evidence late in the disease, an **air enema** is sufficient to both **diagnose and treat**. An abdominal ultrasound is a non-invasive test that can increase pre-test probability if you see the "target sign".

4) Meckel's Diverticulum

Meckel's diverticulum is a remnant of the omphalomesenteric (Vitelline) duct, which may contain gastric mucosa, which can bleed. It's the most common cause of **GI bleeding** in a **child**; it presents with either **FOBT+** or **hematochezia** in a kid. This bleeding is **painless**. The classic **rule of 2s** is often pimed, but rarely tested ( $<2$  years old, 2:1 ♂:♀, 2 inches in length, 2 feet from the ileocecal valve, 2% of the population). To diagnose, do a Meckel's scan (**technetium-99**) radionucleotide scan. Treat it surgically.

5) Swallowed Blood

If a patient presents with **melaena** everyone gets very excited. But **babies** can swallow **maternal blood** and **children** can swallow their **own!** So while we ask about red meat and iron supplementation in adults, look for a **history of epistaxis** in children. Perform an **Apt Test** in neonates to figure out if it's just mom's or baby's blood. If it is, don't worry about the "GI bleed."

Premature Disease	How to look for it
Retinopathy of prematurity	Ophtho exam
Respiratory distress of the newborn	Chest X-ray
Intraventricular Hemorrhage	Brain Ultrasound

In any baby with **recurrent infections**, **prolonged infections**, or infections with **weird bugs** there should be an increased index of suspicion for an immunodeficiency. Since **maternal antibodies** are present for about **6 months** after birth it'll be hidden until they wear off. In general, unless there's a high index of suspicion based on a clinical exam the first step is usually **Immunoglobulin Levels** with a **CBC** (white count). This will provide evidence for **sufficient numbers** of both cells and immunoglobulins. After that it's up to you to get the **specific tests** or **slides** to definitively diagnose. While the basic sciences will tell us that certain cells are designed to fight certain infections (**B cells Bacteria**, **T cells virus & fungus**), in real life you'll find that immunocompromised kids can get all sorts of crazy infections that don't always follow these rules.

## B-CELLS

### X-Linked Agammaglobulinemia of Bruton

It's an **X-linked disorder** (only boys get it) of a **B cell deficiency**. Recurrent "normal" infections (**sinusitis / otitis / pneumonia** – which are usually caused by encapsulated organisms (Strep pneumo, H. flu)) are often **frequent or severe**. May also be missing tonsils. Get the Ig Levels; this disease will be apparent as **all immunoglobulins are deficient** (IgM, IgG, IgA). Confirm the diagnosis with ↓B cells and a compensatory ↑T cells. Patients will need **prophylactic antibiotics** and **monthly immunoglobulins**. If it's a kid older than **15** on **first presentation** consider Combined Variable Immune Deficiency (CVID).

### IgA Deficiency

This is the **most common (1/500)** and **most benign** of the immunodeficiencies. IgA protects against the mucosal barrier so patients may have **respiratory or GI infections**. However, IgM still works so these patients may never be diagnosed at all. The big red flag is a patient who gets an **anaphylactic reaction** after **blood transfusion** from exposure to the new (and foreign) IgA.

### Hyper IgM Deficiency

When Ig levels are gotten due to immunodeficiency suspicion, there'll be **low levels of IgA and IgG**, but with a compensatory increase in the **IgM**. A case might be an infant with PCP. Differentiation doesn't occur, but the body is still able to do some defending with the less selective IgM.

## T-CELLS

### DiGeorge Syndrome

The **thymus** and **facial structures** come from the **3<sup>rd</sup> pharyngeal pouch**. With deficiency of the 3<sup>rd</sup> pouch, there'll be: **micrognathia**, **wide-spaced eyes**, **low-set ears**, and **absent thymic shadow** (the syndrome). This disease can be suspected on the baby's physical appearance, but any **fungal** or **Pneumocystis Pneumonia** should be a huge red flag. There may be an underlying **cardiac defect** that has to be identified. Start by giving **antibiotics** and **prophylaxis against PCP** (Bactrim/Dapsone). Cure by giving the baby a **thymic transplant**. If the facial structures lead to thinking about DiGeorge, pay close attention to the **calcium**; absent **parathyroid glands** can produce **hypocalcemia** (and **seizures**).

Wiskott-Aldrich

In **boys** (because it's **X-linked**) with <sup>(1)</sup>**normal bugs infections**, <sup>(2)</sup>**thrombocytopenia**, and <sup>(3)</sup>**eczema**, think Wiskott-Aldrich.

Ataxia-Telangiectasia

Yeah, you'll see this. Not. Know "**Telangiectasias + Ataxia, DNA repair, lymphoma, leukemia.**" If there's a picture of an eyeball, look for telangiectasias (extra blood vessels) and any of these symptoms. Never suggest this to an attending unless it's Dr. House. Pick it on the exam. It's incredibly rare.

SCID

The kid has **no immune system (Bubble boy)**. Knowing that this can be caused by **adenosine deaminase deficiency** was required for step I. so they need **PCP** and **MAC** prophylaxis (Bactrim, Azithromycin). To cure, get a **bone marrow transplant**.

CVID

Like the name suggests, this is a combined B cell and T cell problem. But unlike SCID (Bubble boy disease), it tends to be mild and often not diagnosed until the teenage years after a lifetime of infections. Can be treated with IVIG based on severity.

Chronic Granulomatous Disease

Macrophages can eat but **not kill** organisms that are **catalase +**. When **chronic skin (staph)** or **Aspergillus** infections are seen think of this. The body knows there's an infection - antibodies are produced ( $\uparrow$ **IgM** and **IgG**) and cells are dispatched ( $\uparrow$  **WBC**) – it's just that the cells can't do anything. Confirm with a **negative nitro blue tetrazolium test** that reveals an absent respiratory burst. Organisms that produce their own  $H_2O_2$  can be killed. Treat with daily Bactrim and BMT.

Leukocyte Adhesion Deficiency

Neutrophils can't **adhere** or **get out of** the blood vessels. Thusly, there's **no pus** despite a **massive leukocytosis** and **high fever** ( $\uparrow$  cytokines, antibodies, and leukocytosis in response to infection). An early sign (that'll give the diagnosis away in a vignette) is **delayed separation of the cord**. Get a Bone Marrow Transplant.

Chediak-Higashi

It's an **Autosomal recessive** disorder leading to **impaired microtubule polymerization**. It will also show **albinism**, **neuropathy**, and **neutropenia**. Look for **giant granules** in **neutrophils**.

C5-C9 (Terminal Complement Deficiency)NeisseriaC1 Esterase DeficiencyAngioedema

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C5-C9 (Terminal Complement Deficiency)NeisseriaC1 Esterase DeficiencyAngioedema

Introduction

Just like an adult, there are **prehepatic** (hemolysis), **intrahepatic** (metabolic), and **posthepatic** (biliary obstruction) causes. In a neonate (especially in a preemie) hepatic function is far less than an adult, compounding any problems.

Types of Bilirubin

There are two types of bilirubin. **Conjugated** bilirubin is **water soluble** so it **can't cross blood brain barrier**, but can be excreted in the **urine**. It can't cause brain damage, but is **always pathologic** - indicative of problems with **biliary excretion**. Conversely, **unconjugated** bilirubin is **lipid-soluble** so it **can cross blood brain barrier**, potentially leading to **kernicterus** (irreversible deposition in the basal ganglia and pons). It's **potentially fatal**. Unconjugated bilirubin is either **prehepatic** (hemolysis) or **intrahepatic** in adults, but can actually be **physiologic** in a neonate.

Workup for Jaundice

All babies in the newborn nursery are screened for hyperbili in using a transcutaneous sensor. If the transcutaneous level is high or rises quickly, draw a bilirubin level. An **unconjugated hyperbilirubinemia** should prompt assessment for hemolysis: with a **Coombs Test** (isoimmunization), **CBC**, and a **Reticulocyte count** (pay particular attention to the tree to the right). On the contrary, a **direct** hyperbilirubinemia is more dangerous. It requires a workup for **sepsis** (WBC, Blood Cx), **obstruction** (HIDA scan), and almost any **metabolic** disease (Crigler-Najjar, Rotor, Dubin-Johnson). A **black liver** is Dubin-Johnson.

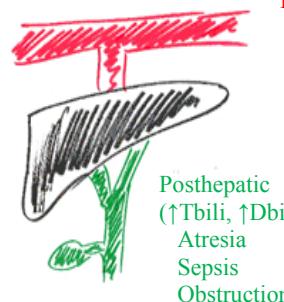
Treatment of Jaundice

Keep an eye on the bilirubin. If levels get **>20** then the risk of kernicterus is too great and an **exchange perfusion** must be performed. For mild elevations (**>10**) the baby goes under a **blue light lamp** (or gets put near a window). It changes the indirect to direct bili (excreted in the urine). However, do **not light up** a direct bili because it won't help and will just end up **bronzing** the baby. The goal of indirect therapy is to make it **water-soluble**. Direct bilirubin already is.

Breast Feeding vs Breast Milk Jaundice

In **breast feeding, jaundice is a quantity issue**. Without sufficient volume bowels don't move fast enough; the body **reabsorbs bilirubin** and bilirubin builds up. By **increasing the number of feeds** the problem fixes itself. In order to be reabsorbed from the gut the bilirubin must be **unconjugated** so there will be an elevation in indirect bilirubinemia. Breast feeding occurs with the first week of life (**<7 days**).

In **Breast Milk Jaundice** it's the breast milk itself, inhibiting glucuronyl transferase (the conjugation enzyme). Supplementing with **formula feeds** will fix it. Breast Milk Jaundice occurs in the second week of life (**> 10 days out**).



Prehepatic ( $\uparrow$ Tbili, nl Dbili)  
Too much Blood  
Too much Hemolysis

Intrahepatic (mixed picture)  
Crigler-Najjar (type 2)  
Gilbert's  
Dubin-Johnson  
Rotor  
Hepatitis  
Sepsis

**UNCONJUGATED**

Lipid Soluble  
Cross BBB  
**Kernicterus**  
 $\emptyset$  Urine Excretion

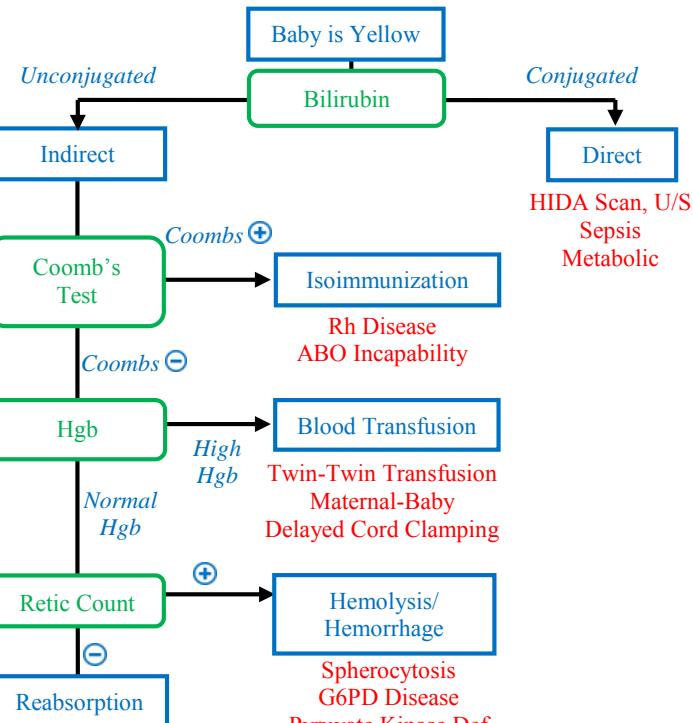
**CONJUGATED**

Water Soluble  
Can't Cross BBB  
 $\emptyset$  Kernicterus  
Urinary Excretion

**PHYSIOLOGIC**

Onset  $\geq$  72 hrs  
Bilirubin  $\uparrow$  <5/day (slow)  
**D. Bili <10% Total**  
Resolves in 1 week (term)  
or 2 weeks (preterm)

Onset <24 hrs  
Bilirubin  $\uparrow$  >5/day (fast)  
**D. Bili > 10% Total**  
Resolves in  $\geq$  1 week (term)  
 $\geq$  2 weeks (preterm)

**Breast Milk Jaundice**

<b>Breast Milk</b>	<b>(Lack of) Breast Feeding</b>
> 10 days of life	<7 days of life
<b>Enzyme Inhibition</b>	<b>Not enough feeding</b>
Insufficient Conjugation	↑ Enterohepatic Reabsorption
<b>Supplement</b>	↑ Feed Frequency

Amblyopia

This is essentially a **cortical blindness** and a defect of **development** that results when misalignment of the eyes (many causes including cataracts, tumor, strabismus, ocular motor dysfunction) → competing visual inputs → the brain will “turn off” inputs from the busted eye. One eye will be **normal** while the other eye will go **blind**. Fix the underlying problem.

Strabismus

This is misalignment of the eyes that, if left untreated, can lead to amblyopia – or permanent “lazy eye”. Strabismus confirmed on physical exam when the **reflection of light comes from separate locations on each eye**. If present from birth, this needs to be surgically corrected to avoid amblyopia. However, if baby was NOT born with it, consider that this could simply be a refraction problem that can be fixed by **glasses** and then will **resolve spontaneously**.

Retinoblastoma

In the nursery, instead of a **red light reflex** a **pure white retina can be seen** in the back of the eye. Don’t confuse this with a cataract in front of the eye. **Resect** the tumor. **Avoid radiation** (↑ risk of “2<sup>nd</sup> knockout” in the good eye). Observe the patient for future **osteosarcoma** - especially in the distal femur.

Cataracts

Congenital cataracts have a **milky white** appearance in the front of the eye. You’ll see them just by looking. They are caused either by the TORCH infections if present at birth or **galactokinase deficiency** if acquired early in life. **Fix** it before **amblyopia** sets in with surgical removal of the cataract.

Retinopathy of Prematurity

**Premature neonates** requiring high-flow O<sub>2</sub> can get these growths on the retina. Using **laser ablation** can improve vision in life. Look also for **intraventricular hemorrhage**, **bronchopulmonary dysplasia**, and **necrotizing enterocolitis** in a preemie in the ICU.

Conjunctivitis in Newborns

What we care about in newborns is being able to discern between a bacterial conjunctivitis that will cause baby to go blind and a chemical or viral conjunctivitis that will just get better on its own. We **screen and treat** all mothers for STIs. But sometimes a baby gets through without mom knowing or being treated. If that’s the case, we’re trying to protect baby from Gonorrhea and Chlamydia. We can use **silver nitrate drops** as **prophylaxis**. This stuff burns and can induce a **chemical conjunctivitis** (clear, non-purulent discharge on day 1). Use the timing and the laterality to help you decide which bacteria it is. **Gonorrhea** is first, appearing at **2-5 days** and is a **purulent bilateral** discharge. It’s treated with **topical erythromycin**. **Chlamydia** occurs at **day 7-14** and is **mucopurulent unilateral** discharge. It’s treated with **topical PLUS oral erythromycin** to prevent pneumonia.

*This is a duplicate note-set from Surgery. The questions, the notes, and the video are identical for Peds-Ophtho and Surgery-Peds-Ophtho*

Gonorrhea is gram negative diplococci  
Chlamydia shows nothing (bacteria is intracellular)

Type	Timing	Purulent	Problems	Treatment
Chemical	<b>24 hrs</b>	Non-purulent	Bilateral	Caused by silver nitrate drops
Gonorrhea	<b>Day 2-5</b>	Purulent	Bilateral, can turn into blindness	<b>Topical erythromycin</b> Or <b>Silver Nitrate Prophylaxis</b>
Chlamydia	<b>Day 7-12</b>	Muco-purulent	Unilateral Can turn into pneumonia	<b>Oral + Topical Erythromycin</b> or <b>PPX</b>

Adult orthopedics has a great many diseases to learn and pediatrics ortho is no different. For pediatrics every disease has its own unique presentation. Learning each constitutes strict memorization but there's only a few things to commit for each disease. Keep in mind - if you're studying for a test this makes for a great extended matching set.

### 1) Hip Pathology

Knowing the **age**, **presentation**, and **treatment** will help build a differential for "hip disease."

#### i. Developmental Dysplasia of the hip

The hip is insufficiently deep so the femur head constantly pops out. Diagnosed during the well-baby exam (**newborn**), there'll be a clear **click** sound on **hip flexion** (Barlow's and Ortolani's). Confirm the diagnosis with an **Ultrasound**. Put the child in a **harness** to keep the femur approximated to the joint as it grows out.

#### ii. Legg-Calve-Perthe Disease

When a child is around **six years old** they can suffer from **avascular necrosis** of the hip. There'll be an **insidious onset knee pain** and an **antalgic gait**. Diagnose by **X-ray** and then **cast**.

#### iii. Slipped Capital Femoral Epiphysis

An orthopedic emergency, it can occur in **adolescents** who are either **obese** or in a **growth spurt**. They'll complain of **hip** or **knee pain** of sudden onset. Get a **frog-leg position x-ray** to confirm. **Surgery is required**.

#### iv. Septic Hip

The differential of pediatric hip disease could be done by age alone were it not for this. It shows up in **any age** (though usually a **toddler**) after a **febrile illness** and complaining of joint pain. Do an **X-ray** first then a **joint aspirate with smear and culture**. It needs to be **drained** and baby needs **antibiotics**.

#### v. Transient Synovitis

Presents with pain (usually in hip) or refusal to bear weight on one side about 1 week after URI (so no longer has fever, unlike septic hip). Normal X-rays. Treat with rest and NSAIDs.

### 2) Osgood-Schlatter Disease

Occurring in **teenage athletes**, it presents as a **painful knee without swelling**. The athlete has two options - stop exercising and cast it (curative) or **work through it**. If they work through it there'll be a **palpable nodule** from osteochondrosis. Otherwise, it causes no permanent sequelae but it does hurt.

### 3) Scoliosis

A developmental disorder of the **spine** found in **adolescent girls**. Their thorax will tip to the **right** causing a cosmetic deformity. More severe disease can cause **respiratory** issues. Perform an **Adam's Test** (girl bends forward, asymmetric shoulders are diagnostic) and confirm with **X-ray**. Treat with **bracing**.

### 4) Bone Tumors

In kids, **1° Tumors** cause **low grade focal pain** and may invade locally. Have two in mind. **Osteogenic Sarcoma** presents with a **sunburst onion skin** pattern typically at the **distal femur**. It's associated with **retinoblastoma**. The other is an **Ewing's sarcoma** found in the **midshaft** (may have "onion skin" pattern on X-ray) caused by **T(11:22)**.

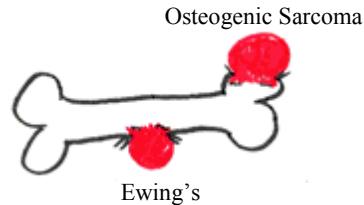
### 5) Special Considerations for Fractures

Fractures are the same as for adults except when it comes to the **growth plate**. If the fracture involves the growth plate an **ORIF** is needed to ensure the plate is realigned. Otherwise the kid will grow up with one leg shorter than the other.

*This is a reproduction of the surgery content in the pediatrics section, should you be viewing only pediatrics*

Dx	Age	Patient	Dx	Tx
<b>DDH</b>	Newborn	Clicky Hip	U/S	Harness
<b>LCP</b>	6	Insidious Onset Antalgic Gait	XR	Case
<b>SCFE</b>	13	Fat kid with knee pain (nontraumatic)	XR	Surgery (Emergency)
<b>Septic Hip</b>	Any (Toddler)	Joint pain after febrile illness	Aspirate	Drain and Abx

Dx	Patient	Sxs	Dx	Tx
<b>Osgood Schlatter</b>	Teenage Athlete	Knee pain with calcification	Clx	Cast Extended
<b>Scoliosis</b>	Teenage Girl	Adam's Test	XR	Brace
<b>Osteogenic Sarcoma</b>	Retinoblastoma	Femur / Tib Pain	XR Sunburst	Resection
<b>Ewing's Fractures</b>	(t11:22)	Mid-Shaft Pain	XR	Resection if a plate involved do open reduction and internal fixation



Introduction

Pediatric CT surgery focuses around the defects in cardiac development. That means **murmurs**. Each murmur has a characteristic **sound**, **appearance**, and **association**. Chest X-rays or EKGs may give clues, but **all cardiac defects are diagnosed by Echo**. Before beginning our discussion of the major cardiac defects, let's take a moment to go over **innocent murmurs**.

An **innocent murmur** is grade 1 or 2 out of 6 and is systolic in an otherwise healthy kid. It can represent any number of high flow states typical in kids and doesn't need a workup (but it's important to tell the parents so they know this for future doctor visits). If **new, diastolic, or  $\geq 3 / 6$** , get an echo and work it up.

Left to Right Shunts

Left to right shunts are caused by a hole between **high and low pressures**, allowing blood to flow from the left ventricle (which is oxygenated) back into the pulmonary circulation. This causes **increased vascular markings** on chest X-ray. The response to high pressure in the pulmonary circulation is hypertrophy with resultant **pulmonary hypertension**. Left alone long enough, there'll eventually be a **flow reversal** (Eisenmenger's) turning these **noncyanotic** lesions to cyanotic ones.

i. Atrial Septal Defect

Because the atria are low pressure the consequences are small, so this can be found at **any age**. The thing that gives it away is the **fixed wide split S<sub>2</sub>** (easier to say on a test than to identify) and usually the murmur isn't heard. 90% close on their own, but if they persist or are diagnosed later in life, **closure** is achieved either with **cath** or **surgery**.

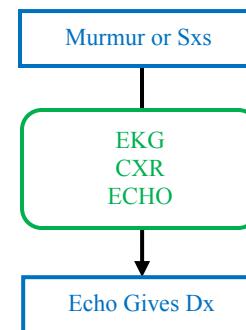
ii. Ventricular Septal Defect

This is the **most common congenital heart disease**. It's a link between the ventricles (high pressure). There'll be a **harsh holosystolic murmur** (the smaller the hole the louder the murmur). In a kid, there's been no time for mitral regurgitation to develop (sounds the same) and these are symptomatic young. There'll be a **failure to thrive, dyspnea**, or full-blown **CHF**. If asymptomatic, give it a chance to close spontaneously. If there's **CHF** or **persistence to 1 year of age** surgical correction is mandatory.

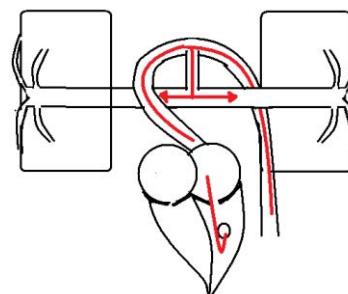
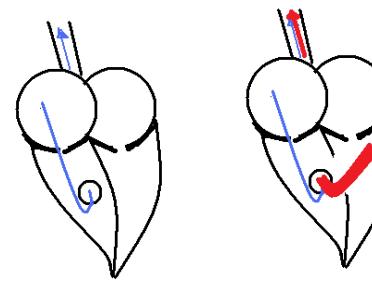
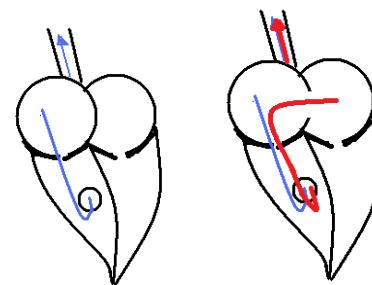
iii. Patent Ductus Arteriosus

A connection between the **aorta** and the **pulmonary artery**. Exam reveals a **continuous "machinery-like"** murmur. The murmur may not be apparent on day one, so may be noticed on the exit exam. If there's **no CHF** then the PDA can be closed with **indomethacin** (**ends** the PDA). However, if symptoms are severe (high flow, **CHF**) surgery is needed. The PDA must be closed by **6-8 months** regardless. If for some reason a PDA is needed (Tetralogy) **prostaglandins** can be given to maintain it.

*This is a duplication from the surgery videos, in case you are studying pediatrics only.*

Left to Right Shunts

↑ Pulmonary Flow  
↑ Pulmonary Vasculature (CXR)  
↑ Pulmonary Pressure  
Right Ventricular Hypertrophy  
Eisenmenger's (Reversal of Flow)



Right to Left Shunts

Something must go very wrong in order for blood to go out into systemic circulation as deoxygenated blood. After all, a simple hole would result in a left to right shunt. So, blood isn't going to the lungs. This results in **cyanosis (blue baby)** and **decreased vascular markings** on chest X-ray. They're the "T" diseases. They present either with acute cyanosis or chronic effects (such as clubbing). While there are others, these two are most commonly seen, discussed, and tested.

iv. Transposition of the Great Arteries

The most common cyanotic defect of the **newborn**. During the first **8 weeks** of embryogenesis the heart forms and twists. If it doesn't twist two independent circulations form: the **Vena Cava - RIGHT Ventricle - Aorta** ("systemic") and the **Pulmonary Vein - LEFT Ventricle - Pulmonary Artery** ("pulmonary"). This means that blood pumped to the periphery isn't oxygenated; the oxygenated blood is simply circulated through the lungs. Look for "egg shaped heart" on CXR (but in real life, take care of baby first!). Even though it's common in children of **diabetic mothers** with poorly controlled sugar it does **NOT** happen in gestational diabetes (by 20 weeks the heart has already formed). Without a **PDA** this is **fatal** (so give **prostaglandins**). It presents on **day 1** as a **blue baby**. Surgery must be done to correct it ASAP. If surgery is not immediately available, take the baby to the cath lab for balloon septoplasty to buy some time.

v. Tetralogy of Fallot

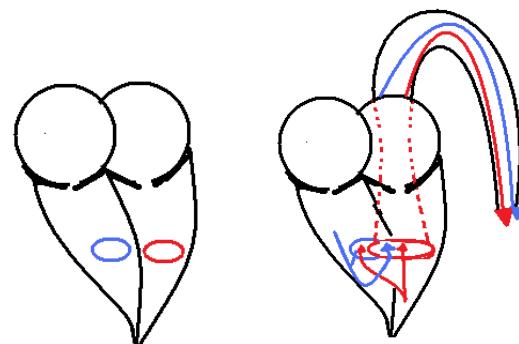
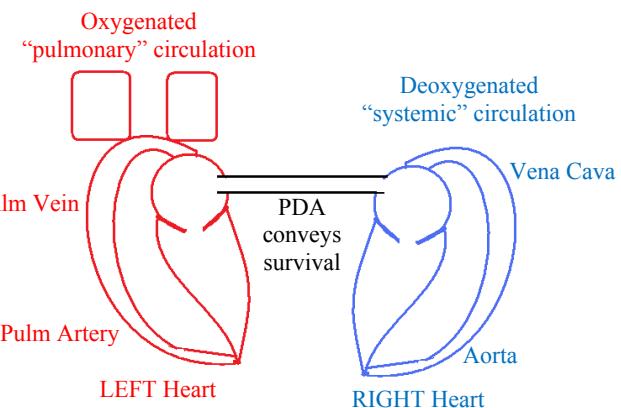
The most common cyanotic defect of **children** (because TGA babies die or get fixed). It's caused by an endocardial cushion defect. It's a "tetra-ology," and is defined by an **Overriding Aorta**, **Pulmonary Stenosis**, **Right Ventricle Hypertrophy**, and a **Ventricular Septal Defect**. If severe we get a blue baby and it requires immediate intervention. The tricky way of presenting is in a toddler with **Tet Spells** (cyanosis relieved by squatting). Squatting causes an increase in systemic vascular resistance, pushing more right ventricular blood into the lungs. Look for a **boot-shaped heart** on chest X-ray. The question stem may also give you a history of being born in a third world country and/or clubbed fingers, cyanosis. This is associated with **Down syndrome**. Surgery is definitive therapy, held over with a **balloon septoplasty**.

Coarctation of the Aorta

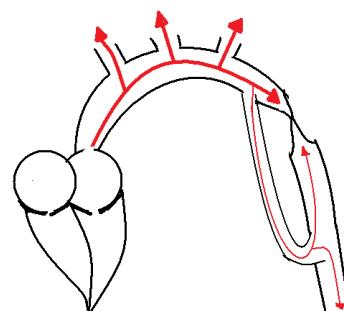
Thrown in here because it doesn't really fit in either category. In a baby with **hypertension, claudication** (pain/crying/refusal to walk with walking, relief with sitting), or an obvious temperature difference between arms and legs suspect coarctation. First, get **blood pressures** on arms and legs; there will be a large disparity. Do an **angiogram** to definitely diagnose. Surgically correct. If it's allowed to persist an **X-ray** will show **rib notching** as collaterals erode into the ribs.

Right to Left Shunts

↓ Pulmonary Flow  
↓ Pulmonary Vasculature (CXR)  
Deoxygenated blood in periphery  
Blue Baby Syndrome



*The others are rare. Things like **Truncus Arteriosus**, **Tricuspid Atresia**, and **Total Anomalous Pulmonary Venous Return** are almost never seen. Review Step 1 notes for clarity or to impress your attending*



Introduction

Infections that happen to adults can happen to kids too. This section is just a touch of the topics covered in the medicine ID section in case you aren't doing the full course. There are some small pearls unique to kids.

	<b>Scabies</b>	<b>Lice</b>	<b>Pinworm</b>
<b>Itchy Skin</b>	Itchy webs of hands and axilla, especially in family	Itchy Scalp ± visualized lice or nits (eggs)	Itchy Butt
	Scrape the skin to see eggs on a scope	Just look - they are big, body, head, pubis	Tape Test
	Cover kids in permethrin or lindane	Use Permethrin and cut air	Albendazole

\*\*\*don't forget to treat the whole family & all linens in the house\*\*\*

<b>Osteomyelitis</b>	Bone pain / refusal to bear weight Hematogenous spread or direct trauma, cellulitis Staph Aureus most common in everyone Pseudomonas puncture wound Salmonella sickle-cell Pasturella animal bites CBC, ESR, Blood Culture are peripheral XR may be Θ initially Bone Scan better, cannot have cellulitis Bone Culture best test
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<b>AIDS</b>	Caused by HIV either congenital (↓ risk with AZT and no breastfeeding) or teenage sex Develop recurrent infections or failure to thrive, usually nonspecific. Any opportunistic infection may not equal AIDS if young. <b>ELISA → Western Blot</b> if ELISA + Treat with prophylaxis and antiretroviral like in adults >350 Normal HAART >200 ↑Normal Infxns HAART <200 PCP Bactrim, Dapsone <50 Toxo, MAC, CMV Bactrim, Azithromycin
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<b>Septic Joints</b>	Red, Hot, Tender Joints and usually only one Arthrocentesis for stain and culture Tx with abx, r/o other juvenile arthritis ***think gonococcus in teenagers***
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	<b>Meningitis</b>	<b>Babies</b>	<b>Adolescent</b>
Patient		Bulging fontanel on a fussy baby	Typical adult, headache, nausea/vomiting, nuchal rigidity
Organisms		Group B Strep E.Coli Listeria	H. Flu Strep Pneumo Neisseria
Empiric Abx		Ceftriaxone Vancomycin <b>Ampicillin</b>	Ceftriaxone Vancomycin ± Steroids
Dx	Lumbar Puncture with culture and sensitivities. Abx then CT scan if signs of ↑ ICP		

<b>Tuberculosis</b>	PPD → XR → RIPE + → - → INH TB Sxs → XR → RIPE Hematogenous direct trauma, cellulitis BCG - does NOT change PPD reading - is used against disseminated TB, not the pulmonary TB Isolate baby from mom until INH onboard. Baby gets INH, mom goes down normal diagnostic path. Also, no breastfeeding!
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**Viral Meningitis** = give acyclovir, assume HSV until proven otherwise (serious complications). Once ruled out, take off. Most common bug is enterovirus

**Petechial Rash** = N. Meningitis until proven otherwise

**Introduction**

Children are prone to viruses. We prevent them with vaccines, but all it takes is one suspicious parent to say no and suddenly these kids get disease. Can adults get these diseases too? Of course. But it's more likely to see these **viral exanthems** in children. See the Derm-Infectious Disease Adult Rashes for more rash disease. Learn the **Pattern, Development, and Timeline** of the **fever + rash** to nail these on the test.

**Erythema Infectiosum**

Caused by **parvovirus B19**, there's usually a nonspecific prodrome and low grade fever that gives rise to an erythematous rash. It's isolated to the face bilaterally (**slapped-cheek**). This disease is benign on its own in a normal healthy baby and **resolves spontaneously**. If there's increased cell turnover (hemolysis, especially sickle cell) or decreased production (anemia, heavy metals) this infection may precipitate an **aplastic crisis**. If baby gets sick and is near mom while she's pregnant it can cause **hydrops fetalis** in the new baby. Separate mom. Adults may also have joint pain.

**Measles**

Caused by Rubeola, there's an obvious prodrome of low grade fever and the "four hard Cs" – **cough, coryza** (runny nose), **conjunctivitis**, and **Coplik Spots** (Koplik Spots are small irregular spots with white centers on buccal mucosa). After the spots, the **fever and rash start together**. The rash spreads and clears from **head to toe**. Later in life a potentially lethal complication (**subacute sclerosing panencephalitis**) can occur. Vitamin A may improve outcomes of measles.

**Rubella**

Caused by Rubella, the rash itself looks just like measles. It **starts on the face, spreads to the toes**, and is likewise **macular**. However, during the rash these patients do not look as sick as measles. Also, the prodrome of **tender generalized** (periorbital, postauricular) **lymphadenitis** precedes the rash. Since Measles and Rubella look the same they're in the same vaccine. Congenital Rubella: heart defects, deafness, cataracts, developmental delay, rash.

**Roseola**

Caused by HHV-6, there's a prodrome of a **high-fever (> 40 °C)** that **breaks as the rash starts**. The rash is a **macular rash that begins on trunk and spreads to the face**. Febrile seizures may result from extreme fever during the prodrome.

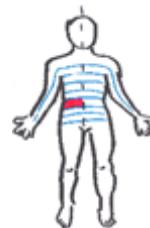
**Varicella**

Chickenpox are caused by **Varicella Zoster**. A vague, nonspecific viral prodrome indicates contagion. What follows is a **wide spread** rash of **vesicles on an erythematous base** that are in **different phases** (eruption, ulceration, crusting). Contagion ends with a final crust. **Scarring** and **Shingles** (reactivation) can be prevented with **immunization**.



Varicella Zoster (Shingles)

A sequelae of Varicella seen in **immunocompromised adults** who had chicken pox. Reactivation causes an **extremely painful** prodrome that **precedes a rash** in the **same dermatomal distribution** of the pain and **never crosses midline**. It generally isn't treated, though acyclovir may decrease duration. If pain persists **beyond resolution of the rash** (**postherpetic neuralgia**) treat the pain with TCA or GABAentin.

Mumps

Mumps is a little inappropriate for this section as it doesn't cause a rash. Instead, it causes **bilateral parotid swelling** and **orchitis** in **pubertal males**. Caused by paramyxovirus. Its prodrome is nonspecific. Inducing salivation (**Pickle Test**) is **painful** and the parotid outlets may swollen. Can lead to infertility.

Hand-Foot-Mouth

Caused by Coxsackie A virus, it also has a vague, nonspecific prodrome but may present with **oral pain**. Like varicella, it has a **vesicle** on an **erythematous base**, but will primarily involve only the **hands, feet, and mouth** (thus the name). It can also involve the buttocks.

Molluscum Contagiosum

Caused by a poxvirus that makes **flesh colored, domed papules with central umbilication**. Likes the trunk, arms, legs and diaper area. Benign and clears on its own but can take 1-2 years.

Scarlet Fever

Caused by Group A strep. Begins with fever, sore throat and desquamating "sandpaper" rash that **begins on trunk and spreads outwards**. Look for a **strawberry tongue**. Penicillin will treat, prevent rheumatic heart, but cannot prevent post-strep glomerulonephritis.

Disease	Bug	Prodrome	Rash	Other
Erythema Infectiosum	Parvovirus B19	Vague, Nonspecific	Slapped Cheek appearance then to chest	Aplastic Crisis Hydrops Fetalis
Measles	Rubeola	Cough, Coryza, Conjunctivitis with Koplik Spots	Erythematous Macular Rash Starts Head → Toes Clear Head → Toes	SSPE Vaccine
Rubella	Rubella	Tender, Generalized Lymphadenitis	Erythematous Macular Rash Starts Head → Toes Clear Head → Toes	TORCH Vaccine
Roseola	HHV-6	<b>High Fever</b>	Truncal Rash Spreads to Face. Starts when the fever breaks	Febrile Seizures
Varicella (Chickenpox)	Varicella Zoster	Vague and Nonspecific	<b>Vesicles on an erythematous base in different stages</b> (eruption, ulceration, crusting)	Shingles Vaccine
Varicella Zoster (Shingles)	Varicella Zoster Reactivation	<b>Pain in a dermatome</b>	<b>Vesicles on an erythematous base in a single dermatome and respects midline</b>	Ø
Mumps	Paramyxovirus	Vague and Nonspecific	Parotid Swelling ± Orchitis ⊕ Pickle Test or ↑ Amylase.	Vaccine
Hand Foot and Mouth Disease	Coxsackie A	Vague and Nonspecific May have <b>oral pain</b>	<b>Vesicles on an erythematous base located on the hands, feet, and mouth</b>	
<b>Scarlet fever</b>	Group A strep	Fever, sore throat <b>Strawberry Tongue</b>	Desquamating <b>Sandpaper</b> rash on trunk that spreads out	Penicillin Rheumatic fever Glomerulonephritis
<b>Molluscum Contagiosum</b>	Poxvirus	None	Domed papules with <b>central umbilication</b>	Clears spontaneously

Introduction

Trauma of all sorts can happen to children just as it happens to adults. There's an entire trauma subsection in surgery. Here we hit the highlights of the findings, focus a bit of time on mechanism, and designate a bunch on **prevention and treatment**.

Head Trauma

Children have proportionally **larger heads** which makes them **top heavy**. This means when a kid goes airborne (**MVA, trampoline, or pedestrian struck**) they play "lawn dart," head first. Their heads are also big targets for trauma (like **baseballs**). Kids play sports where they're at an increased risk. Finally, kids are small and targets for **abuse**. Suspect abuse when children do not cry with severe injuries, multiple fractures, or any subdural hematoma not associated with an MVA. **Prevention** is a major part of kids' lives. Keeping them safe is critical in keeping them healthy. When used properly **helmets, seat belts, and car seats** make a huge difference. A common question is when a kid can go back to play following a **concussion**. It's dependent on the **grade** (severity) and symptoms. Any time there is **+Loss of Consciousness** do a **CT scan**. See Surgery - Sub - Neurobleed.

Drowning

It takes only a **cup of water** to drown. Young kids (<5 yo) are curious and top-heavy and can easily **topple into tubs, buckets, and puddles**. Supervision is incredibly important. Adolescents think they're supermen and partake in risky behavior (**motor vehicles, alcohol, and diving**). Both groups have impaired swimming abilities (lack of skill vs inebriation), making **pools** dangerous for everyone. **Limiting access** with **gates and fences** and having kids use **flotation devices** prevents death. Kids who drown usually die; resuscitation efforts are often unsuccessful as the brain can't go without oxygen for more than a few minutes. Drowning in **cold fresh water** has the best prognosis; decreasing metabolic demand increases survival. Salt water drowning is the worst as it results in **pulmonary edema** complicating post-drowning care. There's technically no such thing as near-drowning – just different outcomes of drowning.

Burns

Burns can happen whether a child is trapped in a fire, dunked in a hot tub (**abuse**), or by pulling boiling water from a stove. Burns are broken into **degrees**. If >10% of **BSA** burned (using either **rule of 9s** or **1 palm = 1% rule**) they need to be admitted to a **burn ward** and also have their **fluid replaced**. Use the **Parkland 50-in-8 50-in-16 rule** to replace, then be sure to add the routine **maintenance**.

Sudden Infant Death Syndrome

We don't know why this happens. Reduce risk "back to sleep" (sleeping on the child's back), eliminate blankets/stuffed animals in crib, no bed sharing, no smoking,

HEAD TRAUMA

<b>Disease</b>	<b>Trauma</b>	<b>Symptoms</b>	<b>CT</b>	<b>Treatment</b>
Epidural Hematoma	Temple Trauma	<b>+LOC</b> with Lucid Interval	Biconvex "lens"	Evacuation
Subdural Hematoma	Major trauma or abuse	<b>+LOC</b> Ø Lucidity	Concave "crescent"	Evacuation ICP
Concussion	Sports Trauma	<b>+LOC</b>	Grade III	1 month rest
		<b>+Amnesia</b>	Grade II	1 week rest
		Ø Amnesia <b>+LOC</b>	Grade I	20 minute rest
Cerebral Contusion	Major Trauma	<b>+LOC</b>	Punctate Hemorrhage	Manage ICP

Head Trauma Prevention

Helmets in sports and on bikes

Seat belts in cars

Car seats from day 1 facing rear in the back seat

4 ft + 40 lbs to a booster seat

Eliminate trampolines

Drowning

Def = respiratory impairment from submersion/immersion

Outcomes = death, morbidity, no morbidity

Salt-Water = ↑Edema worse prognosis → give PEEP

Fresh-Water = better prognosis

Drowning Prevention

Locked Gates Surrounding all pools

Constant supervision near tubs and tanks

Use of life jackets, NOT arm floaties

Burns

1<sup>st</sup> Degree = epidermis only, **+ pain + erythema**

2<sup>nd</sup> Degree = epi + dermis, **+ pain + blisters + erythema**

3<sup>rd</sup> Degree = through dermis, **white and painless** with surrounding 2<sup>nd</sup> degree burns

Parkland Formula	%BSA x Kg x 4 + Maintenance	50% in 8 hrs
		50% in 16 hrs
DAILY Fluid Rate	0-10 kg 100cc/kg 10-20 kg 50cc/kg 20+ kg 20cc/kg	HOURLY 0-10 kg 4cc/kg 10-20 kg 2cc/kg 20+ kg 1cc/kg

Rule of 9s

Head: 18

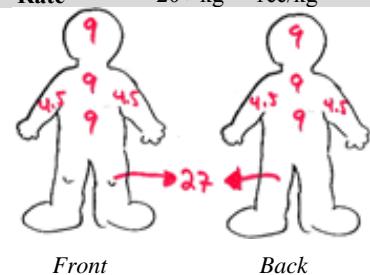
Front Thorax: 18

Back Thorax: 18

Arm: 9

Arm: 9

Legs: 9, 9, 9



Introduction

“Seizures” is a major topic covered in the medicine videos. Kids can have any kind of seizure - just like adults – but there are also special seizures that affect children.

1) Absence

Kids who are suspected to have **ADHD** may have more than just trouble paying attention. If the child has trouble paying attention it might actually be **hundreds of tiny seizures**. These seizures are **complex** because the child **loses consciousness**, but **partial** because there are no external signs. He/she will see skip-phase conversations, the teacher jumping from topic to topic, starting and stopping sentences randomly as he/she comes in and out of consciousness. Confirm the seizures with **EEG** and treat with **ethosuximide**. This can easily be misdiagnosed as ADHD.

2) Febrile Seizures

In **young** children, any febrile illness can cause a **rapid spike** in body temperature. The rapid rise in temperature, not the high fever, can cause a seizure. When the child seizes with a fever look for the **source** and **control the fever** with **Tylenol**. Do **NOT** give aspirin, ever, because of risk of Reye’s syndrome. If the source of the seizure can’t be found on routine examination additional studies may be required (**EEG / CT / LP**). Most (98%) children will NOT develop epilepsy.

3) West Syndrome (Infantile Spasm)

If that **young (< 6 months old)** child has **bilateral jerking** of the **head or extremities** but **without fever**, consider infantile spasms. This syndrome is confirmed by **interictal EEG** showing **hypsarrhythmia**. The spasms can be treated with **ACTH** but the **psychomotor retardation** can’t be controlled; it’s associated with mental retardation and a poor prognosis.

4) Lennox-Gastaut Syndrome

Recurrent and difficult to treat seizures, usually presenting in boys between 2 and 6 years old. **Interictal EEG** shows **slow spike-and-wave** pattern. Also associated with psychomotor and mental retardation.

5) Tuberous Sclerosis

Technically, this can be diagnosed at any age and seizures don’t need to be present. But if a **young (< 2 years old)** child comes in with **afebrile seizures** or a febrile seizure requires a CT, suspect TS. The **seizure** and the **ash leaf spots** (enhanced by **Wood’s lamp**) are enough to prompt a **CT scan** to reveal the **tubers** in the brain. Prepare the child for **mental retardation** and **sebaceous adenomas**.

<b>Complex</b>	<b>Simple</b>
Loss of consciousness	No loss of consciousness
<b>Generalized</b>	<b>Partial</b>
Total body	Specific Symptoms
<b>Seizure</b>	<b>Epilepsy</b>
Usually one-time event*	Lifelong “focus” in brain

5 “F”s of Simple Febrile Seizures

- Age **Five** months to **Five** years
- **First** time seizure
- Occurs with a **Fever**
- No **Focal** features
- Lasts less than **Fifteen** minutes

\*If the 5 “F”s are fulfilled, it is a simple febrile seizure. Up to **five %** of children will have a simple febrile seizure in their lifetime and **family history** of seizures increases risk. Besides treating the cause of the fever, no further workup or treatment is required.

Pediatric Antiepileptic Drugs “Greatest Hits”

Lorazepam	1 <sup>st</sup> treatment for status epilepticus
Phenytoin	generalized complex seizures
Phenobarbital	Partial seizures
Ethosuximide	Absence seizures
Carbamazepine	Trigeminal neuralgia
Lamotrigine	
Valproate (Valproic acid)	
Levetiracetam	

Foreign Body Aspiration

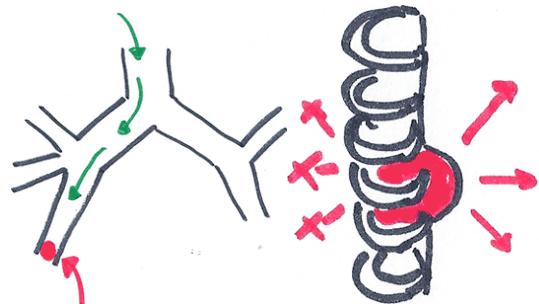
One way kids sample the world is with their mouths. Anything that fits in the mouth can potentially obstruct the airway. Airway obstruction presents with **sudden onset dyspnea and coughing** - especially in an **unsupervised child**. Physical exam findings are dependent on the location of the obstruction. **Unilateral absent lung sounds or inspiratory wheezes** are indicative of upper obstruction. **Expiratory wheeze** is lower. This is different from the adult aspiration pneumonia causing an abscess or pneumonitis; it's acute and needs to be fixed immediately. Do a **Chest X-ray** first to identify the lesion (**coin sign ⊖ on AP films** rules out tracheal obstruction) then a **rigid bronchoscopy** to **visualize and remove** the object. If an infection develops, treat it. Since it's **kids <4** at the greatest risk don't give them **danger foods** (peanuts, peanut butter, m&ms, hot dogs, etc); feed them **soft foods only**.

Asthma

There's a 20 minute video about asthma in medicine pulmonology. The discussion here is a simple rehashing of that information in more of a list form. Asthma is a **reversible bronchoconstriction** and **inflammation** following exposure to a **trigger**. Diagnosis is made by **Pulmonary Function Tests** showing a **decreased FEV<sub>1</sub>/FVC** that **reverses to normal after bronchodilators**. Upon initial presentation a **Chest X-ray** can be gotten to rule out masses (but an X-ray should be normal in asthma) and a **skin test** performed to identify allergen triggers. Chronic management is to **avoid triggers** and stabilize inflammation. Depending on severity and frequency treatment is with: **Short Acting Beta Agonists** (Rescue Inhalers), **Inhaled Corticosteroids** with rescue, **Inhaled Corticosteroids + Long Acting Beta Agonists** (never on their own), then finally **oral steroids**. Acute attacks are treated with **Albuterol** and **Ipratropium** (Combivent), and **Steroids** (dexamethasone). If in status asthmaticus, treatment may require **Intubation ± ECMO**. Soft signs of asthma include the **eosinophilia** on CBC, **X-ray** showing flattened diaphragms and hyperinflation, and increased resonance to percussion on physical exam. **Prevention** is paramount for kids; **remove pets, cigarettes, carpet, and plush toys** from the child's living environment. For more on asthma see the medicine material.

Bronchiolitis

Bronchiolitis is an **inflammatory disorder (itis)** of the **small airways** (bronchioles) caused by a **viral infection (RSV)** in a very young child (< 2 years), usually in the fall or winter. It's inflammatory and so may produce wheezing, but it doesn't respond to β-agonists or removal from triggers as asthma would. All the desired tests wanted for a lung problem (CXR, CBC, PFTs) show **normal lung findings**. The only way to definitively diagnose bronchiolitis is with **nasopharyngeal washings** with culture. The decision will be to hospitalize the patient or not, rather than diagnose. Any kid with an **SpO<sub>2</sub> < 92**, **premature birth < 34 weeks**, **age < 3 months**, or **cardiopulmonary abnormality** comes into the hospital. In the hospital he/she gets oxygen, intravenous fluid, contact isolation, and a **trial of β-agonists** (continued only if it helps, stopped if it does not improve).



Right mainstem is straighter and more dependent, FBAO more likely to go here

Tracheal rings would prevent object from protruding in all directions except rear  
 ⊖ coin sign on AP  
 ⊕ coin sign on Lateral

*Don't be tricked into choosing parainfluenza*

Cystic Fibrosis

Cystic Fibrosis is a difficult disease because it affects multiple organ systems, though they usually follow a pulmonologist. It's an **autosomal recessive** mutation of the chloride channel transmembrane receptor (CCTR). While often diagnosed on **prenatal screening** (it's the most common genetic disorder in whites), there may be children who escape the screen (foreigners / immigrants). Patients with **meconium ileus** (first day of life), **failure to thrive** and **cardiopulmonary defects** (weeks of life) or **frequent respiratory infections** (weeks of life) are highly suspicious. Mom may notice that baby has a **salty taste**. If they make it to adulthood without help they'll be **infertile** (if **male** because of bilateral absence of the vas deferens), **short-statured**, and suffer repeated **pneumonias**. You may also see multiple nasal polyps and clubbed fingers. Any child that comes back positive for the screen or are exhibiting signs and symptoms must be brought in for a **sweat chloride test (>60 in kids or >80 in adults)** is diagnostic. Management is focused on the lungs (pulmonary toilet, aggressive treatment of **pseudomonal pneumonia**) and the **pancreas** (supplementing digestive enzymes and fat-soluble vitamins). Genetic counseling is critical for the parents. Life expectancy is ~38 years.

Pneumonia

See medicine content.

**Pseudomonas** has been typically the associated pulmonary infection in cystic fibrosis, though **Staph aureus** has gained ground (age < 10)

*Pseudomonas in teens and adults*

*Staph aureus in neonates and children.*

Disease	Patient	1st Test	Best Test	Treatment	Prophylaxis
Foreign Body Aspiration	<4 yo with <b>sudden onset dyspnea</b> after being <b>left unsupervised</b>  Unilateral changes in lung sounds  <b>Peanuts, M+M, Hot Dogs</b>	XR  ⊕ Coin Sign on AP rules out trachea	<b>Rigid Bronchoscopy</b> (Dx + Tx)  Patient can clear object on own if breathing and item stuck	Retrieval	Keep out of reach of children
Asthma	<b>Paroxysmal Dyspnea</b> and <b>Wheezing</b> especially after exposure to <b>triggers</b> or <b>exercise</b>	XR (hyperinflation) allergen skin test Exam (Wheezing)	PFTs that improve after <b>bronchodilators</b>	SABA ICS ICS + LABA Oral Steroids	Avoid Triggers <b>Pets,</b> <b>Carpet,</b> <b>Plush Toys,</b> <b>Smoking</b>
Bronchiolitis	<2 yo with <b>dyspnea</b> and <b>wheezing</b>  Viral Infection ( <b>RSV &gt; Para</b> )	XR, CBC, Exam  <b>NORMAL</b>	<b>Nasopharyngeal Wash</b>	Hospitalize if: <b>SpO<sub>2</sub> &lt; 92,</b> <b>Age &lt; 3 mo,</b> <b>Preemie &lt; 34 wk</b> <b>Cardio/Pulm</b>	Ø
Cystic Fibrosis	Multiple Clues - <b>Prenatal Screen</b> - <b>Salt Sweat / Skin</b> - Infertility - Failure to Thrive - Recurrent Pneumonia - <b>Pseudomonas or Staph aureus</b>	Prenatal Screen	<b>Sweat Chloride Test</b>	Pulmonary Toilet <b>Pancreatic Enzyme ADEK</b> PNA management	Genetic Counseling

Introduction

Stridor is essentially an **inspiratory wheeze** of the upper airway, indicating a **partial obstruction** somewhere near the **trachea or larynx**. There are many causes of stridor. Five main causes (commonly tested and frequently discussed) are dealt with here. Each disease has a semi-unique presentation but one can't be mistaken for another. Therefore **visual inspection** and **chest X-ray** are usually done to get the diagnosis.

1) Croup (laryngo-tracheo-bronchitis)

Croup is the **benign** cause of stridor in kids usually 6 months to 6 years of age. It's caused by **viruses** (parainfluenza) that produce an inflammation of the upper airway. The patient will present with a **viral prodrome** for a **week** before the development of a **barking seal-like cough** that's interspersed with **inspiratory stridor**. The cough is worse at night. Commonly, parents will say that it got better in the car on the drive to the ED (because of cool night air with the windows down). The diagnosis is clinical but an **AP Film** will show **clear lungs** and a **steeple sign** (subglottic narrowing). Put all these together and the diagnosis is made confidently. Because it's viral it'll get better spontaneously. If causing significant **respiratory impairment** supplement with oxygen and give **racemic epinephrine** (improvement confirms the diagnosis). Refractory disease is treated with IM Steroids.

Scan (coming soon)

*don't be tricked into choosing RSV (that's Bronchiolitis - call it RSV Bronchiolitis)*

2) Epiglottitis

Fortunately, epiglottitis is now **extremely rare** thanks to **Hib Vaccine**. Occurring in children a little older than croup (**3-7 years**), it's a **bacterial** infection of the epiglottis presenting as a patient who is **SICK**. There's **no prodrome** but there's a **high fever** with **rapid onset** (<12 hours). The patient will be **tripodding** to help open the airway and **drooling** because it hurts to swallow. An **AP film** will show a **thumb print sign**, but don't waste time with films. If this disease is suspected go **straight to the OR** for a controlled **intubation** where the swollen epiglottis can be **visualized**. Don't touch the epiglottis. Don't inspect while in the ER. Do your work in the OR. Once the airway is secured, give **antibiotics**. The patient will rapidly improve.

Scan (coming soon)3) Retropharyngeal Abscess

When a kid comes in with **drooling** and a **fever** people get excited about epiglottitis. But as mentioned, the disease is rare thanks to the Hib vaccine. If the kid is **supine** with **limited neck mobility** (not exactly tripodding) and has a **hot potato voice** or **unilateral cervical lymphadenopathy**, consider an abscess. This is where there's time to go the **X-rays (lateral)** to see the **expansion of soft tissue** around the vertebra (soft tissue  $\leq$  50% vertebral width). If a thumb print is seen rush to the OR for epiglottitis. If it reveals an **abscess** do an **incision and drainage** with **culture**. Start empiric antibiotics against strep and staph, then change once cultures and sensitivities come back.

Scan (coming soon)

**4) Bacterial Tracheitis**

While retropharyngeal abscess can mislead for epiglottitis, tracheitis can be confused with croup. It's also a potential sequela of croup. Presenting in the **same age range** with a **prodrome** and even **subglottic narrowing on AP films**, you can barely differentiate the two. Because it's an infection with **Staph Aureus** the child is a little more ill. Where it becomes obvious is either in the **failure to respond** to racemic epi or a croup that **does not improve** on its own. It's **incredibly rare** compared to regular old croup so there'd need to be a good deal of suspicion before trying to get a **tracheal culture, visualize pus, or treat with antibiotics**.

**5) Peritonsillar Abscess**

We said that retropharyngeal abscess can look like epiglottitis. If there's the **hot potato voice**, but in a kid a little older (**> 10 years old**), the same bugs that caused retropharyngeal abscess (**strep/staph**) can be causing THIS abscess. The tonsils will be displaced on inspection. This **abscess** can usually **be seen**, and an X-ray can be done to see soft tissue swelling. Because it's an abscess, **incision and drainage** is required, followed by **antibiotics**. Failure to improve or obstruction of the airway may warrant urgent **tonsillectomy**.

*Adult patients with tracheostomies can get tracheitis easily. It looks like a pneumonia, only there is no consolidation on X-ray. These patients are treated with Pip/Tazo for gram positive, gram negative, and anaerobic coverage. Very different in an adult, and one of the bread-and-butter ENT infections (ENT puts the trache in and manages these patients in the outpatient setting)*

Disease	Patient	Bug	Racemic Epi	Diagnosis	Treatment
Croup	Seal like, <b>barking cough</b> with stridor after a viral prodrome that is worse at night	Parainfluenza	Improves	<b>Steeple Sign</b> on AP X-ray	Misting, Time, Oxygen  <b>Racemic Epi</b>
Epiglottitis	<b>Drooling</b> , tripodding, sudden onset dyspnea and very high fever. Patient is sick as shit	H. influenza (VACCINATE!)	Does not improve	<b>Thumb Print Sign</b> (don't wait!)	<b>Secure Airway in Operating Room</b>
Retropharyngeal Abscess	<u>Hot potato voice</u> <b>Drooling</b> unilateral cervical lymphadenopathy	Strep pneumo Staph aureus	Does not improve	<b>Direct Visualization</b> <b>Soft tissue &gt;50% of vertebra on lateral neck film</b>	Antibiotics  <b>Incision &amp; drainage and Antibiotics</b>
Bacterial Tracheitis	Croup that doesn't get better or refractory to racemic epinephrine	Strep pneumo Staph aureus	Does not improve	<b>Steeple Sign</b> on AP X-ray	Antibiotics
Peritonsillar Abscess	<u>Hot potato voice</u> <b>Drooling</b> Tonsils shifted to the side	Strep pneumo Staph aureus	Does not improve	Visualization	<b>Incision &amp; Drainage and Antibiotics</b>

**Posterior Urethral Valves = Urethra**

If a newborn **male** presents with **low or no urine output**, +/- **palpable bladder** suspect an **obstructive renal failure** caused by a congenital defect of the urethral valves, where they are too far posterior (that is, too close to the bladder). Think of this as the baby equivalent to bladder outlet obstruction from prostate hypertrophy in old men. Do a **catheterization** to relieve the pressure on the bladder. Failure to do so will cause back pressure to rise, leading to **hydronephrosis** and eventual destruction of the kidneys (there might be a history of oligohydramnios). Confirm the diagnosis with **voiding cystourethrogram**. Ablation (and sometimes surgery) of the abnormal valves is required to avoid **renal transplant** in the future.

**Hypospadias = Urethra**

When the **urethral opening** is on the **ventral surface** of the penis **do not do a circumcision** - use the skin to rebuild the penis correctly.

**Epispadias = Urethra**

When the **urethral opening** is on the **dorsal surface** of the penis **do not do a circumcision** – use the skin to rebuild the penis correctly. (same as hypospadias, just on the other side of the penis)

**Ureteropelvic Junction Obstruction = Urethra**

The ureteropelvic junction has been narrowed which limits the urinary volume. A **narrowed lumen** is the main cause. When urinary volumes are normal there are no problems; the child goes through life completely asymptomatic. When faced with **high-volume load (diuresis, 1<sup>st</sup> EtOH binge)**, the **narrow lumen** can't handle the flow. It essentially becomes an acute obstructive uropathy. It then presents with **colicky flank pain** that resolves with the end of the diuretic challenge. Do an **Intravenous Pyelogram** to confirm the stenosis. An ultrasound will be of no use, usually because the high urinary flow has resolved by the time you see the patient.

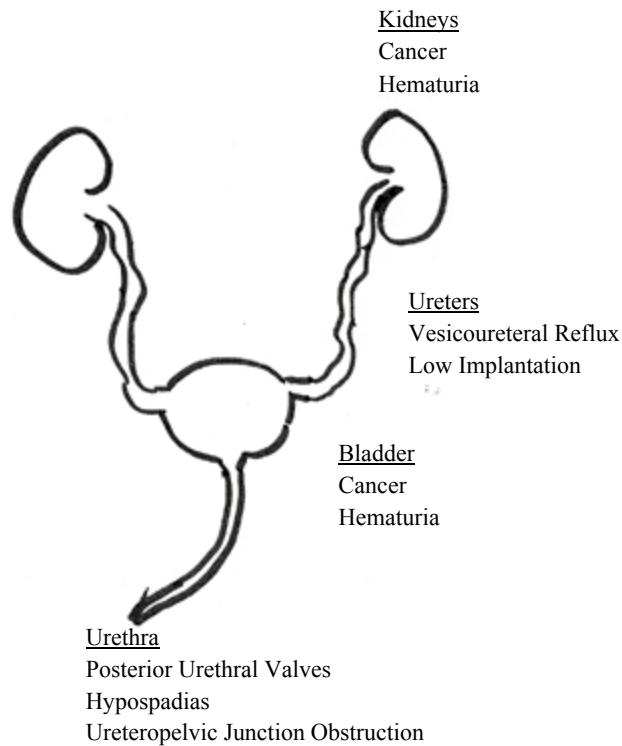
**Low Implantation of Ureter = Ureter**

One ureter puts urine where it belongs (in the bladder) so the child **senses, voids, and empties** the bladder the way she's supposed to. In boys, this remains asymptomatic. In **girls** there's a **constant leak** in addition to the "normal function." There will be no history of dry periods despite adequate toilet training. **Reimplant** the bad one (surgery).

**Vesicoureteral Reflux = Ureter**

This allows bacteria to ascend from the bladder to the kidneys. **Frequent UTIs or any pyelo** in a child should prompt a **Voiding Cystourethrogram (VCUG)** with correction surgically. Alternatively, it can be **treated empirically with antibiotics** and waiting for them to "grow out of it."

*This is duplicated in both pediatrics and surgery*



Cryptorchidism

An **undescended testicle** will both atrophy and become a cancer if not brought down to the scrotum. Even if brought down, it will become cancer. It can be given up to **one year** before **bringing it down**. This allows the functionality to return but the cancer risk remains. He needs the testosterone for puberty, but after puberty, **orchectomy** is needed to prevent cancer.

Potter sequence

Any severe kidney disorder that prevents the fetus from making urine in utero can lead to oligohydramnios which then can lead to the **Potter sequence**. Essentially, the fetus is squished resulting in clubbed feet, limb deformities, "Potter" faces with extra folds around the eyes and pulmonary hypoplasia (because fetus is not drinking the amniotic fluid, the lungs don't develop normally)

Hematuria = Anything, Probably Kidney

Mild hematuria after **mild trauma** or in an **asymptomatic patient** should warrant a diagnostic workup. Kids don't pee blood - the chances that there's a **cancer** or **congenital anomaly** becomes higher. A work up in a child should start with an **ultrasound** and move to radiographs like **IVP**. Avoid CT scans except for staging to avoid high radiation burden in a youth.

Understanding urologic testing

**Intravenous pyelogram** is an injected material that moves into the kidneys and down into the GU system. It looks for **stenosis**. Think of it as an angiogram of the GU system; you're looking for blockages and anatomical variants.

**Voiding cystourethrogram** puts some dye in the bladder. Then the bladder contracts. It isn't in the ureters. It shouldn't go to the ureters. If it **ends up in the ureters, there's a retrograde flow**. That isn't normal.

**Ultrasound** looks at the tubes. It can see how large they are. Not where they go or where they come from, but if they're enlarged. That is, they can **see hydro**. Hydro is caused by **obstruction**. Ultrasound is usually done before IVP. It is rarely useful, but is noninvasive and cheap; it is your starting point.

**Cystoscopy** allows us to get a camera into the bladder and the ureters. It is like a colonoscopy for the bladder instead of the colon. It **allows direct visualization from inside the lumen**. It allows for **biopsy of a mass**. Start here for hematuria and the workup of cancer.

**CT scan** has a large contrast burden. **Don't use it in kids**. But in adults it's ok. It must have contrast to be useful for the GU system. That contrast, much like an Intravenous Pyelogram, gets into the kidneys and is excreted through the ureters. IVP and CT scan give you the same information, CT scan in greater detail. Use IVP on kids (low radiation) and CT scans on adults

Test	Why
Intravenous Pyelogram	Stenosis
Voiding Cystourethrogram	Retrograde flow
Ultrasound	Hydro
IV-Contrast CT scan	Adult IVP
Non-Con CT Scan	Kidney Stones

Introduction

Vaccination recommendations change very year. Since every clinic and pediatrician has a chart for the current standards **don't memorize** vaccine standards. Instead, learn about how to **catch people up**, those that you **can't give**, and the signs and symptoms of the diseases the vaccines protect.

Immunity (Step 1 Review)

Immunity comes in multiple forms. When exposed to an antigen, the innate immune systems develops an **active immunity** by **acquiring** defense against the future antigen. This antigen can be a **vaccine** or an **organism / toxin**. In some cases, it's important to deliver **passive** immunity. This is done with **IVIg** to bind up toxins or bugs that the body can't fight. **Maternal antibodies** serve this purpose as well, which is why immunodeficiency diseases appear after 6 months (when maternal antibodies wear off) and why pediatricians recommend **breast feeding** (IgA for gut prophylaxis). Finally, if enough people get immunized there will be no one to inoculate -- protection by **herd immunity**.

Contraindications and Reactions

There are two worries. Anyone w/ an egg allergy could have a reaction to vaccines grown in eggs (**MMRV, Flu, Yellow Fever**). Live vaccines can also be dangerous for the immuno-compromised (**Flu, MMRV**). Other than that, vaccines are safe unless baby has a **pathologic reaction** (high fever, seizure, shock,  $\geq 3$  hrs of inconsolable crying).

DTaP Diseases

These are rare diseases just aren't seen in the US, but can pop up when parents don't get their child immunized. MMR is covered in rashes. DTaP diseases are covered here. The big **vaccine causing autism** scare is entirely **false** but residual concern prevents some immunizations. Get those kids immunized!

i. Diphtheria

Patients get a **high fever, dyspnea, and dysphagia**. Visual inspection of the pharynx reveals a **grey pseudomembrane** adherently fixed that bleeds if removal's attempted. Secure an airway. Prevent death with **antibiotics after securing the airway**, while giving Ig against the toxin.

ii. Tetanus

Following a **dirty wound** (penetrating metal, burns) the bacteria produces a toxin resulting in **lock jaw and spasms** which are **painful**. There's usually photophobia. Prevent disease with **IVIg** to bind up the toxin and give the **toxoid** to induce immunity. If they already have symptoms, sedation and support can carry the patient through the course. The lethal dose is less than the immune dose, so that infection does not convey immunity.

iii. Pertussis (Whooping Cough)

Patients begin in a general, **vague** but **infectious catarrhal state** (weeks of rhinorrhea and low-grade fever). They then progress to the **paroxysmal phase** with hundreds of **coughing spells** interspersed with **inspiratory stridor**. **Post-tussive emesis** is a buzz word for this disease. Give the child and contacts **erythromycin** to decrease the contagion. Baby has to live out the disease through the **resolution phase**.

Vaccine	Comments
Egg Allergy	Measles, Mumps, Rubella,
Hypersensitivity	Yellow Fever
Contraindication	Influenza (IM)
Live Virus	Measles, Mumps, Rubella Varicella,
Immunodeficient	Intranasal Influenza
Contraindication	
Normal Reaction	< 105° F, rubor/dolor, consolable crying, mild tenderness.
Pathologic Reaction	≥ 105°F, Seizure, Anaphylaxis

Vaccine	Comments
Hep B	Mom: + Baby: IVIg and Hep B NOW Mom: - Baby: Hep B within 2 months Mom: ? Baby: Hep B NOW
DTaP	Requires <b>3 doses in 1<sup>st</sup> year</b> and <b>2 doses before 4-6 years old</b> Tetanus booster <b>q10yrs</b> - Clean Wound, Unknown Status = vaccine - Dirty Wound, Unknown Status = IVIg + Vac - Dirty Wound and Booster > 5 years = vaccine - ANY Wound and Booster < 5 years = observe
Hib	Disease <b>does not</b> confer immunity. Do give Hib vaccine. Hib causes epiglottitis + meningitis
MMRV	Vaccine and Booster before school Measles, Mumps, Rubella, Varicella
Pneumo	To all <b>&gt;65</b> and <b>Lung Dz (COPD)</b> q 5 yrs
coccocal	To all <b>immunocompromised asplenic</b>
Meningo	To <b>everyone</b> vs meningitis, esp. college / military
coccocal	
HPV	To all adolescents before sexually active (11-12)
Hep A	Requires <b>3 doses</b> . if you miss, just resume
Hep B	Day 0, Week 4, Week 24
Flu	Chronic lung disease, health care workers before winter months. Given every year

Disease	Comments
Pertussis	Catarrhal Phase (inconspicuous) Paroxysmal Phase (coughing spells, whoops) Resolution Phase (regular cold symptoms)
Diphtheria	Grey pseudomembrane in oropharynx (don't remove!) Airway, Antibiotics
Tetanus	Dirty Wound, Lock Jaw, Spasms IVIg (Block toxin) and Toxoid (Vaccinate) Lethal dose < Immune Dose

Introduction

Kids can **spit up**. They don't know when enough is enough and may eat more than their bellies can hold. A little bit of regurgitation (**small volume, non-projectile, formula colored**) is totally normal. Most pathologic vomiting occurs very early in life (like hours to days). Once kids hit 2 years old their vomiting is usually just about the same as adults. All causes of pathologic vomiting are **anatomic** - meaning **surgery** to correct.

1) Bilious Vomiting

**Green vomit** is never normal. It's indicative of an obstruction distal to the Ampulla of Vater. Fluid can go into the duodenum from the stomach, but the only way out is the way it came in. Because these disease constitute **total obstruction** they present very early - usually after the **first feed**. The workup begins with an **x-ray (babygram)**. From there, the **gas patterns** differentiate between diseases.

i. Duodenal Atresia

The duodenum **fails to recanalize** in utero. It presents as **polyhydramnios** in utero and bilious vomiting as a neonate. The XR reveals a **double-bubble sign**, but there's **no distal air**. The repair is surgical. This is commonly associated with **Down syndrome**.

ii. Annular Pancreas

If there's a **double-bubble without distal air**, it's possible that the duodenum actually isn't atretic. Instead, it's just that the half of the pancreas that should have gone through apoptosis didn't. It's the same presentation and treatment as duodenal atresia but without association to Down syndrome.

iii. Malrotation

The worst case scenario for **bilious vomiting** and a **double-bubble sign** is malrotation. If there are **normal gas patterns** beyond the double-bubble layer, there's no embryonic failure - a normal bowel has twisted on itself coming back into baby. Usually normal uterine course. A **barium enema** should be done first (less sensitive, but safer). If negative, follow with an **upper GI series**. If ever positive, do **immediate surgery** before the vascular supply dies.

iv. Intestinal Atresia

If there's a **double-bubble or triple bubble** and **multiple-air fluid levels** it's time to talk to mom about her **cocaine** use. This is caused by a **vascular accident** in utero. **Surgically remove** the atretic areas.

2) Pyloric Stenosis

If a nursing baby who has not had any problems suddenly develops **projectile vomiting** after feeds, consider pyloric stenosis. Physical exam will reveal an **olive-shaped mass** and visible **peristaltic waves**. A **CMP** will reveal a **hypochloremic, hypokalemic, metabolic alkalosis**, which should prompt immediate **IVF** for rehydration. Definitive diagnosis is made with **Ultrasound** showing a "**donut sign**." Treatment is with partial **myomectomy**. It's more common in boys.

*Double-Bubble + No Distal Air = Duodenal Atresia*

*Surgery*

*Downs*

*Double-Bubble + No Distal Air = Annular Pancreas*

*Surgery*

*Ø Downs*

*Double-Bubble + Normal Gas = Malrotation*

*Emergency Surgery*

*Double-Bubble + Air Fluid Levels = Intestinal Atresia*

*Tell mom to stop cocaine*

*Boy with olive-shaped mass, projectile vomiting*

*Ultrasound = Donut*

*Surgery = Myomectomy*

Bias

When analyzing a study or screening tool or study, it's important to consider bias. Bias is a systemic error that makes the results differ from the 'true' results. There are three biases that stand out.

1) Lead Time Bias

This is when the **point of diagnosis changes** but there's **no effect on outcome** (mortality). By the time ovarian cancer is diagnosed it's too late. If there was a screen that could recognize it two months earlier (stage IIIa instead of IIIb) it wouldn't change a thing – the patient would still die on the same timeline. However, it'd appear like life was prolonged – instead of 6 months to live it's 8. Those 2 months are the **lead time**. It's bias because if she actually lived longer she would die later.

2) Length Time Bias

Simply put, **deadly disease** is found **less often**. If a patient getting regular interval screening (i.e. annual physical) develops a longer-lasting disease the screen will likely catch it. If he/she develops a deadly acute disease it'll be missed as it occurred spontaneously between screens. The bias is it can give the impression that detecting a disease through a screen causes it to be less dangerous, when in it's really just longer lasting diseases are more likely to be detected.

3) Overdiagnosis Bias

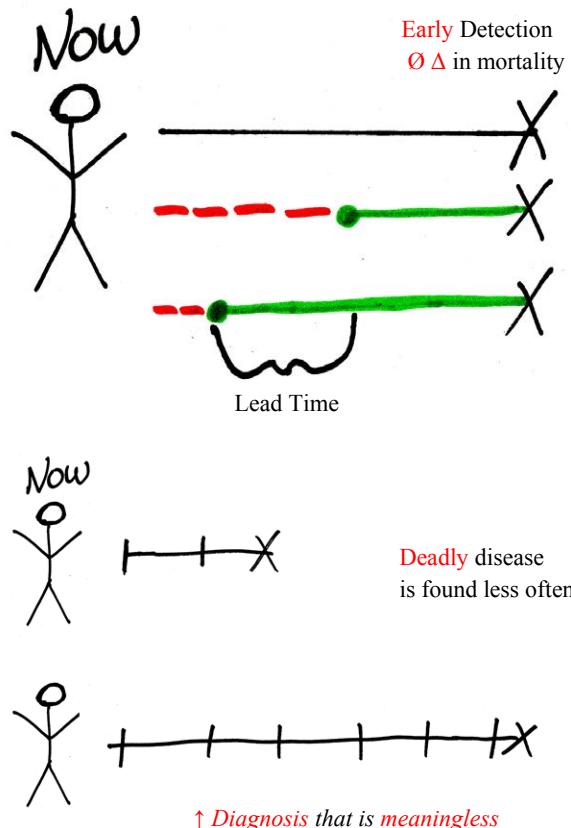
Here, **diagnosis** is **increasing** but it has  $\emptyset$  effect on **mortality** – it's **meaningless**. This is why there isn't population PSA screening for prostate cancer – patients die with it, not from it. This is bias because it inflates survival statistics. We're essentially finding more cases of 'pseudodisease' where it isn't really an issue and it skews the data in those where it is.

**Other Bias (drug ad/research abstract essential)**4) Selection Bias

A patient population **isn't** being chosen at **random**. An example would be comparing two drugs for an outcome but giving one to a sick population and another to a healthy population. The healthy will have the better results but that's due to their health status, not the drug.

5) Measurement Bias

Using **different** tools to **measure** the same thing. An example would be an exercise study that didn't standardize heart rate measurement. On one patient pulse was recorded at the wrist for 15 seconds and multiplied on another he/she was hooked to a monitor and recorded for a minute. The measurement wasn't the same so comparing them as equal is biased.

6) Information Bias

Either the patient or researcher has information that will alter their actions and outcomes. It's the reasoning for **study blinding** in **Randomized Controlled Trials**. Double blind is standard – neither patient nor researcher knows who has placebo vs treatment.

7) Publication Bias

Simply put, **null and negative results are less likely to be published**. This skews public data towards positive results, which can undermine meta analyses by not truly representing all valid studies that have occurred.

8) Confounding

This is a **third variable** that's unaccounted for that has some noncausal association with both the exposure AND outcome. Essentially, it's why correlation doesn't = causation.

**Methods to Eliminate Bias**

Randomization	Blinding
Standardization	Statistical Controlling

\*\*Bias is addressed in study design\*\*

Introduction

Biostats on the Step 2 isn't all that different from the Step 1. It's important to know the basics to understand the **validity** of clinical tests (and it'll be on the exam). The statistics that are going to come up stem from a simple 2x2 table. Create it and everything will be ok. Put disease on top and the test (or exposure) on the left. A patient can either have a disease or not; a test can either be positive or negative. Thus, there are 4 outcomes.

True Positive (a): disease + test +

False Positive (b): disease - test +

False Negative (c): disease + test -

True Negative (d): disease - test -

Sensitivity

**Sensitivity** measures the proportion of patients with disease that have a positive test result. The **first column** gives it: true positives / total positives.  $A / A+C$ . A screening test is usually highly sensitive. An example is the ELISA test; if a patient has HIV we don't want to miss it. ↑ Sensitivity ↓ False Negatives.

Specificity

However, often a test that's sensitive will include false positives. Therefore, a confirmation test with high specificity is used.

**Specificity** is the proportion of non-diseased patients that have a negative result. It's derived from the **second column**: true negatives / total negatives.  $D / B+D$ . A Western Blot follows a positive ELISA. It's highly specific and will show true negatives, ruling out false positives and giving the final confirmation. ↑ Specificity ↓ False Positives.

The best tests are **highly sensitive and specific**.

Prevalence vs Incidence

**Prevalence** is the # of cases of a disease right now - there are 1.2 million Americans living with HIV. It ↑ with survivability (we can treat AIDS so ppl can live with it) and exposure. It ↓ with death and a cure. **Incidence** is the # of new cases in a given time frame - 50,000 Americans are newly infected with HIV annually. It **only changes** based on exposure.

Positive Predictive Value (PPV)

Sometimes it's useful to know the probability of disease in a patient with a positive test result. That's **Positive predictive value**. It's given by the **first row**: true positives / all test positives.  $A / A+B$ . It's affected by the **prevalence** of a disease. If prevalence ↑ PPV ↑ and vice versa.

Negative Predictive Value (NPV)

Conversely, it may be useful to know probability of no disease in a patient with a negative test result. That's **Negative predictive value**. It's derived from the **second row**: true negatives / all negative tests.  $D / C+D$ . It's also affected by the prevalence of a disease. If prevalence ↑ NPV ↓ and vice versa.

**Dz**

	+	-
Test	+	b
-	c	d

*Sensitivity: True Positives / Total Positives = A / A+C*

*Specificity: True Negatives / Total Negatives = D / B+D*

*PPV: True Positives / All Test Positives = A / A+B*

*NPV: True Negatives / All Test Negatives = D / C+D*

*A test can have a defined sensitivity/specifity but its predictive values will change based on the prevalence in the 'study' population*

Understanding the utility of those 4 values will cover most of the statistics points on the test. The next two are lower yield, but related and the math isn't too hard.

### Likelihood Ratio

Likelihood ratios are another way to describe the performance of tests. They summarize sensitivity and specificity into odds. Here's the math then we'll talk results.

$$\text{Positive Likelihood} = \text{Sensitivity} / 1 - \text{Specificity} = \\ (A/A+C) / 1-(D/B+D)$$

$$\text{Negative Likelihood} = 1 - \text{Sensitivity} / \text{Specificity} = \\ 1-(A/A+C) / (D/B+D).$$

Playing it out, if a test is 90% sensitive and 90% specific, the positive likelihood states that a positive test result is 9x more likely to be a diseased patient than a non-diseased. In this example, the inverse is also true for a negative test result. Essentially all we've done is convert probabilities (%) into odds (#x).

### Type I and II Error

If these show up, remember that Type I is a **false positive** and Type II is a **false negative**.

### **Nailing Drug Ads and Research Abstracts**

These are fairly new test concepts that require you to know more epidemiology beyond what we just discussed (which was really biostats). Epidemiology is a massive field so we're going to really pare it down to simplified study design and a few other measures. Also see Bias and Confidence Interval.

### Study Design

The cheapest (\$) and easiest study to do is a **cross sectional** study. It takes retrospective data and analyzes a snapshot of disease and exposure in a given time. It uses prevalence as its measure.

**Case control** studies (\$\$) are also retrospective. They start with disease vs nondiseased groups and looks at exposures. It uses odds ratio as its measure.

**Cohort** studies (\$\$\$) are prospective and start with exposed vs unexposed groups. They then track disease outcomes over time. They use relative risk as their measure.

**Randomized Control Trial** (\$\$\$\$) is the gold standard for studies. It uses treatment vs control groups and tracks disease results. Most commonly uses odds ratio as their measure.

$$\text{Positive Likelihood Ratio} = \text{Sensitivity} / 1 - \text{Specificity}$$

$$\text{Negative Likelihood Ratio} = 1 - \text{Sensitivity} / \text{Specificity}$$

	+	-
Test	a	b
Dz	c	d

*Cross sectional* = Cheapest, retrospective snapshot of dz, prevalence

*Case Control* = Cheaper, retrospective look at exposure on known dz outcomes, odds ratio

*Cohort* = Expensive, prospective look at dz on known exposures, relative risk

*RCT* = Most Expensive, uses control vs treatment groups and tracks disease outcomes, uses odds ratio. Gold standard

Here are additional measurements you need to get drug ads/research abstracts correct.

#### Odds Ratio

Just memorize  $(AxD)/(BxC)$ . This is completely different from page 1 measures - it's a **measure of association** between an exposure and an outcome. It's primarily associated with **case control studies**. There will be an exposure (ie smoking) and an outcome (cancer). The end result (the odds ratio) allows us to say patients with the exposure are (#x) more/less likely to have the disease than patients without the exposure. The same 2x2 can be used to calculate. Disease stays on the top, exposure goes on the left.

#### Relative Risk (RR)

$(A/(A+B)) / (C/(C+D))$ . It's the same concept as Odds Ratio, but associated with **cohort studies**.

#### Number Needed to Treat (NNT)

$1 / \text{Absolute Risk Reduction} = 1 / |\text{control rate} - \text{test rate}|$ . This is the number of patients that must be treated to prevent a single additional bad outcome. NNT = 5, 5 patients must be treated to prevent 1 bad outcome. The test will say new drug x reduces y disease by 20%, vs 10% for the comparison drug. That 10% difference is the risk reduction.  $1 / .2 - .1 = 10$ .

$$\text{Odds Ratio} = (AD/BC)$$

$$\text{Relative Risk} = (A/(A+B))/(C/(C+D))$$

*These are almost always used in the same way in different study types. In most studies they're actually virtually the same #.*

**Dz**

		+	-
Test	+	<i>a</i>	<i>b</i>
	-	<i>c</i>	<i>d</i>

**Confidence interval** (CI) is a means of expressing statistical significance while demonstrating an effect size and power of the study. What? Right, let's just remember a few things to grab easy points on the test.

For our purposes a CI of 95%  $\approx$  p value  $<.05$ . That is, the result's significant 95% of the time.

CIs are given as a range (ie 0.9-1.25) with an associated value. If the range includes 1, the value doesn't matter because it's insignificant. If it **doesn't include 1**, however, (ie 0.09-0.11) then it's automatically **significant**.

When significant we have to look at the associated value. For example, it might say there's a 10% risk (.1). A 95% CI of 0.09-0.11 means that risk is 10% + or - 1% with 95% certainty. This is a very **narrow range** and has **significant power**.

Alternatively, there could be a 50% risk with a 95% CI of 0.1-0.9. This is still significant, but the range is wide and the power is less.

Finally, they could ask you about the difference between two groups/values. If the CIs do NOT overlap, there is statistically significant difference.

If the USMLE asks:

What is the study with the largest effect size?

- look at the associated value, furthest from

What is the study with the greatest power?

- look at the CI range, narrowest wins

What is the best test?

- Consider both effect size and power

Are these tests different?

- See if CIs overlap (if they do they aren't different)

*CI of 95% = 95% value falls within that range*

*Significance – does the range include 1? Insignificant if yes, otherwise significant.*

*Effect size – how large is the effect? If a ratio, the further from 1 the bigger it is.*

*Power – how “strong” is the value? The narrower the range the stronger the value. Effected by effect and sample size.*

### Prevention

Medicine is generally reactive – illness has already struck. However, there are different types of preventions that can be taken to reduce the need to act down the line.

#### Primary Prevention

This addresses healthy individuals and **prevents the onset** of disease. Vaccinations are the prime example. Others are eating a healthy diet and exercising - especially if there's hereditary history of a disease (i.e. hypertension).

#### Secondary Prevention

Now the disease is present. The focus shifts to **preventing the progression** of the disease. Hypertensive blood pressure medications are prescribed to bring the blood pressure to normal levels to prevent myocardial infarction. It's actively treating the more common conditions to prevent something worse from developing.

#### Tertiary Prevention

The disease is getting worse. A significant event has occurred. Tertiary prevention is about **preventing complications** resulting from it. There's already been a heart attack; we're trying to stop coronary heart failure or death from happening.

All medicine falls under one of these three. To know which, simply determine if the process is preventing onset, progression, or complication of disease.

Screening is generally looking for cancer and medical disease.

#### Cancers we screen for

There are currently 4 cancers that are recommended to be screened for.

Cancer	Age	Screen
Colon	50-75	Colonoscopy q10 yrs or Flex Sig q5 + FOBT q3 yrs or FOBT q1 yr
Breast	40	Mammo q1 yr
Cervical	21-65	Pap Smear q3 yrs
Lung	55-74 + 30 pack/yr history	Low Dose CT q1 yr

For **colon cancer** a **colonoscopy** is the preferred screening tool. As of July 2015 breast cancer recommendations were in flux. The age may be increased to 50 to reduce the # of false positives and to limit the stress/anxiety of the screen. Because of this, it's difficult to test on. Historically, it's been an annual mammogram from age 40 on. **Lung cancer** screening with **CT scan** is a fairly new recommendation only applies to individuals with a **30 pack/year** cigarette history within the last 15 years. Cervical cancer continues to start screening at 21 even as that age group starts to fill with women that have the HPV vaccine.

#### Cancers we don't screen for

We don't screen for other cancers because a) we don't have a screening tool that is cost effective or b) that improves mortality. Most notable is **prostate cancer**. For a long time it was screened annually by PSA + digital rectal exam. However, the USPSTF changed its recommendation a few years back as there is a very small benefit given the potential harm. Most men die with prostate cancer – not from it. Another example is **ovarian cancer**. The only screen we have finds it too late – at stage 3 or worse – so there's no benefit. The only exception is if the patient is BRCA 1 or 2  $\oplus$ . Then we can use a **Transvaginal Ultrasound** with a **CA-125** tumor marker

#### Medical diseases we screen for

The table below has the medical diseases that are screened for. In order to get these questions right on the test you have to identify the person who needs the screen and how to do it. The most likely ones to show up are the one time screens: Thyroid, osteoporosis, and AAA.

Dz	Age	Screen
Cholesterol	♀ 45, ♂ 35, <b>20 if at risk</b>	Fasting Lipid Panel q5 yrs
Hypertension	Everybody	Check BP (every time)
<b>Thyroid Disease</b>	♀ <b>50</b>	<b>One time screen of TSH</b>
Osteoporosis	♀ <b>65</b> (high risk at 60)	<b>One time Dexa Scan</b>
<b>AAA</b>	♂ <b><math>\geq 65</math></b> smoke or have smoked	<b>One time U/S of abdominal aorta</b>
HIV	18	Rapid test, at least once, pref q1 yr

\*These recommendations are based on the latest U.S. Preventive Services Task Force (USPSTF) guidelines. Different groups will have different recommendations but these are the ones to go with. We strive to keep this document up to date but all recs can be found here <http://www.uspreventiveservicestaskforce.org/adultrec.htm>

March 2015 – USPSTF no longer recommends Thyroid dz screen. Taking the test before 2018? Still know it.

Introduction

Vaccines are essential in preventing disease. Remember the basics but know that recommendations change annually due to breakthroughs and additional data. As technology improves almost no vaccines. However, contradicted in every scenario is if the patient is VERY sick (fever >104), or has had a severe allergic reaction (ie anaphylaxis) after a previous dose (don't give it again.)

Test-Worthy Notes and Happenings

In November 2013 the CDC recommended that all children get the HPV vaccine. So far it seems the best immune response is when they're pre-teens (11-12). It's recommended for women through 26 and men through 21 – so if a patient is older but hasn't been exposed they can be vaccinated. In practice, giving the vaccine early scares parents – stress it's to build the immune response well before being sexually active.

The flu vaccine is incredibly important. Since it's usually a live attenuated virus it's easy to mistakenly think the immunocomprised shouldn't receive it. The research indicates they should be fine. In practice, there's a recombinant (non-live) version that can be given instead. It also has no egg protein so can be given to everyone without contraindications. But for the test, just remember the live attenuated version, which could elicit a response in those with an egg allergy.

*Note that these are the American requirements – if you leave the continent the list gets longer as you add on vaccines for tropical diseases.*

Vaccine	Age/Frequency	Appropriate	Concontradicted
Tdap	q 10 yrs or q 5 yrs + wound	Everybody	Ø
Pneumovax	Once ♂ 65 ≥ 65	Those that have disease (heart, lung, kidney, liver, DM etc) aka if $\oplus$ comorbid condition	Simultaneously ≥ Zostavax
Zostavax	Once ≥ 60	Everybody	Simultaneously ≥ Pneumovax
Hep A/B	Day 1 = A/B Month 1 = B Month 6 = A/B	Everybody	Ø
Meningococcus	Age 11	College, military, Hajj to Mecca	Ø
HPV	♀ and ♂ before sexually active (11-12) 3 doses over 6 months	All unexposed	Ø
MMR	All children	All children	↓ Immune
HiB	All children	All children	Ø
Flu	Annually	Everybody	Egg Allergy

\*We strive to maintain an up to date list. However, a list of adult vaccinations is maintained by the cdc here  
<http://www.cdc.gov/vaccines/schedules/downloads/adult/adult-schedule.pdf>

\*A full list of contraindications is maintained by the CDC here  
<http://www.cdc.gov/vaccines/schedules/downloads/adult/adult-schedule-contraindications.pdf>

Introduction

- (i) **Substance Abuse** is when the addiction is dominating the patient's life, finding any **one** of these: 1) **Failure to fulfill responsibilities** in work or home, 2) **Legal problems**, often a result of 3) use in **physical harmful situations** (DWI, Sex for Drugs) or 4) **Continued use despite obvious problems** caused by the addiction (legal and familial).
- (ii) **Dependence** is when the body can't get enough or needs more of it. There'll be **tolerance** (requiring increasing amount for the same effect) and often **withdrawal** (physical symptoms when stopped). Because of both, there will be **isolation** from everything else in life while the **majority of time is spent getting the substance**. Finally, the patient may take **too much** - especially in an unfamiliar environment.

The pathology of an addict has a **genetic predisposition to addiction**. When he/she does the substance he/she feels really good - better than everyone else. Eventually he/she needs more and becomes dependent. But it's worse; without the drug he/she is miserable. The loss of the substance causes him/her to feel **worse than normal people** so it gets **used to feel normal**. Because it keeps him/her alive he/she lives to use - doing anything to get a fix. Just a taste/gentle reminder can spark that feeling and lead to **relapse**. Most addicts live a life riddled with relapses, tanking 6-7 times before finally succeeding.

Alcohol

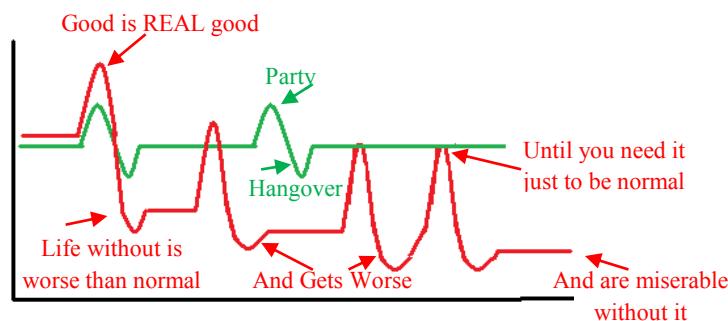
Since **alcohol** is the **most common** abused substance in the United States we'll spend some time on it. It lends itself to the identification of addiction to other substances and uses the principals discussed above. It affects **males > females** (4:1) and clusters in **families**. Screen for it using the **CAGE questionnaire**. Particular attention must be paid to alcohol because it causes **life-threatening withdrawals**. It can cause **psychosis** and **seizures (delirium tremens)** typically 48-72 hours after the last drink. Protect patients with a **chlor diazepoxide (benzo) taper**. Both **Hypertension** and **Tachycardia** are potential warning signs. Tachycardia's more sensitive because a patient may simply have essential hypertension. Further, EtOH compromises the ability to metabolize sugar through a **thiamine deficiency** which is why we give the "coma cocktail" **thiamine** then **D50**. Long-term alcohol use can lead to the **reversible cerebellar dysfunction (Wernicke's)** and to the **irreversible confabulation** and **cerebral atrophy (Korsakoff's)**. EtOH predisposes to **cirrhosis**, **GI bleeding**, **Varices**, **Mallory-Weiss** and a host of other disease. While medical therapy like **antabuse** (causes a disulfiram-like reaction) can be used to aid compliance, only long term **group therapy (AA)** is even remotely helpful. Relapses are common.

Others

For all drugs of addiction (addiction isn't limited to drugs) it's useful to learn the **symptoms of intoxication, withdrawal**, if there are **antidotes** or prophylaxis, and finally any particular details.

ABUSE	
<b>Failure to fulfill responsibilities</b>	
<b>Legal problems</b>	
<b>Physically harmful situations</b>	
<b>Continued use despite problems</b>	

DEPENDENCE	
<b>Tolerance</b>	need more
<b>Withdrawal</b>	physical symptoms
<b>Isolation</b>	from family, friends, and work
<b>Time Spent</b>	getting it
<b>Too much</b>	in one go



CAGE	
<b>Cut down?</b>	
<b>Annoyed by criticism?</b>	
<b>Guilty about drinking?</b>	
<b>Eye opener to get started?</b>	

Acute EtOH Intoxication	
Blood Alcohol Concentration > <b>0.08</b> (2-3 drinks)	
<b>Breathalyzer</b> screen	
Detox Rate is 0.03/hr = reverse extrapolation during criminal investigation	
"Found Down" = <b>Thiamine</b> and then <b>D50</b>	

DEPENDENCE	
S/S Withdrawal	<b>HTN and Tachycardia</b>
PPx Withdrawal	<b>Benzo</b> (also treatment)
Wernicke's	<b>Reversible Cerebellum</b>
Korsakoff's	<b>Irreversible confabulation</b>

<b>Drug</b>	<b>Intoxication</b>	<b>Withdrawal</b>	<b>Drug / Antidote</b>
<b>EtOH</b>	Slurred speech, Disinhibition, Ataxia, Blackouts, Memory Loss, Impaired Judgment	Tremor, <b>Tachycardia</b> , HTN, <b>Seizures</b> , Psychosis	<b>Benzo Taper</b> (withdrawal) <b>Disulfiram</b> (Long-Term)
<b>Benzos</b>	Delirium in elderly, <b>Respiratory Depression</b> and <b>coma</b> (with ↑ dose), amnesia	Tremor, <b>Tachycardia</b> , HTN, <b>Seizures</b> , Psychosis	<b>Flumazenil</b>
<b>Opiates</b>	Euphoria, <b>pupil constriction</b> , <b>respiratory depression</b> , and potential <b>tract marks</b>	<b>Yawning</b> , lacrimation, N/V and hurts everywhere, sweating	<b>Naloxone</b> <b>Methadone</b> (long-term)
<b>Cocaine</b>	Psychomotor agitation, <b>HTN</b> , <b>tachycardia</b> , <b>dilated pupils</b> , <b>psychosis</b> <b>Angina</b> / <b>HTN</b> crisis	Depression, suicidality, “cocaine bugs”	Supportive Care or Benzos α then β blockade
<b>Amphetamines</b>	Overheat (fever, tachycardia) and <b>water intoxication</b> . Pupillary Dilation, Psychosis	Crash	Supportive
<b>PCP</b>	Aggressive psychosis, <b>vertical horizontal nystagmus</b> , impossible strength, blunted senses	Severe random Violence	Haldol to subdue <b>Acidify Urine</b> to enhance excretion
<b>LSD</b>	Rarely seen, Hallucinations, Flashbacks, heightened senses	Flashbacks	Supportive
<b>Marijuana</b>	Tired, slowed reflexes, <b>conjunctivitis</b> , the <b> munchies</b> , overdose brings <b>paranoia</b>	Ø	Supportive (often nothing required)
<b>Barbiturates</b>	Low safety margins, Benzos safer	Redistribute into fat	Ø
<b>Nicotine</b>	None - just jittery and stimulated. Pt has to OD to go into a Vfib	Cravings	<b>Welbutrin</b>

Introduction

**Anxiety** is a diffuse response without a precise feeling involving **worry**, **fear**, and **hyper-vigilance**, coupled with the physical symptoms of anxiety: **palpitations**, **perspiration**, and **dyspnea**. Everyone has felt the sinking feeling in the pit of their stomach before opening a letter about their Step 1 grade or a phone call from the parents at 2 AM bearing bad news. This is what anxiety's all about. Some anxiety is provoked by **triggers** (places and things), but it can also be in a **constant state**.

1) Generalized Anxiety Disorder

Patients who have **constant anxiety** about **almost everything** in life will spend a lot of time worrying and worrying about worrying. If patients have anxiety on **most days** of  $\geq 6$  months and have  $\geq 3$  **somatic symptoms** they meet criteria for GAD. Somatic symptoms manifest as restlessness, irritability, trouble concentrating, sleep changes, etc. If diagnosed, **psychotherapy** is paramount. To let them get control of their lives use **benzos** for immediate relief and **SSRI / Buspirone** for long term therapy.

2) Obsessive-Compulsive

Patients have **persistent, intrusive, unwanted thoughts** (the **obsessions**) that provoke anxiety. The only way to relieve these obsessions is by **performing repeated behaviors** (the **compulsions**) that neutralize the anxiety. The patient is **painfully aware** of the actions/thoughts and how **irrational** they are. They'll even seek help. Two obsessions are common: **contamination** and **safety** - leading to **excessive cleaning** or **door/window/lock checking**. These patients will need **intense desensitization** therapy, but the mainstay is **SSRI**. Once stable a therapist can produce the obsession in reality, preventing the compulsion while controlling anxiety with drugs.

3) Panic Disorders

Patients will experience **Panic Attacks** ("PANICS") that come **without provocation**, i.e. out of the blue. Panic Attacks can resemble a medical disease (MI, Asthma) and should be ruled out if it's the first attack. Because patients get random attacks they may also **fear having them** in public; look for panic attacks  $\pm$  **Agoraphobia**. Onset is usually in **females** in their **20s**. In particular, look for **thyroid** and **drugs**. Once a panic disorder is diagnosed three things can be done. <sup>1</sup>**Abort the attack** with **benzos** but because of their addictive potential, don't prescribe them long-term. <sup>2</sup>**SSRIs** are a better long term choice and are more effective than cognitive behavior therapy. <sup>3</sup>Cognitive Behavioral Therapy should be started as well.

4) Phobias

Specific phobias are **irrational** and **exaggerated fear** of an **object** or **situation**. They produce **anxiety** and **avoidance** of the stimulus. They're generally considered to be learned responses. There was some negative experience that the brain extrapolated to involve the target stimulus. If your family gets eaten by a lion it would be wise to avoid all things with paws, whiskers, claws, or fur. And so, the person who fears all lions will live. Phobia is an irrational exaggeration of the normal response - the same person now fears housecats. Cute, snuggly and purring, they pose no threat. This is a cat phobia.

**Palpitations / Paresthesias**  
**A**bdominal Distress (Pain, Diarrhea)  
**N**ausea  
**I**ntense fear of dying  
**C**hest pain or tightness  
**S**hortness of breath

**(i) Social Phobias**

The situation is often one where **potential embarrassment** could occur (public urination, public speaking) or a fear of crowds + outdoors (**agoraphobia**). While **Cognitive Behavioral Therapy** is the best therapy, remember that **Beta-Blockers** are used for **Performance Anxiety** (stage fright).

**(ii) Specific Phobias**

It's common to hear of people afraid of heights, spiders, or flying. The fear comes from somewhere. Because it's learned we try to learn serenity in the place of anxiety. This is done in two ways via CBT. **Systemic Desensitization** involves stages of anxiety provoking situations, each of which are **conquered sequentially**. The other is **flooding**: overwhelming the patient with a major stimulus while engaging in anxiety-reducing behaviors or under medication. SD is generally more effective but takes longer.

*Reclusive person who does not like going to parties becomes so fearful he/she never leaves his/her house.*

*Fear of clowns*

**5) Post Traumatic Stress Disorder**

This requires a **life-threatening event** (rape, combat, child abuse) or simply **witnessing something terrible** (9/11, Murder, etc). The patient will present with the classic four symptoms: <sup>1</sup>**re-experiencing** event (flashbacks or night mares), <sup>2</sup>**anhedonia**, <sup>3</sup>**increased arousal** (startle reflex, hypervigilance), and <sup>4</sup>**avoidance** of the stimulus. It's often linked to a **location or specific details** of the event. Not all four symptoms need to be present but all four often are. The **closer to the stressor** the treatment gets started the **better the prognosis**. Pharmacotherapy is generally ineffective, but attacks are controlled with benzos. Therapy is focused at **psychotherapy** and **support groups**. If symptoms have been only for <1 month we call it **Acute Distress Disorder**. Initiate psychotherapy before it becomes PTSD, **≥ 1 month of symptoms**.

*Witnessing or surviving a rape, murder, or war with flashbacks, avoidance, and chronic anxiety, the event plaguing your waking mind and your dreams*

<b>Disorder</b>	<b>Symptoms</b>	<b>Pharmacotherapy</b>	<b>Preferred Treatment</b>
Generalized Anxiety Disorder	Worrying about <b>every little thing</b> for <b>most days</b> in <b>≥ 6 months</b> with <b>≥ 3 somatic sxs</b>	Benzos – immediate abortion SSRI – Long Term	Medications (and CBT)
Obsessive Compulsive Disorder	<b>Obsessions</b> (thoughts) provoke anxiety <b>Compulsions</b> (actions) reduce anxiety <b>Egodystonic</b> both the thoughts and actions	SSRI	Medications (and CBT)
Panic Disorder	<b>Random</b> , unprovoked panic attacks ± <b>Agoraphobia</b> “PANICS”	Benzos – immediate abortion SSRI – Long Term	Medications (and CBT)
Performance Social Specific	Anxiety in <b>public speaking</b> or <b>performance</b> Anxiety in social situations <b>Unreasonable fear</b> of a specific <b>object</b> of <b>situation</b>	Beta-Blockers Benzos Not Drugs	Meds  <b>Systemic Desensitization</b> (and flooding)
Post Traumatic Stress Disorder	Follows <b>life-threatening event</b> or <b>witness</b> <b>Avoidance</b> of stimuli <b>Anhedonia</b> <b>Arousal</b> (hyper vigilance, startle reflex) <b>Re-experiencing</b> (flashbacks, nightmares)	Benzos + SSRI	Support Group and <b>psychotherapy</b>  (and SSRI)
Acute Distress Disorder	PTSD for < 1 month	N/A	<b>Psychotherapy</b>

Introduction

A **delusion** is a **fixed false belief**. To the patient it's a glaring universal truth - one that can't be denied. To the rest of the world there's no sound basis whatsoever, however. Delusions often **can't be confronted**, so it's best not to try. Put another way, the patients have **no insight**. In dealing with delusion disorders it's critical to identify the **duration** of symptoms, and how **bizarre the delusion / illogical the thought process**. Study schizophrenia carefully and learn how other delusional disorders are simply spin-offs of this one disease.

Schizophrenia

Schizophrenia is a **thought process disorder** with an unknown etiology. There's definitely a **genetic component** while an **overload of dopamine** (confirmed) and **serotonin** (likely) contribute to a constellation of thought symptoms culminating in the final diagnosis. Schizophrenia typically presents in young adults (**20s**) following a major life stressor (**college**) with a **psychotic break**. A normal healthy child suddenly snaps, acts bizarrely, and hopefully gets on meds. Of course acute psychosis in a teenager may be drug abuse, which must be ruled out first. The end result of schizophrenia is a lifetime of relapses with ever **declining mental functioning** with each break. The diagnosis of schizophrenia is based on **positive symptoms** (things that are there that shouldn't be) such as **Bizarre Delusions** (impossible, often about **persecution**), **hallucinations** (often auditory) presenting as responding to internal stimuli, and **negative symptoms** (things that should be there but are lost) such as a **flat affect**, **poverty of speech**, **anhedonia**, and **cognitive defects**. There are also subtypes of schizophrenia.

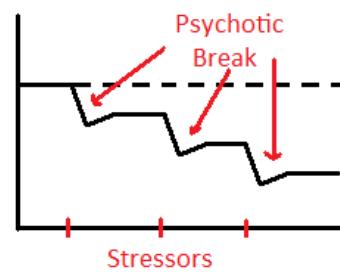
- Disorganized** carries the **worst prognosis**. Patients have very little contact with reality. These are the guys found masturbating in public or howling at the moon.
- Catatonic** is characterized by **psychomotor disturbances**. They either sit in the same spot doing nothing (**immobility, mutism, waxy flexibility**) or they go crazy-all-over (**echolalia, echopraxia, and hypermotility**).
- Paranoid** is the **most common** form. Patients have the **delusions of grandeur** and **persecution**. Hallucinations rule their thoughts.

Despite different subtypes, treatment is the **same for all types**. Antipsychotics are divided into two forms: **typical** (Side Effects,  $\oplus$  Symptoms only, cheap, old) and **atypical** ( $\downarrow$  Side Effects,  $\oplus$  and  $\ominus$  symptoms, expensive, new). All variants (below) are treated the same way except for **the duration** of treatment which mirrors the shorter duration of symptoms that defines the variants.

- Schizophreniform** is schizophrenic symptoms **lasting < 6 months**. It's usually a **psychotic break** rather than an isolated disease; the patient often progresses to full blown schizophrenia at 6 months. Still, treat for **3-6 weeks** and monitor for resolution.
- Acute Psychotic Disorder** is schizophrenic symptoms **lasting < 1 month**, typically following a **severe stressors**. Monitor or treat
- Schizoaffective** has elements of **mood** (mania or depression) dominated by **delusion**. Treat both the mood and the schizophrenia. Always treat delusions first (Antipsychotic before antidepressant).

Delusional Disorder

The **delusions** are fixed, false beliefs but are **non-bizarre** (not true, but believable). There's a **logical thought process** and everything they say is legit (except the delusion). There's no loss of function, but the delusion may cause legal or relationship trouble. Treatment is **gentle confrontation over years of psychotherapy** - no drug will do.



<b>Schizophrenia</b>	$\oplus$ Sxs	Bizarre Delusions Hallucinations Internal Stimuli
	$\ominus$ Sxs	Flat Affect Poverty of Speech Anhedonia Cognitive Defect
	Etiology	Some Genetics (50%) D2 Stimulation 5-HT2 Stimulation Brain Atrophy, Hydrocephalus ex Vacuo
<b>Schizo Subtypes</b>	Disorganized	No contact with reality worst prognosis
	Catatonic	Immobile or all over psychomotor retardation
	Paranoid	Delusions of Grandeur or persecution, Most Common
<b>Diff.</b>	Schizo- phreniform	<6 months sxs Tx is short, 3-6 weeks
	Acute Psychotic Disorder	<1 month of sxs, following extreme stressor
	Schizo- affective	Mood + Delusions Tx delusions then Mood
<b>Delusional Disorder</b>		Non-Bizarre Delusions, Logical thought process, normal explanation except for fixed false belief. Gentle Confrontation
<b>Tx</b>	$\oplus$ Sxs	Typical Haloperidol, Thiazide, Chlorpromazine
	$\ominus$ Sxs	Atypical Risperidone, Quetiapine, Olanzapine, Ziprasidone, Aripiprazole
	Best	Clozapine

Introduction

Essentially, dissociation means **things are happening around us** but we feel as though **it's not happening to us**. We're **consciously unaware** despite our **unconscious participation**. This can be reconciled by "zoning out" - thinking about something else while driving. We get to the intended destination but fail to remember the drive. Some dissociation is normal; too much is pathological.

1) Dissociation Identity Disorder

The most severe of the dissociated disorders where a single individual contains **multiple personalities**. Any number of personalities may exist. Often, personalities are **unaware of each other** so other patient will experience **blackouts** and **memory gaps**. If personality shifts are subtle an exam may only detect amnesia or complaints of "going crazy." When obvious it's quite impressive. **Behavior** (sexual promiscuity, drug-use) and even **appearance** (changes in muscle tone change the look of the face) can change drastically. This only occurs in periods of **intense** and **prolonged stress**; it's extremely rare. The primary personality develops the others to protect him/her (the others are hurt while the primary is shielded). This requires **intense psychotherapy** and **hypnosis** to correct.

2) Dissociative Amnesia

This occurs after an **acute stressor**; the patient may not be able to **remember the event** or even **her identity**. This is a favorite of police dramas on TV. The victim of a rape or attempted murder is **unable to recall the attack**. After the stressor has passed memory is usually regained. Psychotherapy or an amyntal interview can be done to treat. Be cautious of malingering.

3) Dissociative Fugue

This is essentially dissociative amnesia **with travel**. A patient will find him/herself in a **new place** with a **new identity** without recollection of his/her previous life. When confronted (**psychotherapy**) the fugue period is often lost (**amnesia**) and the original personality emerges. This may **resolve spontaneously**, but may also last for **months to years** if not confronted. Beware the malingers (and of Jason Bourne).

4) Depersonalization

This is a name to categorize common experiences that do not require treatment. They're the "**out-of-body experiences**" and sense of "**déjà-vu**" (things are happening and you think for the 2<sup>nd</sup> time). It's typical in the **adolescents** with a typically **benign stressor** (which may be relative severe). Psychotherapy can be used for persistent feelings of **detachment**.

**Gaps in memory**

Reports of **paradoxical behaviors**  
History of **intense prolonged trauma**  
(usually childhood sexual abuse)

**Use hypnosis / psychotherapy**

*Movie Reference: Sybil*

**Amnesia after acute stress**

Ø Travel  
Eventually memory is regained

**Psychotherapy, Amyntal interview**

*Movie Reference: Shutter Island*

**Amnesia after acute stress**

⊕ Travel  
New identify assumed  
May last years or resolve spontaneously

**Amyntal Interview, Psychotherapy**

*Movie Reference: The Long Kiss Goodnight*

**Out-of-body Experience**

Deja-Vu  
Adolescents

Psychotherapy or nothing

Introduction

Discussion of eating disorders is typically centered on **girls** dealing with either **anorexia** or **bulimia**. When considering which disease the girl is suffering from, looking at **body weight** and what thing(s) causes her distress (**being fat** or **doing binge + purge**) is most important. All other facets can be similar between diseases so use those two to differentiate. Note that males can and do suffer from these diseases but it's likely females will be in the questions.

Anorexia Nervosa

Anorexia's typically the eating disorder of the **underweight** female with a **body dysmorphic disorder** (she **perceives herself as fat**). The classic patient will **restrict** (starving herself by hiding food or eating alone), though anorexics can also **binge and purge**. These girls are sick. They're usually **<85% Ideal Body Weight** but have a **fear of weight gain**. They'll have an appearance of hypothyroid (except that they are thin) with **lanugo, bradycardia, lethargy, hypotension, and cold intolerance**. Treatment requires intense **psychotherapy**. In the meantime, these girls require **hospitalization** for nutrient support; managed meals, gastric tube, IV nutrition, etc. If these girls can be caught before <85% IBW, therapy and meds can be started without hospitalization or forced meals. Regardless, they need to be closely monitored.

Bulimia Nervosa

Bulimics are usually **normal weight** or **overweight**, but unlike the anorexic the bulimic is **ashamed** of her actions - she's primarily worried about actions rather than body image. Bulimics will engage in **binge eating** then compensate by **purgung** (vomiting or laxative use) or **fasting**. Because they stick a finger down their own throats, they'll have **dental enamel erosion** from the vomit, **enlarged parotid glands**, and **scars on dorsal surface of hands**. These girls want help. **Psychotherapy** focuses on behavior modification and weight loss. **Antidepressants** are usually effective but it's essential to **avoid bupropion to avoid seizures**.

<b>Dz</b>	<b>Body Image</b>	<b>Method</b>	<b>Weight</b>	<b>Treatment</b>
<b>Anorexia</b>	Disturbed by body image but fear weight gain active body dysmorphic disorder Do not think they have a problem	Usually restrict May binge and purge	<85% Ideal Body Weight Bradycardia, Hypotension, Cold Intolerance, Lethargy	Forced Feeding Antidepressants Psychotherapy Hospitalization
<b>Bulimia</b>	Disturbed by body image but know they have a problem	Usually binge and purge May restrict	Normal or ↑Body Weight Parotid Swelling Dental Erosion Dorsal Hand Scarring	Psychotherapy Antidepressants Avoid Seizures!

Introduction

Impulses are **anxiety-decreasing** actions that are generally **egosyntonic**. There's a link between impulsivity and **low serotonin** levels. It makes sense then that impulses can be controlled with **SSRIs**.

Intermittent Explosive Disorder

There's an **inappropriate violent act** in response to a stressor. The response is **out of proportion** to the stressor. It involves violence towards people or property. After the act, the patient is **calm, relaxed**, and without remorse. Because there's violence it's more frequently seen in **men**. The symptoms tend to lessen with age. Until then, treat the patient with **SSRIs; mood stabilizers** are also handy. Always involve **group therapy** oriented at self-reflection.

Pyromania

Patients **set fire** to things for **pleasure** or **anxiety reduction**. These patients have a fascination with fires and burning - they may even be sexually aroused by fire. There's generally **no successful therapy** and incarceration may be required. You must rule out **Arson**, setting fire for **monetary gain**, and NOT for anxiety or pleasure. That's legal, but important.

*Driver gets cut off. Rather than yelling at the steering wheel person chases down the driver, drags him into the street, and shoots him.*

Kleptomania

A patient has an impulse to **steal**. The disorder usually has an object or environment of interest, that when identified, causes an **increased anxiety**. Only the **theft of the object will reduce anxiety**. A useful test question is the link between this disease in **women with Bulimia + OCD**. Pharmacology is targeted at SSRIs, but **Cognitive Behavioral Therapy is critical** as it can train relaxation techniques. Instead of stealing, reduce anxiety in another way. People who commit multiple petty thefts are not kleptomaniacs - kleptomaniacs usually steal the **same thing** over and over.

*The prisoner was arrested for masturbating after lighting his neighbor's shed on fire.*

*The construction worker, late on the payments for his mortgage, burns his house down to get the insurance.*

*Every time the girl visits a restaurant, she becomes intensely anxious at the sight of a fork. The anxiety is relieved only by stealing the fork.*

Trichotillomania

Patients **pull out their hair** to reduce anxiety. If a patient has **alopecia** we generally don't think of psych. But if the hair's in **different lengths** (vs a **patchy alopecia**) then it's strongly suggestive of trichotillomania vs medical disease. Take steps to rule out hair loss disease (fungus in particular). If she presents with a **small bowel obstruction** as well, think of a **trichobezoar** (a hair ball).

*The 23 year old female with patches of her hair missing presents with a small bowel obstruction*

**DZ**

Intermittent Explosive Disorder	Violent or Destructive Act out of proportion with stressor	Men	SSRIs	Group Therapy
Pyromania	Sets fire for pleasure / Anxiety	Men	None	Incarceration (or Reaction Formation)
Arson	Sets fire for money			
Kleptomania	Steals to reduce anxiety	Women	CBT	SSRI
Trichotillomania	Pulls out hair, may eat hair	Women	CBT	SSRI

**Major Depressive Disorder**

The most important topic on the mood disorders and the largest. It's defined by **depressed mood** or **anhedonia (loss of interest/pleasure)** for **≥ two weeks**. It's more common in women (2:1). A screening test for depression is to identify positives on the **SIG E CAPS** mnemonic. There are two major types of MDE: **typical** and **atypical**. Usually patients slow down - they **sleep less, eat less, and lose weight**; the "typical" features. However, there are cases where people **sleep more, eat more, and gain weight**; "atypical" symptoms. These three characteristics are called the **vegetative symptoms**. Which therapy to initiate is determined by these symptoms (typical SSRIs versus atypical antidepressants). What's most important is to look for **suicidal tendency** and hospitalize if present. If not, start a patient on an **antidepressant**. Therapy begins with **typical SSRIs** (for the typical symptoms) or **atypical antidepressants** (bupropion, venlafaxine). See "psych pharm" for more details. Therapy is more effective when **psychotherapy** is co-implemented. The best therapy is **ECT**, though it may cause **amnesia** and has a negative stereotype affixed due to the older implementation. If the physical exam or studies suggest a medical disease, fix that first (such as **hypothyroid**). If there are **psychotic features** it carries a worse prognosis.

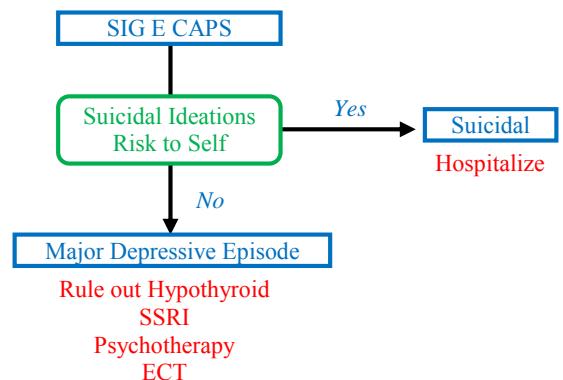
**Dysthymia**

A **mild** form of major depression that lasts **two years**. Because there are no severe symptoms don't really worry about suicide. This patient will be **functioning** but will have **depressed mood**. This is the person you get the feeling is depressed, but does not meet the severe symptoms of an MDE. We treat them the same. Rule out hypothyroid, rule out suicide, and give **SSRIs**.

**Bipolar**

Bipolar is a disease characterized by **mania** mixed with **depression**. There are two types. **Type I** is any bout with full mania. **Type II** has **hypomania** mixed with a **major depressive episode**. It affects men and women equally and has the **strongest genetic linkage**. Mania must be present for **> 1 week**. To diagnose mania, use the **DIG FAST** mnemonic. These are going to be the people with their fingers in everything. They **don't sleep**, go on **spending sprees**, and have **sexual exploits**. They have so much going on that they can't get it all out fast enough (**pressured speech**) and are all over the place (**flight of ideas**). Treatment is based on **mood stabilization**. The best drug is **lithium**. Because this can cause renal toxicity the anti-epileptics **Valproate**, (1<sup>st</sup> line) **Carbamazepine**, and **lamotrigine** (both second line) can be used. When in acute mania they can be brought down with a **benzo**. Finally, bipolar can be revealed by treating depression with an SSRI, unleashing a manic episode.

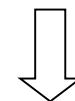
	<b>Typical</b>	<b>Atypical</b>	
<b>SLEEP</b>	↓	↑	Insomnia / Hypersomnia
<b>Interest</b>	↓	↓	Anhedonia
<b>Guilt</b>	↑	↑	Inappropriate Guilt
<b>Energy</b>	↓	↓	Fatigue
<b>Concentration</b>	↓	↓	
<b>APPETITE WEIGHT</b>	↓	↑	Weight Gain /Loss
<b>Psychomotor</b>	↓	↓	Slow Thoughts, movement, speech
<b>Suicidal Ideations</b>	↑	↑	If suicidal, it's an MDE



*Mild versions of disease cause no decreased functioning.  
Think: would I hospitalize this patient? If no, likely a mild version depression - Dysthymia.*

**DIGFAST Mnemonic for Mania**

<b>Distractibility</b>	Distracted
<b>Insomnia</b>	↓ Need for Sleep
<b>Grandiosity</b>	Self Importance
<b>Flight of Ideas</b>	Cannot Follow Conversations
<b>Agitation, Activities</b>	Multiple Incomplete Projects
<b>Sexual Exploits</b>	Spending Sprees, Promiscuity
<b>Talkative</b>	Pressured Speech



- (1) ER: **Benzo**
- (2) Life-Long = **Lithium** or **Valproate**
- (3) Comorbid = **Carbamazepine** or **Lamotrigine**

Cyclothymia

A **mild** form of **bipolar II**. Patients will have **hypomania** - a mania that's less extreme and doesn't affect function. There will also be some **depressive symptoms** mixed between hypomanic episodes. Commonly misdiagnosed as bipolar, it's treated the same way (**mood stabilizers**).

Seasonal Affective

**Cyclic pattern of depression and hypomania** based on seasonal changes, improving with **phototherapy**.

<i>Disorder</i>	<i>Patient</i>	<i>Treatment</i>	<i>Hospitalize if...</i>	<i>Beware</i>
<b>Major Depressive Episode</b>	SIG E CAPS	Typical SSRIs Atypical SSRIs	Suicidal, Homicidal	Antidepressants give motivation back before fixing mood (risk of suicide ↑)
<b>Dysthymia</b>	Chronic, Milder version of MDE	SSRI	N/A	N/A
<b>Bipolar</b>	DIG FAST	Benzos Lithium Valproate, Lamotrigine	Suicidal, Homicidal	Lithium Renal Toxicity
<b>Cyclothymic</b>	Chronic, Milder version of Bipolar II		N/A	Antidepressants revealing manic episode
<b>Seasonal Affective</b>	Depression and Hypomania with the seasons	Phototherapy	N/A	N/A

1) Grief vs Depression

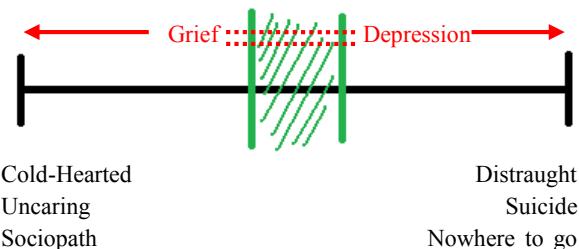
After the **loss of a loved one** (a major stressor) there are two reactions. **Grief** is a **normal reaction** that **doesn't impair** normal functioning and will **improve spontaneously** - though it may progress to depression. **Depression** on the other hand, is **pathologic**, often **impairing function**, and won't resolve in the absence of **pharmacologic intervention**. There are many overlaps between the two. It's important to let the griever grieve, but prevent the depressed patient from committing suicide. The things that turn normal bereavement to depression are **suicidal ideations, persistence > 1 year, or psychotic thoughts** the patient **doesn't realize** are psychotic. The hardest of these are the psychotic thoughts. Seeing or hearing a loved one is normal - especially if the patient is distraught or realizes that it's absurd. Carrying on full conversations or hearing voices asking the survivor to join them is not normal. Treat **grief** with **psychotherapy (talking)** and **depression** with **anti-depressants**.

2) Kubler-Ross Death and Dying

Everyone deals with death of a loved one or even their own dying process in a different way. There are **five stages** typically encountered that may progress in **any order** and even **skip stages** or go **back and forth** between them. It's not just an academic exercise to decide which stage a patient is in, but is useful to anticipate reactions and decide what tone or stance to take with the patients.

3) Post-Partum Differential

The birth of a child can be a fairly stressful event. So stressful that it can **produce mood symptoms**, or, more often, **reveal underlying psychiatric predisposition**. To form a differential and therefore know how to intervene, look at the **timing, severity** of symptoms, and **mom's feeling about baby**. It's especially important to keep a close eye on a patient who has a history of post partum psychiatric illness or those beginning to exhibit symptoms. Bring a patient back for **close follow up**. The goal's to prevent mom from **hurting herself or baby**. Because there is a gradual descent into disease (there's no "switch") it may be possible to detect and prevent potential tragedy.



Grief	Depression
Depressive symptoms <b>+</b> SIGECAPS <b>+</b> SI <b>-</b>	Depressive Symptoms <b>+</b> SIGECAPS <b>+</b> SI <b>+</b>
Symptoms will come and go	Symptoms persist, pervasive
Lasts < 1 year	Lasts > 1 year and
Usually resolve within 2 months spontaneously	Will not resolve without intervention
Psychiatric thoughts allowed, patient recognition	Psychiatric thoughts, patient has no recognition
Less Suicide	More Suicide
Supportive	SSRIs
Able to function but with decreased mood	Loss of Daily Function

Denial  
Anger  
Bargaining  
Depression  
Acceptance

	Baby Blues	Post-Partum Depression	Post-Partum Psychosis
Baby	# 1 Cares about baby	> #1 Doesn't care about baby, may hurt baby	> # 1 Fears the baby, likely to kill it
Timing	Onset and Duration within 2 weeks	Onset within 1 month duration ongoing	Onset within 1 month Duration ongoing
Depression	Dysthymic	MDE	MDE
Psychosis	None	None	<b>⊕</b>
Treatment	Nothing	Anti-depressants	Mood Stabilizers or Antipsychotics

**1) Mental Retardation (aka Intellectually Disabled)**

Any person with an **IQ < 70** (3 standard deviations from the mean) that occurs before **age 18** and **impairs functioning**. There are multiple etiologies of mental retardation: **chromosomal** (Down's, Fragile X, cri-du-chat) and **acquired** (maternal substance abuse in utero, lead poisoning, and trauma). The important thing with MR is to stratify based on **IQ** and **functionality**. In **mild MR (50-70)** patients are educated to a **6<sup>th</sup> grade level** and can function with **minimal supervision** (has a job, lives in a home). **Moderate MR (35-49)** requires substantial supervision but can still **participate**. **Severe (30-34)** and **Profound (<20)** require **institutionalized care** and **constant supervision**. The best thing to do in a patient with MR is begin immediate **education** and **social skills training** once it's identified. For genetic causes, **prenatal screens** and **genetic counseling** are critical.

**2) Autism**

Autism is a disease of **impaired speech** and **social function**. The classic patient is a young patient who exhibits **repetitive behaviors**, fails to reach **developmental milestones** (no social smile, eye contact, parental bonding) and **doesn't develop speech**. The patient will continually rock back and forth, line up objects over and over, and seem to be unable to differentiate living from non-living objects. There's **no diagnostic test, screening test, or treatment**. The disease doesn't manifest until approximately 3 years of age. The urban legend associating autism to vaccinations is **not true** (research is exhaustive). Be aware that there are two other disease that sounds similar but are not Autism.

- i. **Asperger syndrome** is Autism with **retained language skills** -significantly improving prognosis.
- ii. **Rett syndrome** is a disease of **girls** who **regress after 5 months** and progress to death. Genetically inherited, give **genetic counseling** to the parents. On a test, if you see "young girl" and "maybe autism" choose Rett.

**3) ADHD**

Another disease of unknown etiology that basically sums up a kid who **can't focus**. The diagnosis is clinical and thus has rigid criteria. It must be a child **<7 years old** who has symptoms for **>6 months** in at least **two settings**. The "AD" part involves a **poor attention span**; he/she is **easily distracted** and **can't finish tasks**. This presents as a **disruptive student** who **cannot wait his/her turn** with **poor grades**. When delving deeper it's apparent there are also symptoms at home (**disruptive, running all over**). Combine this with the "HD" or **fidgeting** symptoms of interruption, breaking rules, and running crazy, it's ADHD. Help the child focus with **psychostimulants (methylphenidate)**, but give it in the morning because it causes insomnia. Help the parents with **patient education** on the disease and how to handle the rambunctious child. Finally, the child may need **special classes**; he/she CAN learn, but lack of focus prevents getting decent grades.

MR	IQ	Living	Function	Grade
Mild	50-70	Live in Home	Work Alone	6 <sup>th</sup>
Moderate	35-49	Live in Home	Work Supervised	3 <sup>rd</sup>
Severe	20-34	Institutionalized	Basic Function	Ø
Profound	<20	Institutionalized	Care	Ø

Autism	Asperger's	MR
Repetitive	Repetitive	Ø Repetitive
↓Cognition	↓Cognition	↓Cognition
↓Social Interactions	↓Social Interactions	<b>Socially Aware</b>
↓ Language	<b>Intact Language</b>	Intact Language
IQ impaired	IQ impaired	IQ Impaired

**Diagnostic Criteria**

- (1) **Time:** >6 months and <7 years old, ≥ 2 settings
- (2) **AD:** ↓ Attention, inability to finish tasks, easily distracted, difficulty following instruction
- (3) **HD:** Interruptions, Fidgets, Can't Wait Turns

**Treatment**

- (1) Stimulants → **Methylphenidate / Dextroamphetamine**
- (2) Parental Education
- (3) Special Education Classes

*Note – we're still teaching DSM-IV, as that's what Step 2 was this year. We'll be updating to V in 2016.*

4) Conduct Disorder

Conduct disorder is **antisocial personality disorder** in a kid. Look for features that demonstrate a disregard for the rights of others. These are the **bullies** who **pick fights or destroy property**. The biggest tipoff is the **killing of animals**. Other criminal behavior (**lying/stealing**) can be seen. This is likely to progress to antisocial personality disorder. Attempts at correction should be made as soon as possible with **juvenile detention, big brother programs**, or other behavior modifiers.

5) Oppositional Defiant

If you have a kid who **confronts authority** (parents, teachers) by **yelling or throwing tantrums**, but does **NOT break laws** and does **NOT hurt others** it's oppositional defiant disorder. What's critical is the **interaction with peers** that separates this from conduct disorder. They fight, yell, kick, and scream at authority but play well and interact socially with peers. This disorder extends from **inconsistent parenting**; the intervention focuses on **parental education** rather than child behavior manipulation.

6) Learning Disabilities

When a student's performance is **substantially below expected for his/her age and grade**, usually measured by standardized testing, it's time to start fishing. It might be because of medical **conditions** (MR, Deaf, Blind, Non-English Speaker) or a display of poor education to date. Therapy to correct medical conditions, **remediation, special education**, or simply a better student to teacher ratio may improve performance.

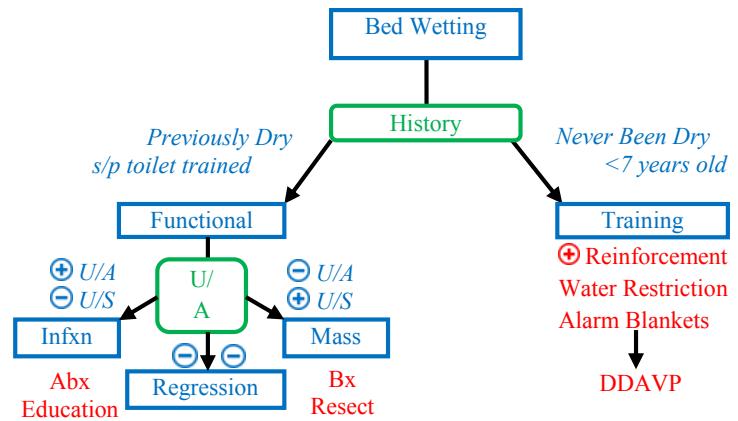
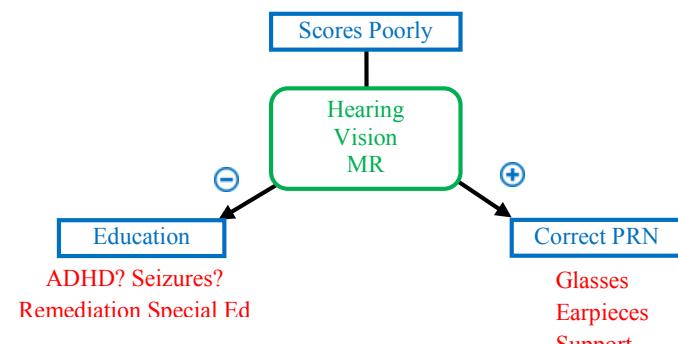
7) Tourette's

Associated with **OCD** and **ADHD**, it almost always has an onset **<18**. It's comprised of an anxiety disorder. The impulse to perform a **tic (motor or vocal)** becomes overwhelming and eventually the patient is compelled to act. These may be simple and hidden (**hair flicks, blinking, rubbing**) or obvious (**vocal**). Vocal tics are rarely swears, but rather usually incomprehensible noises. Treat with **dopamine antagonists**. Look for an "ADHD" kid who gets put on **stimulants** which then **worsens Tourette's**.

8) Enuresis

A child who **wets the bed** first needs to be evaluated for periods of dryness. If the patient is **>4 years old** and has been **potty-trained** with periods of dryness consider **regression** (abuse, new sibling) or an **anatomical problem** (like **infection**). Screen for abuse, educate proper wiping technique for girls, and look for signs of a UTI. But if a child is past the age of toilet training and has **never been dry** you need to help them learn. **Avoid negative reinforcement and punishment** (they're probably already embarrassed, making them feel worse will make the problem worse). Use **positive reinforcement**; start with **nighttime fluid restriction**, then **water alarm blankets**, then, if nothing else works use **DDAVP** to keep them dry. Remember that a failure to learn to toilet train is normal up to age **SEVEN**.

<b>Conduct</b>	<b>Opposition</b>
Breaks Laws	Ø Breaks Laws
Harms Animals	Ø Harms Animals
Bullies Others	Ø Bullies Others
Lies + Steals	Lies + Steals
Defiant to Authority	Defiant to Authority



### Introduction

Personality disorders are **rigid**, **permanent**, and **maladaptive** traits that define the way a person behaves. These traits become embedded **early in adulthood** and are completely **egosyntonic**. They're engrained and patients don't see it as a problem. Thus, it's almost impossible to treat them. Instead, the goal's to learn how to interact with them. Remember, you can't diagnose an **adolescent** with a personality disorder (they might grow out of it), though you can spot traits early on. Be able to identify qualities and be aware of how to interact. Generally, treatment is long-term psychotherapy and is generally unsuccessful.

### **CLUSTER A**

- (1) **Paranoid:** Patients are **mistrustful**, **suspicious of others**, and usually interpret benign behaviors as malevolent. They'll use **projection** as a defense mechanism. They will be **isolated** and may have **short-lived delusions** of persecution that'll interrupt their lives but rarely persist.
- (2) **Schizoid:** Detached "loners" who **don't interact** and are **happy in isolation**. They don't experience emotions like others. Think of the IBM employee with an office under the stairs or a midnight shift toll-booth operator. They usually don't need treatment as they **avoid everyone** - including the clinic. Their logic is they don't get in trouble so why get therapy?
- (3) **Schizotypal:** Everything is **bizarre**. It looks like schizophrenia, with their dress, thought process, and thinking. They don't have **hallucinations**, but do have **magical thinking** (lucky charms, extreme superstition).

*If ever a patient SOUNDS like he/she has a personality disorder but it isn't affecting their lives in any appreciable way, he/she's said to have "Cluster Traits."*

### **CLUSTER B**

- (4) **Borderline:** The patients teeter on the border of psychosis. This personality disorder has many associations. They often complain of **emotional numbness** - committing **suicidal gestures** (like cutting). They're **impulsive** and often engage in **prematurity** and **drugs**. These are the patients who **attempt suicide** to get attention, and if poorly timed, can **succeed**. They also have **rapidly changing moods**: anger, happiness, sadness that **change on a dime** (much faster than a rapid cycler or bipolar). They frequently exhibit **splitting**.
- (5) **Histrionic:** Patients are **attention-seeking** with **excessive contrived emotion**, **over-the-top** action and dress, and **hypersexuality**. They use their physical appearance to be seductive and behave very **theatrically**. Those patients do poorly in a mid-life crisis as their looks begin to fade and no one cares about them anymore. Very similar to narcissistic.
- (6) **Narcissistic:** These patients are **all about themselves** - they express **delusions** of their **own importance**. They also dress over-the-top, but as to draw attention to themselves. They're often **exploitive** and **self-consumed** so they ignore the needs to others. They're special and so demand the **best for themselves**, carrying a sense of entitlement. Frequently it's a sign of insecurity as they're often **jealous of others**.

- (7) **Anti-Social**: The real bad boy of cluster B. They have **no regard for rights of others**, are **impulsive**, and **lack remorse**. These are your criminals. Often preceded by **conduct disorder**, this is the only personality disorder that absolutely can't be diagnosed prior to 18. At 18, conduct disorder becomes antisocial. You can't and **shouldn't treat them**; it just makes them better liars. Often, incarceration is the only option.

### CLUSTER C

- (8) **Avoidant**: These patients are shy, **fearing criticism**, and saddled with a **feeling of inadequacy**. They **desperately want friends** but avoid them for **fear of rejection**. They'll often pass on promotions or choke during presentations because they're afraid of failing and/or being judged. These folks will come see you for help.
- (9) **Dependent**: Patients are **submissive**, **clingy**, and generally **need to be taken care of**. They'll rely on others to make decisions and won't initiate projects or conversations. Because of their **unrealistic fears of isolation** they'll often go to great lengths to save a relationship. They'll also generally obey a stronger voice.
- (10) **Obsessive-Compulsive**: There's going to be a **preoccupation** with **orderliness** and control at the **expense of efficiency**. These patients have difficulty **meeting deadlines** and **finishing tasks**. They're rigid, but despite their failures are egosyntonic.

	<b>PD</b>	<b>Description</b>	<b>Defense</b>	<b>Examples</b>	<b>How to Handle Them</b>
A	Paranoid	Distrustful, Suspicious, Interpret others are malicious	Projection	Gene Hackman in "Enemy of the state"	Clear, Honest, Nonthreatening
	Schizoid	Loners, have no relationships and are happy being alone	-	Night-Shift Toll Booth IBM clandestine Analyst	You won't see them
	Schizotypal	Magical Thinking, Bizarre Thoughts, Behavior, and Dress	-	Lady Gaga	Clear, Honest, Nonthreatening
B	Borderline	Unstable, Impulsive, Promiscuous, unable to control rapid changes in mood emotions emptiness, suicidal gestures	Splitting	"Girl Interrupted" "Fatal Attraction"	Patients will try to change the rules being manipulative and demanding. Follow the rules, do not deviate, be firm, but non-accusatory
	Histrionic	Theatrical, Attention-Seeking, Superficial Emotions, Hypersexual	-	"Marilyn Monroe" "Gone with the Wind"	
	Narcissistic	Self-centered, Inflate sense of worth or talent, Exploitive, demands the best, entitled	-	"Zoolander"	
C	Anti-Social	Criminal. No regard for rights of others. Impulsive, lacks remorse	-	"Tony Soprano"	Jail
	Avoidant	Fears Rejection and Criticism, wants relationships but does not pursue them	-	Really shy, hot librarian "Napoleon Dynamite"	Avoid power struggles make patients choose
	Dependent	Submissive, Clingy, need to be taken care of, unrealistic fear of rejection	-	Stay at home mom in the abusive relationship	Give clear advice; patient may try to sabotage their own treatment
	Obsessive-Compulsive	Order, Control, and perfection at the expense of efficacy	-	"Monk"	

**Anti-depressants**

The theory behind depression is the **monoamine hypothesis** that basically says “you don’t have enough neurotransmitters, that’s why you’re sad.” In particular, focus has turned to **serotonin** and **norepinephrine**. There are multiple mechanisms but they all result in one final outcome - **increased neurotransmitters** leading to elevation of mood. Which medication’s chosen is based on **safety, side effect profile, and patient preference**. Some drugs cause people to get sleepy, others to gain weight or lose libido, and they often effect certain patients more severely than others. It’s a process of **trial-and-error** until one is found that both you and the patient like. That being said, there are some rules. A patient should give a drug a chance. That means giving a drug at least **≥ 6 weeks** and **maximum dose** before switching. Once one that works for the patient is found, treat the disease for **≥ 6 months** to stabilize and avoid relapse. If there has to be a switch allow for a **≥ 3 week washout** to avoid potentially dangerous compound effects. We know that it’s more than just increasing the amount of neurotransmitters in the brain. If it weren’t the effects would be seen immediately. And while people start to get better right away, remodeling has to occur before real benefits are seen. Give **2-3 weeks** for the drugs to take full effect before altering the dose.

Let’s talk some classes; **SSRIs** are generally **clean** and used **1<sup>st</sup> line**, but are known for their **decreased libido and delayed ejaculation** (used as street drugs). They can also cause **serotonin syndrome**. **MAO-Is** are older medications and are rarely used. There’s a unique feature called **hypertensive crisis** when MAO-Is are used either **without washout** or when taken with **tyramine**, found in red wine and cheese (a favorite board question). The **TCAs** are messy. Because they’re messy their “side effects” can be their intended use. They’re loaded with **Anti-Cholinergic side effects** which make them useful for treating **enuresis**. They can also be used to treat **neuropathic pain**. Finally, the **atypicals**, used to treat atypical symptoms, are unique each unto themselves. Fortunately, anti-depressants can also be used to control anxiety over the long-term.

**Mood Stabilizers**

Treating **mania** is a difficult thing to do; options are effective but potentially dangerous. For one, there is usually a limited, **narrow therapeutic index** (especially for **Lithium**). Second, **mania/bipolar** is most common in **women**, and most effective options are **teratogens**. Finally, we don’t really know what causes bipolar, so mood stabilizers are either empiric (**Lithium**) or are **seizure drugs** - for a lack of better options. **Lithium** is the **best drug** but has the **smallest therapeutic index**. Thus, it has the greatest potential for overdose. It also requires **level checks** to prevent nephrotoxicity and Nephrogenic diabetes. The others have pure memorization factoids in the table.

**Anxiolytics**

Briefly discussed here in table format. See the Anxiety section for more details.

**Anti-Depressant RULES**

		<b>≥ 6 weeks trial</b>
		<b>≥ 6 month of treatment</b>
		<b>≥ 3 weeks washout</b>
<b>Max the Dose</b>		
<b>Anti-Depressants</b>		
<b>SSRIs</b>	Fluoxetine Paroxetine Sertraline Citalopram	↓ Libido <b>Serotonin Syndrome</b> = fever, myoclonus, altered mental GI, Insomnia
<b>Safe</b>		
<b>Atypicals</b>	Bupropion  Venlafaxine Mirtazapine Trazodone	<b>Minimal Sex SE</b> , ↑ Risk of <b>Seizures</b>  Diastolic HTN Weight Gain <b>Sedation, Priapism</b>
<b>TCAs</b>	Amitriptyline Nortriptyline <b>Most Dangerous</b> Imipramine Desipramine	Used for <b>enuresis</b> Seconds as <b>neuropathic pain</b> Can be <b>Lethal</b> (Convulsions, Coma, Cardiac) → Wide QRS → EKG! Has <b>Anti-Ach</b> properties (dry mouth, sedation, U <sub>retention</sub> , Constipation)
<b>MAO-Is</b>	Phenylzine Tranylcypromine	<b>HTN Crisis</b> when mixed together, lack of washout or eating of <b>tyramine</b> (red wine/cheese)
<b>Rarely used</b>	Selegiline	Orthostatic HoTN + Weight Gain

**Mood Stabilizers**

<b>Lithium</b>	<b>First-Line, Drug of Choice</b> Bipolar, Acute Mania, Depression Augmentation	<b>Teratogen</b> <b>Nephrotoxic &gt; 1.5</b> Causes Nephro DI Narrow TI
<b>Valproate</b>	<b>First Line</b> if Li contraindicated Bipolar, Seizures	<b>Teratogen</b> (Spina Bifida) Thrombocytopenia Agranulocytosis Pancreatitis
<b>Carbamazepine</b>	<b>Second Line</b> Stabilizer Trigeminal Neuralgia	<b>Teratogen</b> (Cleft palate) Rash, SJS AV Block
<b>Lamotrigine</b>	<b>Second Line</b> Stabilizer Newer anticonvulsant	Blurred Vision SJS

**Anxiolytics**

<b>Benzos</b>	<b>Abort</b> panic attack Treats <b>EtOH</b> withdrawal	<b>Addictive Withdrawal Seizure</b>
<b>SSRIs</b>	<b>First-Line</b> long term treatment for chronic anxiety: OCD, PTSD, AD	See Anti-Depressants. Ø useful in acute attack
<b>β-Blockers</b>	<b>Performance Anxiety</b>	Bradycardia, Asthma
Bupropion	Backup to SSRI	Avoid in <b>bulimia</b> (causes seizures)
Haloperidol Diphenhydramine Lorazepam	Depot form Enhances Sedation Anxiolytics	Called a “B52”

Antipsychotics are used to treat the **psychotic disorders**. The  $\oplus$  symptoms of psychotic disorders are caused by over-stimulation of **Dopamine receptors** in the **mesolimbic pathway**, especially **D<sub>2c</sub>-R**.  $\ominus$  symptoms are caused by overstimulation of **serotonin receptors** - especially **5-HT<sub>1</sub>**. Thus, therapy is focused on antagonism of these receptors. The **typical antipsychotics** are historically first but have a **larger side effect profile**. Within the typicals the potency can be stratified as well as side effects. **Haloperidol** has the greatest potency, **Chlorpromazine** the weakest. Potency is correlated to D<sub>2C</sub> antagonism and inversely related to the **anti-cholinergic** (sedation, drying, urinary retention). Typicals were first in history so they weren't very specific. This means they shut off dopamine not only in the mesolimbic tract, but also in the tubulo-infundibular tract ( $\uparrow$  Prolactin causes **gynecomastia**) and the nigro-striatal tract (**extrapyramidal symptoms**), contributing to decreased compliance. Drugs like **haloperidol** come in **depot forms**, so are often given in times of severe agitation or noncompliance. **Atypical**s were developed to be more selective for dopamine and to also treat  $\ominus$  symptoms. The first, **Clozapine**, stands on its own. It's highly receptor-specific, has no extrapyramidal side effects, and treats both  $\oplus$  and  $\ominus$  symptoms. It's perfect - except for the **agranulocytosis** requiring **weekly CBCs** and registration with federal agencies to monitor its use. It's the **most effective**, the **most dangerous**, and the **drug of last resort**. Attempts to make a safer Clozapine have resulted in the other atypicals. While extrapyramidal symptoms are still possibilities, the side effects bothersome to these drugs are actually **diabetes and weight gain**. In real life, **Risperidone** and **Olanzapine** are the "big guns" while the others are "softer" (weaker on symptoms, decreased side effect profile).

What are these "extrapyramidal symptoms?" It requires a bit more investigation. **Akathisia** is a **subjective** feeling of **restlessness**. **Acute Dystonia** is a reversible condition of involuntary muscle contractions: typically hand ringing, torticollis, and **oculogyric crisis** (the patient can't look down). It can be reversed with **anti-cholinergic** (diphenhydramine). **Dyskinesia** comes from inhibition of the nigrostriatal tract. Too much dopamine can result in psychosis. Too little dopamine yields **Parkinsonism** (dyskinesia) - treat with **anti-cholinergics** or specific dopamine-agonists (**benztropine**). The major worry of these drugs is **tardive dyskinesia**. It's a late-onset **irreversible** condition of temporarily suppressible oral-facial movements caused by **dopamine-receptor sensitization**. You blocked it, the brain says "I need it!" so the brain does it with more receptors). You can only stop the drug (increasing dopamine to a sensitized system only further sensitizes the system) initially **worsening symptoms**. Finally, the thing that can **kill people** is the **neuroleptic malignant syndrome** presenting as **fever**, "lead-pipe" **rigidity**, and **altered mental status**. Draw **CPK** to see it elevated and give **Dantrolene**. Obviously, the **drug's going to be stopped**. Admit the patient to the **ICU**. While you CAN go back on that drug, no psychiatrist would.

### Antipsychotics

#### Typicals

<b>Haloperidol</b>	Are <b>more potent</b> so have <b>better effect</b> but also <b>more side effects</b>	NMS (fever, $\uparrow$ CK, rigidity, AMS)
<b>Fluphenazine</b>	<b>Stop drug</b>	<b>Gantrolene</b>
<b>Thioridazine</b>	<b>D2c only</b> so good for $\oplus$ sxs only	Highest risk of <b>EPS</b>
<b>Chlorpromazine</b>	For noncompliance, use <b>depot</b> (Haloperidol)	Gynecomastia, Sedation, Anti-Ach

#### Atypicals

<b>Risperidone</b>	<b>Less potent</b> but also has <b>less side effects</b>	EPS, Gynecomastia, Sedation, Anti-Ach
<b>Quetiapine</b>	Both <b>D2c</b> and <b>5-HT<sub>1</sub></b> so work on $\Theta$ and $\oplus$ sxs	(small risk)
<b>Olanzapine</b>	Currently "first line" for psychosis	QTc prolongation
<b>Aripiprazole</b>		<b>DM and Weight Gain</b>
<b>Ziprasidone</b>		

#### Clozapine

<b>Unique to itself</b>	The <b>best antipsychotic</b> The most selective for <b>D<sub>2C</sub></b> and <b>5HT<sub>1</sub></b> ( $\oplus$ and $\ominus$ ) Drug of <b>last resort</b>	<b>Agranulocytosis</b> Requiring CBC q week
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### Extrapyramidal Side Effects

<b>Akathisia</b>	<b>A Feeling of Restlessness</b>	$\downarrow$ Dose
<b>Acute</b>	Involuntary muscle contractions,	Anti-Cholinergic
<b>Dystonia</b>	hand ringing, torticollis, and <b>oculogyric crisis</b>	
<b>Dyskinesia</b>	<b>Parkinsonism</b>	Anti-Cholinergic
<b>Tardive</b>	Irreversible <b>hyper-sensitization</b> of dopamine-R = suppressible	Stop Drug, sxs
<b>Dyskinesia</b>	<b>oral-facial movements</b>	<b>initially worsen</b>

### Choosing the Right Drug

Compliant Young Adult, without complications	Any atypical po	$\downarrow$ SE profile
Combative ER patient	Haloperidol + Benzo Diphenhydramine The "B52"	Sedating
Noncompliant Psychotic	<b>Haloperidol</b> depot	q 1wk
Old Psychotic	<b>Atypical or High-Potency Typical</b>	$\downarrow$ Sedation
Hospitalized and off their meds	Atypical, $\uparrow$ Dose q Day until maxed, then try another	
Everything else has failed	<b>Clozapine</b>	Best, most dangerous
Fever, Rigidity, AMS, $\uparrow$ CK	<b>Dantrolene</b> , order CPK, ICU	NMS

1) Sleep Apnea

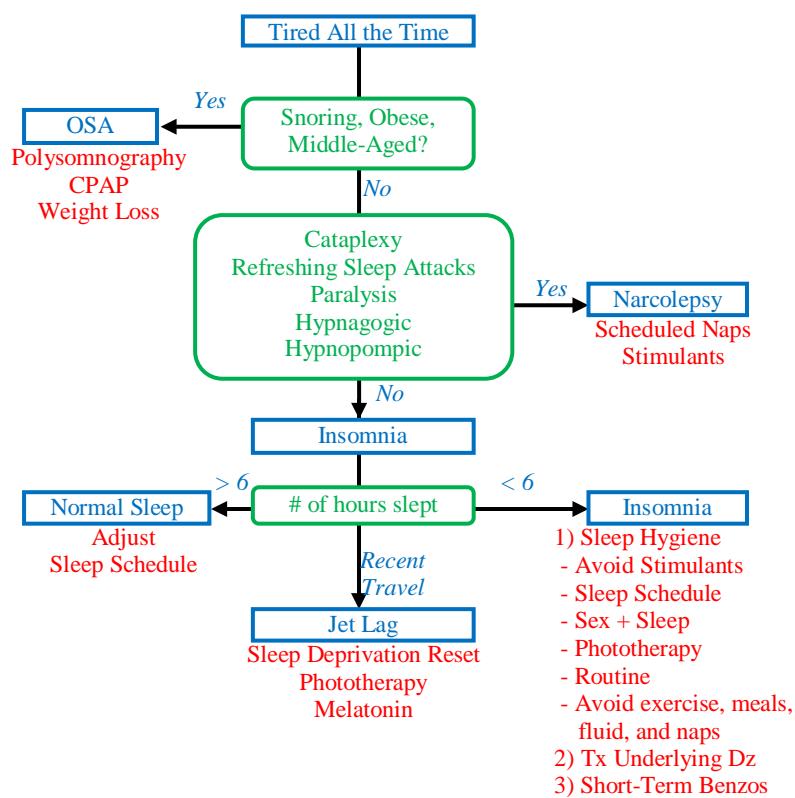
When the **obese**, **hypertensive** middle-aged man comes in complaining of **daytime somnolence**, ask the roommate if they **snore**. If he does, send him for a sleep study (**polysomnography**) to determine the number of disturbances, awakenings, and apnea spells. These people need to **lose weight** and get **CPAP** at night to keep the airways open. Avoid **PHT** and **Cor Pulmonale**. It's possible to have **central sleep apnea** in a thin person - treat with BiPAP with backup vents.

2) Narcolepsy

There's **excessive daytime somnolence** plagued by **sleep attacks**. Since **REM latency is decreased** the patients wake up **refreshed**. AS they fall asleep they lose all muscle tone (**cataplexy**) and may be **paralyzed** upon waking. These events are usually triggered by large sounds and emotional stressors. While commonly associated with narcolepsy, both **hypnagogic** (when GOing to sleep) and **hypnopompic** hallucinations (on waking up) can be experienced by anyone. People are going to nap so it's best to **schedule naps** and use **stimulants** to keep them awake (amphetamines).

3) Insomnia

A patient complaining of **not sleeping enough** or having **troubling falling asleep** has trouble with his/her **sleep hygiene** or an underlying **psychiatric disorder** producing insomnia. In either case, the goal is long-term therapy to treat the underlying disease. Pharmacotherapy, when used, should be with **short term sleep aids (benzos like Zaleplon/Zolpidem, Trazodone, or even diphenhydramine compounds)**. Be aware of potential dependence and adjust accordingly. The first step is to determine the **number of hours** of sleep; if a patient sleeps **6-8 hrs** just **adjust sleep time** or investigate for **OSA**. If sleeping too little, go after sleep hygiene. **Avoid stimulants** (caffeine, cocaine) five hours before sleep, establish a **sleep schedule** (programming the brain to sleep at a certain time), use **phototherapy** (lights out = sleep), use the bed for **sex and sleep** (don't read, watch TV, etc in bed), **avoid exercise, large meals**, and **fluid** before sleep and **avoid naps** during the day (to ensure being tired at bed time).



Introduction

Sleep is a major portion of everyone's lives. Understanding what happens, when it happens, and how to modify it can really help patients. Sleep problems usually involve **tiredness** or the **inability to fall asleep**. Let's review the physiology of sleep, then some of the disorders.

1) Stages of Sleep

- Stage I** is the disappearance of  $\alpha$ -waves - **theta waves dominate**
- Stage II** is the longest sleep stage, having **k-complexes** and **sleep-spindles**
- Stage III** is characterized by **delta-waves**
- Stage IV** has more **delta** activity and is the portal to REM
- REM** is the **dream state**. There's a **loss of tone**, **saccadic eye movement**, and **nocturnal erection**. Resembles an **awake EEG** and takes time to get into.

**REM Latency** from falling asleep to REM sleep has an average of **40 minutes**, meaning **naps aren't restful**. This can be **shortened** by **depression** or **narcolepsy** (narcos go straight into REM, causing cataplexy)

**Sleep Latency** From going to bed to falling asleep. **Elevated in insomnia** and **decreased in sleep deprivation**

The neurotransmitters of sleep can be remembered by the mnemonic of **SAND**. They're the order in which sleep stages occur. It's useful for predicting how drugs will effect sleep and why certain drugs are given to aid with sleep. Other things that can impact sleep are **benzos**, **barbiturates**, and **EtOH**.

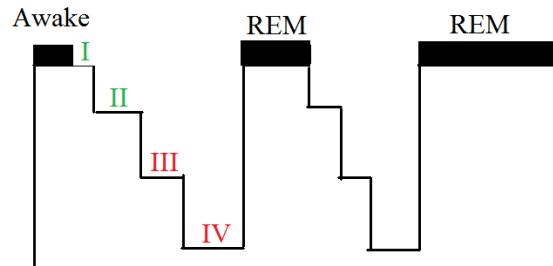
Parasomnias

Parasomnias are the disorders that occur during sleep. Focus on two things here; be able to **diagnose** a parasomnia and reinforce how **drugs influence** the sleep cycle.

**Nightmares** are **dreams gone bad**. They can occur in any age group and occur during **REM sleep**. They'll frighten or startle a person from sleep. Generally, they're recalled upon wakening. Focus should be on dealing with stressors that bring them on, but because they're within REM they can be treated with **TCAs** (what we try) and **EtOH** (what patients use to self-medicate). Generally, pharmacotherapy should be avoided.

**Night Terrors** present in **little boys** who "wake up" and go frantic - **screaming in terror** but **remember nothing** of the event. Parents are the ones who need counseling as the kid could care less. He **sits up** - he has muscle tone so it can't be REM. Night Terrors occur in stage **III/IV**. They generally require no treatment (**reassurance**), but III/IV sleep can be decreased with **benzos**.

**Sleep talking** is just that; the patient has **incongruent speech** during sleep. It does not require intervention.



Stage	EEG
<b>Stage I</b>	Theta Waves, Absence of Alpha
<b>Stage II</b>	K-Complexes, Sleep Spindles
<b>Stage III</b>	Delta
<b>Stage IV</b>	Delta
<b>REM</b>	Awake EEG, Atony, Saccadic Eyes, Erections

Neuro	Effect	Drugs
Serotonin	↑ Sleeps	Melatonin, Tryptophan
ACh	↑ Dreams	
Norepi	↓ Dreams	Cocaine / Stimulants
Dopamine	↑ Wakes	Antipsychotics (sleep more) Bromocriptine (arousal)
GABA	- ↓ Stage 4 - ↓ Sleep Latency	Benzos (not more than two weeks)
Other	↓ REM REM Rebound	EtOH Barbiturates

	Nightmares	Night Terrors
Stage	III/IV	REM
Memory	Ø Remember	Remember
Treatment	Ø Tx or Benzo	Ø Tx or TCA

Pathogenesis and Introduction

ARDS is a **noncardiogenic pulmonary edema** that results from **increased permeability of capillaries** permitting the transudation of fluid from capillaries into the interstitium. This causes a barrier to diffusion preventing gas exchange resulting in a **hypoxemia**. It looks and feels like CHF but the cardiovascular function is intact, hydrostatic pressures are normal (meaning that the **capillary wedge pressure is normal**), and it's the capillary permeability that drives disease. Too many leaky capillaries then leads to pulmonary edema and alveolar derecruitment.

Presentation

This is a patient with **pulmonary edema** (SOB, cough, crackles) and a nasty looking CXR (**bilateral white out**). The patient is also one without a reason for CHF (MI, HTN, Arrhythmia, Fluid) and has instead a **really sick presentation** (as in the ICU). To cause capillary permeability to increase so significantly requires **GNR septicemia, burns, TRALI, or drowning**. These patients usually present to the hospital then crash in the ICU, rather than a person presenting in florid pulmonary edema.

Diagnosis

A patient with a systemic disease and pulmonary edema (especially someone **volume down** or **hypotensive**) is likely enough for the diagnosis. A **CXR** will show **white out** bilaterally. However, to definitively diagnose ARDS vs CHF a measurement of **capillary-wedge pressures** via a **Swan-Ganz cath** is required. This will show a **decreased or normal wedge** (no backup of fluid) and an **increased or Normal LV function** (not heart failure). Both findings are in direct contradiction to CHF. Generally, it's not done for CHF (patients aren't sick enough to get a Swan-Ganz), though there are certainly HF patients sick enough to make it to the ICU. A patient with ARDS will be intubated, full of lines, and ripe to do the assessment on. A PaO<sub>2</sub> to FiO<sub>2</sub> ration will be < 200.

Treatment

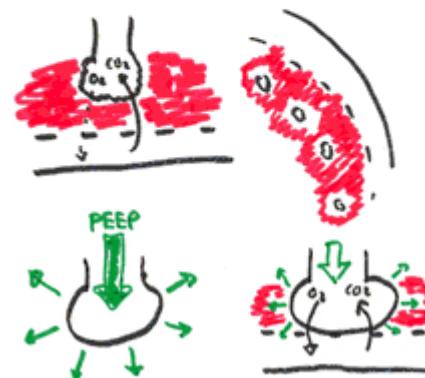
**Intubation** and **Oxygenation** are crucial as first line therapy. With intubation, application of **PEEP** increases the interstitial pressures, forcing the fluid back into the capillaries. The vessels remain leaky and only close once the **underlying disease is corrected**.

Monitoring/Complications

When someone's put on PEEP it's possible to induce **barotrauma** or induce **pneumothorax**. If the patient suddenly presents with worsening SOB after PEEP, suspect barotrauma. However, if a patient becomes **hypotensive** and has a **mediastinal shift** (tracheal deviation) a **tension pneumo** should be suspected. Confirm the diagnosis with a CXR and treat with needle decompression and **chest tube**.



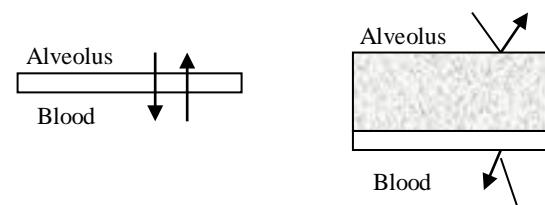
Normal gas exchange and no leaky capillaries in the normal state



Impaired oxygenation as a product of increased diffusion barrier from leaky capillaries in ARDS



PEEP provides alveolar recruitment and improves diffusion of oxygen by reducing diffusion barrier



Gas Exchange Ø Impaired Edema impairs Gas Exchange

$$J = K [P_{cap} - P_{int}] - (\pi_{cap} - \pi_{int})]$$

Fluid movement across a capillary

ARDS causes ↑ in K, fluid leaks out

PEEP causes ↑ in P<sub>int</sub>, pushes fluid back in

	CHF	ARDS
Exacerbating Factors	HTN, MI Fluid Overload	Sepsis, Burns, Drowning, TRALI
Chest X-Ray	Bi Pleural Effusions Bi Hazy Infiltrates	Total White Out Severe Bi Infiltrates
Capillary Wedge	↑ (25)	Normal (10)
LV Function	↓	Normal
Treatment	Diuresis, Control of HTN, PEEP if severe	PEEP Intubation Tx Underlying Dz

Introduction and Pathology

Asthma is a reactive obstructive airway disease caused by an **inflammation** and **Bronchoconstriction** that results in increased resistance to airflow. It's typically **IgE / Eosinophilia** mediated affecting children and young adults. When considering asthma, we have to differentiate between the primary diagnosis in the **outpatient clinic** versus the **exacerbation** in the hospital. Testing, medications, and goals are very different.

Presentation

Patients will complain of **cough**, **wheezing**, and **dyspnea**; they may also claim **chest tightness** during an acute attack. The constricted airways produce air trapping; air can get in on inhalation, but can't get out on exhalation. Physical exam reveals wheezing and a **prolonged expiratory phase** with a potentially **hyperinflated** or **hyperresonant** chest (an ominous sign). Signs of severe dyspnea (accessory muscle use or the absence of lung sounds) signal the presence of **status asthmaticus** - a medical emergency. Obtaining a history and physical as well as risk factors is crucial for the decision making that follows.

Diagnosis

If someone comes in with an acute onset of wheezing and dyspnea SKIP the diagnosis and move directly to treatment. In the **outpatient setting** there are a number of diagnostic modalities, of which **Pulmonary Function Testing** is by far the **best**. If the patient has active airway disease at the time of the test the **FEV<sub>1</sub>/FVC** will be **decreased**. They can be **reversed** with **bronchodilators** to definitively diagnose asthma. A normal patient does not rule out asthma. A patient suspected of having asthma but a normal FEV<sub>1</sub>/FVC can be given the **methacholine challenge** test to provoke bronchoconstriction. There are other ancillary tests that come up from time to time that may be suggestive of asthma. **Eosinophilia** on a CBC or Sputum sample, **Charcot-Leyden Crystals** or **Curschmann's Spirals** on sputum, and **Allergen Skin Testing** are useful, but you should rely on the PFTs for diagnosis.

Besides diagnosis, **severity** of disease is a critical element to evaluate as it'll drive patient management. It's determined by **frequency of daytime symptoms**, **nocturnal symptoms**, and **severity** of the PFTs. They are broken down into steps, or grades, indicating which medications need to be added.

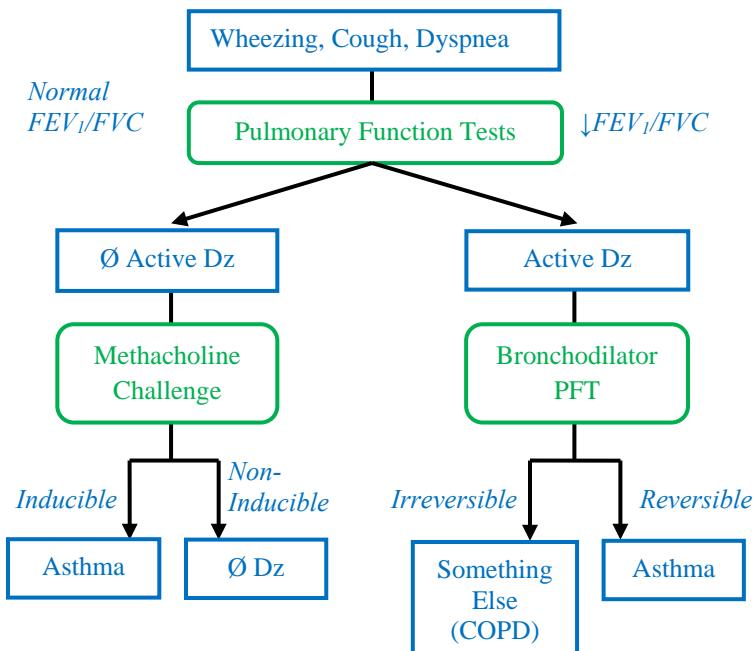
Treatment

Treatment targets the two elements of asthma: **decreasing inflammation** and **reversing bronchoconstriction**. Inflammation is conquered by steroids, bronchoconstriction by beta agonists. Then, there are a few drugs that have been added to the mix.

Patients who have symptoms infrequently can use a **rescue inhaler** (short acting β-Agonists or even Anticholinergics) as needed. As the severity of disease increases medications are added. **Daily Inhaled Corticosteroids** will decrease the inflammation while rescue inhalers can control the bronchoconstriction. For frequent symptoms **Long Acting Beta-Agonists (LABA)** are added to **Inhaled Corticosteroids** (and must NEVER be used on their own). From this point, the dosage of steroid increases from low-dose steroids to high-dose steroids, and then to **PO steroids**.

Risk Factors

- h/o Allergic Rhinitis, Nasal Polyps, Eczema
- Exposure to known precipitants
- Nocturnal Wheezing / Cough (Caution for GERD)
- #of ED Visits, Hospitalizations, and Intubations



- Bronchoconstriction      Theophylline, SABA/LABA, Leukotrienes
- Inflammation      Inhaled / PO Corticosteroids
- Stabilizing      Cromolyn / Nedocromil

Step	Daytime Symptoms	Nocturnal Symptoms	PFTs (FEV <sub>1</sub> )	Treatment
Intermittent	≤ 2 /wk	≤2/month	≥80%	Rescue Inhaler
Mild Persistent	< 1 /day	>2/month	≥80%	Low Dose ICS
Moderate Persistent	≥ 1/day	>1/week	60-80%	Low Dose ICS and LABA
Severe Persistent	≥ 1/day	frequent	< 60%	High Dose ICS and LABA
Refractory	Refractory Severe Persistent			PO Steroids

Be aware of other drugs that can be used in place of or in addition to the LABAs. The new guys to the market are the **Leukotriene Antagonists**. They work on a different mechanism than LABAs and don't have as dangerous side effects. These drugs can be used in place of LABA together with High Dose ICS.

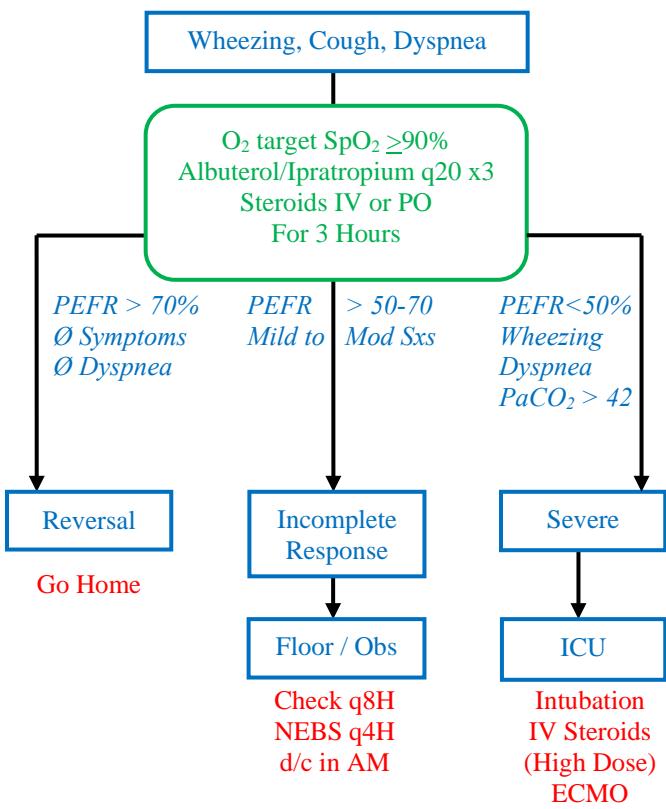
**Theophylline** is a po Adenosine Antagonist. It's pretty old but is still in use.

For exercised induced asthma with **known triggers** the IgE/Histamine Stabilizers (**Nedocromil** or **Cromolyn Sulfate**) can be used **immediately before known exposure** but with limited use.

Really, you should know the Steroid LABA course and at least be aware these other drugs exist.

#### Acute Exacerbation

When someone presents to the ED with acute or refractory symptoms they need to be treated and stratified. Evaluation involves **Peak Expiratory Flow Rates (PEFR)**, the **Physical Exam**, and an **ABG**. A Chest X-ray is not useful but often done to rule out other causes of dyspnea. Treatment begins immediately with **O<sub>2</sub>** **Albuterol/Ipratropium Nebulizers** (to reverse bronchoconstriction) and **corticosteroids** (to reverse the inflammation). If these fail, **Racemic Epinephrine Nebs** or **Subcutaneous Epinephrine** can be added. When he/she first arrives and is diagnosed as an asthma attack a Peak Flow should be performed. If, after **3 hours of continuous nebulizer treatment** there's **no improvement** he/she goes to the ICU; if better (**100% improvement and symptom free**) he/she goes **home**. Anywhere in between gets admitted to the hospital for further management. "Further management" really means Albuterol + Ipratropium every four hours.



Introduction

COPD is a combination of emphysema and bronchitis that produces **airway inflammation** and **irreversible bronchoconstriction**. The primary cause of COPD is **cigarette smoking**. Because only 20% of smokers get COPD but 90% of COPDers were smokers, there must be other contributing factors: **genetic** (as in  $\alpha 1$ -AntiTrypsin deficiency) and/or **environmental factors** influence the final disease. **Emphysema** is the destruction of **alveolar walls** at the terminal bronchiole (i.e. in the **small airways**) with fibrosis. Loss of **elasticity** causes **air trapping** - allowing air in on inhalation while preventing air out on exhalation. **Bronchitis** is defined as a **productive cough for more than 3 months in 2 consecutive years**. It's characterized by **mucous production** that obstructs the large airways.

Together, there'll be **ciliary loss**, ↑**goblet cells**, ↑**mucous production**, increased **smooth muscle hypertrophy** (narrowing the airways and ↑resistance to flow), accumulation of **interstitial inflammatory infiltrates** (causing ↓gas exchange as a result of decreased diffusional area), and a **loss of elasticity** leading to airway collapse during expiration. The chronic hypoxia in alveoli leads to an ↑ **pulmonary vascular resistance** and subsequent **pulmonary HTN**.

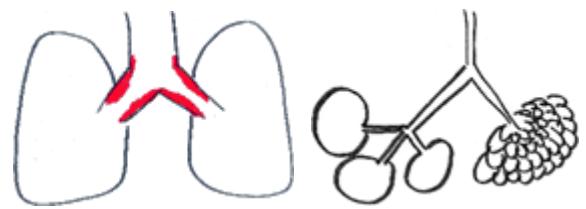
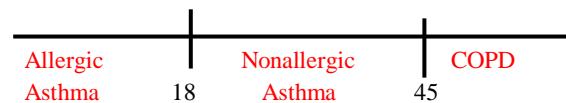
Pathology to Presentation

A patient presenting with COPD will present with wheezing and dyspnea. Risk factors for COPD (as opposed to asthma) are **smoking ~40 pack-year history**, **age  $\geq 45$** , and the physical signs of symptoms of COPD not present in Asthma. With bronchitis the so-called "blue bloaters," the **chronic cough** combined with the **cyanosis** and **edema** predominate. Bronchitis produces hypoxia and the subsequent increase in pulmonary vascular resistance. Signs of **clubbing and edema** of the digits indicates chronic hypoxia. The result is **right heart failure** that manifests with **JVD, edema, and hepatosplenomegaly**. Emphysematics suffer from **air trapping**, which causes the **barrel-chest** of an increased AP diameter and **hyperresonance** on percussion. They'll breathe through **pursed lips** to **prolong expiration** and reduce the resistance of airflow out of their lungs. Because it's a struggle to get air out of the lungs the hard work of breathing causes **weight loss** and **accessory muscle hypertrophy**. The trapped air reduces expulsion of carbon dioxide.

Diagnosis

The only diagnostic modalities that can diagnose COPD are the **pulmonary function tests**. Other tests will be performed as a result of the chief complaint and can be suggestive of the underlying disease. They can also be used to indicate severity of an acute flare. The **CXR** will show **flattened diaphragms, translucent lung fields** (both from increased air in the lungs), and a **rotated heart silhouette**. The **EKG** might show **RVH** (from cor pulmonale) or a **Right Axis Deviation** (from RVH or rotation from

Shortness of Breath and Wheezing by Age



Hypoxia (blue, cyanosis)	Air Trapping
RV Strain	CO <sub>2</sub> Retention
RVF (edema)	Barrel Chest
	Hyperresonant
	Pursed Lips
	noncyanotic

Finding	Finding to Pathology
	Pathology
<b>Barrel-Chest</b>	↑AP Diameter, Accessory muscle hypertrophy
<b>Hyperresonant</b>	Air-Trapping
<b>Flattened Diaphragm</b>	Air-Trapping
<b>Hyperlucency on CXR</b>	Air-Trapping
<b>Weight Loss</b>	Accessory Muscle hypertrophy, ↑ work of breathing
<b>Prolonged Expiration</b>	Overcoming ↑ Airway Resistance
<b>Pursed Lips</b>	Overcoming ↑ Airway Resistance
<b>Hypoxia</b>	Interstitial Inflammation, Bronchiolar Mucus
<b>Edema</b>	Hypoxia → Pulmonary HTN → R heart failure
<b>RVH</b>	Hypoxia → Pulmonary HTN → R heart failure
<b>RAD</b>	R Heart Failure OR Rotated Silhouette
<b>Cyanosis and Clubbing</b>	Hypoxia
<b>Erythrocytosis</b>	Hypoxia
<b>Hypercapnia</b>	Chronic CO <sub>2</sub> retention
<b>Pulmonary Function Tests</b>	Irreversible Bronchoconstriction and inflammation separates wheezing of COPD from wheezing of Asthma. Asthma can be reversed with bronchodilators. Not COPD

over-inflation). An **ABG** will show a **hypoxic hypercapnic respiratory acidosis** and is useful to direct treatment (see later). Finally, PFTs will show an **irreversible obstructive airway disease**: ↓FEV<sub>1</sub> ↓FEV<sub>1</sub>/FVC, ↑RV, ↑TLC, and a ↓DLCO. Finally, even if there are no outwards signs, a **CBC** may show an **erythrocytosis** in response to the hypoxia.

#### Treatment

The goal is to **↓airway inflammation, dilate the airways, control infxn, and maintain oxygenation**. The severity of symptoms directs therapy. To ↓ airway inflammation give **corticosteroids** (inhaled for maintenance). To dilate airways use **anticholinergics** (Ipratropium or tiotropium) and/or **Beta-Agonists** (both short and long acting). Anticholinergics are usually the drug of choice in the elderly due to the the **tachyarrhythmia side effects of Beta-Agonists**. Infections are controlled by **vaccinations** - especially the **annual flu vaccine** and the **pneumovax** starting at age 60. Finally, oxygenation is a big question. To give or not to give - that is the question. Due to the risk of **eliminating hypoxic drive** (chronic hypercapnia results in respiratory drive driven solely by low levels O<sub>2</sub> rather than high levels of CO<sub>2</sub>) there are strict criteria for starting home oxygen. If the **pO<sub>2</sub> < 55** on ABG or **SpO<sub>2</sub> < 88%** on a pulse Ox at rest, activity, or exercise, then **chronic home O<sub>2</sub>** is indicated with a goal of titrating **SpO<sub>2</sub> > 90%**. Smoking cessation, in addition to home O<sub>2</sub>, is the only intervention that will prolong life. However, because there's a lag time between **smoking cessation** and **↓inflammation** the patient may initially get worse.

#### Exacerbation

When a patient has a **drop in SpO<sub>2</sub>** or **↑in productive cough** the patient may be presenting with acute exacerbation. The goal is first to help him/her breathe, cover a potential infection, then figure out **what caused the exacerbation**. The first line therapy is, of course, **Oxygen** while a diagnosis is made. In a patient with acute dyspnea the worry of decreasing hypoxic drive is far overshadowed by the patient's need for oxygen. Then, **NEBS q6H** are crucial. **Ipratropium > Albuterol** but the two are usually give together. **IV Steroids** (dexamethasone 125mg) or PO Steroids can follow if there's no improvement with meds. Follow discharge with a PO taper. Finally, **prophylactic antibiotic** are indicated - even if there's no signs or symptoms of infection. Use anything that will cover for the typical bugs (**amoxicillin, bactrim, 3<sup>rd</sup> gen cephalosporin, FQ**, on a **rotating schedule**). If there's no improvement admission to the ICU with mechanical ventilation may be required.

#### **Treatment Goals and Methods**

<b>C</b>	<b>Corticosteroids</b>	Inhaled maintenance, IV exacerbation, Ø change in mortality unless infection
<b>O</b>	<b>Oxygen</b>	When PaO <sub>2</sub> <55 or SpO <sub>2</sub> <88% titrating to PaO <sub>2</sub> 55-60 SpO <sub>2</sub> >90%
<b>P</b>	<b>Prevention</b>	Vaccines: Pneumovax (q5y) and Flu (q1y) Smoking cessation ↓ Mortality
<b>D</b>	<b>Dilators</b>	Anticholinergics > Beta-Agonists Rescues → Nebs → Continuous (Inpt only)
<b>E</b>	<b>Experimental</b>	Out of our scope
<b>R</b>	<b>Rehabilitation</b>	↑Exercise tolerance, ↓Dyspnea and fatigue Ø Change in Mortality

#### **Interventions in COPD**

Agent	Dose	Comments
<b>Ipratropium</b>	0.5mg NEB q6	First Line
<b>Albuterol</b>	2.5mg NEB q6	First Line
<b>Corticosteroids</b>	Methylprednisolone 125mg IV Prednisone 60mg PO Prednisone PO taper x 2wks	Exacerbation
<b>Oxygen</b>	Titrate to SpO <sub>2</sub> 90-93% or PaO <sub>2</sub> 55-60	Home and In patient
<b>Intubation and Ventilation</b>		Last Resort

Cancer Differential and Diagnosis

Lung cancer presents in either of two ways: **hemoptysis** with **weight loss** or as an **incidental pulmonary nodule**. There's **no screening** for lung cancer so investigation of suspicious patients must be made. Typically, diagnostic investigation begins with the **CXR**, moves to **CT Scan**, then undergoes definitive diagnosis with **Biopsy**. Biopsy is done by **bronch** (which now means **endobronchial ultrasound**, or EBUS), **percutaneously**, or **VATS** depending on the situation/location of lesion. Once diagnosed, therapy is dependent on the ability to tolerate a lobectomy or pneumonectomy, radiation, and chemotherapy (usually Gemcitabine). See Surgery content for additional details.

Squamous Cell Carcinoma

Caused by **smoking**, the lesion is typically **central**. Classic warning signs (**hemoptysis** and **weight loss without fever**) are the tipoff. A CXR may show a large lesion or repeated PNA (caused by obstructing lesion). **EBUS with Biopsy** gets the diagnosis. The cancer may produce **PTH-rp** (parathyroid-like hormone) causing a **hypercalcemia**. Squamous cell carcinoma can also cause an Eaton-Lambert paraneoplastic syndrome – see Neuro, Weakness.

Small Cell Carcinoma

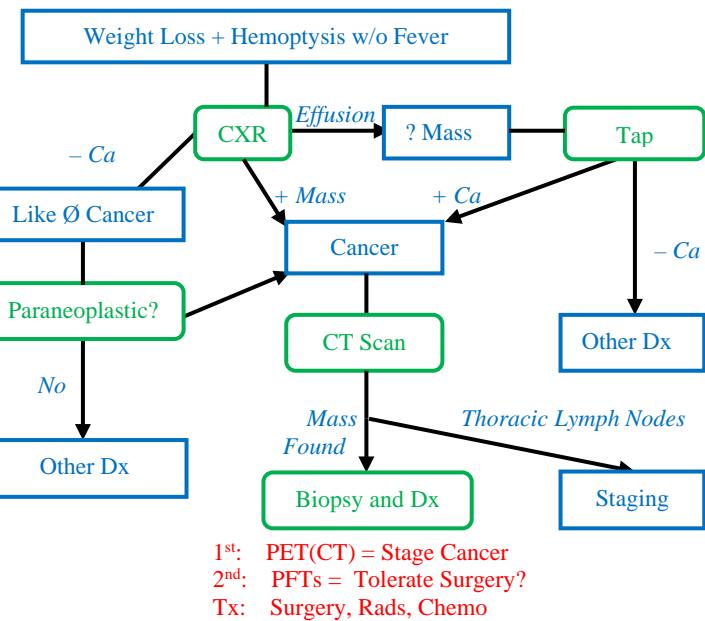
Also caused by **smoking**, it's a **central** lesion that's **typically metastasized** at the time of diagnosis. It's too small to be seen on X-ray so it requires a **CT scan** to make the diagnosis. **EBUS with Biopsy** confirms the diagnosis. The tumor should NOT be resected; it's **exquisitely sensitive to chemo**. Because it's a neuroendocrine tumor it can produce **ADH** (SIADH) or **ACTH** (Cushing's). It does not get large enough to cause obstructive pneumonias or hemoptysis.

Adenocarcinoma

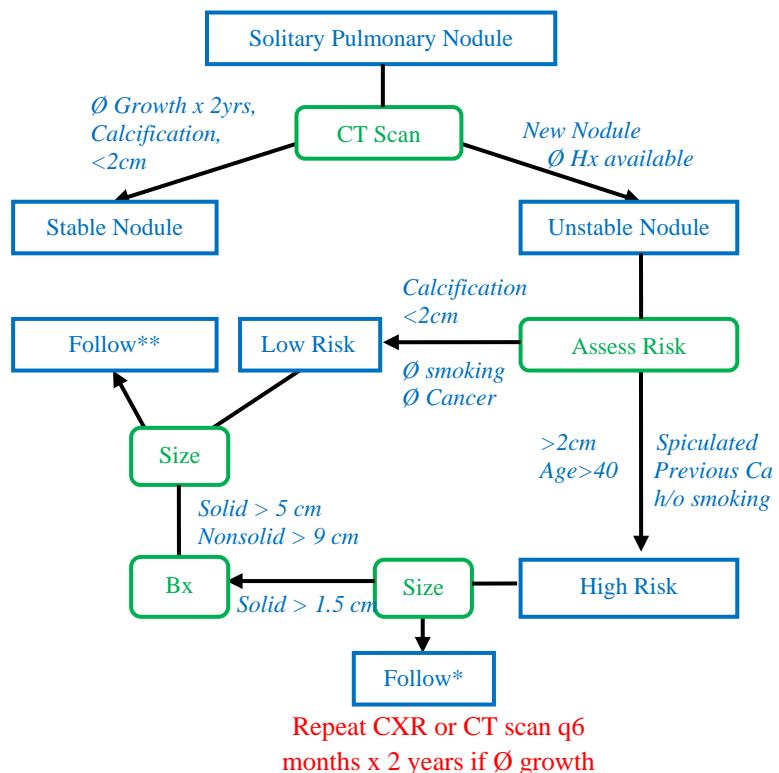
This is the lung cancer that people get when they **don't smoke**. It typically occurs in the **periphery** of the lung and is stuck to the **pleura** causing it to **pucker**. It is either spontaneous or secondary to a remote **asbestos exposure** or other non-cigarette exposure. Smoking makes it more likely, and worse, but is not necessary.

Carcinoid

Carcinoid is a rare neuroendocrine tumor that may occur in the small intestine or the lung. It produces **serotonin** which degrades to **5-HIAA** and gets secreted into the urine (how it's diagnosed). Because the serotonin originates in the lung it will cause a **left-sided valve fibrosis** along with the flushing, wheezing, and diarrhea typical of the intestinal carcinoid. Since the serotonin is degraded by the liver the right side of the heart is spared.



<i>Surgery Alone</i>	<i>Surgery and Adjuvant Chemo</i>	<i>Chemo Radiation WITHOUT surgery</i>
Ia	Ib > 4cm Mass	IV (N2, N3 nodes)
Ib, < 4cm mass	II (N0 or N1 nodes)	IV (Mets)
	III (N0 or N1 nodes)	IV (Pleural effusion)



<i>Cancer</i>	<i>Patho</i>	<i>Location</i>	<i>Histology</i>	<i>Paraneoplastic</i>	<i>Dx</i>	<i>Tx</i>
Squamous Cell	Smoking	Central	Intracellular Bridges, Keratin Pearls	PTH-rp	Bronch	Surgery
Small Cell	Smoking	Central	Neuroendocrine granules on EM	ADH, ACTH	Bronch	Chemo + Rad
Adenocarcinoma	Asbestos	Peripheral	Mucin Glands	-	Perc	Surgery
Carcinoid	Smoking	Anywhere	Salt and Pepper	Serotonin	U 5-HIAA	Surgery

Pathogenesis

There are two types of effusions: transudates and exudates. A **transudate** is a lot of **fluid** and not much else. It's caused by **intravascular pathology**; either an **↑Hydrostatic Pressure** (CHF) or **↓Oncotic Pressure** (Nephrotic syndrome or cirrhosis) from within the blood vessels. These are usually distributed evenly across the lungs and are thus **bilateral**. An **exudate** is a lot of **stuff** in the parenchyma drawing the fluid out. It's caused by **extravascular pathology** - generally an **↑Oncotic Pressure** of the interstitium outside the blood vessels (infection, malignancy, PE, TB, Hemothorax, Chylothorax, or some Zebras). Since this doesn't necessarily distribute evenly it may be **unilateral**.

Diagnosis

Pleural effusion is on the differential for shortness of breath or pleuritic chest pain. However, the diagnosis does not become apparent until the **Chest X-ray**. Once **blunting of the costovertebral angles** (which requires at least 250cc) is seen the diagnosis is made. If more than that is present the **air-fluid level** (the meniscus) rises. While a CT can give insight as to a cause of the effusion, it's better saved until after the thoracentesis and Lights' criteria. After the chest X-ray perform a **recumbent X-ray** to assess if the fluid is **free moving** (not loculated) and in sufficient quantity (**>1cm** from chest wall to fluid level) to do a **thoracentesis**. We don't want to destroy the parenchyma or cause a pneumothorax so we do both the upright and recumbent x-ray. With thoracentesis the **Light's Criteria** (comparing the **Serum Protein** and **Serum LDH** to the **Pleural protein** and the **Pleural LDH**) can be performed. It shows the exudates vs transudates (see the table to the right). The next need is to get a complete characteristic of the pleural fluid for definitive diagnosis (**WBC**, **RBC**, **pH**, and **Glucose**).

Now the CT scan is a good idea but only if there's an exudate without an obvious diagnosis.

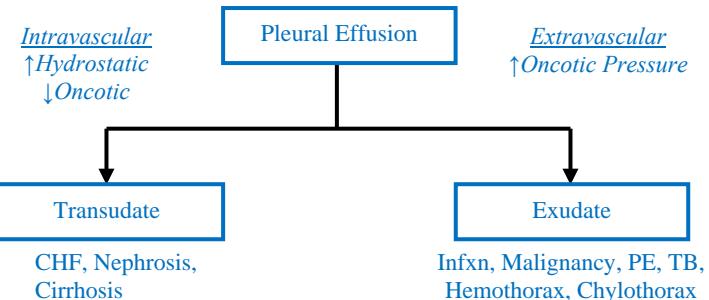
However, if the patient has **CHF** and the diagnosis is leaning that way there's no need do any workup. Simply **diurese** and monitor.

Treatment

If there's a **parapneumonic effusion** or insufficient fluid for a thoracentesis with an underlying cause, a **tube thoracostomy** (chest tube) is required to prevent the formation of an empyema. If you wait too long and an empyema develops, a **thoracotomy** (surgery) is needed. If there's sufficient fluid do a **thoracentesis and treat the underlying disease**. If the underlying disease is already known (CHF, ARDS) then no tap needs to be done.

Overview

- (1) Find an effusion on CXR → Determine **Tappability**
- (2) a. If loculated, **thoracostomy**... failure... **thoracotomy**  
b. If not loculated >1cc **Tap**, if <1cc **Observe**
- (3) If they have CHF diurese and monitor - do NOT tap
- (4) Light Criteria for **Transudate vs Exudate**
- (5) If transudate treat the underlying disease
- (6) If exudates get complete workup, tx as diagnosed
- (7) If all else fails consider Pulmonary Embolism

Upright Chest X-ray

< 250cc	Not visible
250cc	Blunting of the costovertebral angle
>250cc	Meniscus line rises, air-fluid level

Recumbent Chest X-ray

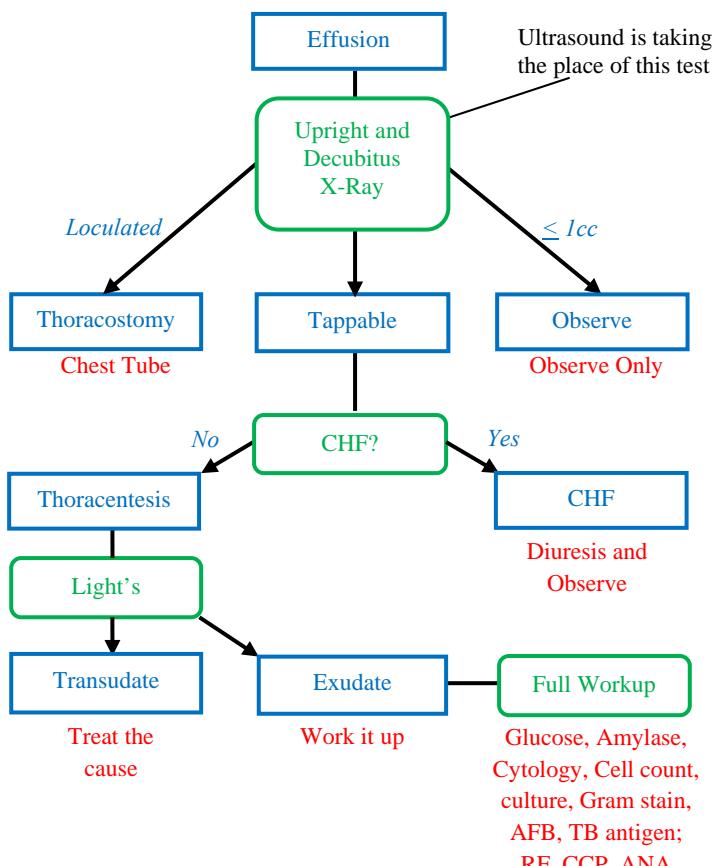
Free fluid vs loculated (Layers out or doesn't)
Volume required for thoracentesis (>1 cm)

Thoracentesis Findings

Transudate	LDH < 2/3 Upper Limit of Normal (~200) <u>and</u> LDH <sub>effusion</sub> / LDH <sub>serum</sub> < 0.6 <u>and</u> Total Protein <sub>effusion</sub> / Total Protein <sub>serum</sub> < 0.5
Exudate	LDH > 2/3 Upper Limit Normal (~200) <u>or</u> LDH <sub>effusion</sub> / LDH <sub>serum</sub> > 0.6 <u>or</u> Total Protein <sub>effusion</sub> / Total Protein <sub>serum</sub> > 0.5

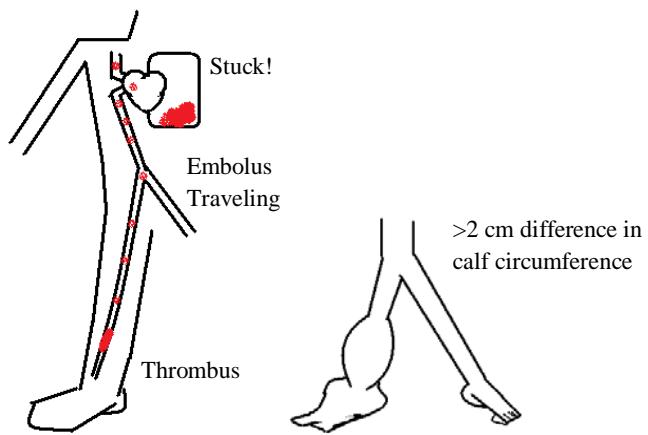
CT Scan

If underlying conditions require for evaluation or diagnosis
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Introduction

Pulmonary embolism should be considered one continuous disease with a deep venous thrombosis. The etiology of DVT / PE is **Virchow's Triad:** 1) **Venous Stasis**, 2) **Hypercoagulable State**, 3) **Endothelial Damage**. Risk goes up with the classic risk factors (bed rest and surgery), hypercoagulable disorders (cancer, OCPs, and genetics), and HTN/Dissection/IV sites. The **thrombus forms** in the **deep veins**; it's typically in the **popliteal** or **femoral** veins. Since there's **Ø valves** in the deep veins, should a piece of a clot should break free (the **embolus**) it can travel up the IVC and into the lungs. It gets stuck in a small vessel of the lung. This has two consequences. 1) Because good blood is unable to get to the alveoli, there's a **limitation of gas exchange**. 2) Because there's less piping to pump blood through there's an increase in **pulmonary vascular resistance**, creating a **right heart strain**.



Yet even the smallest embolus can cause profound dyspnea. A small clot doesn't cause heart strain or significantly impact gas exchange (relative to the size of the lung). How these small emboli cause such profound dyspnea is through **platelet-derived mediators** leading to lung-wide inflammation. This allows fluid to leak out around the alveoli. The fluid is a barrier to the diffusion of oxygen but NOT carbon dioxide. Thus, as the respiratory rate increases **CO<sub>2</sub> is blown off** while **Oxygen can't get in**.

Presentation

The classic patient will present with a **shortness of breath**, **tachypnea**, **tachycardia**, a **pleuritic chest pain**, and a **Clear Chest X-ray**. The difficulty with PE is that there's no clinical finding that screams "PE Here," so the goal is to identify risk factors and rule out other diseases. The presence of a **Homan's Sign** (pain on passive flexion of the foot) is highly suggestive for DVT but its absence means nothing. As such, always at least consider PE when a patient complains of shortness of breath. All that's left is to use the **Well's Criteria** to decide what type of test to do and how to treat it.

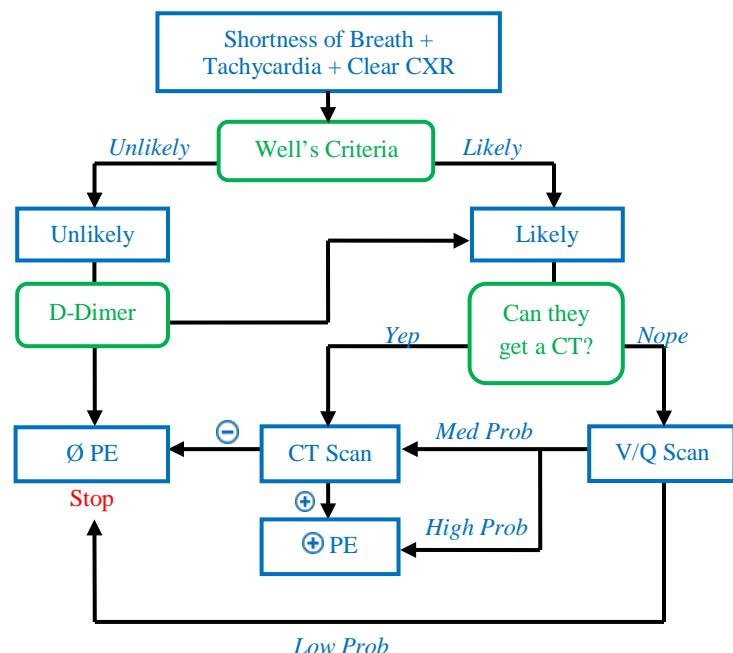
Diagnosis

During the workup of SOB the typical tests of **CXR**, **EKG**, and **ABG** may show soft signs of PE. The CXR is normal - the EKGS show **S<sub>1</sub>Q<sub>3</sub>T<sub>3</sub>** indicative of Right Heart strain - and the ABG may show a **hypoxemic respiratory alkalosis** (the increased respiratory rate because of hypoxia drives venting of CO<sub>2</sub>). The absence of these mean nothing, however. A **D-Dimer** is usually 1<sup>st</sup>, but is only useful if **normal** (rules out PE though does not rule in anything and can be falsely elevated). A lower extremity **ultrasound** is great if **positive** (rules in but not out, as the clot may have already embolized). The two tests that can absolutely diagnose a PE are **Spiral CT** and **Angiogram**. The spiral CT is the modality of choice because it's non-invasive. The Angiogram is invasive and isn't superior to the Spiral CT. However, if the patient can't have **IV Contrast** a CT scan is really useless. Instead, do a **V/Q Scan** to stratify risk into high, medium, and low.

Wells Criteria – Building the Wells Score		
PE most likely diagnosis, s/s DVT		3 each
HR > 100		1.5
Immobilization		1.5
Surgery w/i 4 weeks		1.5
Hemoptysis		1
Malignancy		1
h/o DVT or PE		1.5

Wells Score – for V/Q Scan Interpretation		
Score <2	Score 2-6	Score > 6
Small Probability	Moderate Probability	High Probability

Modified Wells – do I do a CT Scan?		
Score ≤ 4	Score > 4	
Don't Do It	Do It	



Treatment

Treatment is really based on the severity of the disease.

If there's a **massive embolism** that has compromised cardiac function (hypotension) it's imperative to jump right to emergent intra-arterial **tPA** or **thrombectomy**.

In **most cases** there are two treatment goals. One is to shut off those **platelet mediators** using **heparin**. Heparin is the mainstay of therapy; even if a PE is suspected start it. The second goal is to **prevent recurrence** with an anti-coagulator like **warfarin**. To put a patient on heparin he/she needs a **heparin to warfarin bridge**. The target INR is 2-3; give heparin to help the patient right now and to prevent the procoaguable effects of early warfarin.

Those patients who can't tolerate warfarin or who have **DVT/PE while therapeutic** require the placement of a **Greenfield filter** in the IVC.

Obviously, the first step in treatment will be to give a dyspneic patient oxygen.

Monitoring

Warfarin can cause hypercoagulability and thus requires a heparin bridge in the first few days. Likewise, INR must be maintained between 2-3 to avoid bleeding (if it gets too high) and clotting (if it gets too low). While in the hospital, **heparin** can induce a **heparin-induced thrombocytopenia (HIT)**. This usually occurs within 7 days on first exposure and 3 days on repeat. Draw a **HIT panel**, stop the Heparin, and give **Argatroban**.

Pulmonary Embolism

*Path: Virchow's Triad*

*Pt: Shortness of Breath, Tachycardia, Clear CXR*

*Dx: D-Dimer, CT Scan, V/Q Scan*

*Tx: Heparin to Coumadin*

Differential Diagnosis

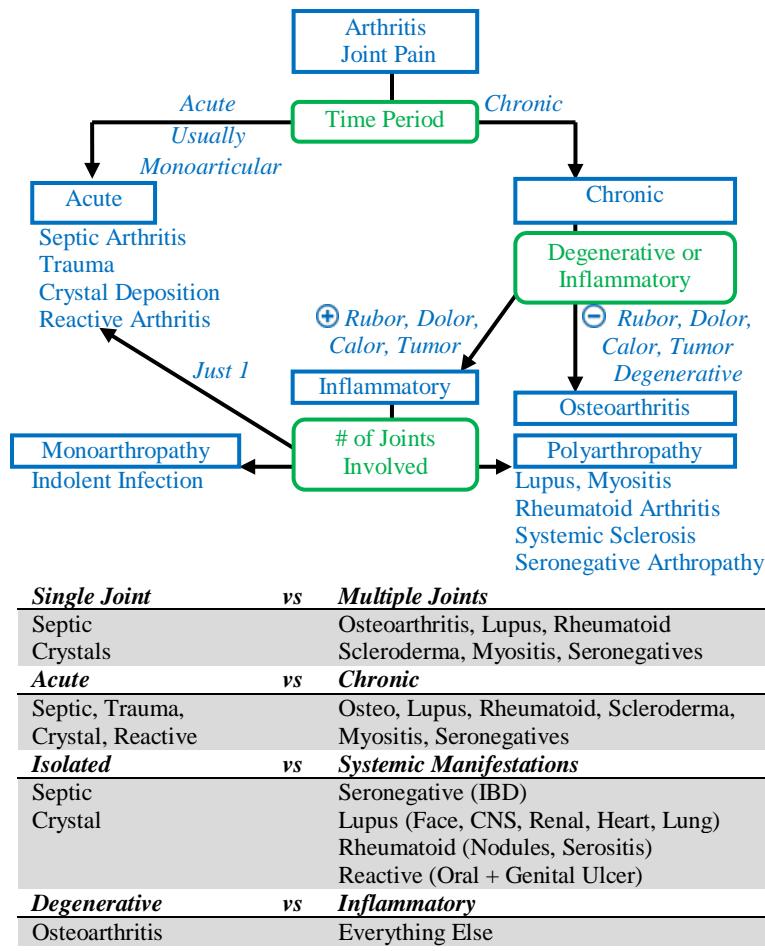
Rheumatology is essentially the diagnosis and management of joint pain. It has quite an extensive differential as it could be the primary complaint or the symptomatology that links all disease. Unfortunately, many of these diseases have a **list of associated symptoms** that have to be memorized in order to ascertain the correct diagnosis. However, there are some classifications that can help reduce the potential list of diagnoses. The **number of joints, pattern, and symmetry** of joint pain play a huge role. Usually **monoarticular** involvement has to do with a disease of **that joint**, indicating an absence of systemic involvement. It's often acute. **Polyarticular** involvement is associated with systemic disease. Let's break it down further. In polyarticular disease **absence of symmetry** means it's likely **degenerative** as it reflects the asymmetry of use. If there's **symmetry** it indicates autoimmune. Finally, even paying attention to **WHICH joint is involved** can be useful (RA spares the DIP for example). Besides that, **extrarticular manifestations** are often unique to a given diagnosis, though crossover does exist. The important thing is that **no one finding** is sensitive or specific – it's the combination of symptoms that lets the diagnosis come to light. Using this algorithm may be useful, but it's the memorization that excels in rheumatology.

Arthrocentesis

If a diagnosis can be made without tapping a joint don't tap it. But if it is tapped differentiating the findings is critical. In a **normal joint** there should be a bunch of fluid - that's it. In **degenerative disease** it's the same; the joint is just degraded (neither normal joint or degenerative joint conditions should have prompted a tap). A **septic joint**, on the other end of the spectrum, will be full of **pus**: white, opaque, LOTS of cells, LOTS of polys. An **inflammatory joint** will be somewhere in between, with some cloudy fluid, some cells, and mostly polys. This is another layer of overlapping clues: whether the joint is **inflammatory vs noninflammatory** (white cells or not). This can also be noticed in the physical exam (rubor, calor, tumor, and dolor present in inflammatory joints).

Antibodies

Memorize them. They're useful as many are **Sensitive** and **Specific**. They're mostly non-diagnostic, but they're another clue. Bottom line: **there isn't one test but rather a combination of findings** (including serology) that leads to diagnosis.



	Normal	NonInflammatory	Inflammatory	Sepsis
Appearance	Clear	Clear	Yellow, White	Opaque
WBC	<2	<2	>2, <50	>50
Polys	<25%	<25%	≥ 50%	≥ 75%
Gram/Cx	⊖	⊖	⊖	⊕
Dz	None	Osteoarthritis	Everything Else	Infection

Antibody	Interpretation	Antibody	Interpretation
Antinuclear Antibodies	Sensitive Lupus	Anti Ro+La Antibodies	Sjogren's
Anti-Histone Antibodies	Specific Drug-Induced Lupus	Anti CCP Antibodies	Rheumatoid Arthritis
Anti-ds-DNA Antibodies	Specific Lupus + Renal Involvement	Anti RF Antibodies	Rheumatoid Arthritis
Anti-Smooth Muscle Ab	Autoimmune Hepatitis	Anti Jo Antibodies	Polymyositis
Mitochondrial Antibodies	Primary Biliary Cirrhosis		
Centromere Antibodies	Scleroderma (CREST)	Topoisomerase Antibodies	Systemic Scleroderma

Introduction

Lupus is an **autoimmune disease** affecting **women** more than men (10:1) and **non-white** more often than Caucasian. The pathogenesis is unknown but it has a clear genetic (i.e. inherited) component. The diagnosis is a **chronic inflammatory systemic disease** without a single unifying pattern, but with commonalities in most patients with the disease.

Presentations

The diagnosis of lupus is made when **4 of 11 criteria** are met. These 11 criteria can be remembered by the mnemonic **SOAP BRAIN MD**. Lupus is a systemic disease that causes dysfunction in multiple organ systems. Lupus is known for its polyarthropathy and joint pain, so consider it in young women with joint pain. If there's a picture of a **malar rash** (bilateral face and sparing of nasolabial fold) and a question on **renal failure** in a healthy young woman, **2<sup>nd</sup> trimester miscarriage**, or **Libman-Sacks endocarditis**, jump to Lupus.

Diagnosis

Because Lupus causes so many problems a number of tests must be done to **rule out other diseases**. The most useful tests are the **antibodies**. The **ANA** is sensitive: useful to rule out disease. The **ds-DNA** is **specific**. Other antibodies include anti-smith (lupus) and anti-histone (drug induced). There are no scans or images that say "Lupus," but **x-rays** will show joint degeneration. Because it's a chronic inflammatory disorder, **ESR + CRP** will be elevated - their degree reflective of disease acuity. During a **flare**, check a **complement level** (if reduced, then it probably IS a flare). The main thing that kills these patients is the **renal failure**. Monitoring of BUN and Creatinine, as well as **screening urinalysis**, is crucial.

If an **acute kidney injury** and **lupus flare** is seen, a **kidney biopsy** is required before giving **cyclophosphamide**.

Treatment

Patients care about the pain in their joints. This can be treated with **NSAIDs**. We care about preventing flares. Disease modifying agents such as **hydroxychloroquine** can spare long-term steroids and prevent flares. **Steroids** are used to induce remission during a flare. Life-threatening nephritis or cerebritis can be treated with **Cyclophosphamide**. **Mycophenolate** represents a safer alternative to cyclophosphamide for induction when there's nephritis. The biologics are NOT approved for lupus (yet).

Drug-Induced Lupus

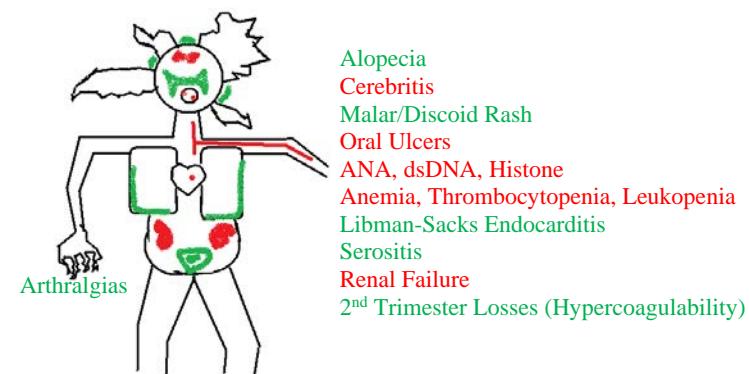
Any drug on the list can cause it: **Hydralazine, Procainamide, INH, α-methyldopa**, etc. It presents with the **skin** and **joint** complaints of lupus, but will **spar CNS** and **Renal** symptoms. Confirm Drug-Induced Lupus with a **positive Anti-Histone Antibody** and stop the drug to reverse the disease.

**BAG OF LUPUS**

- |   |                    |
|---|--------------------|
| 1) Chronic Inflammatory Disorder, Systemic Consequences   |                    |
| 2) Joints, CNS, Kidneys, and a Rash   |                    |
| Multiarthritic  | Renal Failure      |
| Change in mental status   | Malar/Discoid Rash |
| 3) ANA is sensitive, not Specific, 1 <sup>st</sup> test   |                    |
| 4) ds-DNA Specific, not sensitive,  |                    |
| 5) Possible Drug-Induced Lupus with Hydralazine, Procainamide, INH, and α-methyldopa... get an Anti-Histone Ab, stop the drug |                    |
| 6) Treat Arthralgias with NSAIDs  |                    |
| Treat Flares with Steroids  |                    |
| Treat life-threatening disease with Cyclophosphamide  |                    |

**SOAP BRAIN MD**

<b>S</b> erositis	<b>B</b> lood	<b>M</b> alar Rash
<b>O</b> ral Ulcers	<b>R</b> enal	<b>D</b> iscoid Rash
<b>A</b> rthritis	<b>A</b> NA	
<b>P</b> hotosensitivity	<b>I</b> mmunologic	
	<b>N</b> eurologic	

**Treatment**

<b>NSAIDs</b>	Arthralgias (Pain), Serositis (pain)
<b>Low Dose Steroids</b>	Refractory to NSAIDs; generally avoid this
<b>High Dose Steroids</b>	Induction of Lupus flare
<b>Hydroxychloroquine</b>	Induce remission, targets skin and joint
<b>Methotrexate</b>	Alternative to Hydroxychloroquine (2 <sup>nd</sup> line)
<b>Mycophenolate</b>	Potential alternative to Cyclophosphamide
<b>Cyclophosphamide</b>	Nephritis, Cerebritis, life-threatening flare
<b>Biologics</b>	Not approved yet for lupus

When someone comes in with a **single hot joint** with a several **hours duration** (acute) there are a few possibilities. It's likely either a **septic joint** caused by an infection or a **crystal deposition** disease. To determine the diagnosis the history with **risk factors** becomes vital. But no matter how clear the story you can't miss a septic joint so always do an **arthrocentesis**.

### 1) Septic Arthritis

A septic joint gets infected two ways: **direct inoculation** by trauma or by **hematogenous spread**. It really comes down to: is it Staph Aureus / Nongonococcal or is it Gonococcal? Staph can get in via **trauma** (hard to miss the arrow sticking out of the knee) or by hematogenous spread (think **IVDA / Endocarditis** septic emboli). Gonococcus gets in by **hematogenous spread** **only** so look for the young sexually active adult with a **urethral discharge** and a couple of days of **constitutional symptoms** who now has a **hot, swollen knee**. Tapping the joint will show many **polys (>50 WBC 90% Poly)**. Start empiric antibiotics, then alter them as the stain, cultures, and sensitivities become available. If the gram stain is negative do **double coverage** (ceftriaxone + vancomycin).

### 2) Gout

Gout is caused by deposition of **monosodium urate crystals** in the joint space and exacerbated by **hyperuricemia**. Too much uric acid happens either because of **increased cell turnover** (production of uric acid secondary to DNA lysis) or by **decreased excretion** (usually a result of decreasing renal function). It's usually caused by decreased excretion. Look for the **old man** who drinks **alcohol** and is on a **diuretic** (all of these decrease the excretion capacity of the kidney). During an acute flare diagnose gout with an **arthrocentesis**; it'll show **negatively birefringent needle-shaped** crystals. The joint is exquisitely tender so a clear clinical history is sufficient - especially if **podagra** (inflammation of the great toe) is present. Treat acute gouty attacks with **NSAIDs** or **Colchicine**. Colchicine causes diarrhea so is dose-limited by that side effect. Treat chronic gout with the **xanthine-oxidase inhibitor allopurinol** (preferred) or the **uricosuric agent probenecid** to keep the uric acid between <6. Starting treatment may induce an acute gouty attack. Don't stop chronic therapy during this flare.

Gout can get so bad that renal failure may result. This occurs during severe bouts that increase the production of uric acid. One such example is **Tumor Lysis Syndrome** (where a bulky tumor as in **Leukemia** or **Lymphoma** is blasted by **Chemotherapy**). To avoid Tumor Lysis Syndrome, prophylax with **vigorous hydration** and pretreat with **Allopurinol**. If the uric acid levels have already risen, lessen the burden of uric acid with **Rasburicase**.

If the arthrocentesis shows **positively birefringent crystals** it's **pseudogout**. The pathogenesis is unknown but it can be treated with NSAIDs and Steroids.

*Follow along with the diagram on the next page.*

*You're going to tap the joint either way*

*You'll treat empirically based on risk factors.*

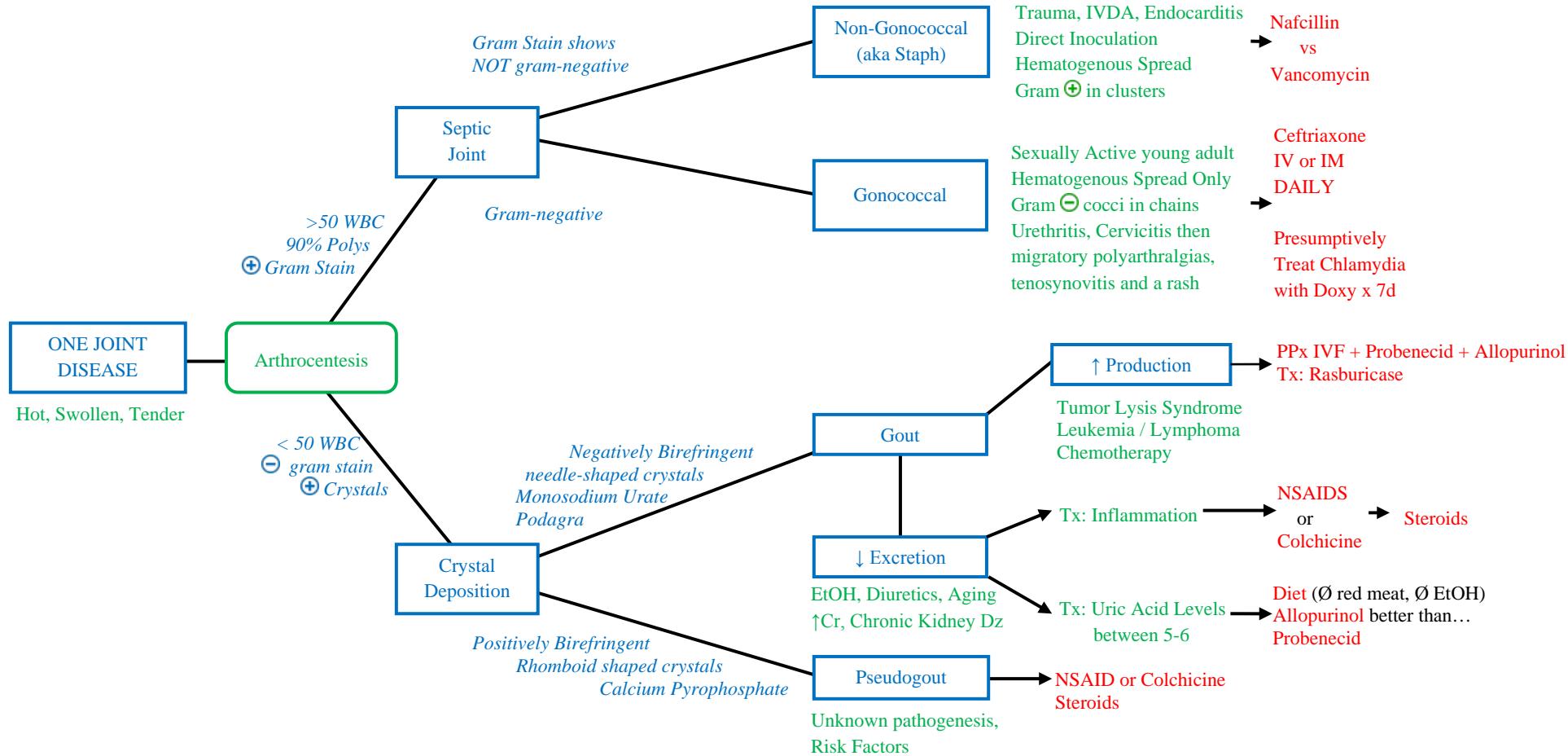
*You'll treat for BOTH if you don't get a definitive diagnosis on Tap.*

#### **ACUTE**

NSAIDs	↓ inflammation	1 <sup>st</sup> Line, Gastritis, CKD
Colchicine	↓ inflammation	2 <sup>nd</sup> line, Diarrhea
Steroids	↓ inflammation	Last Line

#### **CHRONIC**

Allopurinol	Xanthine-Oxidase Inhibitor	Maintenance, can cause acute flare
Probenecid	Uricosurics	Maintenance, can cause Uric Acid Stones



Arthritis	Risk Factors	Joint Tap	Gram Stain	Culture	Crystals	Treatment
<b>Non-Gonococcal</b>	IVDA, Endocarditis, Direct Trauma, Sepsis	>75 WBC 90% Polys	Gram + Cocci in clusters	Staph	Ø	Nafcillin or Vancomycin
<b>Staph Aureus</b>						
<b>Gonococcal</b>	Unprotected Sex, Urethritis, Discharge, Ø Trauma	>75 WBC 90% Polys	Gram - Cocci in chains	Gonococcus	Ø	Daily IV or IM Ceftriaxone
<b>Gout</b>	↑ Levels of uric acid old man on EtOH + Diuretics, Podagra	5-50	Ø	Ø	Urate Crystals negatively birefringent Needle Shaped	NSAIDs or Colchicine Steroids Allopurinol maintenance Probenecid maintenance
<b>Pseudogout</b>	↑ Calcium Pathogenesis Unknown	5-50	Ø	Ø	Pyrophosphate Crystals Positively Birefringent Rhomboid Shaped	NSAIDs or Colchicine Steroids

Scleroderma

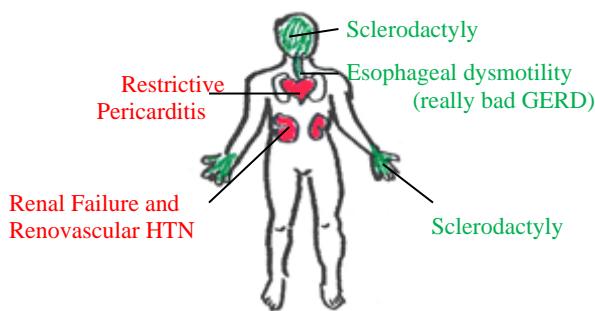
Scleroderma is an **autoimmune disease** resulting in 1) **collagen** replacing **smooth muscle** and 2) wide-spread extraneous **collagen deposition**. The typical patient has **skin tightness** in the hands and face and may suffer some GERD or Raynaud's. In reality, there are two types of scleroderma: CREST and Systemic Sclerosis. **CREST** is a limited disease that **sparing the heart and kidneys** but has **Skin and GI effects**. On the other hand, **systemic sclerosis** is a diffuse disease affecting the trunk with **⊕ cardiac** (restrictive cardiomyopathy) and **⊕ Renal** (renovascular hypertension) effects. Scleroderma is mainly a clinical diagnosis but antibodies may aid getting there. **Anti-Scl-70** (topoisomerase I) is positive in systemic disease while **anti-centromere** is positive in CREST. There's also **no treatment** for the disease itself. Instead, treat the symptoms. Use **Calcium Channel Blockers** for **Raynaud's**, **Penicillamine** for **skin changes**, **steroids** for **acute flares**, and aggressive treatment of hypertension with **ACE-inhibitors**. Collagen in the renal arterioles prevents dilation and constrict. This creates a prerenal picture by activating the renin-angiotensin-aldosterone axis, which exacerbates the hypertension.

Sjogren's syndrome

An inflammatory condition of **exocrine glands** due to **lymphoplasmacytic infiltration**. It can exist on its own (primary) or be part of another Rheumatologic disorder (secondary). It's easy to spot: **Dry Eyes** (Keratoconjunctivitis), **Dry Mouth** (Xerostomia), and **bilateral parotid enlargement**. It's a clinical diagnosis assisted by antibodies (**Ro** or **La** which are specific but not sensitive) and **tear production testing** (Schirmer test). There's **no treatment** so focus on **symptom control** (artificial tears / saliva).

Polymyositis / Dermatomyositis / Inclusion Body Myositis

These three **inflammatory myopathies** are lumped together because their presentation, diagnosis, and treatment are all the same (well, except IBM, which has no treatment). The underlying pathogenesis (**T cell / Immune Complex / T cell** respectively) results in the presentation of **proximal muscle weakness** (difficulty in rising out of a chair but intact grip strength) with **tender muscles**. There may be systemic involvement. The way it comes to light is usually the **dermatologic signs**: 1) erythematous rash on sun-exposed areas (**photosensitivity**), 2) **Heliotrope rash**, a purple discolored around the eyes with periorbital edema, and 3) **Gottron's Papules** (pathognomonic), which are scaly areas symmetrically over major joints (wrists, elbows, knees, ankles). The first test is always **EMG** to determine if it's a nerve conduction issue (MS, for example) versus muscular damage. A **muscle biopsy** is done to definitively diagnose and separates one disease from the other. Other tests may help. The **CK** will be **elevated** (muscular damage) and **Anti-Jo** or **Anti-Mi** antibodies may be present. The goal is to **check for occult malignancy** (as these are often a paraneoplastic syndrome) and treatment is with **high-dose steroids**.

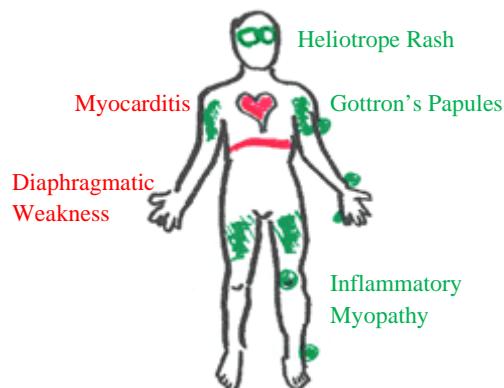
CREST:

Calcinosis  
Raynaud's  
Esophageal Dysmotility  
Sclerodactyly  
Telangiectasia

Anti-Centromere  
PAH

Systemic Sclerosis  
CREST +  
Renal  
Heart

Anti-Scl-70  
ILD



	Scleroderma	Sjogren's	DM/PM/IBM
Pt	Female, Thickened Skin on fingers, GERD, Reynaud's	Female Dry Eyes Dry mouth Bi Parotitis	Proximal Muscle weakness, tender, Heliotrope rash, Gottron's Papules F: DM +PM, M: IBM
Ab	Scl-70 = Diffuse Centromere = CREST	Ro La	Jo Mi
Dx	-	Schirmer Tear Production	EMG Bx MRI / CT (Cancer)
Tx	Penicillamine CCB Steroids ACE	Symptom Relief	Check for Malignancy High Dose Steroids

Introduction

Rheumatoid Arthritis is an **autoimmune disorder**. It's a predilection for joint destruction of the hands, which leads to severe morbidity. The pathology is **pannus formation** at the joint leading to erosions and bony destruction. This pathology is poorly understood, though the diagnosis is often obvious.

Presentation

The details of the presentation are in "diagnosis" below. Look for the **elderly woman** with **hand deformities** that involve **3 or more joints** that's also **symmetric** and presents with **morning stiffness** - especially in the **hands**.

If the disease involves the **DIPs**, **RA is RULED OUT**. RA only affects the MCPs and ICPS.

"Morning Stiffness" + "The Spine" might come up. The reaction is to go for Ankylosing Spondylitis. If it involves the lower back it's ank spond. If it involves the neck (C1, C2) it's RA.

Diagnosis

There are a number of clinical criteria in order to diagnose rheumatoid arthritis. They're not all needed, but some common findings are almost always present on a vignette. The old "wait 6 weeks," is now out; RA can be diagnosed right off the bat.

Serology. Either the **Rheumatoid Factor** (cheap, sensitive) or the **Anti-CCP** (expensive, specific) can be used. If either is positive it counts for serology.

Joints. There must be **symmetric arthritis** that involves **more than three joints** and **spares the DIPs**. Both the number of joints involved and the symmetry are crucial. Look for small joints like hands, feet, and wrists.

Radiology. An **X-ray** can be used to assess for **bony erosions**. This is also symmetric. The x-ray can also identify regular old arthritis if osteophytes are seen.

Nodules. Biopsy of a Rheumatoid Nodule will reveal **cholesterol** deposits. This finding rules out another potential deposition disease. These are pathognomonic.

Treatment

Get these patients on disease modifying agents as soon as possible. The first thought might be NSAIDs if the disease is mild, but NSAIDs don't alter disease course. They're still used - NSAIDs at diagnosis, but escalate to DMARD as soon as possible. Use **Hydroxychloroquine** for non-erosive mild disease and **Methotrexate** for moderate or erosive disease. If DMARDs fail **add biologics**. Before starting biologics a **TB screen** and **vaccines** must be given as they significantly compromise immune function. **Corticosteroids** should be **avoided** - except during life threatening flares - to reduce long-term systemic side effects.

BONUS POINTS: Felty's syndrome

*Rheumatoid Arthritis + Neutropenia + Splenomegaly = Felty's if you see RA + Splenomegaly think Neutropenia RA + Neutropenia think Splenomegaly*

BONUS POINTS: Cervical X-ray

*If a patient with RA is going into surgery for any reason a cervical film should be done since rheumatoid arthritis affects the cervical spine and the cervical spine only.*

*Ø Spine Involvement except C1 + C2*

Clinical Criteria

<b>Symmetrical Arthritis</b> , often of the hands, <b>Sparing DIP</b>
<b>Morning Stiffness</b> for > 60 minutes, improves with use
<b>Multiple Joint Involvement (<math>\geq 3</math>)</b>
<b>Radiographic Destruction of Joints (erosions)</b>
<b>+ Rheumatoid Factor or + Anti CCP</b>

Rheumatoid Nodules

*Nobody Should Have Rheumatoid Symptoms 3 times (X)*

*N: Nodules*

*S: Symmetric*

*H: Hands*

*R: RF or CCP*

*S: Stiffness*

*3: 3 or more joints*

*X: X-ray findings of erosions*

Be Careful

*In life, you can have Rheumatoid Arthritis with negative RF and negative Anti-CCP, or no Rheumatoid Arthritis with positive RF and positive Anti-CCP. On a test it's always black and white: if positive, then disease, if negative, then no disease.*

Treatment

DMARD	Methotrexate (1 <sup>st</sup> line) Hydroxychloroquine (2 <sup>nd</sup> line)
Anti-TNF	Etanercept, Infliximab
Glucocorticoid	Flares
NSAIDs	Symptom control – always include a medication to actually stop the disease (DMARD or biologic) and supplement with NSAIDs for symptoms

Introduction

This group of diseases are unique in that they show a predilection for the **spine**, particularly the **sacroiliac joints**, and have a higher incidence in **men** (much unlike the majority of rheumatologic diseases). There's a correlation to **HLA-B27** but it isn't useful for diagnosis. These patients are **seronegative**: they have no RF, CCP, or ANA reactive antibodies. What separates them from each other is their **extra-articular involvement** and links to other **inflammatory conditions**.

1) Ankylosing Spondylitis

Ankylosing spondylitis is the most commonly tested seronegative arthropathy. It occurs in men in their **20s** and **30s**. They will have **lower back pain** with **morning stiffness** that improves with use. It's caused by **sacroiliitis** with **fusion of the sacral joints** and calcification of tendons, which produces the **bamboo spine** on X-ray. Other tendons can calcify as well - especially the **Achilles tendon**. It can be associated with inflammatory bowel disease (distracting towards enteropathic) but its course is different. The treatment is based on severity and presence of axial vs peripheral joint involvement. Therapy generally starts with **NSAIDs**, escalates to **Methotrexate**, and if all else fails move to monoclonal antibodies (TNF-alpha inhibitors) like **Etanercept**.

2) Reactive Arthritis

People with HLA-B27 who also get **nongonococcal urethritis** (usually Chlamydia) will "react" and develop an **asymmetric bilateral arthritis** of the **lower back** and **hands** as well as a **conjunctivitis**. Treating the underlying infection will prevent this **acute** disease from transforming into chronic. Treat the Chlamydia with **doxycycline** and arthritis with **NSAIDs**.

3) Psoriatic Arthritis

Psoriasis + Arthritis is psoriatic arthritis. The main joint involved will be in the **hands**. It's a **symmetric PIP and DIP arthritis** with **erosive pitting** of the nails. The arthritis may precede the psoriatic plaques (making the diagnosis difficult). The goal is symptom control with **NSAIDs** if there's mild arthritis and NO skin disease. Use **Methotrexate** if it's severe or there are skin findings, **Anti-TNF** if Methotrexate resistant.

4) Enteropathic / IBD-Associated

While ankylosing spondylitis is associated with, but independent of IBD's course, this disease directly correlates with IBD. Treating the IBD fixes the arthritis. The arthritis is **symmetric** and **bilateral, non-deforming, peripheral** (fingers), and **migratory**. It also involves the lower back. The person will have some history of diarrhea to tell you they have IBD.

*HLA-B27 doesn't help - DON'T order it.*

*UNLESS you have a clear diagnosis of ankylosing spondylitis despite negative films (x-ray and MRI)*

*RF, CCP, ANA don't help - DON'T order them*

*32 year old man with lumbar stiffness in the morning who gets an x-ray showing 'any positive finding' of the lumbar spine. The vignette should NOT include something about diarrhea.*

*Start him on NSAIDs and escalate to Methotrexate. Monoclonal antibodies CAN be used to treat the pain (unlike all other seronegatives).*

**TNF-Alpha-Inhibitors**  
*Etanercept  
 Infliximab  
 Adalimumab*

*Gonococcal Urethritis = Septic Arthritis (one joint)*

*Non-Gonococcal Urethritis + Arthritis = Reactive Arthritis (back and hands)*

*Urethritis + Arthritis + Uveitis = Reiter's Syndrome*

*NSAIDs: Mild arthritis and no / 'meh' skin findings  
 Methotrexate: Severe arthritis and real skin findings  
 TNF-a Inhibitors: Nonresponsive to Methotrexate*

*Steroids: no... Steroids bad and lead to flare of psoriasis*

*See how this is different from Ankylosing Spondylitis?  
 Treating IBD makes this better. Treating IBS in AS does not.*

Disease	Presentation	Diagnosis	Extraarticular	Treatment
Ankylosing Spondylitis	Back Pain + Morning Stiffness relieved by exercise (Sacroiliitis)	Bamboo spine on X-ray	IBD but independent of IBD course	NSAIDs Steroids Anti-TNF
Reactive Arthritis	Nongonococcal Urethritis Conjunctivitis Asymmetric Bilateral Arthritis	Ø PCR/DNA Chlamydia	Nongonococcal Urethritis (usually Chlamydia)	Doxycycline and NSAIDs
Psoriatic Arthritis	Psoriatic Patches Erosive pitting of nails MCP, DIP, PIP Arthritis	Ø	Psoriasis Arthritis may appear first	UV light NSAID (no skin) Methotrexate (skin)
Enteropathic Arthritis	Non-deforming, migratory, asymmetric Bilateral Arthritis In a patient with IBD	Ø	IBD and dependent of IBD course	Tx IBD with ASA compounds (mesalamine)

Categorization of Abdominal Pain

**Perforation** presents with a **sudden onset** of abdominal pain that is both **vague** and **persistent**. It is severe. This person will lay **motionless** in fear that any movement will slosh fluid around and aggravate his/her pain. There will be **obvious peritoneal signs**.

**Obstruction** is usually **colicky** (comes and goes) with contraction of the obstructed lumen. The pain is **localized** - generally near the area of the affected organ (gallbladder, kidney). The patient will squirm to try to find comfort, but will find none. If there are signs of peritoneal irritation (though there are often **none**) they will be **localized**.

**Inflammation** has a **crescendo** abdominal pain that becomes **constant** and is **localized** - as is the peritoneal pain. Inflammation causes systemic findings: **fever + leukocytosis**.

**Ischemia** of visceral organs causes necrosis. This presents with a **sudden onset** abdominal pain that is **out of proportion** to the physical exam. There are no signs of peritoneal irritation; there may be **bloody stool** if the gut is affected. Look for the old guy whose status is post **MI** (shock) or with **Afib** (arterial emboli). Intervene **early** rather than later.

Management

If the acute abdomen is more than just abdominal pain, in that there are **⊕ peritoneal findings**, the only option is **Ex Lap**. Finding the correct cause isn't necessary, but testing is often done. An **upright KUB** will demonstrate **free air** and a **CT scan** can likely give the correct diagnosis. Before cutting get the usual tests to rule out **mimickers** of Acute Abdomen pain and identify risk factors for surgery: **CXR** (lower lobe pneumonia), **EKG** (MI), and **Amylase/Lipase** (pancreatitis). Finally, if the patient is at risk for **spontaneous bacterial peritonitis** (larger amount of ascites), a paracentesis may be done in conjunction with treatment against the bacteria. All other causes of abdominal pain are covered in their respective sections.

Peritoneal Signs

- (1) Abdominal Pain
- (2) Involuntary Guarding → SURGERY!
- (3) Rebound

Systemic Findings of Inflammation

- (1) Fever
- (2) Leukocytosis
- (3) Tachycardia

For more information on "Acute Abdomen" aka "Abdominal Pain for Surgery" check out the GI medicine content on abdominal pain

Type	Timing	Pain	Peritoneal	Timing	Patient	Dx	Tx	Examples
Perforation	Sudden Onset	Severe	Generalized	Constant	Motionless	Upright KUB	Ex-Lap	Duodenal Ulcer, Chicken Bone, Iatrogenic
Obstruction	Sudden Onset	Severe	Localized	Colicky	Moving Around	U/S or CT scan	Variable	Cholecystitis, Ureteral Stone, Ectopic Pregnancy
Inflammation	Crescendo	Severe	Localized	Constant @ maximum intensity	Fever + Leukocytosis	U/S or CT scan	Variable	Diverticulitis Appendicitis Pancreatitis Salpingitis Cholecystitis
Ischemia	Sudden Onset	Severe out of proportion to physical exam	Generalized	Constant	Bloody Diarrhea, s/p MI or Afib	Arteriogram, Colonoscopy	Ex-Lap	Mesenteric Ischemia

This is a smattering of information on quite a large topic. You can't possibly know everything about breast cancer, but here are the highlights.

### Pathology

There are a few ways someone can end up with breast cancer. The first is through **estrogen**. The more estrogen a woman is exposed to the greater her chances of breast cancer. This means that **early menarche, late menopause, nulliparity and hormone replacement therapy** (OCPs don't count) increase her risk. The second is to get **radiation** to the chest (like from treatment of Hodgkin's Lymphoma). The third is genetics - mainly the **BRCA1/2** mutation that substantially increases the risk of "lady cancers" (Breast and Ovarian).

### Patient presentation

There are three main presentations. The first is the **asymptomatic screen** (the way we should find breast cancer). The second is the **breast lump**, which requires you to determine whether it's cancer or not. The third is **obvious cancer** with the skin dimpling, fixed, firm axillary nodes, and an obvious large, fixed breast mass. Regardless of how the diagnosis is arrived at, the therapy will depend on the stage and the biopsy.

### Screening

**Mammogram** is the screening test of choice. There's a bit of a controversy right now, however. The USPSTF recommends starting at 50 years old and screening every two years (**50q2y**) while the ACS/NCI says to start at 40 and screen annually (**40q1y**). 40q1y catches more cancer but puts a larger number of women through unnecessary testing and more complications. 50q2y is an attempt at balancing risk and benefit; curing cancer vs avoiding unnecessary procedures and cost-conscious care. There is not a right answer.

Other options exist, however. The **MRI** is the **best screen** but is cost prohibitive. MRI should be chosen as a screening (rather than diagnostic) tool in patients with extremely high risk. That is, people with a super strong family history or those who have received radiation.

**Self-exams** and **clinical exams** do **NOT BENEFIT** anyone. Don't do them. Just screen with mammograms and MRI.

ETIOLOGY	→ PRECANCER	→ CANCER
<b>ESTROGEN</b> - Obesity - Nulliparity - Early Menarche - Late Menopause - HRT	"pre-cancer" is Carcinoma in Situ For breast cancer	Adenocarcinoma
<b>GENES</b> - BRCA 1/2 - Radiation <b>Identify and Modify Risk Factors</b>	Local Resection is curative	Surgery, Radiation And/Or Chemo
	Screen if able	Diagnose and stage
<b>Prophylactic Mastectomy (BRCA only)</b>	Mammogram MRI (High risk)	Core Needle Biopsy SLNB --> ALND

### *Conflicting Recommendations*

USPTF: Start at 50, screen every 2 years, **50q2y**

ACS/NCI: Start at 40, screen every 1 year, **40q1y**

### *Picking the test*

If you screen: Mammogram first

If you diagnose: Mammogram first

If high risk (BRCA or Radiation): MRI

If young (see next page): Ultrasound

Diagnosis

This is actually quite a complex concept – what do you do for a woman with a breast mass? Let's start with what's certain.

**Biopsy** is the answer. If there's a chance it's cancer, we want to do a biopsy. But which? A **fine needle aspiration** is sufficient when there's a cyst and you think it's NOT cancer (see <30 years old). An **excisional biopsy** is the choice when it's so obvious it's cancer you just take it out. The standard, and what you should associate with the diagnosis of breast cancer, is the **core-needle biopsy**. It takes a large piece of tissue and allows for lots of stains (bigger than an FNA) but is breast conserving (isn't an excision).

Patient screens positive on mammogram? Biopsy. You have a high suspicion it's cancer? Biopsy. But - when a woman is young (<30 years old) the likelihood of something else is so high that you shouldn't go after a biopsy. In a young woman start with **reassurance** (watch and wait to see if a lump goes away). If that doesn't work, pick an **ultrasound**. If the ultrasound shows a cyst, **aspire** it. If it goes away or shows an infection, done. But, if the ultrasound shows a mass, the aspirate is bloody, the cyst recurs, or she's older than 30 years old go to a diagnostic mammogram and biopsy.

Treatment

The treatment is based on the **stage**. Staging is not required for a medical student, but it's included to the right just in case. See the next page, right column, to tie together stage with treatment.

There are multiple elements to treatment in breast cancer:

**Surgery.** A lumpectomy + axillary lymph node dissection (ALND) + radiotherapy (RT) is equal to a mastectomy + axillary lymph node dissection (ALND) for local control. A sentinel lymph node dissection should be made prior to ALND in order to avoid the morbidity associated with lymphedema. If a sentinel node is negative, there's only a 5% chance that other nodes are involved.

**Diagnostic Dilemmas**

A lump, a lump! If < 30, start here, go 1-4

1. < 30 = Reassurance (2-3 cycles)

Then 2. <30 + persists = get ultrasound

Then 3. <30 + ultrasound with cyst = Aspirate

Then 4. < 30 + cyst resolves = reassurance

But if at any time....

1. >30

OR 2. Ultrasound shows mass

OR 3. Aspirate is bloody

OR 4. Cyst recurs



Mammogram (diagnostic) → Biopsy

**Simplified Staging of Breast Cancer  
(do not memorize)**

STAGE	SIZE	NODES
<i>Stage I</i>	<2 cm	& 0
<i>Stage II</i>	<2 cm	& 1-3
	2 - 5 cm	OR & 0-3
<i>Stage III</i>	-	+4
	>5cm	- Affixed to chest wall
<i>Stage IV</i>		Distant Metastasis

See it as...

Small = Stage I No Nodes: Stage I

Middle = Stage II Some Nodes: Stage II

HUGE = Stage III LOTS of Nodes: Stage III

**Chemo.** Chemo is often anthracycline-based (Doxorubicin-Cyclophosphamide) with a taxane (Paclitaxel). It can be neoadjuvant (before surgery) or after surgery (adjuvant). Know that Doxorubicin causes a **dose-dependent irreversible CHF**.

**Targeted Therapy.** Part of the biopsy is to determine if the lesions have tumor markers.

**Her2Neu** is a tyrosine kinase associated with worse prognosis, but also provides a targeted chemotherapeutic agent. **Trastuzumab** inhibits Her2Neu. It causes a **dose-independent reversible CHF**, and therefore q3month Echocardiograms are required for patients receiving this medication.

**Estrogen (ER) and Progesterone (PR) receptors** allow for endocrine therapy. Which therapy the patient gets is dependent on menopause. For **premenopausal** women, use **Selective Estrogen Receptor Modulators (SERMs)** such as **tamoxifen** (stronger, causes DVT, causes endometrial cancer) or **raloxifene** (weaker, no DVT, no endometrial cancer). For **postmenopausal** women, use **aromatase inhibitors** like anastrozole.

#### Prevention

**Trastuzumab** and **Doxorubicin** cause heart failure. Get Echocardiograms throughout treatment.

**SERMs** have been shown to reduce the incidence of invasive breast cancer in women who are post-menopausal and have increased lifetime risk for Breast Ca.

**BRCA1/2** gets prophylactic mastectomy and bilateral salpingo-oophorectomy. If she really doesn't want that, annual MRI and mammography is indicated.

Keep in mind this is trying to SUPER simplify things

Carcinoma In Situ: Breast Conserving Therapy

- Lumpectomy + RT + ALND
- Mastectomy + ALND

Invasive Carcinoma – Systemic therapy

- Mastectomy + ALND + Chemo + Targeted
- Lump + RT + ALND + Chemo + Targeted

Neoadjuvant chemo (before surgery)

- Inflammatory breast cancer
- Locally Advanced (Stage IIIa)

Adjuvant Chemo (after surgery)

- Stage I and II

Local Control:

- Surgery
- Radiation

Systemic therapy

- Chemotherapy
- Targeted therapy

#### **Treatment based on biopsy and stage**

Her2Neu +	Trastuzumab
Her2Neu -	<b>Bevacizumab</b> hormonal therapy
ER/PR + & postmenopause	Aromatase-Inhibitors
ER/PR + & premenopause	SERM
ER/PR -	No option
Stage 1 - 4	CHEMO <ul style="list-style-type: none"> <li>- Anthracycline</li> <li>- Cyclophosphamide</li> <li>- Paclitaxel</li> </ul>

#### **High Yield Associations for Breast Ca Treatment**

Tamoxifen	Better, ↑DVT, ↑ Endo Ca
Raloxifene	Worse, ↓DVT, ↓ Endo Ca
Trastuzumab	Heart Failure, Reversible, EARLY
Doxorubicin	Heart Failure, Irreversible, LATE
Daunorubicin	The other Doxorubicin
BRCA 1/2	Ppx Bilateral Mastectomy + BSO
ALND	Sentinel Lymph Node First

Colon Cancer

Right Sided cancers **bleed** while Left Sided cancers **obstruct**. In a **post-menopausal woman** or any age man with an **Iron Deficiency Anemia**, or in any aged patient with a **change in stool caliber** (alternating constipation and diarrhea or pencil thin stools) suspect cancer. Diagnose with a **colonoscopy** and **biopsy**, though a **FOBT + Flex Sig** can be used if colonoscopy is unavailable. Treat it with a **hemicolectomy**. Screening can be done using colonoscopy starting at **50** and checking **q10 years**. Polyps are premalignant and need to be evaluated with biopsy.

Ulcerative Colitis

This is a medical disease that can be treated with surgery when it's **refractory to medical treatment** or with long-standing disease (**>20 years = malignant transformation**). Do surgery to remove the **anal mucosa** (which is always involved) through the entire **affected mucosa**. This is usually **curative** for UC (unlike for Crohn's, where surgery is not curative).

Hemorrhoids

There are two types of hemorrhoids - **External hurt** while **Internal Bleed** (bright red blood on toilet paper or stool). When medical therapy (**preparation H**) fails, you can **resect external** or **band internal**. Be cautious to leave endogenous mucosa so as to prevent stenosis of the anal opening.

Anal Fissures

Caused by an abnormally **tight sphincter**, the mucosa tears with passage of stools. It presents as **pain on defecation** that lasts for hours. A physical exam (which may need to be done under anesthesia) will reveal the fissure. Try **sitz baths**, **NTG paste**, or **Botulism**. After that fails (and it usually does), do a **lateral internal sphincterotomy**.

Anal Cancer

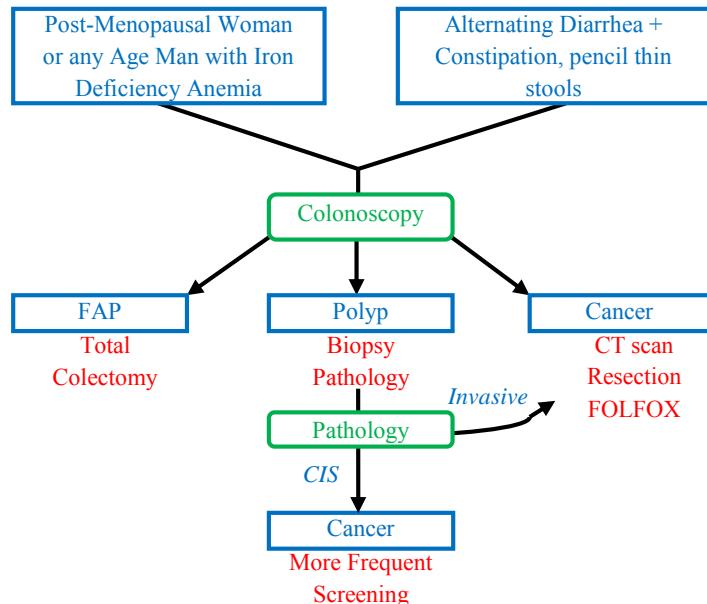
A **squamous cell carcinoma** caused by **HPV**. It's common in **HIV positive males** and people who engage in **anal receptive sex**. An **anal prep** can be done for high risk patients. Diagnosis is made by **biopsy**. Treat with the **Nigro Protocol** (chemo-radiation) followed by resection if necessary.

Fistulas

Surgeons should stay away from **Crohn's disease**. However, bad Crohn's - especially with **ischiorectal abscesses** (which are treated with I&D + MTZ) - can develop fistulas. Fistulas can be on the **vagina, urethra, skin, or GI organs**. Because of chronic inflammation, fistulas will not heal. Patients will present with **fecal soiling**. Probe the fistula on exam then do a **fistulotomy** (a LIFT procedure).

Pilonidal Cyst

An abscess of an **infected follicle** found on the small of the back. It requires a **hairy butt** to get the disease, but it's probably a **congenital defect** that allows the hair to travel into the skin. Treat with **drainage** followed by **resection**.



**GERD**

The typical pain of GERD is **burning retrosternal chest pain** that is worse with **laying flat** or with **spicy foods**. It is common in the **obese**. It improves with **antacids**. This is a medical problem treated first with **life-style modifications**, then a **PPI trial**, then diagnostic procedures. An EGD is usually done first to reveal complications while the **24-hr pH monitor** confirms the diagnosis. If there are **metaplastic changes** or **high-grade esophagitis** (stricture) **Nissen Fundoplication** may want to be considered. Prior to surgery, do every test under the sun: **manometry**, **24-hr pH**, and **EGD with Bx**. If there is cancer an **Esophagectomy** is required.

**Achalasia**

The LES cannot **relax**. Food goes down the esophagus and gets “**stuck**.” The patient will learn that food will pass with the aid of gravity (eats upright only). A **barium swallow** reveals a **Bird’s Beak Deformity**. While that is often sufficient, a **manometry** (failure to relax) is definitive. Options are **dilate** with a balloon, **relax** with **botox**, or cut the sphincter with a **Heller Myotomy**.

**Cancer**

A progressive dysphagia to solids then liquids is often preceded by **GERD** (**adenocarcinoma** of the **lower third** of the esophagus) or by **smoking** (**squamous cell carcinoma** of the **upper third** of the esophagus). Do a **barium swallow** to identify the location of lesions and identify safety of the EGD (to avoid perforation). Confirm with an **EGD with Bx** and assess stage with a **CT Scan**. Treatment is **resection**.

**Mallory-Weiss Tear**

A **mucosal** (superficial) tear of the esophagus that occurs after **forceful vomiting**, usually at the GE junction. It will present as **bright red emesis** which resolves spontaneously. Nothing need be done.

**Boerhaave**

An **esophageal perforation** caused by prolonged **retching**. The patient will be sick. There will be **fever**, **leukocytosis**, **Hamman’s Crunch** (air in the mediastinum heard with each heartbeat). Do a **gastrografin** swallow first (water soluble to prevent mediastinal irritation). If negative, follow with a **barium** swallow. Conclusive diagnosis (and hopeful therapy) can be made with **EGD**. Surgical repair is definitive.

**Perforation**

Esophageal perforation is a full thickness tear through all layers of the esophagus. It can occur from something as simply as a chicken bone, though **iatrogenic** is by far the most common cause. Treat it like a **Boerhaave’s**.

**GERD**

Sx: Weakened LES allows reflux of Gastric Contents  
Pt: Burning retrosternal CP worse when laying down, bad taste in the mouth, better with antacids

**Achalasia**

Sx: LES too strong, stays contracted  
Pt: Food gets stuck  
Dx: Barium Swallow, Manometry  
Tx: Dilation, Botox, Myotomy

**Cancer**

Sx: GERD = Adeno, Smoking/Drinking = SCC  
Pt: Progressive Dysphagia to food then liquids and wt loss  
Dx: Barium Swallow (avoid Perforation)  
EGD + Bx (definitive)  
CT scan (staging)  
Tx: Resection

**Mallory-Weiss**

Path: Submucosal Tear, Minor Bleeding  
Pt: Forceful vomiting → Hematemesis → Resolution  
Dx: None needed, though EGD would confirm  
Tx: Spontaneously Resolves

**Boerhaave**

Path: Full thickness mucosal tear, mediastinitis  
Pt: SICK. Fever, Leukocytosis, Hamman’s Crunch  
Dx: Gastrografin Swallow → Barium Swallow → EGD  
Tx: Surgical Repair

Surgery content for this topic is a reduced and simplified version of Internal Medicine GI-Gallbladder. It's present for Surgery-Only review (Shelf Studying).

#### Gallbladder Means Gallstones

Except for the obstructive jaundice section, gallbladder pathology generally means gallstones. We're going to talk about when stones (cholelithiasis) go bad.

#### Gallstones

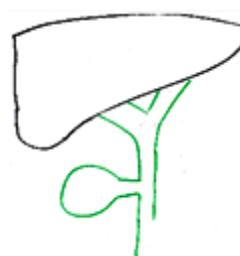
Gallstones occur in **females** who are **fat, forty, and fertile** (they have **four or five** kids), and those who have a **hemolytic anemia**. Generally, **asymptomatic gallstones are left alone**. Symptomatic gallstones present with a **colicky RUQ abdominal pain** that may radiate to the **right shoulder** and occur after a **big fatty meal**. Symptoms are typically **self-limited**. An outpatient **ultrasound** diagnoses it. An **elective cholecystectomy** can be done if the patient desires.

#### Acute Cholecystitis

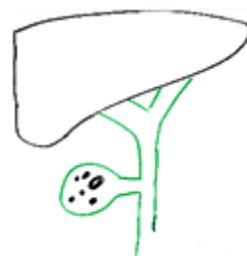
When a gallstone gets in the cystic duct and **stays there** an inflammatory process develops. This causes a **constant RUQ abdominal pain** accompanied by a **mild fever** and **mild leukocytosis**. It's often preceded by an episode of cholecytic colic. Diagnose with an **ultrasound** - though a **HIDA scan** can be used in equivocal ultrasounds. Do **IVF + NPO + NG suction + Abx** to let the acute process cool down and the stone to pass, then do an **elective cholecystectomy**. If symptoms do not improve **emergent cholecystectomy** (btw the only indication for emergency cholecystectomy) is done to prevent perforation.

#### Ascending Cholangitis and Choledocholithiasis

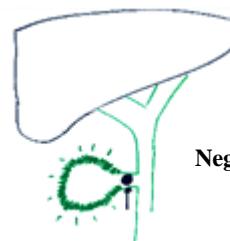
If there's an **obstructive jaundice** and/or **pancreatitis** along with cholecystitis symptoms, there may be a stone in the common duct (**choledocholithiasis**). An **ERCP** will give the diagnosis and is the treatment (retrieve the stone). If however, there's a **high fever (>104.1)**, **severe leukocytosis**, and symptoms of obstructive jaundice without peritoneal findings, there's an infection behind the stone: **cholangitis**. Decompress the biliary tree with ERCP, percutaneous drainage, or surgery. Add **IV Abx**. In this case, wait for current flare to end then do **elective cholecystectomy**.



Normal Anatomy of the Hepatobiliary system



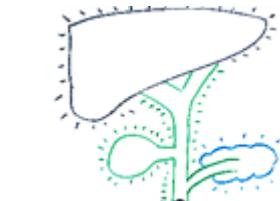
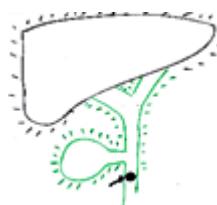
Asx Gallstones present, without obstruction



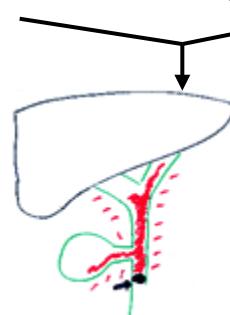
Acute Cholecystitis. Gallstone lodges in Cystic Duct, inducing Inflammation of the Gallbladder. No hepatic/pancreatic involvement



HIDA scan. Normal on left has tracer throughout biliary system. Obstruction on right prevents filling of the gallbladder. Positive study.



Choledocholithiasis. Obstruction of common duct distal to pancreas. Both involved. ↑AST/ALT, ↑Cong Bili, ↑Amylase, ↑Lipase



Ascending Cholangitis

Choledocholithiasis + Infxn Proximal to obstruction. Chills, High Fever, Severe Leukocytosis

#### **Charcot's Triad (Cholangitis):**

- (1) RUQ Pain
- (2) Fever,
- (3) Jaundice

Dx	Path	Pt	Dx	Tx
Stones ("Lithiasis")	Cholesterol = the "Fs" Pigmented = Hemolysis	ASX	U/S, Diagnosis not required	None
Cholecystitis	Cystic Duct Obstruction	RUQ Pain, Murphy's Sign	U/S → HIDA mild fever, mild leukocytosis	Cholecystectomy
Choledocholithiasis (koh-lee-doh-koh)	Common Bile Duct Obstruction = Hepatitis and/or Pancreatitis also	RUQ Pain, Murphy's Sign + ↑AST/↑ALT, ↑Lipase/↑Amylase	U/S → HIDA mild fever, mild leukocytosis	ERCP, Cholecystectomy
Ascending Cholangitis	All of the above PLUS Infection behind the stone	RUQ Pain, Murphy's Sign + ↑Labs, T >104, Leukocytosis	U/S → HIDA severe fever and leukocytosis	ERCP Urgent Cholecystectomy

Introduction

Ulcers are essentially **tissue breakdown**. With multiple etiologies, history and presentation will often clinch the diagnosis. **Stage** of lesion is important for documentation and therapy. Ulcers are treated by correcting the underlying pathology.

(1) Compression Ulcers

Found in **bed-ridden** patients, it is sufficient evidence for **abuse**. It occurs at areas where bone comes close to the skin (**sacrum**, **knee**, and **ankle**). It's caused by prolonged **pressure** on a dependent area. The patient should be **rolled** frequently to alleviate pressure. The treatment is the same idea: keep **pressure off** the wound with rolling, air mattresses, etc.

(2) Diabetic

People with diabetes suffer from **neuropathy** (they can't feel their shoes crushing their toes) and from **microvascular disease** (so they have a component of arterial insufficiency). Because diabetic neuropathy starts distally and moves proximally, the ulcers are usually found in the **feet** and **toes** including their **heels** and **ankles**. Theoretically, blood glucose control, elevation, and cleaning of the wounds will help them heal. In reality, these ulcers often lead to **amputations**.

(3) Arterial Insufficiency

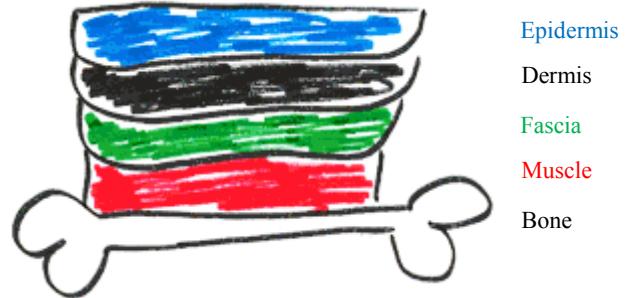
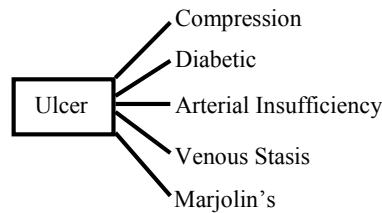
If an ulcer is at the **tips of toes** (i.e. as far from the heart as possible) think of arterial insufficiency. While this could be from an embolus (cholesterol emboli after catheterization), it's usually seen in **peripheral vascular disease** with typical **stigmata**: (1) **scaly** skin, (2) **hairless** feet, (3) and **decreased pulses**. Claudication may be present. Do an **ultrasound Doppler** to check for macrovascular disease. If it's **⊕**, confirm with an **arteriogram** and **revascularize**. If macrovascularized, stop - amputations are on the way.

(4) Venous Insufficiency

Because the veins fail to drain, fluids leak out. Edema causes compression. The skin will be **edematous**, **indurated**, and **hyperpigmented** (indicative of long-standing edema); the ulcer is almost always **above medial malleolus**. Treat the edema by controlling CHF/cirrhosis/nephrosis and use **compression stalkings** to decrease edema.

(5) Marjolin's Ulcer

A result of chronic inflammation, this is a **squamous cell carcinoma**. It occurs at sites of a chronic sinus draining tract or on a wound that heals and breaks down over and over again (like a 3<sup>rd</sup> degree burn or radiation). The ulcers are **ugly, deep**, and with **heaped up margins**; they do not heal. Confirm with a **biopsy** and treat with **wide excision**.

**Stage I: Nonblanching Erythema**

**Stage II: Epidermis and Partial Dermis**

**Stage III: Through Epi and Dermis, Ø**

**Stage IV: Muscle or Bone**

<b>Ulcers</b>	<b>Patient</b>	<b>Where</b>	<b>Treatment</b>
<b>Compression</b>	Bed-ridden patients with wounds on dependent bone-skin contact	Sacrum Heel Shoulders	Rolling (PPx) Air Mattress
<b>Diabetic Ulcer</b>	Diabetic patient with ulcers secondary to tight or injured feet	Foot Toe Heel	DM Control Amputation
<b>Arterial Insufficiency</b>	PAD patients with scaly, hairless, skin with decreased pulses	Tips of Toes	U/S Arteriogram Revascularize Stop Smoking Cilostazol
<b>Venous Stasis</b>	Edematous, hyperpigmented, Indurated Skin	Above Medial Malleolus	Compression Stalkings
<b>Marjolin's Ulcer</b>	Sinus draining tracts, old wounds, heaped up margins, deep ulcers that don't heal	Anywhere	Biopsy Wide Resection

Etiology of Jaundice

Jaundice is a problem of **bilirubin production** (hemolysis), **conversion** (liver disease, acute or chronic), or **excretion** (obstruction). These are covered in depth in the medicine topics. In surgery it's important to recognize the laboratory findings (**production**: ↑unconjugated bilirubin only; **conversion**: ↑unconjugated bilirubin and LFTs; **obstruction**: ↑conjugated bilirubin and LFTs and Alk Phos, and Pancreatic Enzymes) and know the difference between **Viral** (AST and ALT in the 1000s) and **EtOH Hepatitis** (AST:ALT > 1.5). The rest is the topic at hand - obstructive jaundice.

Obstructive Jaundice

When the biliary tree is blocked the liver does what it's supposed to do: conjugate bilirubin. There will be an **elevated conjugated bilirubin** in obstructive jaundice. That means it's water-soluble; it will be **excreted in the urine** turning it the color of bilirubin (making **dark urine**). The stool will lose its pigment (**clay colored stools**). Other signs of obstruction may be present (**pruritus** or **icterus**, for example) but the patient is going to be yellow (**jaundice**). The decision is if it is an acute **inflammatory** process or a chronic **malignant** one. The first step is in the physical exam. A **palpable, nontender gallbladder** generally means a cancer (the gall bladder produces fluid but there's nowhere for it to go, so it just blows up like a balloon). A **tender gallbladder** (Murphy's Sign) is indicative of an inflammatory process, cholecystitis, making the likely culprit a stone. The next step is an **Ultrasound**: a **thin walled, dilated** gallbladder is that balloon swelling with fluid, walls free of inflammation with a distal obstruction (cancer), while a **thick-walled rigid** gallbladder is from chronic inflammation. In addition, it might even be possible to **see the stones** in the gallbladder (but rarely, if ever, the offending stone).

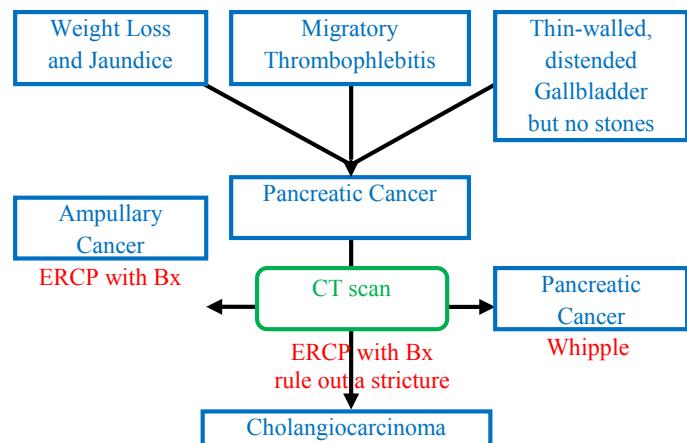
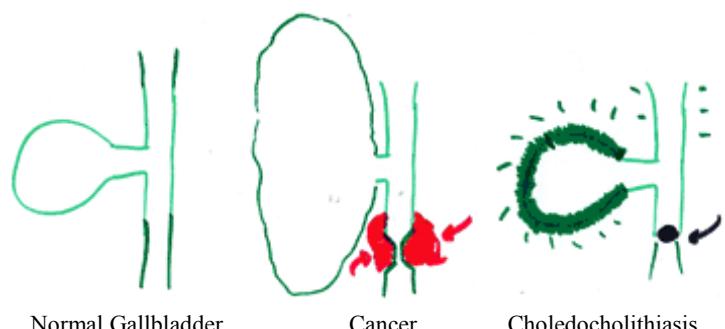
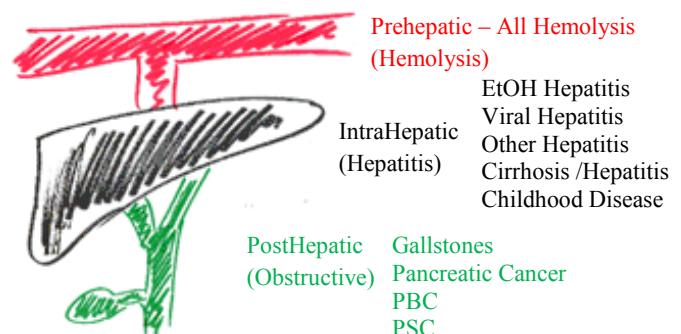
(1) Choledocholithiasis

**Fever, Leukocytosis, Abd Pain, Jaundice** and a **Stone** on U/S puts the diagnosis past cholecystitis. Now the stone is in the duct, preventing excretion of at least liver enzymes, if not also pancreatic. Do an **ERCP**, which is both **diagnostic** and **curative**. Recall that simple cholecystitis cannot cause jaundice.

(2) Cancer

There are three tumors that can present with **painless jaundice**, a **palpable gallbladder**, and usually **weight loss**.<sup>1</sup> The dreaded **pancreatic cancer** (adeno from the head of pancreas strangles the biliary tree) requires a **whipple** procedure (pancreato-duodeno-jejunostomy) and carries a dismal prognosis.<sup>2</sup> **Cholangiocarcinoma** (cancer of the duct itself) can be the source of obstruction, and<sup>3</sup> the obscenely rare **Ampulla of Vater** cancer which can bleed into the GI lumen. In any case, **ERCP with Biopsy** or **CT Scan** for staging is performed. As a pearl, if anything is seen about **migratory thrombophlebitis** (described as palpation of "rigid cords" of superficial veins that come and go) it is essentially pathognomonic for pancreatic cancer.

	<b>Malignant</b>	<b>Obstructive</b>
Physical Exam	Palpable nontender Gallbladder	Tender Gallbladder
Ultrasound	Thin-Walled Distended Gallbladder	Thick-Walled rigid gallbladder
Stones	Ø Stones	⊕ Stones
Diagnosis	ERCP with Bx	ERCP
Treatment	CT scan stage	ERCP
	Surgery	ERCP



Chest Pain

Two killers must be thought of and ruled out: **MI** and **PE**.

- 1) MIs are silent 2/3 of the time post-op. Every patient should be on tele in recovery and high risk patients should stay for 1 night for monitoring. **ST Δs** or **+ Troponins** clinch the diagnosis. **DO NOT** give **clot busters**. All other therapies are equal to non-op MIs.
- 2) PEs will be **Short of Breath** with some chest pain that is **pleuritic** with **sudden onset dyspnea**. "Soft Signs" are: **ABG** with **Hypoxic Hypocapnia**, **S<sub>1</sub>Q<sub>3</sub>T<sub>3</sub>** **EKG** and a **clear CXR**. Confirm the diagnosis with a **CT scan**. Put them on **Heparin** to prophylax and then as a treatment to **Coumadin Bridge**. With recurrence or PE on Coumadin, use a **Greenfield filter** on the IVC and continue Coumadin.

Pulmonary Complications

See Post-OP Fever. Just remember we **intubate** patients only **after sedation** and do not attempt surgery until **8 hrs NPO** to avoid **aspiration pneumonia**. Prevention is key. If suspected (combative patient, emergency surgery) do a bronchiolar lavage to **remove aspirate**. Steroids do NOT help.

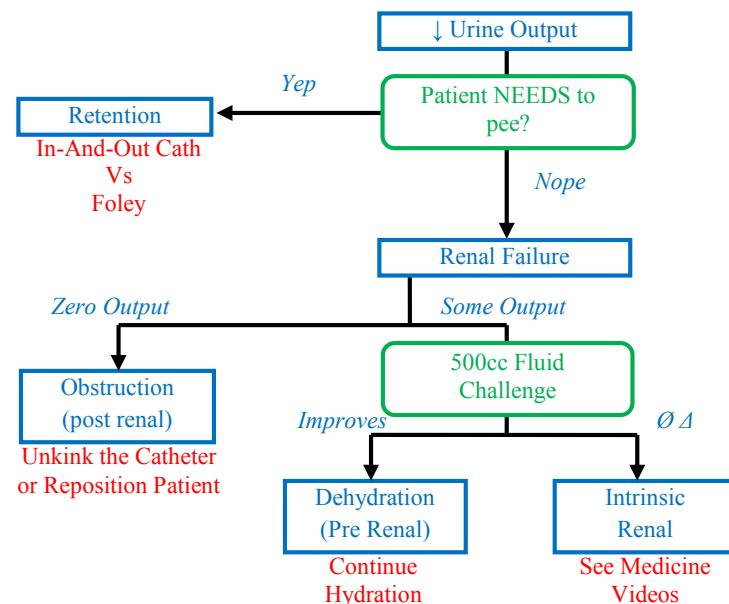
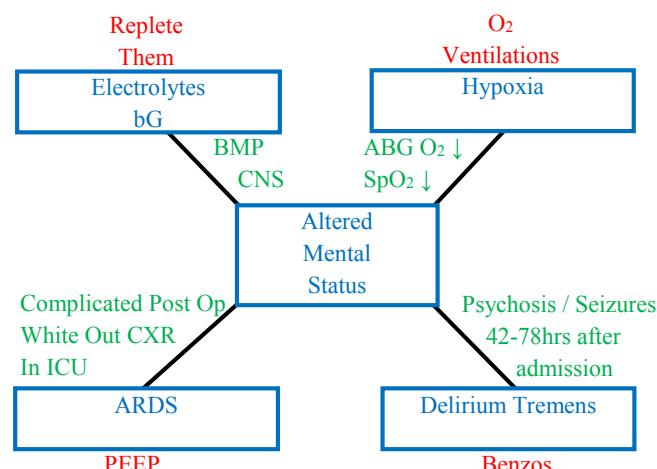
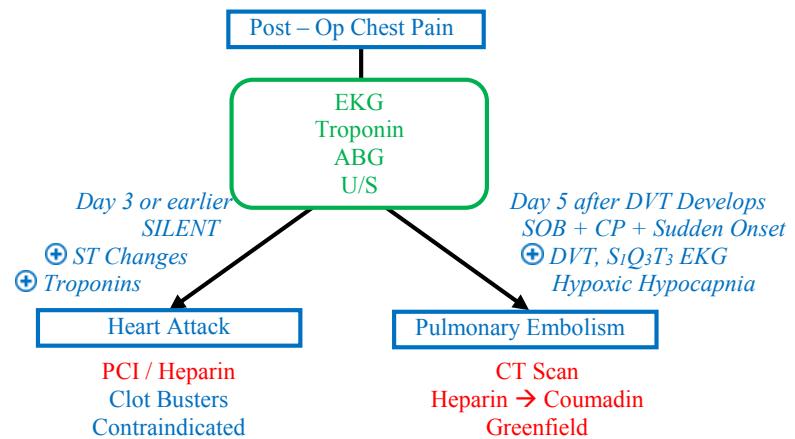
Altered Mental Status

A post-op delirium is just as complex as an out-of-hospital one. However, since we NPO patients, keep them under watch, control fluids and blood glucose (rather than having them "found down" with a host of potential intoxications), it is usually one of a few things. **Hypoxia** can do it and is a simple fix (**give O<sub>2</sub>** and **intubate** as needed). A patient that lands in the ICU because of a rocky hospitalization should be suspected for **ARDS**. Get a **chest X-ray** to see the **white out** and treat with a ventilator giving **PEEP**. An easy thing to fix is **electrolytes** and **hypoglycemia** (get a **CMP** and replace). The one to really watch for is the guy who swears he does not drink, but then has a **seizure** or who is **psychotic 48-72 hrs** after admission. He is in **Delirium Tremens** and needs emergent **Benzos**.

Renal Complications

Beyond infection there are only a few diseases to consider; they are all based upon **how much urine** is being made.

- (1) **Urinary Retention** is common. If the patient feels the need to void but can't, do an **in-and-out cath after SIX hours** of not voiding. Leave a Foley in place if two in-and-out caths are required. If a patient will be under for **>3 hrs**, a **Foley** catheter is placed automatically. It's more common and worse in men.
- (2) **Zero Output** means a mechanical obstruction or post-renal failure. Anuria is rare (unless BOTH ureters are cut). Unkink the **catheter** and urine will flow.
- (3) **Low Output** is a problem with Renal Failure (prerenal or intrinsic). Look at the Renal Failure section for details. But first, just do a **500cc bolus challenge**. If dehydrated, Urine Output will increase slightly with the bolus. If it doesn't, there is some sort of intrinsic **renal failure** that requires a more vigorous workup.



Abdominal Distention

This is not an uncommon occurrence. Mucking around in the gut can cause some problems. Given the situation, it should be possible to determine which of these is going on:

- (1) **Paralytic Ileus** is expected post-op. We frequently assess if there has been “**gas passed**,” progressing to passage of stool. Ileus is common on the first day but should subside with **ambulation** and **diet**. Though distended, there should be no pain. An upright and flat KUB should show diffuse enlargement of small and large bowel. Watch for hypokalemia - a common cause of ileus.
- (2) **Bowel Obstruction** is a big deal. It is discussed in greater detail in its own video heading later. If what appears to be a paralytic ileus has **not resolved** by **day 5-7**, do a Flat and Upright KUB to see dilated loops of bowel and **air-fluid levels** with decompressed bowel beyond the obstruction. A **contrast swallow CT** could also be done to see if tracer material passes the obstruction to confirm. Ultimately, this patient goes back to the OR.
- (3) **Ogilvie Syndrome** is a “paralytic ileus of the colon” that occurs in **elderly sedentary patients** who become immobilized after surgery. Their **colon only** will be very dilated, shown on a flat and upright KUB. Do a **colonoscopy** to **rule out cancer** and to **decompress** the abdomen (two for one deal). Leave a **rectal tube** in place.

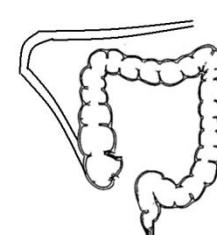
Wounds

In the immediate post-op period it's essential to look for failure of wound closure

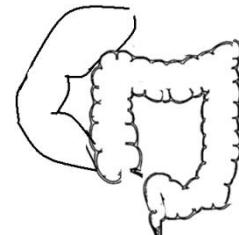
- (1) **Dehiscence**. The skin is intact but the **fascia has failed**. If dressings are unusually soaked or have a **salmon-color** (blood and peritoneal fluid look sort of pink) think dehiscence. Evisceration must be prevented. **Bind** the abdomen and limit movement and straining. This is a potential hernia so **reoperate** to prevent or fix it. This is non-emergent.
- (2) **Evisceration**. Both the **skin and fascia fail** after a patient strains / coughs / has any increase in intra-abdominal pressure. The wound pops open the **bowel pops out**. This is an emergency. Cover the bowel with **warm saline dressings** and get back to the **OR. NOW**. Absolutely never push it back in.

Fistulas

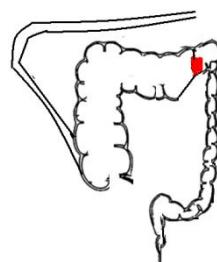
Fistulas are defined as a **connection between two epithelialized surfaces**. They are common in IBDS and when surgical wounds fail to heal. Where they exist consider what has kept them open. Use the “**FRIEND**” or “**FETID**” mnemonic. Things that keep a fistula open are **Foreign Bodies**, **Epithelialization**, **Tumor**, **Infection/Irradiation/IBD**, or **Distal Obstruction**. It's necessary to either (a) **remove the fistula** or (b) **divert** the bowel so the fistula can close on its own.



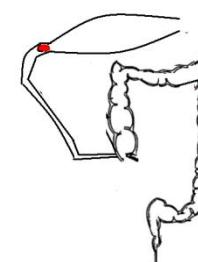
Normal Bowel



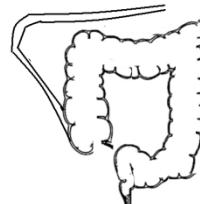
Ileus, Large + Small Bowel



Large Bowel Obstruction



Small Bowel Obstruction



Ogilvie's Syndrome

**Acute Pancreatitis**

Caused most commonly by **Gallstones** and **EtOH**, it presents with a **boring epigastric pain radiating to the back**, typically after a heavy meal or EtOH, that is **relieved by leaning forward**. Diagnosis is made by **Amylase** and **Lipase** being elevated (Lipase is the best). Treat it by giving the bowel rest, fluids, and analgesia (**IVF+NPO+Morphine**). This on its own is a medical condition and does not require further diagnostics or interventions. Complications and sequella, however, are a surgical topic. **Never** order a **CT scan** on initial presentation (there is a risk of exacerbating complications).

**Hemorrhagic Pancreatitis**

If an acute pancreatitis with a **poor Ranson's criteria** or a **declining hematocrit** comes in, it's safe assume this is something more deadly than just pancreatitis. At this point, the "danger danger" signs should be going off ( $\downarrow \text{PO}_2$ ,  $\uparrow \text{PCO}_2$ ,  $\downarrow \text{pH}$ ,  $\uparrow \text{WBC}$ ) and the patient needs an **ICU** and monitoring with **CT Scans** - as often as every day. It still isn't surgical, however.

**Pancreatic Abscess**

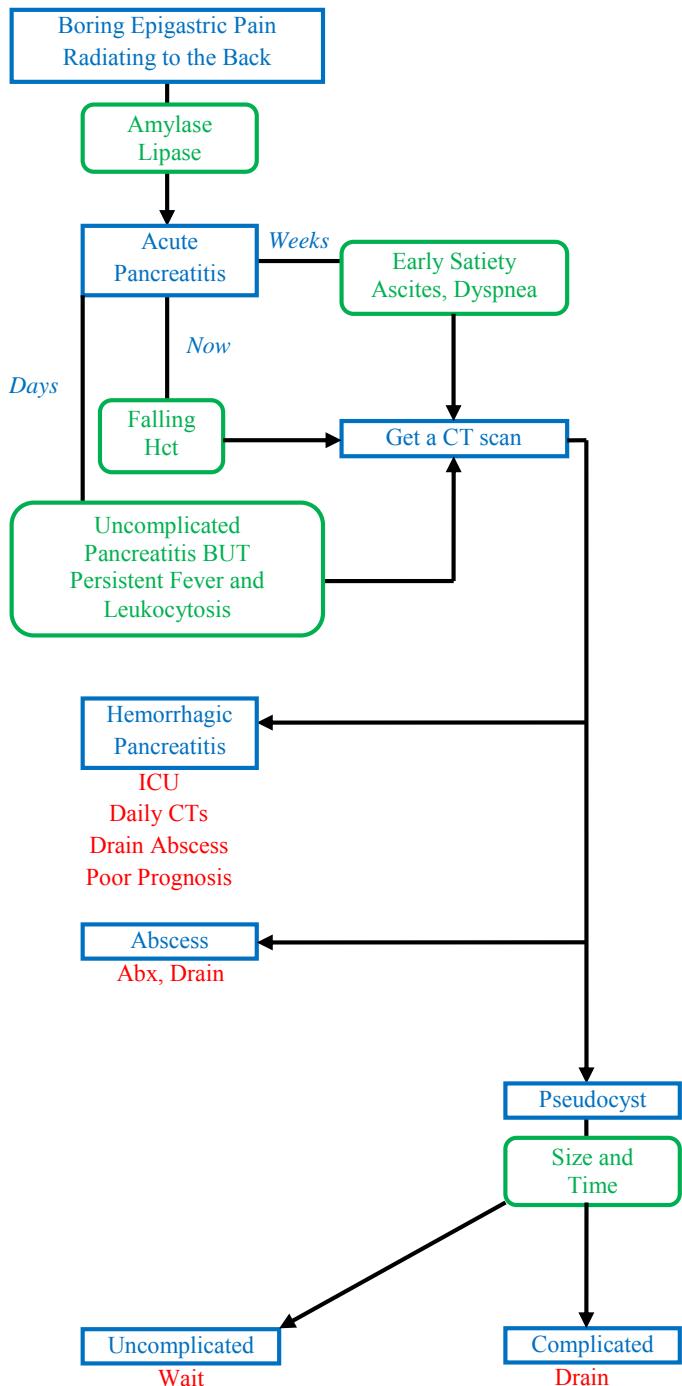
For the hemorrhagic pancreatitis patient, death is complicated by multiple abscesses. The **CT scan** can pick them up (and is why they're done serially). In a patient who is not in the ICU (i.e. typical acute pancreatitis), suspect an abscess when **fever and leukocytosis persist**. This is the point where a **CT scan** should be ordered in a previously uncomplicated acute pancreatitis managed medically. When found, they need to be **drained**. The best is **percutaneous**; if severe, drain them **surgically**.

**Pancreatic Pseudocyst**

An abscess is an early sequelae of pancreatitis. A late sequelae is a **pseudocyst** - so named because it does not have an endothelial lining. In someone with mass symptoms (**dyspnea, ascites, and early satiety**), after acute pancreatitis suspect a pseudocyst. Get a **CT scan** or **Ultrasound** to identify the cyst. If  $< 6 \text{ cm AND } < 6 \text{ weeks old}$ , just watch and wait. If  $> 6 \text{ cm OR } > 6 \text{ weeks}$ , the risk of hemorrhage or infection is too great. They need to be **drained**: to the skin (**percutaneous**), the GI tract (**cystogastrostomy**), or surgically (**open**).

**Chronic Pancreatitis**

Patients present with **chronic pain** that mimics acute pancreatitis. Remember a few things about them: (1) it **can't be fixed** and surgery is contraindicated, (2) **treat the pain** - this hurts a lot, (3) they need to have their **DM, steatorrhea, and malabsorption** managed closely and medically.



Fever in the post-op period can be narrowed down by **when the fever started** and a little bit on the history. Symptoms often aren't useful because patients are either sedated or on pain medications – they may misrepresent themselves. The common **5-Ws** is how you can remember to look in one place or another. **Drugs** are at either end of the spectrum.

#### Malignant Hyperthermia (Wonder Drugs)

If there's a **fever after anesthesia** (halothane or succinylcholine) or a **fever > 104**, assume malignant hyperthermia. There's no reason for hyperthermia during surgery. Give the patient **Oxygen, Dantrolene, Cooling Blankets**, and watch for myoglobinuria (i.e. follow with a U/A).

#### Atelectasis (Wind)

A fever on the **first day**. Do a **CXR** and listen to the lungs. If positive, give **spirometry** to improve ventilation. If there isn't improvement a complete fever workup may be needed: **XR + U/A + Blood Cultures**.

#### Pneumonia (Wind)

A fever on the **second day** - especially if the atelectasis was not fixed - can turn into pneumonia. Because you're a good student and already gave prophylactic spirometry (which everyone should get), the worry is now about pan culture. First, do a **CXR** to see the **infiltrates**. Treat for Hospital Acquired Pneumonia (Vancomycin and Zosyn) while awaiting **cultures**.

#### UTI (Water)

A fever on the **third day** is likely to be a UTI. Do a **U/A** and **Culture** then treat with the appropriate antibiotics. This is the only fever that can't be prophylaxed against; but you can decrease the incidence by taking the foley out early. If they can pee on their own, let them.

#### DVT (Walking)

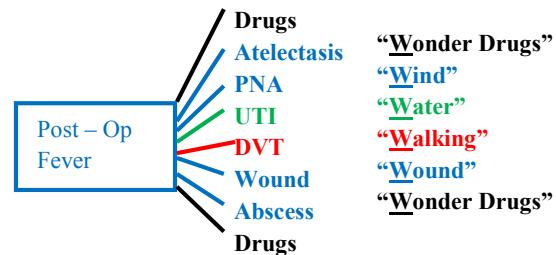
If a patient has a fever that starts on **Day 5**, remember the Virchow's Triad. Surgery + Immobilization = bad news. A **⊕ Exam** (Homan's Sign) is useful (95% Sp) but miserably sensitive. Part of the "pan-culture" workup is to do an **ultrasound** of the deep veins. Anticoagulate with **Low Molecular Weight Heparin**. Prophylax with **early mobilization** and heparins.

#### Wound Infection (Wound)

A fever that begins after **7 days** is likely to be a wound infection. A good closure and good **wound care** could prevent this. By this time the erythema of surgery has gone; it's likely infection. If it's just **erythematous and warm** it's a cellulitis. Treat with **antibiotics**. If **erythematous, warm AND boggy**, drain the **abscess**. If not sure, an **Ultrasound** can be done to clarify.

#### Deep Abscess (Wound)

Someone messed up. Bad. There was a **dirty** surgery, but it's only come to light **2 weeks later**. You'll probably pan culture the patient thinking "new infection unrelated to the surgery" but no - a **CT scan** will show the deep abscess that needs to be drained, often prompting revision and another trip to the OR.



When	Dz	Tx	PPx
During Surgery	Malignant Hyperthermia	Dantrolene Cooling O2	Family History
Right After Surgery	Bacteremia	Blood Culture, Abx	Don't Poke the Bowel
Day 1	Atelectasis	CXR, ICS	ICS
Day 2	Pneumonia	CXR, Abx	ICS
Day 3	UTI	U/A, Abx	None
Day 5	DVT	U/S, Heparin	Ambulation, Heparin
Day 7	Wound	U/S, Abx	Don't mess up
Day > 10	Abscess	CT, Drain / Abx	your surgeries

Introduction

Before a patient can go to surgery he/she must be considered for peri-operative morbidity and mortality. Emergent Surgeries are emergent and must be done emergently - regardless of the status of the patient. However, subacute and elective procedures may be more harmful than the condition they intend to treat.

Cardiac Risk

There are two things that outright **contraindicate** non-cardiac surgery: **EF <35%** (75% chance of perioperative MI) and an **MI within 6 months** (40% mortality @ 3 months vs 6% @ 6 months). Both add up to one thing: **pump failure**. Use the Goldman Index to determine cardiac risk aka how vulnerable the pump is. Do NOT memorize the table, but the attending will be impressed rates of perioperative complication, especially the presence of **JVD** as the worst prognostic factor on the index. Consider **EKG, Echo, Arteriogram**, or potentially a CABG before the intended surgery. If not, optimize the patient medically.

Pulmonary Risk

The problem with the lungs will be **ventilation** rather than oxygenation. It's imperative to **move the lungs** and **remove CO<sub>2</sub>** so they can do their job. Any patient with an existing pulmonary disease (**smoker, COPD, fibrotic lung, asthmatic**) should be evaluated. The first step is the **FEV<sub>1</sub>/FVC** (the best prognostic indicator). Then, **Blood Gases** (low O<sub>2</sub> or high CO<sub>2</sub> is bad). **Smoking Cessation** should be started **8 weeks** before surgery (because congestion initially worsens) and bronchodilators should be given to optimize FEV<sub>1</sub> at the time of surgery.

Hepatic Risk

The liver is required to metabolize toxins and anesthesia. The Child-Pugh Score can be used to ascertain the functionality of the liver. **Bilirubin, Albumin, PT, Encephalopathy, and Ascites** are used to determine risk. If any **one** is abnormal (without another cause such as heparin) there's a **40% mortality risk**. If all are deranged it's bad news - mortality approaches **100%**. The Child-Pugh Score isn't included to purposefully prevent an attempt to memorize it. Its intent is for determination of who should get a liver transplant, though it can be used to judge surgical risk.

Nutrition

**Malnutrition** is identified by a loss of **Body Weight > 20%** in a few months, an **albumin < 3** or **anergy to skin antigens**. An ancillary test is a prealbumin that will tell you their current nutritional state (what's being made) versus the albumin that shows their past nutritional state (what's already made). The goal of therapy is vigorous nutritional support, **PO is better than IV, and 10 days is better than 5 days**.

Metabolic

Simply said, don't operate on anybody with **DKA** or **↑Blood Glucose**. Control bg with hydration/Insulin and ensure Urine Output before attempting surgery.

	<b>Goldman Index</b>	<b>Complication Risk</b>	
<b>JVD</b>	<b>11</b>	>25	22%
<b>MI w/i 6 mos</b>	<b>10</b>	25	11%
<b>Arrhythmia</b>	<b>7</b>	12	5%
<b>Age &gt; 70</b>	<b>5</b>	1	1%
<b>Emergency Surgery</b>	<b>4</b>		
<b>Aortic Stenosis</b>	<b>3</b>		
<b>“Sick” Patient (ICU)</b>	<b>3</b>		
<b>Thorax/Abd Surgery</b>	<b>3</b>		

FEV <sub>1</sub> / FVC	↓
ABG	↑CO <sub>2</sub>
	↓O <sub>2</sub>
Smoking	Smoke

*Albumin is where they are  
Prealbumin is the direction they're headed*

Mechanical Bowel Obstruction

It is caused by either **adhesions** (most common with previous abdominal surgeries) or **hernias** (most common cause without previous surgery). There will be **colicky abdominal pain** with progressive distention of the abdomen. Early on, there will be **+ gas/stool** and a condition called **borborygmi** where there are **high-pitched, rapid, crescendo** bowel sounds. Late, the distal intestines decompress while the proximal bowel swells. Now, there are **Ø bowel sounds** and **Ø gas or stool**. Confirm what's seen on a **KUB** (1<sup>st</sup> test, dilated loops of bowel with air-fluid levels) with either a **barium X-Ray** or a **CT-Scan**. Ex-lap is required to release the bowel and allow forward flow. However, if there is any flow do not go to surgery unless there are signs of **strangulation**. Sit and wait, doing **serial abdominal exams** in the meantime.

Strangulation

When a bowel has its blood supply cut off it's considered strangulated. It presents like an SBO but also has **fever, leukocytosis, constant pain, and peritoneal irritation** - even up to **full-blown sepsis**. Because it counts as an acute abdomen, immediate surgery is required.

Hernias

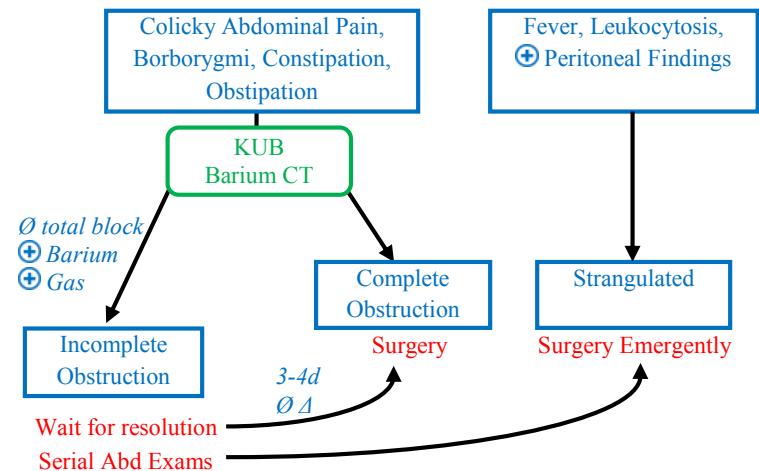
Hernias are just a **wall defect** that intestines can move through. **Direct** hernias are groin hernias of adults that pass directly through the **transversalis fascia** and are the "adult" hernia. **Indirect** hernias are groin hernias which pass through the **inguinal ring**, an embryonic defect, so are the "baby hernia". **Femoral** hernias are groin hernias pass **under** the **inguinal ligament** and are the "woman" hernia. Finally, the most common is a **ventral** hernia, caused by an incomplete closure after surgery (i.e. **iatrogenic**). Hernias aren't a big deal so long as the hernia is **reducible**. If it becomes **irreducible** (that is, it becomes **incarcerated**) it can present with obstruction. Both reducible and irreducible are considered elective operations, though incarcerated is **urgent non-emergent** that shouldn't be postponed. If the incarcerated hernia turns **strangulated**, it becomes a medical emergency requiring Ex-Lap right now.

Appendicitis

A patient who presents with a classic history does not need diagnostic tests. Go straight to treatment (surgery). A patient that presents with **anorexia**, then vague **perumbilical pain** that migrates to **McBurney's Point** (RLQ) with **focal peritoneal findings** is appendicitis. If unsure, get a **CT scan** while preparing the OR. If the classic picture is there DO NOT GET A CT (lot of radiation for nothing).

Carcinoid

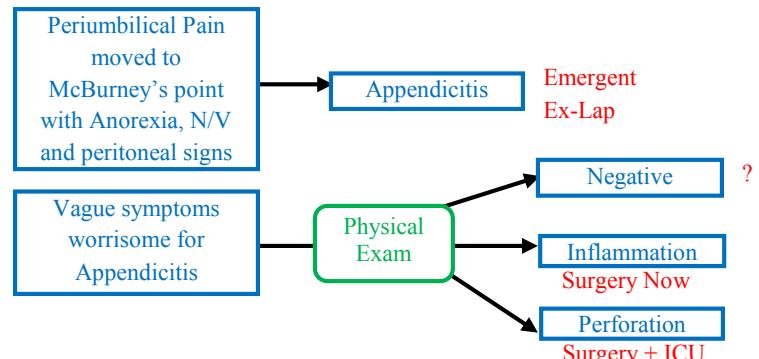
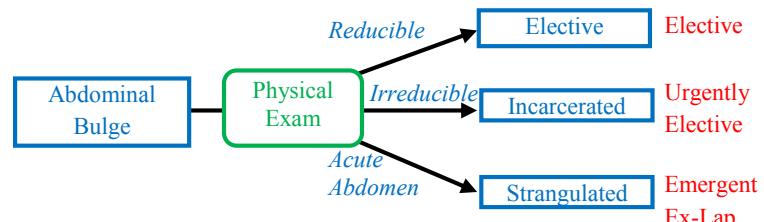
Let's briefly mention it. Carcinoid produces **serotonin**. Intestinal serotonin is degraded by the liver. With **mets to the liver**, serotonin goes to the **R heart** causing fibrosis, flushing, wheezing, and diarrhea. The liver degrades serotonin sparing the **L heart**, releasing **5-HIAA** to be excreted into the urine; it is used as a screening tool for the cancer. It must be staged and resected.

Question is: When do Hernias go to OR?

1. Emergent = Black/Blue, Acute Abdomen, Sepsis
2. Soon = Acutely irreducible or +SBO without Emergent
3. Elective = reducible hernia and Ø SBO and ØAcute Abd

Question is: What type is it?

1. ♀ = Femoral Hernia, under ligament
2. ♂ adult = direct, through transversalis
3. ♂ baby = indirect, through the inguinal ring



Glaucoma

A common cause of **blindness** in the aging population, Glaucoma is screened for every visit to the **ophthalmologist**. Most of the time it's silent and managed medically. A particular variant, **acute narrow angle glaucoma**, is caused by fluid being trapped in the anterior chamber. After a patient has spent a prolonged period in **low light situations** (i.e. a movie theater) the iris dilates, decreasing flow from the anterior chamber out of the eye. This produces **eye pain, headache**, and an intensely **rigid eyeball**. There may be **halos** or **corneal clouding**. The problem is that the pupil dilated so pressure built up. Now the pressure is so high the pupil can't constrict. So, when tested the pupil will **not react to light**. While preparing an OR or getting the ophthalmologist, give things that will **constrict the pupil** and let the fluid out ( $\alpha$ -agonists,  $\beta$ -Antagonists) as well as diuretics to decrease intraocular pressure (**mannitol**). Drill a hole with a laser to let out fluid. **NEVER GIVE ATROPINE**.

Orbital Cellulitis vs Periorbital Cellulitis

Infection and inflammation that involves the ocular muscles needs immediate surgery and drainage. If there is **inflammation** of the "eye area" and there is **extra-ocular muscle paralysis** get a **CT scan** to confirm orbital cellulitis and do **surgery now**. If however, there is no extra-ocular paralysis, consider it periorbital cellulitis and treat like a regular cellulitis with antibiotics.

Retinal Detachment

This can occur **spontaneously** (Marfan, HTN) or following major **trauma**. The patient will either complain of **floaters** (indicating minor disease) or a **veil or cloud** on top of their visual picture (indicating severe disease). **Laser** will "spot-weld" the retina back into place. Vision is compromised from there on, but without treatment she/he will lose all vision. But the complaint of a "veil" may only be **transient**. In that case it is amaurosis fugax - a preliminary sign of impending artery occlusion.

Embolic Occlusion of the Retinal Artery

Everybody learns about the **old person with jaw pain and a headache** that needs steroids to prevent blindness in Temporal Arteritis in pathology. If a patient complains of **painless unilateral vision loss** without **any other stroke symptoms** and is **old**, consider an embolic (or even thrombotic) occlusion of the retinal artery. Generally, there is not enough time to do anything about it. However, the patient should **hyperventilate rebreathed CO<sub>2</sub>** (as in a paper bag) to vasodilate arteries and apply **orbital pressure** (push on the eye) to move the clot farther downstream, compromising a smaller area of vision. If available and within a limited timeframe, **intrarterial tPA** is technically possible (though difficult).

Corneal Abrasions

Pain in the eye from **toxic** or **traumatic** exposure requires **vigorous irrigation**. Flush out the irritant(s) then do a **fluorescein dye test** to see the extent of the damage. Surgery may need to be done to repair lacerations.

Additional details are available in the medicine videos “Murmurs” and “ACS”.

#### Aortic Stenosis

Common in **old men**, it has a higher incidence in **bicuspid valves**. It's usually the result of aging (**calcification**). It's a **crescendo-decrescendo** murmur heard at the **Right Sternal Border** that radiates to the neck. It presents with **angina** (most common), **syncope**, or **CHF** (worst prognosis). Do a valve replacement as soon as the diagnosis is made.

#### Aortic Insufficiency

This is a **high-pitched blowing diastolic** murmur heard at the 2<sup>nd</sup> intercostal space at the right sternal border. If it's chronic, the valve should be replaced if there are signs and symptoms of **Left Ventricle Dilation**. Other signs of chronic AI are widened pulse pressure, water-hammer pulses, pistol-shot pulses, and head bobbing. If there's a sudden destruction of the valve (as in endocarditis) there will be a rapid decline into **florid heart failure**. This will require **emergent replacement**.

#### Mitral Stenosis

Look for a history of **rheumatic heart disease** in a patient with **Afib** or **CHF** symptoms (pulmonary edema, exertional dyspnea). It's a **rumbling diastolic** murmur with an **opening snap**. Treatment isn't necessary until the patient gets tired of the symptoms. Options are a **commissurotomy** (balloon dilation) or simply **replacement of the valve**.

#### Mitral Regurgitation

Caused by **infection** or **infarction**, it produces a **holosystolic** murmur that occludes both S1 and S2 at the **cardiac apex** that radiates to the **axilla**. Just like regurg, replace it when desired or treat with **LV dilation**.

#### Coronary Artery Disease

The **obese, hypertensive, diabetic, hypercholesterolemic smoker** that presents with **progressive refractory angina** or even a full-blown **MI** becomes a candidate for intervention. When we talk about **revascularization surgery (CABG)** a couple of things should be met. 1) Blood vessels have a **70% stenosis**, 2) **Mainstem Equivalent** (LAD or 3+ vessel disease), and 3) there is **good LV function** or reperfusion will **restore ventricular function**. The most significant vessel (usually the **LAD**) is connected to the **internal mammary artery** while the others get the **great saphenous vein**. If there is a **single-vessel disease**, consider balloon angioplasty with stenting. After cardiac surgery it's essential to **avoid strain, record/pull drain**, and **maintain cardiac output**. That means **EKG, IVF**, and if needed, **cardiac indexing** with cardiac wedge pressures.



Pt: Old man, Bicuspid Valves, Calcifications

Murmur: Crescendo-Decrescendo @ RSB

Sx: Angina, Dyspnea, Syncope, CHF

Tx: Replace when identified, urgently if symptoms or flow gradient > 50

Pt: MI, Dissection, Marfan syndrome

Murmur: High-pitched blowing diastolic

Sx: Heart Failure, Widened Pulse Pressure

Tx: Replacement

Pt: Rheumatic Heart Disease

Murmur: Diastolic Rumbling opening snap

Sx: Afib, CHF

Tx: Commissurotomy / Balloon Angioplasty → Replace

Pt: Mitral Valve Prolapse, Ischemia, Infection

Murmur: Holosystolic blowing radiates to axilla

Sx: Afib, CHF

Tx: Replace

**Thyroid Nodule Simplified**

In a **hyperthyroid** patient nodules are almost **never** cancer. Do a **RAIU** to show an increased uptake after you ensure the **thin** patient with **heat intolerance, weight loss, and diarrhea** is indeed hyperthyroid with a **TSH+T4**. If the nodule is “hot” it can **be resected** or hit with **radioiodine ablation**. There is almost no need to even biopsy it. However, in a **euthyroid** patient nodules can be cancer. Do a **TSH/T4** to show he/she is euthyroid, then do an **ultrasound guided FNA** to get a diagnosis. FNA is the mainstem of management. If  $\oplus$  for cancer proceed to **Thyroidectomy**. If it’s  $\ominus$  for cancer but looks like follicles, consider thyroidectomy anyway because follicular cancer can look normal. Follow up with a **radioactive I<sub>2</sub>** for mets.

**Parathyroid**

If it's been established that **hyperparathyroidism** is the cause of  $\uparrow$ **PTH**,  $\uparrow$ **Ca**,  $\downarrow$ **P** - not from mets to bone or other condition - the affected gland needs to be removed. Usually there is a singular adenoma, resulting in a **single gland resection**. Use the **Sestamibi scan** to find which one is enlarged. Take caution after resection for **hypocalcemia** (perioral tingling, Chvostek Sign, Troussseau sign); as the atrophied glands kick in they may not produce enough initially.

**Cushing's**

A **fat, hairy, pimply lady** with a **buffalo hump, HTN, and DM** has Cushing's syndrome. The most common cause is **iatrogenic steroids** for some inflammatory condition. The job in surgery is to identify where the tumor is. The key is **“Low-ACTH-en-High.”** Perform a **low-dose** dexamethasone suppression test. It should fail to suppress since it's Cushing's. An **ACTH** level will then determine if there's an autonomous adrenal adenoma versus some signal driving the adrenals (either ectopic or pituitary adenoma). Only if ACTH is the culprit do you perform a **High-Dose** dexamethasone suppression test which will only suppress in the pituitary disease. Then, either get an **MRI** of the brain (pituitary) or a **CT Chest/Abd/Pelvis** looking for the ectopic **lung cancer**. Resect the tumor to cure.

**Zollinger-Ellison (Gastrin)**

In a patient with **persistent ulcer disease** and **diarrhea** consider this **gastrinoma**. First measure **serum gastrin** then do a **secretin test** (showing a paradoxical increase). Identify the tumor with a **CT scan** of the pancreas. Cut it out.

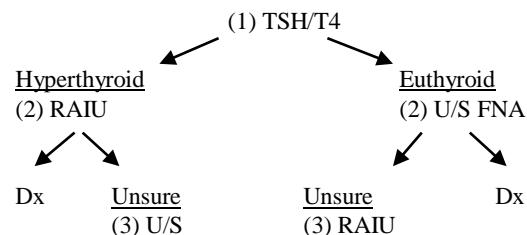
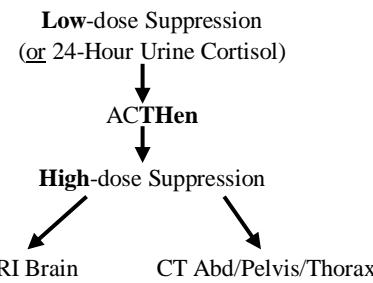
**Insulinoma (Insulin)**

In a patient with **repeated hypoglycemic** states, especially if he/she is **fasting**, first consider **factitious** then **insulinoma**. To rule out factitious, get a **C-peptide assay**; it's normal or low in factitious, elevated in insulinoma. A **CT scan** locates the adenoma so it can be **resected**.

**Glucagonoma**

In a patient with **migratory necrotolytic dermatitis** (he/she will often just tell you this) and a touch of **DM**, get an elevated **glucagon level**. Do a **CT** to find it and try to **resect it** (often, this fails).

*The included material is a condensed surgical review of select topics in endocrine, considered in depth in the medicine sections. This is intended for those studying a Surgery-Only review (i.e., for the shelf)*

**“Low-THen-High”**

TIA/Carotid Stenosis

If a patient has a **TIA** the reflexive **CT Head, Echo, U/S Carotids** should be done. For surgery, a patient requires a **carotid endarterectomy** if there's a **>70% occlusion** and the symptoms are caused by the lesion (i.e. Right-sided stenosis and Left-sided hand weakness).

CVA/Stroke

If the stroke is **ischemic** ( $\oplus$  neurologic symptoms +  $\ominus$  Blood on CT) the therapy is medical. Treatment involves (a) **tPA** to dissolve the clot if within **4.5 hours of symptom onset** or when patients went to sleep. An ischemic stroke can **convert to hemorrhagic** if tPA is given and dead brain is revascularized. Treatment for stroke is generally targeted at having **prevention** (ASA + Plavix) + **rehab**.

Hemorrhagic Stroke / Intracranial Hemorrhage

A patient with  $\oplus$  neurologic deficits and  $\oplus$  Blood on CT will have a **headache** or may be in a **coma secondary to herniation**. Rapid bleeds are generally fatal quickly. Controlling **HTN**, targeted **rehab**, and  $\downarrow$  Intracranial Pressure are goals. Surgical intervention may involve a **craniotomy** or placement of a **VP shunt**. Intracranial hemorrhages occur most often at the **caudate/putamen** with devastating motor and sensory defects.

Subarachnoid Hemorrhage

Any patient presenting with the **worst headache of his/her life** should be considered for SAH. It's often preceded by a milder "**sentinel bleed**" that an ER missed because there were no signs of meningeal irritation. Now the patient is in **pain**, a **coma**, or a **coffin**. A **CT** scan shows  $\oplus$  blood but **outside the parenchyma** and **between the gyri** (separating it from other bleeds). An **LP** can be done to look for **xanthochromia** (old RBCs in CSF) and an **angiogram** demonstrates the aneurysm. If attended to **immediately** the artery can just be **clipped** or **coiled**. If  $> 48$  hrs, there needs to be a **6 week** wait before surgery to prevent a reflexive **vasospasm** with a **calcium channel blocker**. Control the **Blood Pressure** (target Systolic Blood Pressure is  $< 150$ ) that caused the artery to pop and admit the patient to the **ICU**.

Epidural Hematoma

Skull trauma. It involves a  $\oplus$  **Loss of Consciousness** with a **Lucid Period** and then a **rapid decline of consciousness**. Discussed in the head trauma section. Get a **CT scan** and **drill a hole**.

Subdural Hematoma

Skull trauma. It presents as an **old** (atrophy) person or a **young child** (abuse) with declining mental function. Get a **CT scan** and **drill a hole**.

*Cut out the thrombus if >70% stenosis + Sxs*

*tPA if within 4.5 hours (used to be 3)  
ASA, Plavix, Rehab if not*

*Control HTN,  
Relieve pressure with craniotomy or VP shunt*

*The real bleed presents with meningeal irritation: nuchal rigidity, nausea, vomiting, photophobia, etc.*

*Clip = Better, for Surgical Candidates  
Coil = Worse, endovascular treatment for poor surgical candidates*

**1) Carpal Tunnel**

Caused by **repetitive use** and seen in people who do office work, there's an inflammation of the carpal ligament, which compresses the **median nerve**. Patients will complain of a **numbness and tingling** of the hand in the **median nerve distribution** (first three digits) brought on by **tapping** the carpal ligament. **Hypothenar atrophy** will also be seen. The diagnosis is clinical, so we start with treatment first. Try **splints** and **NSAIDs** first. An **x-ray** should also be done to rule out other diseases should that fail. Surgery to release the nerve is definitive, but before going for that get an **electromyography**.

**2) Trigger Finger**

The patient is unable to **flex the middle finger**. When forced, there's a **pop**. Give **steroids**. Surgery is definitive (releasing the fascia).

**3) De Quervain's Tenosynovitis**

Prolonged extension of the thumb (mother cradling baby, guy lifting heavy weights). The diagnosis is clinical - the thumb hurts, but it's possible to **reproduce pain of the thumb and hand** by placing the thumb **inside a closed fist** and performing an **ulnar deviation**. With increased pain, the diagnosis is clear. Try **NSAIDs** and splinting. **Steroids** are best.

**4) Dupuytren's Contracture**

Found in **alcoholic males** with **Scandinavian ancestry**, it presents as **palmar nodes** and the **inability to extend** the hand flat. The fascia actually pulls the hand closed. It's a **clinical** diagnosis and requires **surgery** to release the fascia.

**5) Felon**

It's just an **abscess**, but is found in the **nail pulp**, typically following a **penetrating injury**. It's trapped inside a fascial plane so is **exquisitely tender**. There will also be a **fever**. It's an abscess so simply **drain it**.

**6) Jersey Finger**

When the flexor tendon of a finger becomes injured (ripped off the finger by forceful **hyperextension** as in pulling away from a clenched fist clutching a jersey), that finger **can't flex**. So, when the patient makes a fist one finger is left extended. Treat by **splinting** and allow it to heal. Surgical reattachment is possible but will not be the answer on the test.

**7) Mallet Finger**

When the extensor tendon of a finger becomes injured (ripped off the finger by **forceful flexion**) that finger **can't extend** when the hand is extended. Treat with **splinting** and allow it to heal.

Disease	Path	Patient / Physical	Dx	Tx
Carpal Tunnel	Repetitive use of wrist, inflammation of carpal ligament	Numbness and Tingling of median nerve distribution brought on by tapping on carpal ligament	r/o others with XR	NSAIDs/Splint EMG Surgery
Trigger Finger		Inability to flex middle finger. When forced, it pops	Clx	Steroids
De Quervain's	Continued forced extension of the thumb (baby cradle, weights)	Pain on thumb and hand when used. Exacerbated by finger-in-fist with ulnar deviation	Clx	Steroids
Dupuytren's	Alcoholic Scandinavian Men	Palmar Nodes unable to extend flat	Clx	Surgery
Felon	Abscess in pulp	Abscess after penetrating injury	Clx	Drain + Abx
Jersey Finger	Forced Hyperextension (lig tears)	Inability to flex finger, passive flexion OK	Clx	Splint
Mallet Finger	Forced flexion (lig tears)	Inability to extend finger, passive flexion OK		

Adult orthopedics has a great many diseases to learn and pediatrics ortho is no different. For pediatrics every disease has its own unique presentation. Learning each constitutes strict memorization but there's only a few things to commit for each disease. Keep in mind - if you're studying for a test this makes for a great extended matching set.

### Hip Pathology

Knowing the **age**, **presentation**, and **treatment** will help build a differential for "hip disease."

i. Developmental Dysplasia of the hip

The hip is insufficiently deep so the femur head constantly pops out. Diagnosed during the well-baby exam (**newborn**), there'll be a clear **click** sound on **hip flexion** (Barlow's and Ortolani's). Confirm the diagnosis with an **Ultrasound**. Put the child in a **harness** to keep the femur approximated to the joint as the joint grows out.

ii. Leg-Calve-Perthe Disease

When a child is around **six years old** he/she can suffer from **avascular necrosis** of the hip. There'll be an **insidious onset knee pain** and an **antalgic gait**. Diagnose by **x-ray** and then **cast**.

iii. Slipped Capital Femoral Epiphysis

An orthopedic emergency, it can occur in **adolescents** who are either **obese** or in a **growth spurt**. They'll complain of **hip** or **knee pain** of sudden onset. Get a **frog-leg position x-ray** to confirm. **Surgery is required**.

iv. Septic Hip

The differential of pediatric hip disease could be done by age alone were it not for this. It shows up in **any age** (though usually a **toddler**) after a **febrile illness** and complaining of joint pain. Do an **x-ray** first then a **joint aspirate with smear and culture**. It needs to be **drained** and baby needs **antibiotics**.

(5) Osgood-Schlatter Disease

Occurring in **teenage athletes**, it presents as a **painful knee without swelling**. The athlete has two options - stop exercising and cast it (curative) or **work through it**. If he/she works through it there'll be a **palpable nodule** from osteochondrosis. Otherwise, it causes no permanent sequelae but it does hurt.

(6) Scoliosis

A developmental disorder of the **spine** found in **adolescent girls**. Their thorax will tip to the **right** causing a cosmetic deformity. More severe disease can cause **respiratory issues**. Perform an **Adam's Test** (girl bends forward, asymmetric shoulders are diagnostic) and confirm with **X-ray**. Treat with **bracing**.

(7) Bone Tumors

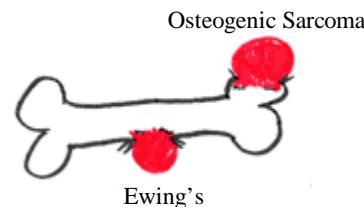
In kids, **1<sup>o</sup> Tumors** cause **low grade focal pain** and may invade locally. Have two in mind. **Osteogenic Sarcoma** presents with a **sunburst onion skin** pattern typically at the **distal femur**. It's associated with **retinoblastoma**. The other is an **Ewing's sarcoma** found in the **midshaft** caused by **T(11;22)**.

(8) Special Considerations for Fractures

Fractures are the same as for adults except when it comes to the **growth plate**. If the fracture involves the growth plate an **ORIF** is needed to ensure the plate is realigned. Otherwise the kid will grow up with one leg shorter than the other.

Dx	Age	Patient	Dx	Tx
<b>DDH</b>	Newborn	Clicky Hip	U/S	Harness
<b>LCP</b>	6	Insidious Onset Antalgic Gait	XR	Case
<b>SCFE</b>	13	Fat kid with knee pain (nontraumatic)	XR	Surgery (Emergency)
<b>Septic Hip</b>	Any (Toddler)	Joint pain after febrile illness	Aspirate	Drain and Abx

Dx	Patient	Sxs	Dx	Tx
<b>Osgood Schlatter</b>	Teenage Athlete	Knee pain with calcification	Clx	Cast Extended
<b>Scoliosis</b>	Teenage Girl	Adam's Test	XR	Brace
<b>Osteogenic Sarcoma</b>	Retinoblastoma	Femur / Tib Pain	XR Sunburst	Resection
<b>Ewing's Fractures</b>	(t11;22)	Mid-Shaft Pain	XR	Resection if a plate involved do open reduction and internal fixation



Introduction

Pediatric CT surgery focuses around the defects in cardiac development. That means **murmurs**. Each murmur has a characteristic **sound**, **appearance**, and **association**. Chest X rays or EKGs may give clues, but all cardiac defects are diagnosed by **Echo**. Before beginning our discussion of the major cardiac defects, let's take a moment to go over **innocent murmurs**.

An innocent murmur is **NEVER diastolic** or  $\geq 3/6$ . Innocent murmurs are always systolic murmurs and low grade (difficult to hear). They can represent any number of high flow states typical in kids. **Innocent murmurs** don't need workups. If they **persist** or no longer meet criteria for innocent they must be worked up with CXR, EKG, and Echo.

Left to Right Shunts

Left to right shunts are caused by a hole between **high and low pressures**, allowing blood to flow from the left ventricle (which is oxygenated) back into the pulmonary circulation. This causes **increased vascular markings** on chest x ray. The response to high pressure in the pulmonary circulation is hypertrophy with resultant **pulmonary hypertension**. Left alone long enough, there'll eventually be a **flow reversal** (Eisenmenger's) turning these **noncyanotic** lesions to cyanotic ones.

i. Atrial Septal Defect

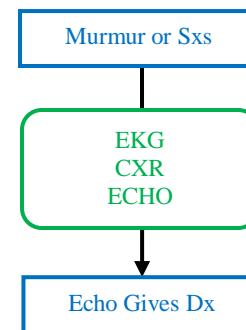
Because the atria are low pressure the consequences are small, so this can be found at **any age**. The thing that gives it away is the **fixed wide split S<sub>2</sub>** (easier to say on a test than to identify) and usually the murmur isn't heard. **Closure** is achieved either with **cath** or via **surgery**.

ii. Ventricular Septal Defect

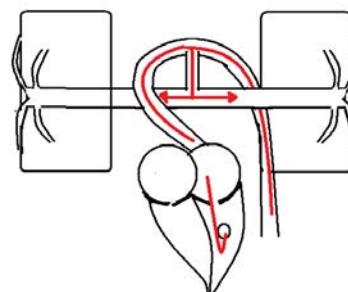
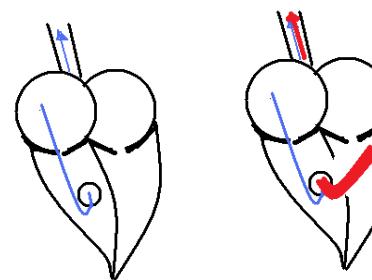
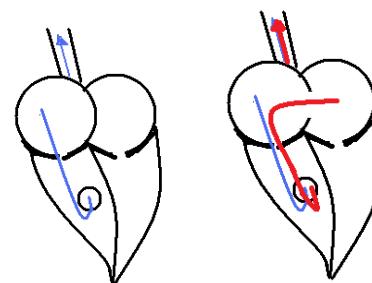
This is the **most common congenital heart disease**. It's a link between the ventricles (high pressure). There will be a **harsh holosystolic murmur**. In a kid, there's been no time for mitral regurgitation to develop (sounds the same) and these are symptomatic young. There'll be a **failure to thrive**, **dyspnea**, or full-blown **CHF**. If asymptomatic, give it a chance to close spontaneously. If there's **CHF** or **persistence to 1 year of age** surgical correction is mandatory.

iii. Patent Ductus Arteriosus

A connection between the **aorta** and the **pulmonary artery**. Exam reveals a **continuous “machinery-like” murmur**. The murmur may not be apparent on day one, so may be noticed on the exit exam. If there's **no CHF** then the PDA can be closed with **indomethacin** (**ends** the PDA). However, if symptoms are severe (high flow, **CHF**) surgery is needed. The PDA must be closed by **6-8 months** regardless. If for some reason a PDA is needed (Tetralogy) **prostaglandins** can be given to maintain it.

Left to Right Shunts

↑ Pulmonary Flow  
↑ Pulmonary Vasculature (CXR)  
↑ Pulmonary Pressure  
Right Ventricular Hypertrophy  
Eisenmenger's (Reversal of Flow)



Right to Left Shunts

Something must go very wrong in order for blood to go out into systemic circulation as deoxygenated blood. After all, a simple hole would result in a left to right shunt. So, blood isn't going to the lungs. This results in **cyanosis (blue baby)** and **decreased vascular markings** on chest x-ray. They are the "T" diseases. They present either with acute cyanosis or chronic effects (such as clubbing). While there are others, these two are most commonly seen, discussed, and tested.

iv. Transposition of the Great Arteries

The most common cyanotic defect of the **newborn**. During the first **8 weeks** of embryogenesis the heart forms and twists. If it doesn't twist two independent circulations form: the **Vena Cava - RIGHT Ventricle - Aorta** ("systemic") and the **Pulmonary Vein - LEFT Ventricle - Pulmonary Artery** ("pulmonary"). This means that blood pumped to the periphery isn't oxygenated; the oxygenated blood is simply circulated through the lungs. Even though it's common in children of **diabetic mothers** with poorly controlled sugar it does **NOT** happen in gestational diabetes (by 20 weeks the heart has already formed). Without a **PDA** this is **fatal** (so give **prostaglandins**). It presents on **day 1** as a **blue baby**. Surgery must be done to correct it ASAP.

v. Tetralogy of Fallot

The most common cyanotic defect of **children** (because TGA babies die or get fixed). It's caused by an endocardial cushion defect. It a "tetra-ology," and is defined by an **<sup>1</sup>Overriding Aorta, <sup>2</sup>Pulmonary Stenosis, <sup>3</sup>Right Ventricle Hypertrophy, and a <sup>4</sup>Ventricular Septal Defect**. If severe we get a blue baby and it requires immediate intervention. The tricky way of presenting is in a toddler with **Tet Spells** (cyanosis relieved by squatting). Squatting causes an increase in systemic vascular resistance, pushing more right ventricular blood into the lungs. Look for a **boot-shaped heart** on chest x-ray. This is associated with **Down's Syndrome**. Surgery is definitive therapy, held over with a **balloon septoplasty**.

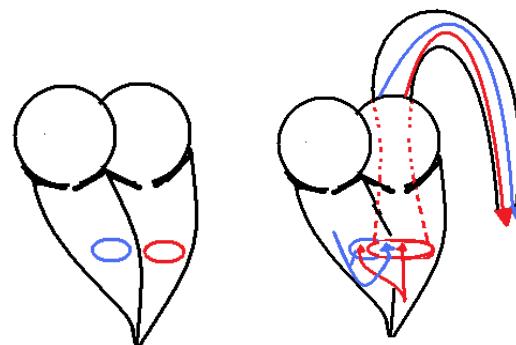
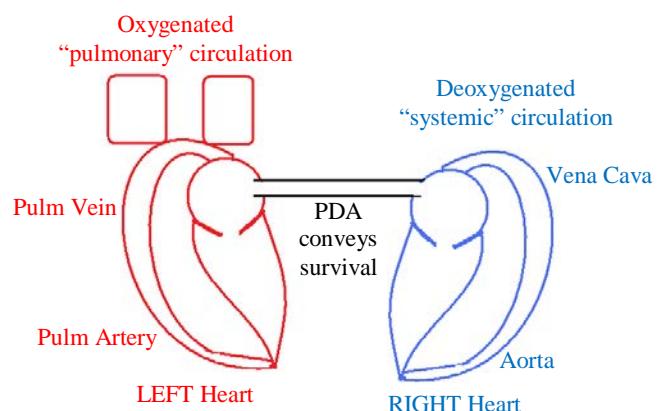
The others are rare. Things like **Truncus Arteriosus**, **Tricuspid Atresia**, and **TAPVR** are almost never seen. Review Step 1 notes for clarity or to impress your attending.

Coarctation of the Aorta

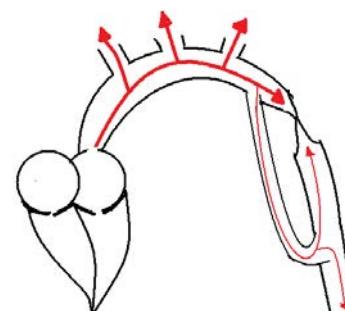
Thrown in here because it doesn't really fit in either category. In a baby with **hypertension, claudication** (pain/crying/refusal to walk with walking, relief with sitting), or an obvious temperature difference between arms and legs suspect coarctation. First, get **blood pressures** on arms and legs; there will be a large disparity. Do an **angiogram** to definitely diagnose. Surgically correct. If it's allowed to persist an **X ray** will show **rib notching** as collaterals erode into the ribs.

Right to Left Shunts

- ↓ Pulmonary Flow
- ↓ Pulmonary Vasculature (CXR)
- Deoxygenated blood in periphery
- Blue Baby Syndrome



Total Anomalous Pulmonary Venous Return



Esophageal Atresia

A **newborn** presenting with **choking with feeds** and **excessive salivation** should prompt the attempted passage of an NG tube, which will **coil on CXR**. There are four types, but knowing which (for you) is not important. Before **surgically correcting** look for other **VACTERL** anomalies - especially cardiac and renal.

- V**ertebral (XR)
- A**nal (imperforate)
- C**ardiac (Echo)
- T**racheal
- E**sophageal
- R**enal (Ultrasound)
- L**imbs (Thumbs in particular)

Imperforate Anus

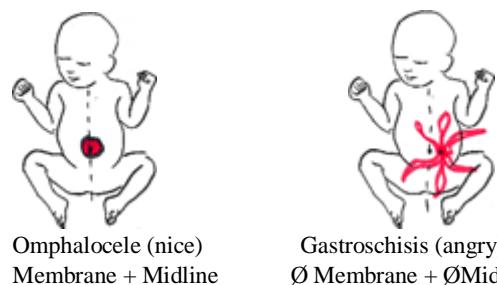
**NEVER** take a 1<sup>st</sup> temp rectally. An imperforate anus will be found on visual inspection but where the pouch of the colon is must be identified. Turn the baby upside down and take a **babygram** (an x-ray of the entire baby) to see where the blind end of the colon is. If it's **near the anus**, simply correct it right now. If it's high in the abdomen, place a **colostomy** and repair when older. If **fistulas** are present, they can be left alone until toilet training (because the baby will be soiled in diapers regardless), but if you fix the pouch fix the fistula.

Congenital Diaphragmatic Hernia

If you hear **bowel sounds** over the lungs and there's a **scaphoid abdomen** in a **dyspneic baby**, get a **babygram** to see the loops of bowel in the thorax. A hole in the diaphragm, it's always on the **left** (the liver prevents right sided lesions) and most commonly **posterior** (Bochdalek most common), but can be anterolateral (Morgagni). The problem is not the hernia per se, which can be repaired easily, but the **hypoplastic lung** that requires intubation and ventilation for baby's survival.

Gastroschisis and Omphalocele

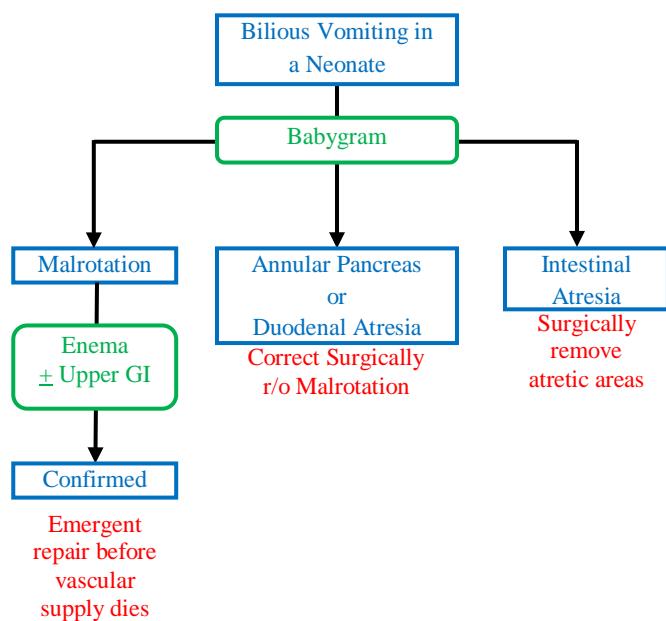
Extrusion of the bowel is both obvious and dangerous. If it's **to the Right of midline and without a membrane** then it's **gastroschisis** (and angry sounding word and angry looking dz) with an increased risk of infection. Conversely, it's **midline with a membrane** it's **omphalocele**. Both conditions require the construction of a **siloh**, whereby contents are twisted in gradually overall time and the defect is repaired.

Extrophy of the Bladder

A **midline defect** might sound like gastroschisis, but if it's **red, shining, and wet with urine** it's no bowel – it's a bladder. This requires emergent surgery. Delayed corrections will fail.

Bilious Vomiting

A **bilious vomit** is indicative of an obstruction distal to the ampulla of vater. Bile can get into the GI tract, but cannot go "forward" so goes "backward" and comes out as vomiting. The first step in working up bilious vomiting is to get a **babygram**. What you get back is highly nonspecific, but there are clues. **Multiple Air-Fluid Levels** is indicative of **intestinal atresia** (a vascular accident in utero, i.e. mom used cocaine). The **double-bubble sign** is associated with **duodenal atresia** (and Down's), **annular pancreas**, and **malrotation**. The chances are greater for malrotation if there are **normal gas patterns beyond** (gas had to get here before the obstruction arose). Do a **contrast enema** (safer) followed by an **Upper GI** series (better). Malrotation can cause ischemia and must be ruled out first.



Amblyopia

This is essentially a **cortical blindness** and a defect of **development** that results when misalignment of the eyes (many causes including cataracts, tumor, strabismus, ocular motor dysfunction) → competing visual inputs → the brain will “turn off” inputs from the busted eye. One eye will be **normal** while the other eye will go **blind**. Fix the underlying problem.

*This is a duplicate note-set from Pediatrics. The questions, the notes, and the video are identical for Peds-Ophtho and Surgery-Peds-Ophtho*

Strabismus

This is misalignment of the eyes that, if left untreated, can lead to amblyopia – or permanent “lazy eye”. Strabismus confirmed on physical exam when the **reflection of light comes from separate locations on each eye**. If present from birth, this needs to be surgically corrected to avoid amblyopia. However, if baby was NOT born with it, consider that this could simply be a refraction problem that can be fixed by **glasses** and then will **resolve spontaneously**.

Retinoblastoma

In the nursery, instead of a **red light reflex** a **pure white retina can be seen** in the back of the eye. Don’t confuse this with a cataract in front of the eye. **Resect** the tumor. **Avoid radiation** (↑ risk of “2<sup>nd</sup> knockout” in the good eye). Observe the patient for future **osteosarcoma** - especially in the distal femur.

Cataracts

Congenital cataracts have a **milky white** appearance in the front of the eye. You’ll see them just by looking. They are caused either by the TORCH infections if present at birth or **galactokinase deficiency** if acquired early in life. **Fix** it before **amblyopia** sets in with surgical removal of the cataract.

Retinopathy of Prematurity

**Premature neonates** requiring high-flow O<sub>2</sub> can get these growths on the retina. Using **laser ablation** can improve vision in life. Look also for **intraventricular hemorrhage**, **bronchopulmonary dysplasia**, and **necrotizing enterocolitis** in a preemie in the ICU.

Gonorrhea is gram negative diplococci  
Chlamydia shows nothing (bacteria is intracellular)

Conjunctivitis in Newborns

What we care about in newborns is being able to discern between a bacterial conjunctivitis that will cause baby to go blind and a chemical or viral conjunctivitis that will just get better on its own. We **screen and treat** all mothers for STIs. But sometimes a baby gets through without mom knowing or being treated. If that’s the case, we’re trying to protect baby from Gonorrhea and Chlamydia. We can use **silver nitrate drops** as **prophylaxis**. This stuff burns and can induce a **chemical conjunctivitis** (clear, non-purulent discharge on day 1). Use the timing and the laterality to help you decide which bacteria it is. **Gonorrhea** is first, appearing at **2-5 days** and is a **purulent bilateral** discharge. It’s treated with **topical erythromycin**. **Chlamydia** occurs at **day 7-14** and is **mucopurulent unilateral** discharge. It’s treated with **topical PLUS oral erythromycin** to prevent pneumonia.

Type	Timing	Purulent	Problems	Treatment
Chemical	<b>24 hrs</b>	Non-purulent	Bilateral	Caused by silver nitrate drops
Gonorrhea	<b>Day 2-5</b>	Purulent	Bilateral,  can turn into <b>blindness</b>	<b>Topical erythromycin</b>  Or <b>Silver Nitrate Prophylaxis</b>
Chlamydia	<b>Day 7-14</b>	Muco-purulent	Unilateral  Can turn into <b>pneumonia</b>	<b>Oral + Topical Erythromycin</b>  or <b>PPX</b>

Necrotizing Enterocolitis

Seen in **premature babies** after their first feeding. It produces a **bloody diarrhea**, abdominal distention, and a drop in platelet count. Stop all feedings and start **TPN**. Do a **babygram** that shows **pneumatosis intestinalis** (gas inside the bowel wall). If it's that bad do surgery.

Meconium Ileus

In babies with **cystic fibrosis** (you know this because of routine neonatal screens) who develop **bilious vomiting** and **trouble passing their first bowel** suspect meconium ileus. An **X-ray** will show multiple **dilated loops** of small bowel and a “**ground glass**” appearance. Confirm the diagnosis with a **gastrografin enema**. Because it's water soluble it draws fluid into the lumen, dissolving the meconium and **treating** while diagnosing.

Pyloric Stenosis

If baby has made it out of the nursery and starts to have **nonbilious projectile vomiting** occurring **after meals** (usually in **weeks** of life), suspect pyloric stenosis. Because nothing is really wrong with baby he/she's **hungry** and **eats** as such. Physical exam will reveal a palpable **olive-shaped mass**. An **ultrasound** will show the **donut sign** and you may reveal it with laboratories showing the classic **hypochloremic, hypokalemic, metabolic alkalosis**. Fix the electrolytes first then do a **myectomy**.

Biliary Atresia

If the baby gets a little bit older (**6-8 weeks**) and the neonatal **jaundice does not resolve**, it might be because of **biliary atresia**. It might also be due to an inborn error of metabolism or cystic fibrosis. Rule out the others, then do a **HIDA scan after phenobarbital x 1 wk**. Atresia is definitively diagnosed by failure of bile to reach the duodenum, even after the phenobarbital stimulation.

Hirschsprung's

Presenting either as a **failure to pass meconium** or **chronic constipation**. The bowel is usually distended - palpable through the abdomen. The **normal colon is dilated** and the **bad colon decompressed**. The bad colon has no innervation, and so has absent peristalsis. A **barium enema** reveals a dilated colon. Definitive diagnosis is made by **full-thickness biopsy** demonstrating **absent ganglia**. Take out the bad colon and reanastomose.

Intussusception

In a **healthy** 6-12 month old baby who suddenly has **colicky abdominal pain** and then has **courant jelly stool**, do an **air enema** which is both diagnostic and therapeutic. Surgery may be done if the vascular supply was compromised and necrotic bowel occurred.

Introduction

Skin cancer is the **most common cancer** in all comers. It comes from **sun-exposure**. But it's not just exposure that makes the difference, it's more about being sun-burned. There are **sun-occupations** (sailor, farmer, construction), there are **sun-locations** (hands, face, back, shoulders), and there are **sun-people** (those who **easily burn** – fair skinned, fair haired – and those who **have burned** – the worse the burn the higher the risk).

The **earlier the diagnosis the better the prognosis** so it's worth getting good at detecting it. It's also worthwhile to teach patients both **sun protection education** and **how to self-monitor for melanoma**. If you, or the patient, come across a suspicious lesion, it might just save someone's life. On the test it's picture recognition – knowing what the disease looks like and being able to identify it (coming here soon).

Basal Cell Carcinoma

Malignancy of epidermal **basal cells** (thus the name) that generally **doesn't metastasize**. There are 6 subtypes of basal cell carcinoma, but you shouldn't engage those. Look for a **pearly lesion** or one that's **non-healing and bleeds easily**. Skin cancer risk is as in the introduction. While this cancer **doesn't metastasize**, it **will locally invade** and needs to be removed. The diagnosis is made by **excisional** or incisional biopsy. A punch biopsy is usually wrong for basal cell. The treatment is complete if a **wide excisional biopsy** was made with > 1mm margins. If cancer still exists, **Mohs** surgery can be performed. If the cancer is aggressively invading and on an extremity, **amputation** is indicated. The idea is to spare the patient cosmetic deformities; if it's big, start with something less invasive, then go more invasive after diagnosis is confirmed.

Squamous Cell Carcinoma

A malignancy of **keratinocytes**. The lesion is described as a **well-demarcated red papule** in sun-exposed areas. Risk factors are the same as in the introduction. The diagnosis and management of SCC is identical to BCC, with some caveats. SCC **can metastasize** but usually doesn't. For high-risk tumors, **add radiation** therapy to surgical resection. Unlike SCC of the lung, SCC of the skin has **NO paraneoplastic syndromes**. SCC can be snuck into a vignette through the **pigmented lower lip lesion** or the **Marjolin ulcer**, a non-healing necrotic ulcer that heals and breaks down over and over again. Biopsy the margin to confirm SCC. See Medicine – Dermatology – Hyperpigmented Lesions for more on Bowen's Disease (SCC in situ) and Keratoacanthomas.

*Things that increase skin cancer risk*

- Number of times sunburned
- Severity of times sunburned
- Early-life burns worse than late-life burns
- Fair Skin, Fair Hair
- Jobs that increase exposure

## The tricks about diagnosing Basal Cell Carcinoma

*Small lesion not on the face = excisional biopsy  
Large lesion not on the face = incisional biopsy  
Any lesion on the face = incisional biopsy*

## The tricks about treating Basal Cell Carcinoma

*Small lesion not on the face = excisional biopsy  
Large lesion not on the face = wide excision  
Large lesion on an extremity = amputation  
Any lesion on the face = Mohs*

## The tricks about diagnosing Squamous Cell Carcinoma

*Small lesion not on the face = excisional biopsy  
Large lesion not on the face = incisional biopsy  
Any lesion on the face = incisional biopsy*

## The tricks about treating Squamous Cell Carcinoma

*Small lesion not on the face = excisional biopsy  
Large lesion not on the face = wide excision  
Large lesion on an extremity = amputation  
Any lesion on the face = Mohs*

*Radiation for high risk tumors*

Disease	Physical	Mets	Paraneoplastic	Invasion	Diagnosis	Treatment
Basal Cell Carcinoma	Waxy or Pearly	Ø Mets	Ø Paraneoplastic	+ Local Invasion	Incisional Excisional	Resect, Amputate
Squamous Cell Carcinoma	Pigmented or Ulcer	+ Mets	Ø Paraneoplastic	Ø Local Invasion	Incisional Excisional	Resect , Radiation
Melanoma	ABCDE	+ Mets	Ø Paraneoplastic	Ø Local Invasion	Punch Bx Excisional	<0.5 mm = Local Resect >1 mm = wide resection >4 mm = mets, Ø chemo

Melanoma

We're going to spend some time on Melanoma. Skin cancer is the most common cause of cancer. Melanoma can't be treated. If you miss a melanoma, the patient will die. If you catch melanoma early, you literally save the patient's life. The natural course of melanoma is sporadic. It naturally **waxes and wanes** throughout its course of metastasis. I want you to feel this up front: **Chemo doesn't work. Radiation doesn't work. Surgery doesn't work.** Once it's metastasized, it's too late. You'll debulk nests of tumors for palliation. The patient can live 10 years or 2 months. Nothing we do alters the course of the disease to any meaningful extent, so it's better to **catch it early and cure it** rather than find it (too) late.

Melanoma is a cancer of **melanocytes**. Melanocytes have pigment in them. Thus, the cancer is going to be a **pigmented lesion**. The classic board picture is a **jet black, smooth lesion** on sun-exposed skin. However, Melanoma is the "great imitator" because it can present as literally any skin lesion and has many histological subtypes. The point of this is **if the lesion is suspicious, get the biopsy**. The biopsy can be AVOIDED if there's hair within the lesion.

A lesion is considered "**suspicious**" if it meets **any one of these 5 criteria** (ABCDE). **Asymmetric**, has **Irregular Borders**, consisting of **different Colors**, any lesion  $> 0.5$  cm in **Diameter**, or is **Evolving** (ABCDE is changing).

Diagnosis can be made in one of two ways.

If the lesion is large, or the suspicion for melanoma is low, choose a **punch biopsy**. This captures good tissue next to cancer tissue. It spares the cosmetic deformity of excision.

If the lesion is small, or the suspicion for melanoma is high, choose **wide excisional biopsy** (this is the preferred method).

**NEVER** do a shave biopsy of melanoma.

The biopsy allows you to see both histological subtype (don't memorize histological subtypes) and **Breslow's depth**.

If there's melanoma it needs to come out. If the diagnosis was via an excisional biopsy with negative margins, that job is done. If not, it's essential to excise the primary lesion. Actual treatment is based on the Stage of tumor, using the TNM system that integrates Breslow's depth. That's far too cumbersome to memorize, so use the strategy to the right.

Hope is on the horizon. Studies using **immunotherapy** (programming white cells to attack cancer) is promising, but won't be on the test. If you work at an advanced academic center you might see this being done. Otherwise, it comes down to "cure with resection" or "palliation and pray."

**ABCDE** = Cancer

**A**symmetric

Irregular **B**order

Mixed **C**olors

Large **D**iameter  $> 5$ mm

**E**volving (changes in ABCD)

You need ANY 1 to suspect cancer

*Clark's Classification is something you might hear about. These days it's used only when Breslow's Depth is  $< 0.5$ mm as its predictive value isn't as good as once thought*

<b>Breslow</b>	<b>Treatment</b>	<b>Margin</b>
<0.5mm	Local resection	0.5cm
1-2mm	Wide Resection and SLND if tracer +	1cm
2-4mm	Wide Resection and SLND if tracer +	2cm
>4mm	Palliative Chemo and radiation, debulking of tumor burden palliative only	N/A

*This is not how melanoma is treated. It's treated based on staging, of which Breslow is just one piece. This strategy will get you the right idea. "The deeper it's gone the worse it is and the more that has to be done."*

**Intro**

Hypertension that is **not essential** or **secondary hypertension** has multiple surgical causes. See the medicine lectures for a broader differential.

**Primary Hyperaldosteronism**

In a patient with **Hypertension** and **Hypokalemia** get a **Renin/Aldo** level. ↑ **Aldosterone** and ↓ **Renin** means the drive of aldosterone is in the gland (a cancer or adenoma). Soft signs include **Hypernatremia** (↑Na) and **Metabolic Alkalosis**. While hyperplasia of the adrenal gland may be considered (**postural aldo levels** will increase while upright), it's uncommon in an adult. Once the adenoma is identified, do a **CT scan** to find it and **resect**.

**Renovascular Hypertension**

**Bilateral Renal Artery Stenosis** secondary to atherosclerosis is a medical disease found in old men. The radiographic findings are similar to those of a surgical disease, but nothing is done in these old fellas. **Young women with fibromuscular dysplasia**, however, need **dilation** of the renal arteries. Diagnose both conditions with a **Renal Artery Doppler** and confirm (if necessary) with **arteriogram**. An **ACE-I Scan (captopril)** may be used instead of renal artery Doppler. Be mindful that this will present as a hyperaldosterone state driven by high renin - a result of a stenosis of the renal artery delivering limited blood to the kidney.

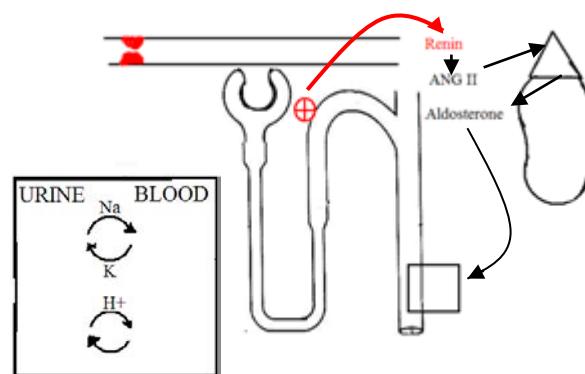
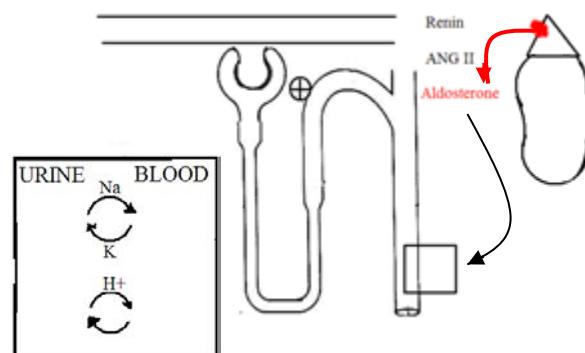
**Pheochromocytoma**

**Paroxysmal Pressure (HTN), Palpitations, Perspiration, Pain (Pounding headache), and Pallor.** Measure **24-hr urinary metanephrenes** and **catecholamines** (VMA is most sensitive). If elevated, follow with a **CT scan** and **resect**. Pretreat patients with **α-blockade** before β-blockers to prevent unopposed alpha stimulation.

**Coarctation**

**Torso hypertension and Leg Hypotension / claudication** in an adult is coarctation. There should be **rib notching** on the chest x-ray. Be careful not to miss simple peripheral vascular disease (see vascular section). The best test is an **arteriogram**, but **CTA** or **MRA** can be sufficient. Surgical correction is sufficient.

The included material is a condensed surgical review of select topics in Hypertension, considered in depth in the medicine sections. This is intended for those studying a Surgery-Only review (i.e. for the shelf)



**Asymptomatic Hematuria**

While there are many causes of hematuria, if there's **asymptomatic hematuria** in any patient consider a urologic cancer. Workup is with a **cystoscopy**, **intravenous pyelogram**, **renal ultrasound**, and **CT scan**. It can be a cancer of the bladder, ureters, and kidneys.

**Renal Cell Carcinoma**

Presents with **hematuria**, **flank pain**, and a **flank mass**. Only 30% of patients present with the typical triad, but every one of the Board patients will have it. An **ultrasound** will reveal a **flank mass** and a **CT scan** will demonstrate the full extent, including ruling out **vena cava** or **renal vein** involvement. Surgery is the treatment. Suspect this in a patient with hematuria without urgency, frequency, and dysuria.

**Bladder Cancer**

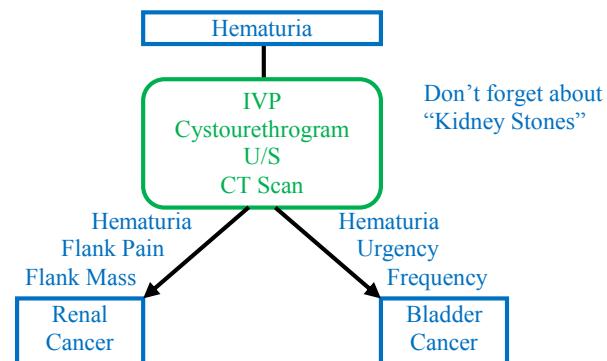
Risk increases with **smoking** and **exposure to β-alanine dyes** (dry cleaning). It may present with voiding symptoms but usually has a **painless hematuria**. If it's a larger tumor an **IVP** or **Cystourethrogram** will reveal it. This might be chosen because it's mildly invasive. The first and best test to actually see the cancer is with a **cystoscopy**.

**Prostate Cancer**

Prostate cancer occurs in **old men** and often contends with the diagnosis of **benign prostatic hypertrophy** (urinary retention, urgency, frequency, and dysuria). While there is a good deal of controversy over screening (PSA and DRE), a **firm nodular prostate** on digital rectal exam in tandem with an **elevated PSA** has a decent sensitivity. If suspected, a **transurethral biopsy** confirms the diagnosis. A **CT scan** will stage the disease. Because men often die WITH prostate cancer and not OF prostate cancer, although **surgery** is an option, so are medical therapies to prevent tumor growth: **anti-androgens (Flutamide)**, **GnRH agonists (leuprolide)**, or **orchietomy** as the cancer is responsive to androgens. Treat metastasis the same way.

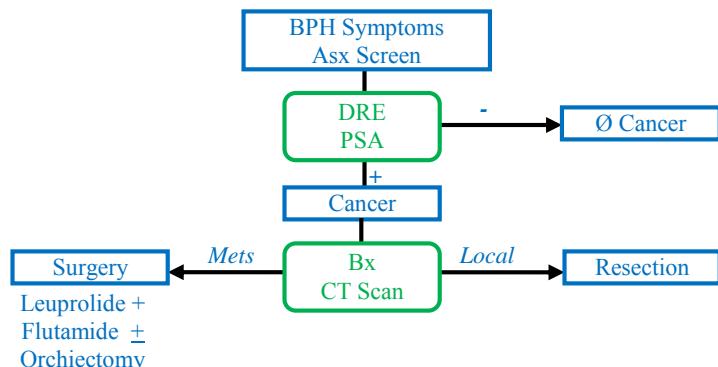
**Testicular Cancer**

A **painless testicular mass** in a **young man** is highly suspicious for testicular cancer. The first test is trans-illumination (which is negative). Since most tumors are malignant and FNA just **spreads the tumor**, a biopsy is done by **orchietomy**. There are some tiny details about testicular cancers that need to be known. Luckily, **Seminomas** are exquisitely **sensitive to chemo and radiation**. Follow an **endodermal sinus tumor** with **AFP**; follow **Choriocarcinoma** with **β-HCG**.



Unless Strong Clinical Suspicion: "CIVUS"

<b>Cystoscopy</b>	Visualize Bladder
<b>Intravenous Pyelogram</b>	GU system
<b>Voiding Cystourethrogram</b>	GU system
<b>Ultrasound</b>	Pelvic Mass
<b>CT Scan</b>	Masses and Staging



<b>Tumor</b>	<b>Risk</b>	<b>Symptoms</b>	<b>Marker</b>	<b>Treatment</b>	<b>Diagnosis</b>	<b>Mets</b>
Renal Cell Carcinoma	Smoking	Flank Pain, Flank Mass, Hematuria	Ø	Surgery	U/S → CT → Bx	Ø
Bladder Cancer	Smoking Dyes	Painless, Asymptomatic, Hematuria	Ø	Surgery	Cysto → IVP → Bx	Ø
Prostate Cancer	Aging	Urinary Retention, Firm Exam DRE	PSA	Surgery	Bx	Leuprolide Flutamide Castration
Testicular Cancer	Cryptorchidism Klinefelter	Painless Testicular Mass	Endo: AFP Chorio: B-HCG	Surgery	Orchiectomy	Radiation Chemo = Platinum (Seminoma)

1) Benign Prostatic Hypertrophy

This causes **urgency**, **frequency**, **dribbling**, and **trouble starting** and **trouble stopping** the flow of urine. It's a natural process of aging and **isn't premalignant**. DRE reveals a smooth, **rubbery prostate** and essentially rules out cancer. The next step is to **rule out infection** with a U/A and UCx. The most important thing to do is to **rule out an obstructive uropathy** with a CR (rule out renal failure). Then, it's medical therapy – **no biopsies!** Treat with  **$\alpha$ -blockers** for immediate symptom relief and a **5- $\alpha$ -reductase inhibitor** for long term therapy. If there's ever evidence of obstruction (**pain**,  $\uparrow$ **Cr**, **hydro-anything**) do an **in-and-out-cath** to decompress the bladder.

2) Erectile Dysfunction

When a man can't achieve an erection begin by deciding if it's **psychogenic** or **organic**. Do this with **nighttime tumescence** to determine if nocturnal erections occur. If he does have erections at night, it's psychogenic and he needs **psychotherapy**. However, if the patient can't achieve erections at night there's an organic cause. Organic causes of **atherosclerosis** or **diabetes** are usually **gradual onset** and can be treated with **phosphodiesterase-inhibitors**. Other organic causes may include a **spinal injury** or an **Arteriovenous malformation** which will **not** be helped by PDE-i. Instead, he can try **vacuum pumps**, or as the last option, **prosthetic devices**.

3) Stones

Kidney stones presents as **colicky flank pain** with **hematuria**. The workup involves U/A and Uex looking for crystals, then a **CT scan** to find the size and location of the stone. Try **hydration** and **analgesics** to pass the stone, **lithotripsy** to break it up, and finally a **nephrostomy** (where urologists come in). See the medical renal section for more details.

4) Bacterial Prostatitis

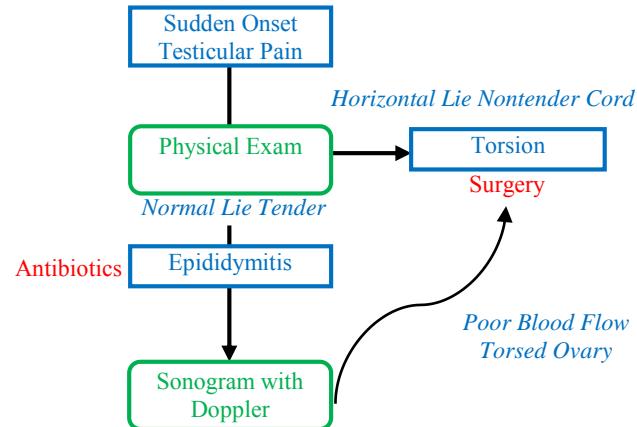
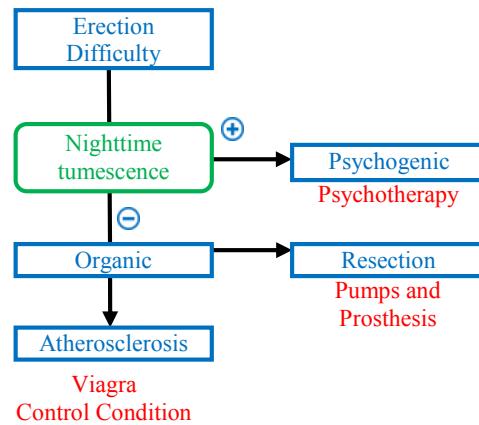
In a patient who has **UTI symptoms** but also **fever**, **chills**, and **low back pain** pyelo might be suspected. If the guy is old, check his **tender prostate** and get a U/A. Once the U/A shows bugs, give **IV antibiotics**. Do not do any more DREs: frequent massage can cause **septic shock**. There's no need for a culture. Send him home on **long term fluoroquinolones**. On the other hand, a person with a **tender prostate but no bacteria in the urine** has a prostatitis (noninfectious) and just needs **NSAIDs**.

5) Testicular Torsion

In a **kid** who has a **sudden onset testicular pain** but without fever, pyuria, or mumps suspect torsion. The testis will be exquisitely **tender** with a **horizontal lie**. Ultrasound with Doppler will show decreased blood flow. This is a urologic emergency and requires **surgical intervention** followed by "tacking" aka **orchipexy**. If it happens to one it can happen to the other - tack that one too.

6) Acute Epididymitis

It's important to separate **torsion** (surgery) from **epididymitis (antibiotics)**; it's also a **testicular pain of acute onset**. The testicle is in **normal lie** and the **cord is tender** (differentiating it from torsion). Because it's so devastating to miss torsion, do a **sonogram**. However, if it's a **sexually active kid** who has gone for days with the pain it can't be torsion. It's usually **E. Coli**. Treat the bug with abx.



**Posterior Urethral Valves = Urethra**

If a newborn **male** presents with **low or no urine output**, +/- **palpable bladder** suspect an **obstructive renal failure** caused by a congenital defect of the urethral valves, where they are too far posterior (that is, too close to the bladder). Think of this as the baby equivalent to bladder outlet obstruction from prostate hypertrophy in old men. Do a **catheterization** to relieve the pressure on the bladder. Failure to do so will cause back pressure to rise, leading to **hydronephrosis** and eventual destruction of the kidneys (there might be a history of oligohydramnios).<sup>-</sup> Confirm the diagnosis with **voiding cystourethrogram**. Ablation (and sometimes surgery) of the abnormal valves is required to avoid **renal transplant** in the future.

**Hypospadias = Urethra**

When the **urethral opening** is on the **ventral surface** of the penis **do not do a circumcision** - use the skin to rebuild the penis correctly.

**Epispadias = Urethra**

When the **urethral opening** is on the **dorsal surface** of the penis **do not do a circumcision** – use the skin to rebuild the penis correctly. (same as hypospadias, just on the other side of the penis)

**Ureteropelvic Junction Obstruction = Urethra**

The ureteropelvic junction has been narrowed which limits the urinary volume. A **narrowed lumen** is the main cause. When urinary volumes are normal there are no problems; the child goes through life completely asymptomatic. When faced with **high-volume load (diuresis, 1<sup>st</sup> EtOH binge)**, the **narrow lumen** can't handle the flow. It essentially becomes an acute obstructive uropathy. It then presents with **colicky flank pain** that resolves with the end of the diuretic challenge. Do an **Intravenous Pyelogram** to confirm the stenosis. An ultrasound will be of no use, usually because the high urinary flow has resolved by the time you see the patient.

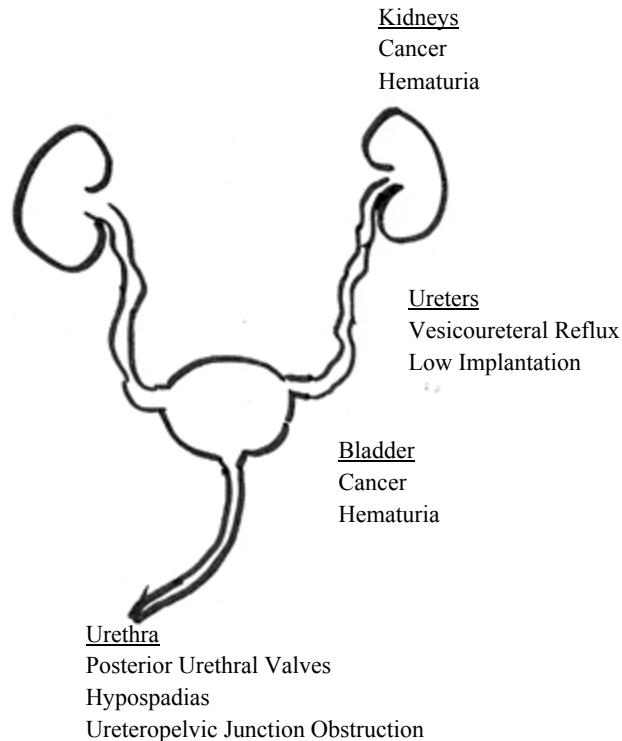
**Low Implantation of Ureter = Ureter**

One ureter puts urine where it belongs (in the bladder) so the child **senses, voids, and empties** the bladder the way she's supposed to. In boys, this remains asymptomatic. In **girls** there's a **constant leak** in addition to the "normal function." There will be no history of dry periods despite adequate toilet training. **Reimplant** the bad one (surgery).

**Vesicoureteral Reflux = Ureter**

This allows bacteria to ascend from the bladder to the kidneys. **Frequent UTIs or any pyelo** in a child should prompt a **Voiding Cystourethrogram (VCUG)** with correction surgically. Alternatively, it can be **treated empirically with antibiotics** and waiting for them to "grow out of it."

*This is duplicated in both pediatrics and surgery*

**Cryptorchidism**

An **undescended testicle** will both atrophy and become a cancer if not brought down to the scrotum. Even if brought down, it will become cancer. It can be given up to **one year** before **bringing it down**. This allows the functionality to return but the cancer risk remains. He needs the testosterone for puberty, but after puberty, **orchectomy** is needed to prevent cancer.

#### Potter sequence

Any severe kidney disorder that prevents the fetus from making urine in utero can lead to oligohydramnios which then can lead to the **Potter sequence**. Essentially, the fetus is squished resulting in clubbed feet, limb deformities, “Potter” faces with extra folds around the eyes and pulmonary hypoplasia (because fetus is not drinking the amniotic fluid, the lungs don’t develop normally)

#### Hematuria = Anything. Probably Kidney

Mild hematuria after **mild trauma** or in an **asymptomatic patient** should warrant a diagnostic workup. Kids don’t pee blood - the chances that there’s a **cancer** or **congenital anomaly** becomes higher. A work up in a child should start with an **ultrasound** and move to radiographs like **IVP**. Avoid CT scans except for staging to avoid high radiation burden in a youth.

#### Understanding urologic testing

**Intravenous pyelogram** is an injected material that moves into the kidneys and down into the GU system. It looks for **stenosis**. Think of it as an angiogram of the GU system; you’re looking for blockages and anatomical variants.

**Voiding cystourethrogram** puts some dye in the bladder. Then the bladder contracts. It isn’t in the ureters. It shouldn’t go to the ureters. If it **ends up in the ureters, there’s a retrograde flow**. That isn’t normal.

**Ultrasound** looks at the tubes. It can see how large they are. Not where they go or where they come from, but if they’re enlarged. That is, they can **see hydro**. Hydro is caused by **obstruction**. Ultrasound is usually done before IVP. It is rarely useful, but is noninvasive and cheap; it is your starting point.

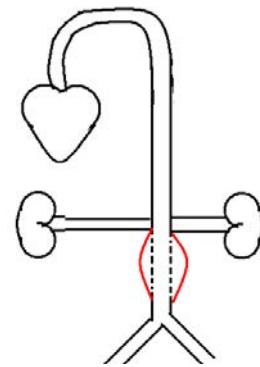
**Cystoscopy** allows us to get a camera into the bladder and the ureters. It is like a colonoscopy for the bladder instead of the colon. It **allows direct visualization from inside the lumen**. It allows for **biopsy of a mass**. Start here for hematuria and the workup of cancer.

**CT scan** has a large contrast burden. **Don’t use it in kids**. But in adults it’s ok. It must have contrast to be useful for the GU system. That contrast, much like an Intravenous Pyelogram, gets into the kidneys and is excreted through the ureters. IVP and CT scan give you the same information, CT scan in greater detail. Use IVP on kids (low radiation) and CT scans on adults

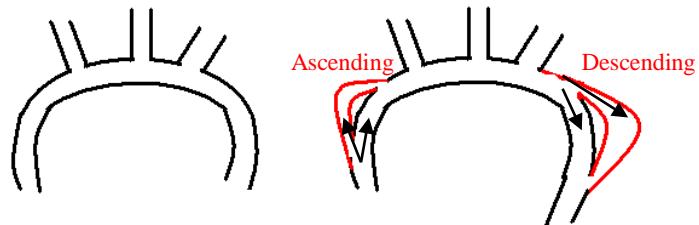
Test	Why
Intravenous Pyelogram	Stenosis
Voiding Cystourethrogram	Retrograde flow
Ultrasound	Hydro
IV-Contrast CT scan	Adult IVP
Non-Con CT Scan	Kidney Stones

Aortic Aneurysm

AAA arise in the abdomen, usually below the renal arteries. A product of **atherosclerosis**, they appear **asymptomatic in old men** - especially in those who **smoke**. One might be able to be palpated if it's severe enough. If it can be felt, it needs to be sized with an **Ultrasound** or **CT**. Alternatively, these tests might be done for something else when one is happened upon. An angiogram may show a "normal" lumen so don't do it. Surgery is required to fix the lesion if the aneurysm is either **>5.5cm** or if it is increasing in size by **>0.5cm/year**. Otherwise, it needs to be **followed** annually with either CT or Ultrasound. However, if there's **pain** the aneurysm is about to blow (**tender**) or is already leaking (**back pain**); surgery is done regardless of size. For screening, recent recommendations are that all **>65 + Male + Smoking History** patients should get a one-time **ultrasound screen**.

Dissecting Hematoma

Occurring in a patient with **uncontrolled hypertension** it presents as a **tearing chest pain that radiates to the back**. Yes, patients with syphilitic aortitis or Marfan syndrome are at risk - but those are rare. Because it's a chest pain, be sure to rule out MI with an **EKG** or **cardiac enzymes**. To work up the dissection an **X-ray** is done first to show a **widened mediastinum**. The best test is a **Spiral CT**, though an angiogram may be done if index of suspicion is high and CT negative. Warning - an angiogram may blow out the dissection. Generally, **medically control the descending hematoma** and **surgically correct if ascending** (because the dissection can compromise the **carotids** and the **aortic valve**).

Arterial Embolization

Patients at risk for arterial clots are **Afib** and those with a **Recurrent MI**. Fat emboli may result from **angio-cath**. There will be a sudden onset of an extremity that is **painful, pale, pulseless**, with **parasthesias**, and **poikilothermia** ("cold"). You have **6 hours** to fix it. Do an **ultrasound** or **arteriogram** to find the site of lesion. Interventions include **embolectomy**, **localized tPA**, or **heparin**. Once treatment is started and blood flow returned, evaluate for compartment syndrome (which, if present, requires a myotomy).

**5 Ps of Embolism**

<b>P</b>	Painful
<b>P</b>	Pale
<b>P</b>	Pulseless
<b>P</b>	Paresthesia
<b>P</b>	Poikilothermia

Subclavian Steal Syndrome (step exam popular)

If a patient gets **arm claudication** and **posterior CN sxs** (vertigo, pre-syncope, N/V) it's Subclavian steal syndrome. **Bypass** the arm stenosis to permit blood flow without stealing it from the brain.

Peripheral Vascular Disease

Peripheral vascular disease is a problem of atherosclerosis that's known to be exacerbated by **smoking** and found in older people. Intervention is based on patient need and vascular stability.

The patient will present with **claudication** (pain in the leg or calf while walking). Confirm the presence of a vascular problem with an **Ankle-Brachial Index**. Loss of hair on hair-bearing regions or reduced pulses might be seen. Cool extremities is the most common finding.

If it affects his/her lifestyle then it's time to intervene. If there's no impact on lifestyle and the patient doesn't have rest pain, watching and waiting is ok. "Watching and waiting" means conservative therapy (see the last paragraph on this page).

Once intervention is chosen it has to be confirmed. There's a **single occlusion** that can be corrected versus untreatable **diffuse disease**. A single occlusion represents a region that can be bypassed or stented, while diffuse disease is essentially untreatable. To determine which it is, follow the ABI with **Ultrasound with doppler** looking for a **pressure gradient** drop. If there isn't one there is diffuse disease; the only therapy is conservative measures. If there is one, confirm with **arteriogram**.

A lesion that is both **in the femoral artery** and **<3cm** can be **stented**. Everything else get a **bypass**. Typical bypass are (aorto-fem, fem-fem, and fem-pop). Essentially, take the nearest good flow and connect it to the bad flow distal to the lesion.

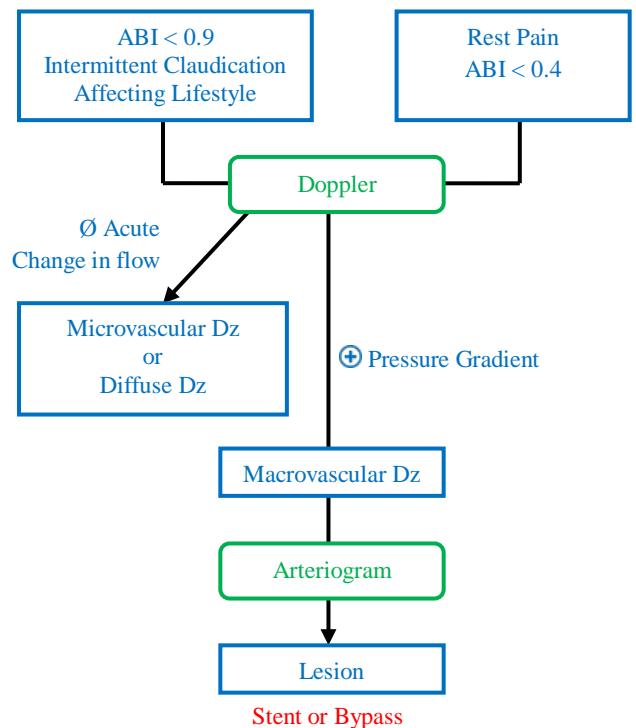
The big red flag and marker for an urgent condition is the patient with **rest pain** (versus claudication). Here, there must be intervention. The patient will paint a picture of arterial insufficiency: **shiny scaly skin** distal to the occlusion with **pale painful legs** that improve (and turn **purple**) when dependent. Fix it or amputate.

**Most patients will not have an intervention.** Most patients will not have an investigation. If the patients' symptoms do not significantly impact his/her life, then he/she ought to be treated with conservative management and **no investigation** should be made (saves money).

If the patient's symptoms interfere with his/her lifestyle or there is rest pain, then an investigation needs to happen. Know, though, that intervention is **palliative - not curative**.

Conservative therapy means:

1. Control risk factors (diabetes, hypertension, dyslipidemia)
2. **Smoking Cessation**
3. Exercise classes to get more distance before symptoms
4. **Cilostazol** for symptom control, only if no CHF
5. Anti-platelets: **Aspirin** will do, Clopidogrel if stented



ABI	Index
Normal	0.9 – 1.2
Mild	0.8-0.9
Moderate	0.5-0.8
Severe	<0.5

**Penetrating Trauma**

There are two types of penetrating trauma to the abdomen

i. **Gunshot**

A bullet that enters the peritoneum requires **exploratory laparotomy**. Period. The risk that a visceral organ has been punctured is too great. Open the patient and “**run the bowel**,” sewing any holes and stopping bleeding. It **isn’t necessary to remove the bullet**. There are times where **small caliber gunshots** to the **Right Upper Quadrant** may not need ex lap, but those decisions will be made by someone else. For you, any gunshot **below the nipple line** gets an ExLap.

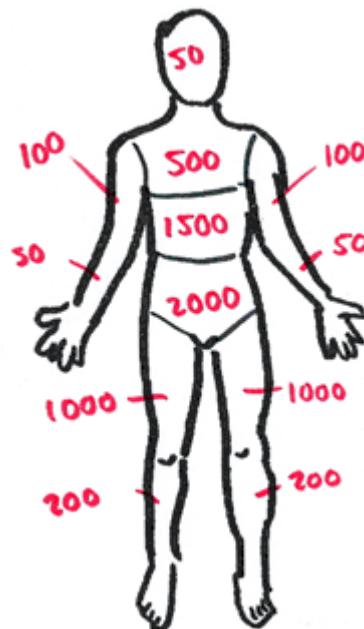
ii. **Penetrating / Stab / Object**

If there’s a big ol’ hole or it’s a serious wound it calls for an ExLap. That means **evisceration**, **peritoneal signs**, or **hemodynamic instability** goes directly to **ExLap**. The same is true if the patient has been impaled. But if the patient has just a little cut and it isn’t clear if it has penetrated into the peritoneum, there are two options. The first is to **explore the wound** being cautious not to perforate the peritoneum with a finger if it isn’t already (if the finger pops through, the patient goes to ExLap). The second thing is to get a **CT** and **FAST** to rule out intra-abdominal complications.

*If penetrating injury from the nipple to the hip, explore the abdomen*

**Blunt Trauma**

The decision for surgery in blunt trauma isn’t so simple. Many organs can be affected. The reasons to go to surgery are uncontrolled **hemorrhage** or visceral organ rupture (**peritoneal findings**) Findings that would prompt investigation are any  $\oplus$  peritoneal findings or signs and symptoms of **shock**. The pelvis can hold **2000mL** of blood and the abdomen **1500mL**, enough to cause irreversible hemodynamic shock (i.e. death). The first step is to decide if there’s bleeding or not with **Focused Abdominal Sonography** following **Trauma (FAST)** which is a quick and easy way to say “yes” or “no.” The older **diagnostic peritoneal lavage** is rarely done. If stable enough to wait, a **CT scan** is definitive and can give a more specific location and site of the hematoma.

i. **Ruptured Spleen**

The spleen is **not vital** but **bleeds like crazy**. It has a capsule to contain it, but is often difficult to repair. Because of its **immune function**, repair is preferred. However, **splenectomy** is performed if it can’t be repaired or there are other injuries to tend to. Make sure these patients get **vaccinated** against **encapsulated organisms** after surgery.

ii. **Ruptured Liver**

The most common cause of intra-abdominal hemorrhage. Repair as much as possible and perform a **lobectomy** as needed. The ligamentum teres causes liver lacerations.

iii. **Ruptured Diaphragm**

After abdominal trauma, **bowel sounds in the chest** confirmed by an **X-ray** - often missed. Suspect this with a  $\oplus$  **Kehr's Sign** which is shoulder pain from diaphragmatic irritation following trauma.

*Pringle Maneuver = compression of hepatoduodenal ligament, sealing the hepatic artery and portal vein. Continued bleeding means transection of the hepatic vein*

iv. Other Organs

**Pancreas, kidneys, small bowel** - all can be affected and require repair. However, these often do not cause hemodynamic instability

Pelvic Fractures (Abdominal Blunt Trauma)

High-speed, large-damage trauma (MVAs or Falls) can cause **pelvic fractures**. Pelvic fractures are the **gateway injury**. Once one is identified, urologic and rectal injury must also be considered. Look for evidence of urethral injury (**blood @ meatus** or a **high-riding prostate**) and do a **retrograde urethrogram** prior to the insertion of a foley. To look for rectal injury, do a **proctoscope**. Ureter injury can be difficult to diagnose. It can be evaluated either with an **intravenous pyelogram** preoperatively or **methylene blue** intraoperatively.

Finally, even though the pelvis can contain up to **2L** of blood, **never explore a pelvic hematoma**. While it's bleeding it's necessary to **replace blood** and **follow H/H**. Eventually, the bleeding will **tamponade** if left alone. Because most of the bleeds in the pelvis are venous, as long as there is **no hemodynamic instability** external fixation and serial hemoglobins is an acceptable answer. What becomes very important, then, is diagnosing a pelvic fracture (other sorts of bleeding require surgical intervention). The pelvis is a donut; if it fractures in one place it's likely to fracture in another. **Hip-rocking** will produce **crepitus, pain, and mobility**. Externally fix the pelvis to help it heal. A pelvic fracture should also be suspected even without obvious signs if looking for a **large bleed** that isn't found in the abdomen or thigh. Do an **X-ray** followed by a **CT** to confirm it.

*Blood at meatus + High riding prostate = Urethra Injury*

- Retrograde Urethrogram
- NO foley

*Pelvic injury = Rectal injury*

- Proctoscope (DRE not sensitive)

*Not really a way to suspect Ureter injury*

- Intravenous Pyelogram (preoperatively)
- Methylene Blue injection (intraoperatively)

*Hemodynamically stable + Pelvic Fracture + bleed*

- do NOT explore
- external fixation

*Hemodynamically unstable + pelvic fracture + bleed*

- explore
- internal fixation

Injury	Condition	Intervention	Then	Extra
Gunshot Wounds	ExLap Regardless of findings			No need to remove the bullet
Stab Wounds	Hemodynamic Instability Peritoneal Signs Evisceration Negative for all above	Ex Lap Ex Lap Ex Lap Explore Wound	FAST, CT Scan, Ex Lap if $\oplus$	
Blunt Abdominal Trauma	Hemodynamic Instability Peritoneal Signs Hemodynamically Stable Ruptured Diaphragm Ruptured Spleen Ruptured Liver	FAST Ex Lap FAST CXR FAST FAST	Ex Lap  CT Scan, Ex Lap if possible CT Scan, Ex Lap CT Scan, Repair, Splenectomy CT Scan, Repair, Lobectomy	Kehr's Sign Vaccinate Most Common
Pelvic Fracture	Bleed but $\ominus$ FAST Blood @ Meatus or high-riding prostate Crepitus, Pelvic, Mobility	CT Scan Retro Urethrogram XR	Serial H/H, Give Blood Foley Cath CT Scan, Blood as Above	NEVER explore

1) Rabies

Rabies must be considered when any **animal bite** has occurred. What is done with the animal and the person depends on risk of the animal. If a **domesticated animal** is **provoked** (a little girl pulls a dog's tail), just **observe** the animal. If it's an **unprovoked** attack (signs of rabies) or is a **wild animal** the index of suspicion goes up. Wild animals usually run. The animal needs to be **captured and killed** so we can look for signs of rabies in the brain biopsy. If  $\oplus$  **Rabies** or the animal is **Unavailable** (nutty squirrel attacks and flees) give **rabies ppx** (vaccine + IgG).

2) Snakebite

Snakes may be venomous or not. A venomous snake can envenomate or not. Those that are venomous will have danger features: **slit-like eyes, rattlers, cobra cowl**. They should prompt **anti-venom** treatment. **Young snakes** can't control their venom and are more dangerous. If the snake can't be identified, look for signs of toxin (**erythema, skin changes, and pain**). Movies show **cutting, sucking, and tourinquetting** - those are delay measures that are **not** done in the hospital. We're providing treatment and operating if necessary.

3) Bee Stings

In any regular person bee stings hurt and the pincer may need to be removed. End of story. Susceptible/allergic people go into **anaphylaxis** (warm, flushed, wheezing, stridor) and require vasopressor support with **1:1000 Sub Q Epinephrine**. This is a form of vasomotor shock. Giving antihistamines is useless as the reaction has already occurred.

4) Black Widow Bites

If the patient sees a **black spider** with an **hourglass** on the belly (highly unlikely to see it and get bit) and then has **abdominal pain or pancreatitis** it was a black widow. Give **IV Calcium Gluconate** to stabilize muscles.

5) Brown Recluse

If a patient is going through an **attic or old boxes** (especially in the **south**) and gets bit by "something" think brown recluse. The patient will be asymptomatic for the first day. The next day there is a small ulcer. This is the time to act. **Necrotic ulcers** with a **ring of erythema** at the **bite site** is brown recluse. A **wide debridement** will need to be done. Continue to monitor as the toxin goes to work over about a week. Skin grafts will be placed after the fact.

6) Human Bites

Human bites that break skin are some of the dirtiest wounds possible. Whether from **sexual endeavors** or a **fist fight** (knuckle on tooth) there is likely a cover story. The patient needs surgical exploration and massive irrigation. Antibiotics are generally not done as a prophylactic, but close monitoring for abscess formation is critical (strep, staph, anaerobes).

*Animal Bite*

*Domesticated Animal and Provoked → Observe  
Wild Animal → Kill + Biopsy  
Unavailable or  $\oplus$  Bx → IgG + Vaccine  
 $\ominus$  Bx → Observe*

*Snakebite*

*Danger: Slit-Like Eyes, Cobra Cowl, Rattlers  
Pt: Erythema, Skin Changes, Pain at site  
Tx: Anti-venom IV, Ø Tourniquet/Cut/Suck*

*Bee Stings*

*Normal: remove pincer, treat pain  
Anaphylaxis: Epi Sub Q 1:1000*

*Black Widow*

*Danger: Black Spider with Hourglass Belly  
Pt: Abdominal Pain, Pancreatitis  
Tx: IV Calcium Gluconate*

*Brown Recluse*

*Danger: Attic, Boxes and Ulcer at Bite site  
Pt: Necrotic Ulcer with Ring of Erythema  
Tx: Wide debridement, grafts*

*Human Bites*

*Danger: Sexual Endeavor, Fist Fight  
Pt: Laceration only, cover story  
Tx: Wash, abx and drain if abscess*

There should be some tight, knee-jerk reactions with each kind of burn that should be known. Beyond that, it's fluid management and calculating area burned.

### 1) Chemical Burns

**Alkaline** are **worse** than **acidic** burns. It's imperative to **irrigate like crazy**. Attempts to neutralize will result in **burns**. There are some buffers, they shouldn't be applied to the skin. Simply irrigate to get rid of the chemical. If ingested, do **NOT induce vomiting**, but rather do a **mild buffer**.

### 2) Electrical Burns

Caused by **lightning strikes** or contact with **high-voltage lines** they cause both **entrance** and **exit** wounds. These take the path of least resistance (i.e. through the electrical conduction system of the heart) causing **arrhythmias**. It also travels through bone, heating them, and cooking the muscle nearby. This yields **massive myoglobinuria** (check a **CK**) as the muscle is destroyed. But because the muscle is next to the bone, there may be **no external signs** of injury. Hydrate and give mannitol to avoid **renal failure**. Finally, **muscle contractions** can cause posterior shoulder dislocations. Long-term sequelae are **demyelination syndromes** and **cataracts**.

### 3) Respiratory Burns

If there are **burns** or **soot** in or around the **mouth or nose** consider inhalation injury (**smoke, chemical, etc**). The patient is usually trapped indoors near a fire. The major concern is the **airway**. Patent now, it can **close fast**. Analyze the airway with **bronchoscopy** but **secure** it with **intubation**. If it needs to be determined who needs an airway, use **ABGs** - but do it fast.

### 4) Circumferential Burns

Yeah that burn hurts, but the swelling and **edema** that forms under a **thick, leathery eschar** will tamponade vessels (on the extremity) or constrict breathing (on the thorax). **Cut the eschar** to allow the tissue to expand. Because the burn killed the nerves, it can just be cut out without anesthesia and at the bedside!

### 5) Fluids Rule-of-Nines / 50-50 in 8-16

Only **2<sup>nd</sup>** and **3<sup>rd</sup> degree** burns count. When using the rule of nines we're estimating the **body service area burned** in order to determine severity and **how much fluid** is needed. With significant burns, there'll be massive fluid and electrolyte shifts/loss. Use the **Parkland Formula** to decide how much fluid to give. The first **half** is given in **8 hrs** and the second **half** is given in **16 hrs**. While the formula is used to determine replacement, 2000 D<sub>5</sub>W is for daily losses. Realistically, just start them off at a fluid rate and adjust to a **U<sub>output</sub>** or **Central Venous Pressure** that is adequate. From there, it's about supportive care: **pain management, nutrition, electrolytes**, and rehab. **Early regrafting** can be done on small areas of burns, but a long **painful rehab** is ahead of the patient. Early movement is critical to prevent scarring. Use **silver sulfadiazine** and **mafenide** to prophylax against infection. In a **pediatric patient** take one of the 9s and give it to the head.

**1<sup>st</sup> Degree = Epidermis, Erythema, Ø Blister**

**2<sup>nd</sup> Degree = Dermis, Erythema, +Blister**

**3<sup>rd</sup> Degree = Dermis or deeper, painless, white or charred, edges surrounded by 2<sup>nd</sup> degree burns**

Chemical Burns → Irrigation

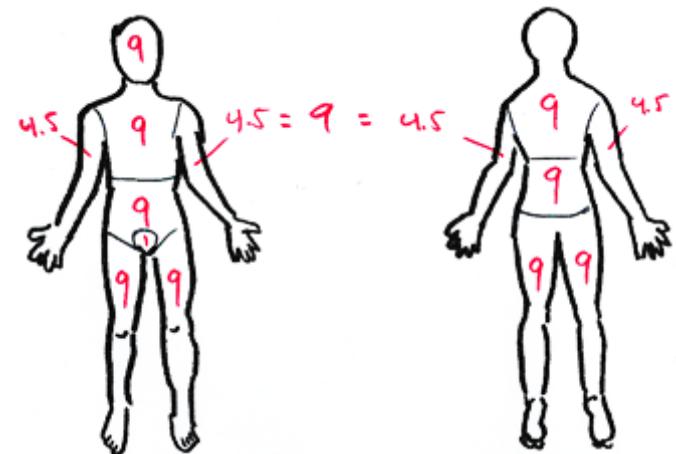
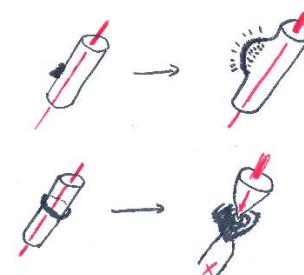
- Never buffer on skin
- Never induce vomiting (buffers ok)

Electrical Burns → U/A, Myoglobin, CK

- Arrhythmias
- Posterior Shoulder Dislocations
- Demyelination

Respiratory Burn → Intubate

- Bronchoscopy
- Endotracheal Intubation



(Kg x % BSA Burned X 4cc) of LR + 2000cc D<sub>5</sub>W

1) Rib Fracture

Caused by **blunt trauma** to the chest, it produces sharp strands of bone that can cause **penetrating** type injuries. Rib fractures **hurt** but are rarely deadly on their own. In the elderly, who may not **breathe enough** (because it hurts to do so), **atelectasis** and **pneumonia** may develop (and kill them). Treat the pain, but don't go overboard with **opiates** because they also cause respiratory depression.

2) Pneumothorax

A product of **penetrating trauma**, air rushes into the pleural space and compresses the lung. This causes super-atelectasis and resulting **dyspnea**. The lung sounds will be decreased on the effected side with **hyperresonance**. Place a **chest tube** to take out the air and re-expand the lung. Because there's no compromise to vascular supply, there isn't a need for a needle decompression. X-ray shows **vertical lung shadows** inside the normal lung space.

3) Hemothorax

Also caused by **penetrating trauma**, blood rushes in instead of air. **Dyspnea** prompts a CXR showing **air-fluid levels**. This could also be a chylothorax but management is identical. There will be decreased lung sounds and it will be **dull to percussion**. Place a **chest tube** (thoracostomy) and drain the blood to prevent empyema. Here is where pneumothorax is different. **Surgical exploration** (thoracotomy) for the source of bleeding is required if the chest tube produces  $\geq 1500\text{mL}$  on **insertion** OR **600mL/6hrs**, indicating the bleeding is systemic and will not stop on its own. This is rare because the pulmonary vasculature is a low-pressure system and clots easily.

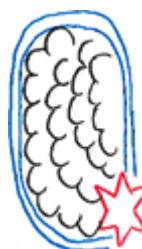
4) Sucking Chest Wound

Caused by an externally **penetrating trauma**, it's obvious on physical exam. A **flap of skin** forms a one-way **valve**, allowing air to enter the pleural space, but then trapping the air on exhalation. This trapped air accumulates, producing a **tension pneumothorax**. There's need for an **occlusive dressing** (like cyran wrap) **taped on 3 sides**. Treat the pneumo for the air that is already there.

5) Flail Chest

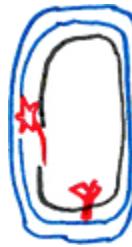
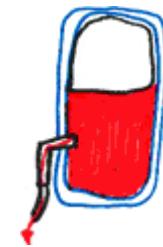
This requires **two or more ribs broken in two or more places**, which means pretty significant **blunt trauma**. The effected piece moves **paradoxically** to the rest of chest (**sucks in on inhale, protrudes on exhale**). It's necessary to keep the ribs aligned to heal, so use **wraps** or **weights** to do so. This may cause dyspnea so monitor with pulse oximetry and ventilation. The real problem is the fact that the patient suffered an impact so severe it caused a flail chest. Look for and be cautious to treat more severe disease: **pulmonary contusion**, **cardiac contusion**, and **aortic dissection**. Any flail chest, **scapular fracture** or **sternal fracture** implies significant trauma and should increase the index of suspicion for underlying disease.

Chest Tube High (air floats)

Penetrating trauma  
pops the lung

Air fills pleural space

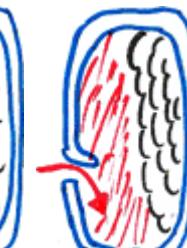
Vertical Air-Lung Level

Pleural space full of air  
(Resonant to percussion)Penetrating trauma  
causes a bleed

Chest Tube Low (Blood sinks)

Horizontal Air-Fluid  
LevelPleural space full of blood  
(Dull to percussion)

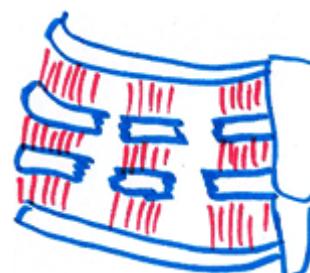
Valve open on inhale   Valve closes on exhale



Valve open on inhale   Valve closes on exhale



Air Trapping



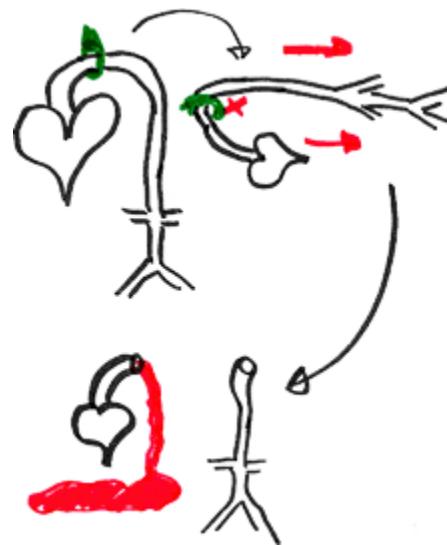
Two or more ribs broken in multiple places

6) Pulmonary Contusion

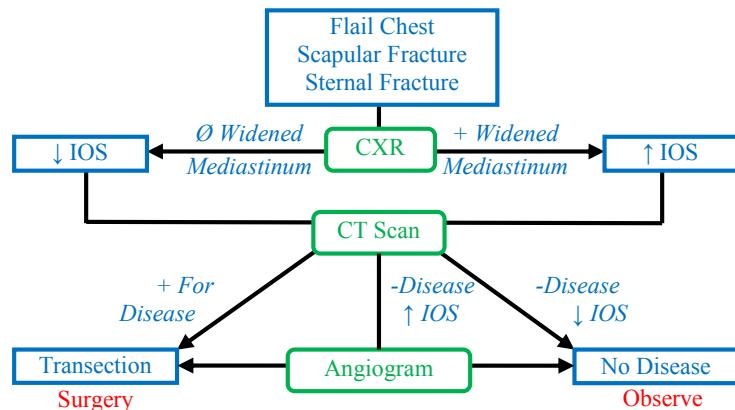
A contused lung already has leaky capillaries. It then becomes sensitive to **fluid shifts**. Because it may not be immediately apparent, look for clues of severe trauma (scapular fracture, sternal fracture, flail chest) and treat as though they have it. **Avoid crystalloids** (LR + NS) and fill the vascular volume with **colloids** (blood and albumin). Use diuretics and be cautious with heart failure (a contused myocardium may lead to pump failure). If it happened, a **chest X-ray** will show **white out 48hrs after injury**. If they had enough trauma to cause it, they are likely in the ICU getting serial X-Rays anyways.

7) Myocardial Contusion

You know when to look for pulmonary contusions. At the same time, look for myocardial contusions with **serial EKGs** and **Troponins**. They will be elevated from the beginning. The only thing to be done is stabilize and treat **arrhythmias** and **heart failure** as they occur - just like an **MI** (MONA-BASH).

8) Traumatic Dissection of Aorta

The aortic arch is held in place by the **ligamentum arteriosum**, the former ductus arteriosum. Most of the aorta is freely floating. In a **deceleration injury** (i.e. a front-end car crash) the visceral organs continue forward except for the one attachment site at the arch, which **shears** the aorta. Full transections are almost **instantly fatal** and are found dead at the scene. Partial transections develop an **adventitial hematoma** which are **asymptomatic** until they rupture and the patient dies. The first step is to do an **X-ray**. If there is a **widened mediastinum** the index of suspicion is high. Now do a **CT scan**. If positive, go to **surgery for repair**. If negative and low index of suspicion, it's ok to stop. But if there's a high index of suspicion on the X-ray and the CT was negative, it's still necessary to rule out the disease with an **angiogram**.



Injury	Trauma	Patient	Dx	Tx	Other
Rib Fracture	Blunt	Pain on inspiration	CXR = Fx	Pain control, avoid atelectasis → PNA	Ø
Pneumo thorax	Penetrating	Dyspnea, Hyperresonant lung sounds, ↓ breath sounds, Ø Tracheal Deviation	CXR = Vertical Lung Lines Dark Fields	Chest Tube	Ø
Hemo thorax	Penetrating	Dyspnea, Dull Percussion, ↓ breath sounds, Ø Tracheal Deviation	CXR = Air-Fluid Levels, Thick white fields	Chest Tube	> 600mL/6hrs or >1500mL on insertion, do surgical exploration
Sucking Chest Wound	Blunt	Skin flap valve Hyperresonant Tension Pneumo	Ø Radiographic Finding	Occlusive Dressing	Taped on 3 sides to avoid tension pneumo
Flail Chest	Blunt	Paradoxical movement of chest wall	CXR = Multiple ribs with multiple fractures	Banding or weights	Look for contusions and ruptures
Pulmonary Contusion	Blunt	Hidden, appears 48 hrs later	CXR = White out (days later)	Colloids, Diuretics	Exquisitely sensitive to fluid
Myocardial Infarction	Blunt	Hidden, appears immediately, dyspnea	EKG + Troponins	Chase Arrhythmias and Heart Failure	Ø

Penetrating trauma to the head is a bad thing. It's visible; there is no diagnostic challenge and the treatment is surgery. The prognosis is poor. Thus, we'll focus on **blunt head trauma** and its various presentations. The diagnostic test of choice is always the **CT scan** and is essentially always done.

### 1) Basilar Skull Fracture

If there are **raccoon eyes** (periorbital ecchymosis), **battle signs** (postauricular ecchymosis), or **oto- or rhinorrhea** (clear CSF) there's a fracture of the base of the skull. Management of the fracture itself isn't as important as the **cervical spine** which must be evaluated by **CT scan**. The patient will be in the scanner anyways, so it's easy to move it down a little.

### 2) Acute Epidural Hematoma

Classically caused by trauma to the **side of the head** (baseball to the temple for example) that shears the **middle meningeal artery**. The history will be after trauma: **loss of consciousness** followed by a **lucid interval** then with general decreasing mental function to **coma**. The expanding hematoma causes a herniation syndrome of the uncus: **ipsilateral fixed dilated pupil** and **contralateral hemiparesis**. Diagnosis is made clearly with **CT scan** showing a **lens shaped** hematoma. **Craniotomy** and evacuation produces excellent results.

### 3) Acute Subdural Hematoma

In a **young person** a subdural hematoma injury requires a significant amount of force. For this reason there's usually a **positive loss of consciousness** without a lucid interval following **major trauma**. The patient's neural status is likely from the initial blow rather than the hematoma. **Craniotomy** is performed if midline shift is noted on CT, otherwise the goal is to **decrease ICP** with elevation, hyperventilation, and mannitol. **CT scan** shows a **crescent-shaped** hematoma.

### 4) Chronic Subdural Hematoma

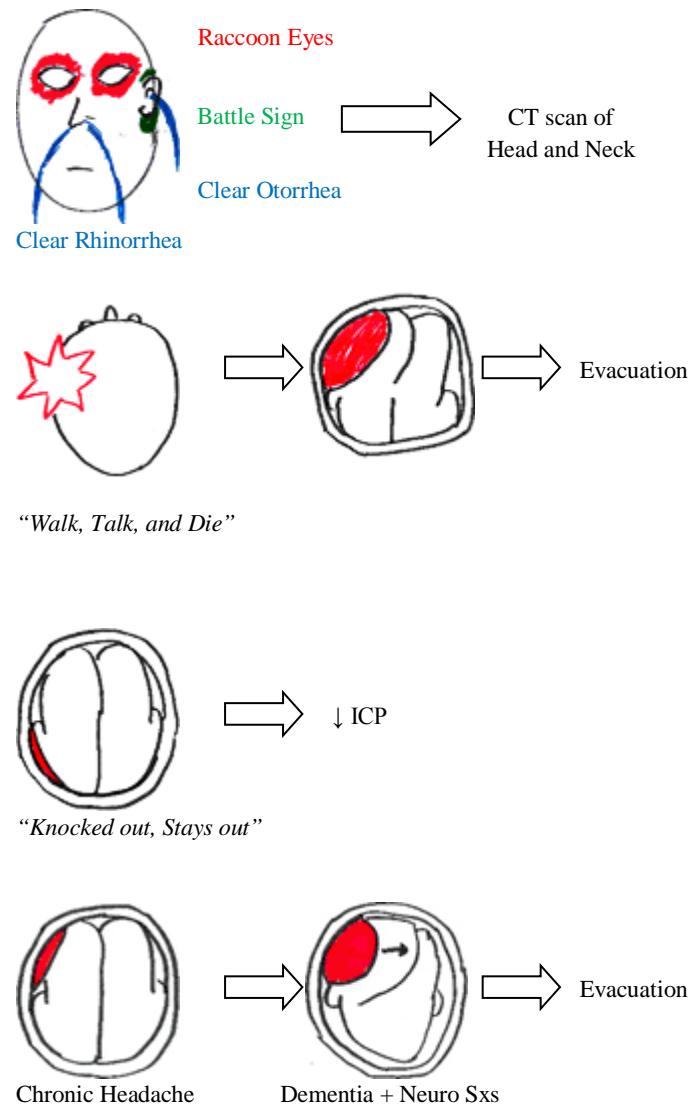
In the **elderly, demented patients, and alcoholics** brain atrophy has tensed the **bridging veins** so that even minor trauma can shear the veins, producing the slowly evolving hematoma. The patient will have a **gradually deteriorating mental function** appearing as a dementia. **CT scan** reveals the hematoma; evacuation reverses the effects.

### 5) Diffuse Axonal Injury

In **angular trauma** such as spinning in a car struck on an angle, the axon fibers can shear. This produces a **blurring of the grey-white matter** that's seen best on **MRI**. The degree of injury correlates to the length of the coma and overall prognosis. Little can be done - surgically or otherwise. It's essential to monitor and manage **ICP** until they come out of the coma.

### 6) Concussion

Following head trauma, if there's a **loss of consciousness**, especially with **retrograde amnesia**, the patient likely has a concussion. Popular with **sports injuries** the patient of course gets a **CT**. If the CT is normal he/she can go home **but with family** to ensure he/she doesn't slip into a coma. He/she must stay awake.



PRAY

*Go home, but poke him/her to make sure he/she wakes up*

**1) Penetrating Trauma of the Neck**

Before beginning, anyone with penetrating trauma to the neck who is deteriorating (**expanding hematoma**, **coughing blood**, or going into **shock**) needs immediate surgery. However, because the blood supply is difficult to control (blood comes from the subclavian under the clavicle and disappears into the skull) and there are so many vital structures nearby we only want to do surgery when necessary. **Stab wounds** are the **most conservative** as they are not guaranteed to penetrate. Get an ultrasound or arteriogram to rule out bleed and observe. **Bullets**, on the other hand, generally shred things up. Because it's possible to get good control of the vessels in the middle zone, **explore all gunshots in this area**. However, it's risky cutting into the other two, so do a thorough evaluation (**arteriogram**, **esophagram**, and **bronchoscopy**) before surgery. Alternatively, a **CT head and neck** can be done and surgery follows if something is found. A CT is likely to be ordered anyways to evaluate the **spine and cord**.

**2) Cord Injuries**

Any trauma to the spinal cord (**blunt** or **penetrating**) will be definitively diagnosed with an **MRI**. Surprisingly, most of the cord damage is done by the **edema** (unless it's a tearing trauma like a knife or gunshot). To decrease damage and retain neurologic function, give **high dose dexamethasone** in the ICU. Use defects to localize lesions. We'll discuss only the key traumatic lesions here. See "Neuro" notes for more lesions.

(i) Complete Transection

**Motor** and **Pain** and **Sensory** are lost below the site of lesion. There'll be **lower motor neuron** symptoms at the level of the lesion and **upper motor neuron** symptoms below the lesion. All lesions are bilateral.

(ii) Hemisection

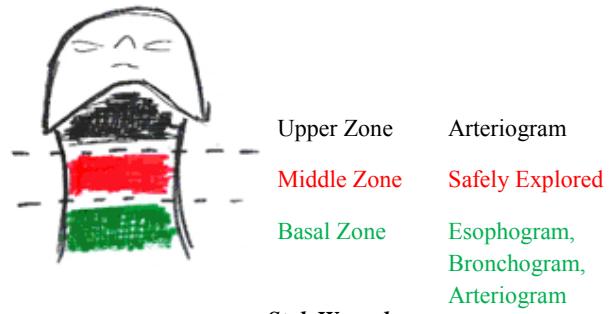
This occurs almost always after a clean-cut wound like a **stabbing**. Because motor and sensory cross at the brainstem, there's an **ipsilateral** loss of **motor and sensory** below the lesion. Pain fibers cross immediately, so there's a loss of **pain contralaterally**.

(iii) Anterior Cord Syndrome / Syringomyelia

Either from a burst fracture or from a **fluid filled central canal**, the syrinx eats into the spinal cord. Pain fibers cross near the central canal so **bilateral pain and temperature** is lost first in a **cape-like fashion**. There's preservation of motor and sensory. This can also be seen in lower extremities in the presence of an **AAA**, resulting from **artery of Adamkiewicz** infarction.

(iv) Central Cord Syndrome

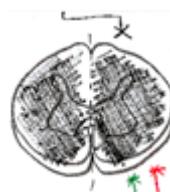
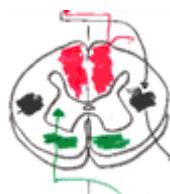
Occurs when the **elderly hyperextend** their **neck** (no headrest in an MVA). There's often a **paralysis** and **burning pain** in the upper extremity with preserved function in the lower extremity.

**Stab Wounds**

All hematoma, gurgling, shock	Surgery
Upper Zone	Asx
Middle Zone	Asx
Basal Zone	Asx

**Gun Shots**

All hematoma, gurgling, shock	Surgery
Upper Zone	Asx
Middle Zone	Asx
Basal Zone	Asx



Nothing gets through. No motor, no sensory, no pain/temp on both sides. Everything above the lesion still works.



Half the cord works.

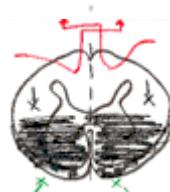
**Pain** + Cross (Contralateral Broke)

**Motor** Ø Cross (Ipsilateral broke)

**Sensory** Ø Cross (Ipsilateral broke)



Pain/Temp crosses, breaking both sides  
All others intact



Motor and Pain/Temp broken on both sides  
Sensory intact

Introduction

Whenever dealing with a trauma patient, the priorities are the ABCs: Airway, Breathing, Circulation - in that order. Without a patent airway air is unable to move with breaths. Without breathing it's impossible to deliver oxygen or remove CO<sub>2</sub> - there's no point in having circulation. Therefore, the first step should be the evaluation of the airway.

- 1) **Airway:** an airway is considered **patent** if the patient is **talking, coughing, or moving air**. If the patient is **gurgling** (blood or fluid), there's **stridor** (laryngeal edema), or has **no air movement** (apnea), then we must intervene. A patient may appear stable but requires prophylactic intervention in the case of an **expanding hematoma** or **severe trauma**. An airway is assessed with a **head-tilt chin-lift** and secured with an **endotracheal tube** or with **cricothyroidotomy**. Emergent tracheostomy should NOT be attempted in the ER, only in the OR.
- 2) **Breathing:** if there are **bilateral breath sounds** the patient is breathing adequately. A **BVM** or **ventilator** may be needed to assist ventilations. Monitor breathing with **pulse oximetry** and/or **end-tidal capnography**.
- 3) **Circulation:** shock is defined by any number of parameters. A **Systolic Blood Pressure < 90** or **Urine Output < 0.5mL/kg/hr** or clinical signs of shock (**pale, cool, diaphoretic, sense of impending doom**) is sufficient to diagnosis shock.

Shock

Shock in the traumatic setting has one of three causes.

- 1) **Hemorrhage** drains the tank. There is a hole somewhere that needs to be plugged. The patient will have **flat veins** and **rapid HR** to compensate. The most important thing to do is **plug the hole** in the OR. However, there may be **transport time** or **prep time** before the hole can be closed. In the meantime, start **2 large bore IVs ( $\geq 16$  G)** and run fluids. First **LR** then **Blood** as it becomes available. See **Resuscitation and Location** to the right.
- 2) **Tamponade** is caused by severe **blunt trauma** that reduces cardiac filling. Blood backs up into the venous system so the patient presents with **distended Neck Veins** but **clear lung sounds**. Emergent **pericardiocentesis** (ER) or **mediastinotomy/thoracotomy** (OR) is required.
- 3) **Tension Pneumothorax** is caused by **penetrating trauma** and fills the pleural space with air or blood, compressing the veins feeding the heart. There are **distended neck veins** (like in tamponade) but there are **reduced lung sounds** on the affected side and **tracheal deviation** away from the lesion. Emergent **needle decompression** and **chest tube** (thoracostomy) is required.

<b>Unconscious (GCS&lt;8)</b>	<b>Expanding Hematoma</b>	<b>Talking in full sentences</b>
<b>Gurgling</b>		
<b>Stridor</b>		
	<b>Cutaneous Emphysema</b>	<b>Coughing Good Air Movement</b>

**Managing the Airway**

<b>OPA</b>	Avoid OPA in gag reflex
<b>NPA</b>	Avoid NPA in facial fracture
<b>ET Tube</b>	Preferred Definitive Method
<b>NT Tube</b>	Avoid in facial fracture
<b>Cricothyroidotomy</b>	If ET Fails, temporizing
<b>Tracheostomy</b>	Only in OR, Definitive

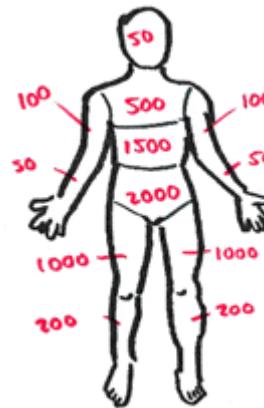
**Breathing**

<b>Monitor</b>	SpO <sub>2</sub> , ET-CO <sub>2</sub>
<b>Intervene With</b>	BVM, Ventilator, Oxygen

**Circulation**

**Shock = SYS BP < 90 or U<sub>output</sub><0.5mL/kg/hr**

Type	Physical	Path	Tx
<b>Hemorrhagic</b>	Flat Veins, Clear Lungs	Active Bleeding	IVF, Blood, Surgery
<b>Tamponade</b>	Engorged Veins, clear Lung Sounds	Blunt Chest Trauma	Pericardiocentesis Pericardial Window
<b>Tension Pneumo</b>	Engorged Veins, ↓ Lung Sounds	Penetrating Chest Trauma	Needle to Chest Tube
<b>Cardio genic</b>	Engorged Veins, ↑ Lung Sounds	Massive MI	Inotropes
<b>Vasomotor</b>	Flushed, Pink, Warm	Spinal Trauma or Anesthesia	Vasopressors
<b>Septic</b>	Flushed, Pink, Warm	Sepsis	Vasopressors and Abx

**Hemorrhagic Resuscitation**

- (1) Direct Pressure
- (2) Elevate Extremity
- (3) Arterial Tamponade
- (4) Tourniquet
- (5) 2 Large G IVs → IO
- (6) IVF (Crystalloids)
- (7) Blood
- (8) Surgery

[Intervene Now](#)

[Airway](#)  
[Intervene Soon](#)

[No Intervention](#)

Do not be confused by some of the causes of non-traumatic shock

- 1) **Cardiogenic** shock occurs after a **major MI** and is a product of **pump failure**. Forward flow fails so blood backs up. There will be **bilateral pulmonary edema** and **distended neck veins**. This is the major differential against tamponade and tension pneumo. Giving fluids can be **fatal** while the treatment is actually **inotropes**. Don't get tripped up.
- 2) **Vasomotor** shock is loss of sympathetic tone that keep the arteries constricted. There's massive **vasodilation** everywhere; suddenly the tank is too big to be filled by what's in the body. This occurs in **spinal trauma** or **anesthesia**. The patient will be **pink, warm and dry** with a low BP. Give back the tone with **vasopressors** and correct the underlying problem.
- 3) **Septic**. Local cytokines increase blood flow (leukocyte delivery) and increase vascular permeability to fight local infection. Cytokines everywhere cause a variant of vasomotor shock, resulting in **vasodilation (warm, pink, and dry)**. Identify the organism with **blood cultures** and treat with both **vasopressors** and **antibiotics**.