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# Cardiac Cases

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NURS 380

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# Med Review Bingo

Fibrinolytic

Warfarin

Aspirin

Antiarrhythmics

Adenosine

Amiodarone

Digoxin

Dopamine → ↑ BP & HR  
in case of shock

Norepinephrine  
catecholamine  
(internal & external)  
↑ BP

Nitroprusside

Clevidipine

Atorvastatin

ACE inhibitor

Beta blocker

Nitrates

Spironolactone

Loop diuretics

IV  
↓ BP in hypertensive emergencies  
fast acting CCB  
↓ BP in HTN emergencies

- pMT  
- block effect of adrenaline  
relax & widen vessels on the heart

- potassium sparing diuretic

- inhibit Na+ reabsorption

# Cardiac Medication Review

# Fibrinolytics

- ACE

promotes fibrin dissolution  
(gone over IV)

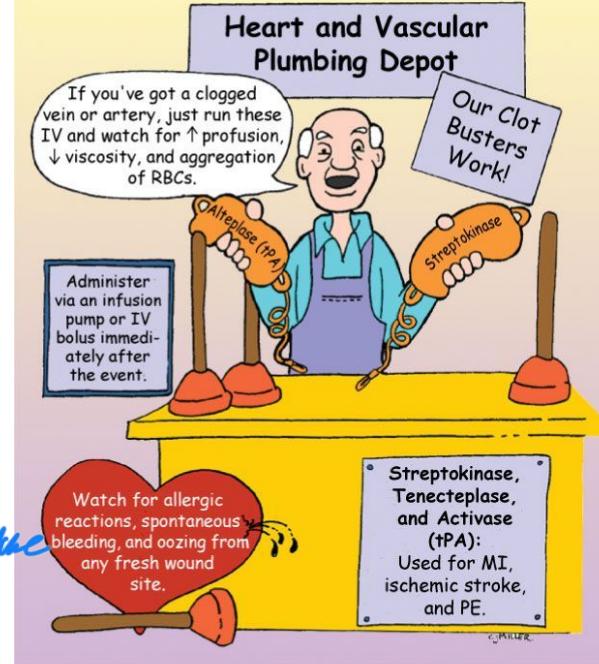
short half-life (gone over IV)

longer half-life  
so can give as bolus over 5 min

- Alteplase, tenecteplase, reteplase, streptokinase *↳ good drug acute stroke*
- Dissolve intravascular clots to prevent ischemic damage and restore blood flow
- Uses: STEMI/AMI, DVT, PE, AIS, occlusion of indwelling catheters, intracardiac thrombus formation, frostbite (off-label)
- Contraindications? *hemorrhage, low platelet count, recent surgical procedure or trauma*
- Nursing management?

- baseline labs (platelets, clotting times, PT/INR, aPTT)
- q15 vitals / 2 hrs → q30 vitals / 2 hrs

## THROMBOLYTICS

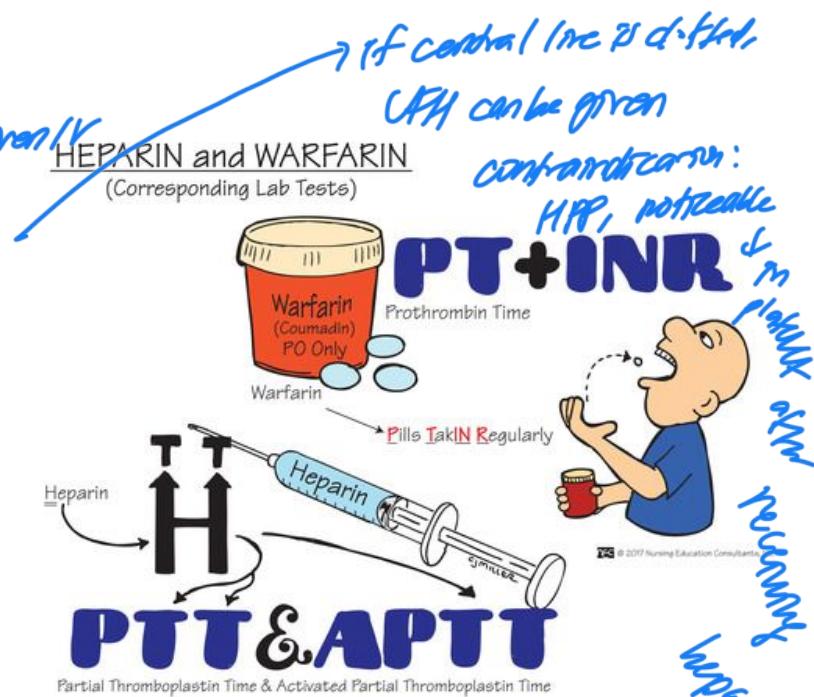


- frequent neuro checks
- watch for s/s of bleeding (skm)

# Anticoagulants

- Unfractionated heparin (UFH)
  - Indicated for ACS, venous thromboembolism, PCIs, and patients who have received fibrinolytic therapy
  - Prevents clot formation
  - Narrow therapeutic range, increased bleeding risk, HIT, monitoring
- Low molecular weight heparins (LMWH)
  - enoxaparin (Lovenox) *500 IU tabs*
  - Derived from UFH; indicated for unstable angina, NSTEMI, DVT
  - Longer half-life, predictable effects, administered subQ
  - Adverse: bleeding, thrombocytopenia, elevated liver enzymes, injection site complications

*usually given to take home*



# Anticoagulants

re. Argomax, argatroban (typically given IV)

- Direct thrombin inhibitors
  - bivalirudin (Angiomax), argatroban > usually given IV
  - Used in patients who have a history of HIT and are undergoing PCI
  - Dosage based on aPTT results or ACT



Warfarin (coumadin)

activated clotting time

- Oral chronic anticoagulation therapy
- Interferes with vitamin K synthesis which means vitamin K is also the reversal agent
- Indications: AF, HF, prosthetic valves, post AMI anticoagulation, VTE, cardiomyopathy
- Contraindications: uncontrolled hypertension, severe hepatic or renal impairment + if they are going to surgery soon
- Starting dose? Titration parameter?

- Others 5mg/day

- Direct oral anticoagulants (DOACs)
- Only approved for Afib
- Rivaroxaban (Xarelto) and apixaban (Eliquis)
- Andexanet alfa (Andexxa) is reversal agent

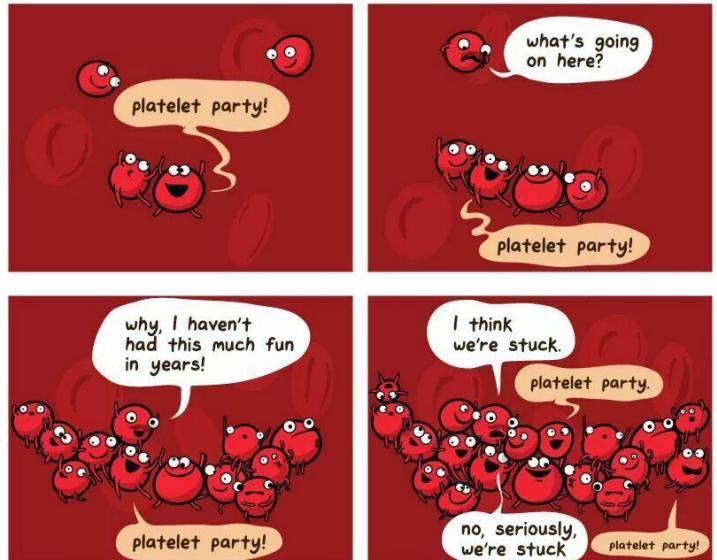
Gas off-label uses

- INR levels can indicate effectiveness of coumadin  
why?

PT (prothrombin time) - how many seconds it takes for your blood to clot

INR (international normalized ratio) - calculated from PT. Normal range is 0.8 to 1.1

# Platelet Inhibitors



MoA:  
inhibit COX enzyme that  
inhibits platelet aggregation

- Aka antiplatelet agents
- Indications: ACS, post PCI with stenting, mechanical heart valves in combo with warfarin, acute ischemic stroke, stable angina, Kawasaki disease, afib with high risk of stroke, primary prevention of VTE
- Classified based on mechanism of action
- Aspirin most commonly used
- Clopidogrel (Plavix), ticagrelor (Brilinta), prasugrel (Effient), cangrelor

usually used in conjunction of aspirin in dual antiplatelet therapy

# Antiarrhythmics

Controls abnormal heart rhythms

adenorme - briefly  
interrupt conduction  
in the heart

potent antiarrhythmics  
medication  
for several types of tachyarrhythmias

# ANTIARRHYTHMICS

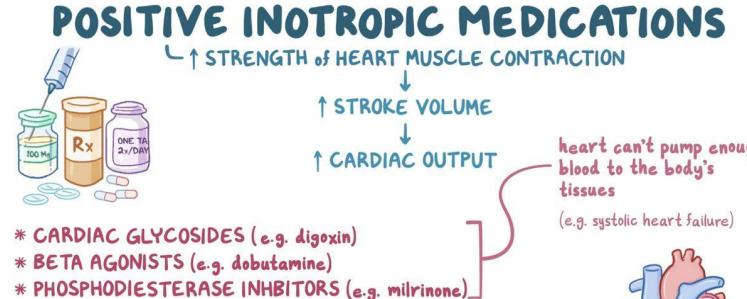
DRUG CLASS	NAME	SIDE EFFECTS
CLASS I	• A: Quinidine, Procainamide, Disopyrimide	• Thrombocytopenia, Wide QT, Cinchonism (Quin.), Drug-induced Lupus (Pro.), Heart failure (Dis.)
	• B: Lidocaine, Mexiletine	• CNS & Cardiovascular depression
	• C: Flecainide, Propafenone	• Arrhythmias post-MI
CLASS II	• Selective: Metropolol, Esmolol, Atenolol	• Hypoglycemia unawareness, Bradycardia, Dizziness, Sleep alterations • Met: Dyslipidemia
	• Non-selective: Propranolol, Timolol, Carvedilol	• Non-sel: Bronchospasm, vasospasm
CLASS III	• Sotalol	• Excessive beta blockade
	• Amiodarone	• Pulmonary fibrosis, Hepatotoxicity, Thyroid alterations, Corneal & skin deposits, Neurologic alterations, Constipation
	• -tilide	• Torsade de pointes
CLASS IV	• Verapamil, Diltiazim	• Flushing, Bradycardia, Peripheral edema, Constipation

# Inotropes

↑ Improve CO, MAP and perfusion throughout the body  
supports cardiac function of low cardiac output  
(e.g. shock or recent MI)

- Increase cardiac contractility
- **Dobutamine**, dopamine, isoproterenol, **milrinone**
- **Dobutamine**
  - Indications: decreased contractility due to HF or cardiac decompensation
  - 0.5 mcg/kg/min to 40 mcg/kg min
  - Increases risk of afib with RVR and HTN
  - Contraindications: AMI, unstable angina, arrhythmias, hypokalemia

## POSITIVE INOTROPIC MEDICATIONS



# Vasodilators

- Indications: HTN, MI, angina, HF, stroke, CKD, preeclampsia, HTN emergency
- Most commonly affect arteries but some are venous vasodilators
- Nitroprusside — *IV & very very strong*
  - Acute HTN, acute decompensated HF, induction of perioperative hypotension
  - IV infusion in D5W
  - 0.5-4 mcg/kg/minute with max 10mcg/kg/min for less than 10 minutes
  - Half life 2 minutes
- Nitroglycerin (CnPr)
  - *sublingual*
  - *take q15, 3 max, and if ineffective go to ER immediately*
  - *gives people massive headache*
  - *↑ BP*
  - *contraindicated: viagra*

# ACE Inhibitors

- Indications: HTN, HF, STEMI, diabetic neuropathy and IBD (off-label)
- Oral only (enalapril is the only IV ACEI)
- Adverse: **dry cough**, dizziness, hypotension, increased BUN and creatinine, syncope, hyperkalemia, **angioedema**
- Contraindicated in pregnancy

# Beta Blockers

-101

start slowly & low dose

(12.5 mg of metoprolol)

- Negative inotropes
- Long-term use best for HTN and HF
  - Also used for CHF, tachycardia, HTN, hyperthyroidism, essential tremor, aortic dissection, glaucoma, migraine prophylaxis, long QT syndrome
- Small dose for patients who are BB naive
- Adverse: bronchospasm, fatigue, dizziness, nausea, constipation, ED, weight gain, heart blocks
- Antidote? - **glucagon** (if it doesn't work, then temporary pacing)

# Diuretics

- Mainstay of heart failure management
- Categorized by MOA and area of function
  - Loop diuretic?
    - Furosemide (maximum dose 240mg as a push)
    - Push slowly (over 2 min)
  - Thiazide?
    - hydrochlorothiazide
  - Aldosterone antagonist? (Potassium sparing diuretic)
    - spironolactone



# Topics from Adult ACS Case

# Angina

stable Ø  
- elevated ST  
- s/s: chest discomfort  
provoked w/ exertion & alleviated  
at rest or by nitrates  
- β-blockers, CCBs, angioplasty

unstable  
- depressed ST/T wave changes

- Chest pain or discomfort caused by myocardial ischemia
- Angina =/= cell death
- 3 types:
  - Stable angina - occurs with exertion, relieved by rest
  - Unstable angina - occurs at rest, requires more frequent nitrate therapy
  - Variant/Prinzmetal's - caused by coronary artery spasm
- Assessment data?  
Ø supply demand mismatch  
myocardial oxygen demand transiently exceeds myocardial oxygen supply
- Interventions
  - Nursing
  - Medical



# Acute Coronary Syndrome

- Umbrella term for stable/unstable angina and MI
- Causes - decreased coronary artery perfusion
- Types of MI
  - NSTEMI vs STEMI
  - Type I - spontaneous MI due to plaque rupture
  - Type II - coronary vasospasm, embolism, arrhythmia, anemia, respiratory failure, hypotension, shock
- Signs/Symptoms
  - Differences in presentation for men vs women

Plaque rupture with thrombus



MI Type I

Vasospasm or endothelial dysfunction



MI Type 2

Fixed atherosclerosis and supply-demand imbalance



MI Type 2

Supply-demand imbalance alone

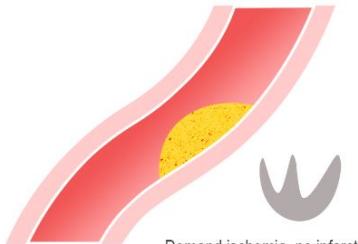


MI Type 2

# ACUTE CORONARY SYNDROME

## 1 STABLE ANGINA

Angina pain develops when there is increased demand in the setting of a stable atherosclerotic plaque. The vessel is unable to dilate enough to allow adequate blood flow to meet the myocardial demand.



Demand ischemia, no infarct

## 2 UNSTABLE ANGINA

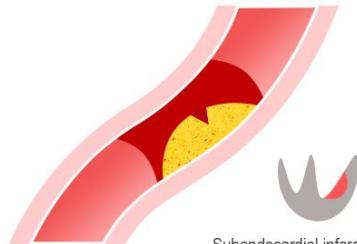
The plaque ruptures and a thrombus forms around the ruptured plaque, causing partial occlusion of the vessel. Angina pain occurs at rest or progresses rapidly over a short period of time.



Supply ischemia, no infarct

## 3 NSTEMI

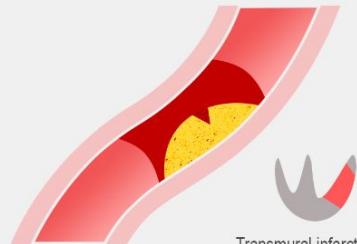
During an NSTEMI, the plaque rupture and thrombus formation causes partial occlusion to the vessel that results in injury and infarct to the subendocardial myocardium.



Subendocardial infarct

## 4 STEMI

A STEMI is characterized by complete occlusion of the blood vessel lumen, resulting in transmural injury and infarct to the myocardium, which is reflected by ECG changes and a rise in troponins.



Transmural infarct

### ECG



Normal



Normal, Inverted T waves, or ST depression



Normal, Inverted T waves, or ST depression



Hyperacute T waves or ST elevation

### TROPONINS

Normal

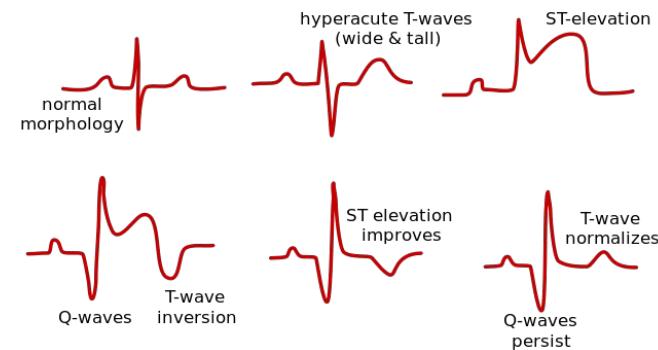
Normal

Elevated

Elevated

This infographic was created by Paula Sneath and Leah Zhao for the Sirens to Scrubs series of CanadiEM.org.

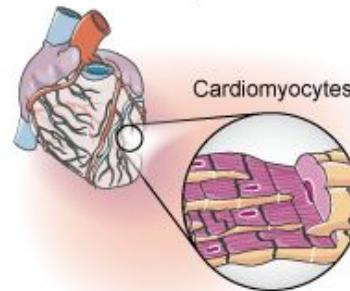
# ACS - Diagnosis



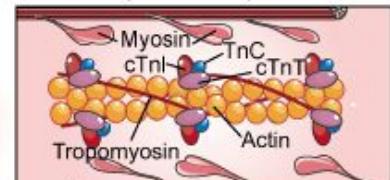
# Cardiac Biomarkers

- **CK - creatine kinase**
  - Found in heart and skeletal muscle, brain
  - Released when (any of the three above are) damaged - aka. nonspecific
- **CK-MB - heart specific**
  - Heart-specific CK enzyme
  - Detected in serum **4 hours after injury**
  - Peaks by 24 hours
  - Normalizes 48 - 72 hours
  - **Normal: 3 - 5% of total CK or 5 - 25 IU/L**
- **Troponin (most specific and sensitive)**
  - Found in heart muscles
  - First line test for MI
  - Three subunits: troponin C, troponin I, troponin T
  - T and I detected in serum 4 hours after injury, peaks in 24 - 48 hours, remains elevated for days
  - **Normal: 0 - 0.04 nanograms/ml**
  - Drawn every 6 hours until it plateaus (once it starts going down)
  - Value has nothing to do with severity

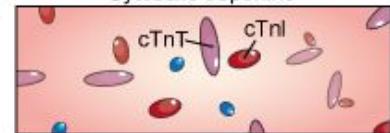
a Structure of cardiac troponins



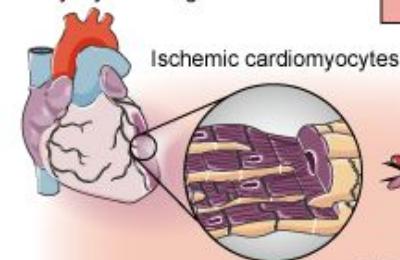
Myofibrillar troponins



Cytosolic troponins

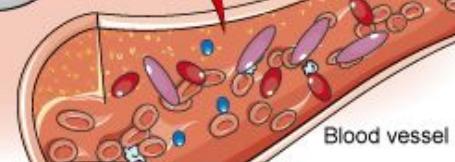


b Cardiomyocyte damage



Ischemic cardiomyocytes

Release of  
cardiac troponins into  
the bloodstream



Blood vessel

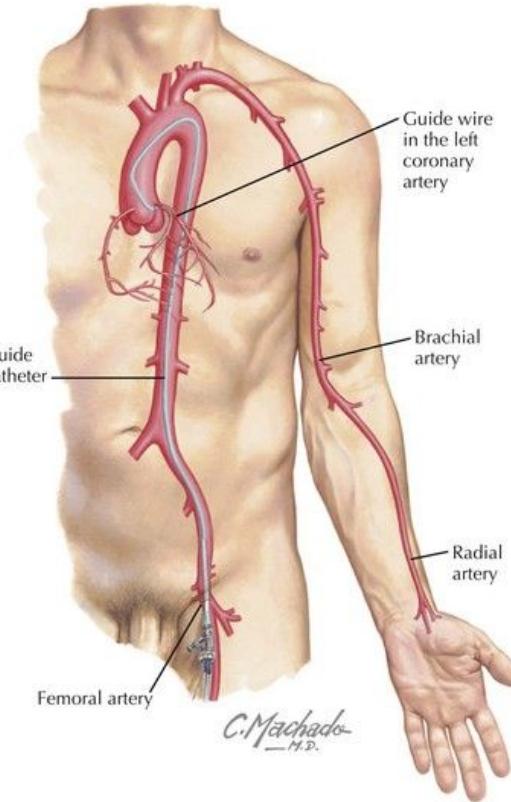
# ACS - Treatment

- Treatment (establish reperfusion, reduce infarct size, treat complications, emotional support)
  - Pain relief
  - Oxygen
  - Antidysrhythmics
  - Prevention of platelet aggregation
  - PCI/PTCA
  - Fibrinolytic therapy
  - Surgical revascularization

diltiazem (Cardizem)	Antiarrhythmic/CCB used primarily for afib/flutter, SVT	IV: 0.25 mg/kg Cont IV: 5-15 mg/h	Hypotension, edema, dizziness, bradycardia
amiodarone (Cordarone)	Antiarrhythmic used for afib/flutter, SVT, vfib/tach	IV: 150mg or 300 mg Cont IV: 150 mg over 10 minutes, 360 mg at 1mg/min for 6 hours, then 0.5 mg/min for 18 hours (540 mg)	Bradycardia, AV blocks, hypotension, pulmonary fibrosis, long half-life
alteplase (t-PA)	thrombolytic	IV: 0.9 mg/kg with 10% of total dose bolused over 1 minute and remainder as gtt over 1 hour	Bleeding, reperfusion arrhythmias, reocclusion/reinfarct
clopidogrel (Plavix)	Inhibits clotting mechanisms and prevents platelet aggregation in MI, UA, AMI and post PCI	PO: 300 mg loading dose then 75mg/day in combo with aspirin	Bleeding, epigastric discomfort, bruising

# PCI Care

- Site care
  - Femoral vs radial
- Activity
- Monitoring for complications
  - EKG changes
  - Reperfusion injury
  - Bleeding
- Medications
  - Antiplatelets/anticoagulation
  - Beta blockers
  - Pain management
- Education
  - Diet
  - Exercise
  - Discharge/follow-up care

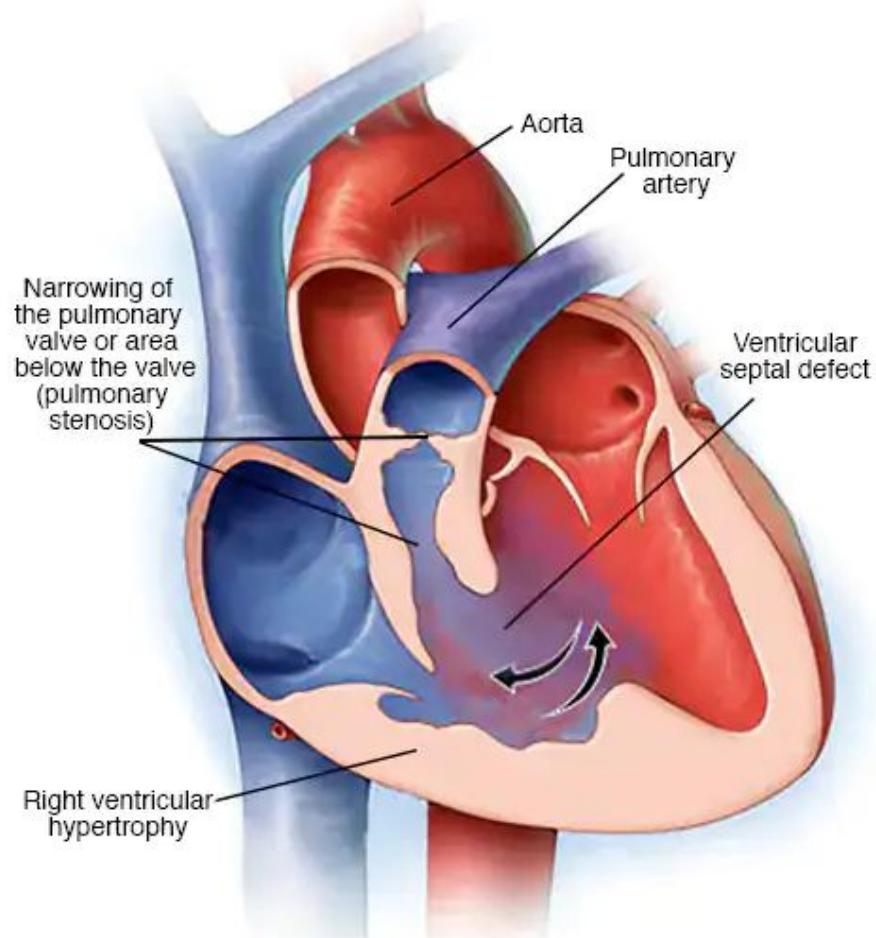


# Pediatric Cardiac Case Study



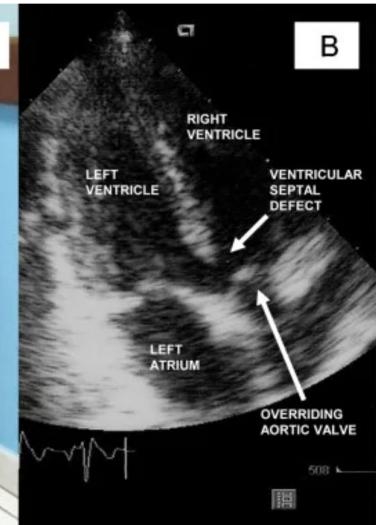
# Tetralogy of Fallot (TOF)

- Combination of four congenital heart defects:
  - VSD
  - Pulmonary stenosis
  - Misplaced aorta
  - RV hypertrophy
- Causes/Risk Factors
  - Untreated maternal diabetes
  - PKU
  - Viral illness
  - Chromosomal abnormalities (trisomy 18, 21, 13)



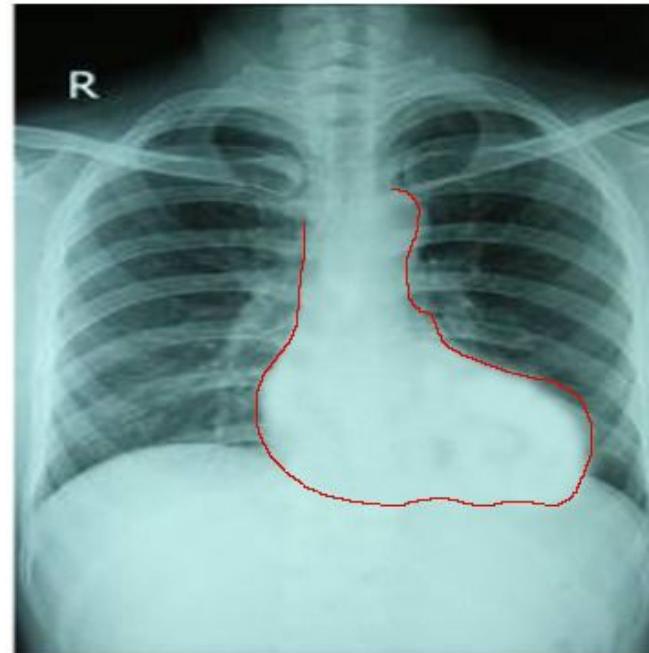
# TOF History & Physical

- Dependent on severity
- Cyanosis
- Dyspnea and tachypnea during feeding or exercise
- Poor weight gain
- Fatigue
- Prolonged crying
- Murmur/abnormal heart sounds
- Prominent ventricular impulse & palpable thrill
- “Tet spells”
- Squatting



# TOF Management

- Diagnosis
  - Clinical signs/symptoms
  - Tests/labs
- Treatment
  - Tet spells
  - Shunt placement
  - Intracardiac repair
- Avoiding complications
  - Heart failure
  - Arrhythmias
- Education
  - Preventing infection
  - Preventing tet spells
  - Feeding
  - Exercise limitations
  - Pregnancy (later)
  - Medications



# Peripartum Cardiomyopathy

# Peripartum Cardiomyopathy Pathophysiology

- Type of systolic heart failure or dilated cardiomyopathy
- Four criteria
  - Development of cardiac failure in the last month of pregnancy or within five months of delivery
  - Absence of other cause of cardiac failure
  - Absence of recognizable heart disease before last month of pregnancy
  - LV dysfunction (EF <45%) **normal 54-74%**
- Etiology unclear
- Misdiagnosed or delayed diagnosis
- High mortality rate (20-50%)

# PPCM Risk Factors

- Multiparity
- Black race (Nigerian or Haitian ancestry or ethnicity)
- AMA (>30)
- Pre-eclampsia
- Gestational HTN
- Autoimmune disease
- Substance use disorder
- Genetic predisposition

# PPCM Signs & Symptoms

Table 1.

Signs and symptoms in peripartum cardiomyopathy vs normal pregnancy, pulmonary embolism, and upper respiratory infection

Pregnancy	PPCM	PE	URI
Fatigue	Fatigue	Fatigue	Fatigue
Tachycardia	Tachycardia	Tachycardia	
Dyspnea	Dyspnea	Dyspnea	
Edema	Edema	Edema	
Chest pain	Chest pain		
DOE	DOE		
PND/orthopnea	PND/orthopnea		
Rales	Rales		
S3 heart sound	S3 heart sound		
Cough		Cough	
Hepatosplenomegaly			

# Labs/Diagnosis

- B-type natriuretic peptide (BNP)
  - Hormone secreted by cardiomyocytes in response to stretching
- D-dimer
  - Fibrin degradation product
  - Elevated in any process that causes fibrin to break down (surgery, trauma, infection, liver disease)
  - Normally undetectable
- Extra heart sounds (S3 gallop)
- Cardiac enzymes
- Preeclampsia workup
- EKG
- Chest CT/CXR
- Echocardiogram

Age Range	BNP Level	What It Means
All ages	Under 100 pg/mL	Normal
Ages 50 and older	450 pg/mL and up	Acute heart failure
Ages 50 to 75	900 pg/mL and up	Acute heart failure
Ages 75 and older	1,800 pg/mL and up	Acute heart failure

# Treatment

- Fluid restriction
- Sodium restriction
- Beta Blockers
- Diuretics (cautious if pregnant)
- Digoxin
  - Cardiac glycoside
  - Antiarrhythmic and BP support, inotropic support
  - Side effects: N, V, D, dizziness, HA, weakness, anxiety, depression
  - Adverse: digoxin toxicity (atrial tachycardia, v tach, afib with slow response) Therapeutic level: 0.8 - 2.0 ng/mL. Toxic: >2.5 ng/mL
  - Antidote: digibind/ digoxin immune fab
  - Oral, IV (usually a loading dose followed by maintenance dose)

# Treatment

- ACEIs and ARBs contraindicated
  - Hydralazine to reduce afterload
  - Anticoagulation to prevent thrombus formation
  - Prolactin inhibition (bromocriptine)
  - Complications: ECMO, heart transplantation, ventricular tachyarrhythmias leading to defibrillator placement
- 
- Treatment, especially medications, should last for 1 year
  - EF typically normalizes within 6 months
  - Subsequent pregnancy not recommended (30% chance of recurrence)