

Anesthetic Considerations

AAA	11
Achondroplasia	13
Acromegaly	14
Addison's Disease (Adrenal Insufficiency)	15
Airway Syndromes	17
Amyloidosis.....	19
Amyotrophic Lateral Sclerosis	20
Anaphylaxis.....	22
Ankle Block	24
Ankylosing Spondylitis	26
Anorexia, BMI <17.5	28
Aortic Stenosis	29
Aortic Regurgitation.....	31
Aspiration.....	33
Asthma.....	35
ASRA Consensus (2002)	37
Brachial Plexus Blocks 1/2	39
Brachial Plexus Blocks 2/2	41

Brain Death and Organ retrieval.....	43
Bradycardia	45
Bronchiectasis.....	46
Bronchopleural Fistula.....	47
Burns (>10% BSA 3 rd degree or 25% 1-2 nd degree)	49
C1 Esterase Inhibitor Deficiency (Hereditary Angioedema)	51
Caesarian Section.....	52
Carcinoid	54
Cardiac Assesment for Non-cardiac Surgery	56
Cardiac Transplant:.....	58
Cardiogenic Shock.....	60
Cardiomyopathy	62
CEA.....	64
Cervical Plexus Block.....	66
Chronic Obstructive Lung Disease	68
Chronic Renal Failure.....	70
Cocaine Intoxication / Pregnancy	72
CO Poisoning/Smoke Inhalation	74

Complex Regional Pain Syndrome	76
Conn's Syndrome (hyperaldosteronism)	77
Unstable C-spine	78
Croup/ Laryngotracheobronchitis	80
Cushing's Syndrome (hypercortisolism)	82
Cyanotic Heart Disease	83
Cyanotic Neonate	87
Cystic Fibrosis	88
Delayed Emergence	90
Diabetes Insipidus.....	92
Diabetes Mellitus	94
DKA & HONK	96
Disseminated Intravascular Coagulation	98
Difficult Airway	100
Down's Syndrome.....	102
Drowning	104
ECMO	106
Eisengmenger's Syndrome	108

Electroconvulsive Therapy	110
Epiglottitis	112
Increased EtCO ₂	114
Femoral Nerve Block (L2,3,4)	116
Fetal Distress	118
Fontan's Circulation	120
Foreign Body	121
Foreign Environment	123
G6PD	125
Guillain Barre Syndrome	127
HCM	129
HIV	133
Hyperkalemia	135
Hyperparathyroidism	137
Hypoparathyroidism	139
Hypertension	140
Hypertension: Emergency	142
Hyperthyroidism	144

Thyroid Storm	146
Hypotension.....	148
Hypothyroidism	150
Perioperative Hypoxemia	152
Increased Airway Pressure	154
Ethics/ Informed Consent	156
IVRA	160
DDx Post-op Jaundice	162
Jehovah's Witness	163
L to R shunt	165
Laryngotracheal Trauma.....	166
LASERS (Light Amplification by Stimulated Emission of Radiation)	168
Lithium Toxicity.....	170
Liver Failure	171
Liver Transplant	173
Local Anesthetic Toxicity	175
Long QTc Syndrome	177
Lower limb Revascularization	179

Lung Isolation.....	181
Lung Transplant Recipient	183
Malignant Hyperthermia	185
Marfan's Syndrome	187
Massive Hemoptysis	189
Massive Transfusion	191
Mediastinal Mass.....	193
Mediastinoscopy.....	195
Metabolic Acidosis.....	197
Microlaryngoscopy	199
Mitral Regurgitation	201
Mitral Stenosis	203
Mucopolysaccharidosis (hurler's and hunter's)	205
Multiple Sclerosis.....	206
Muscular Dystrophy.....	208
Myasthenia Gravis	210
Myasthenic Syndrome	212
Myotonic Dystrophy	213

NEC.....	215
Neuraxial Opioid Monitoring.....	217
Neurofibromatosis.....	219
Neuroleptic Malignant Syndrome	221
Non-obstetrical surgery for the Parturient.....	223
Obesity: BMI >30, Morbid Obesity: BMI>40 kg/m ²	225
Obstetrical Hemorrhage	227
Obstructive Sleep Apnea	229
Open Eye.....	231
Pacemakers.....	233
Pain	235
WHO Relief Ladder/Algorithm for Cancer Pain	237
Parkinson's Disease	238
Pediatric Patient	240
Pediatric Stridor.....	241
Pharyngeal Abscess	243
Pheochromocytoma	245
Pneumonectomy	247

Popliteal Nerve Block L4-S3	249
Porphyria	251
Posterior Fossa Surgery	253
Preeclampsia and HELLP Syndrome	255
Prematurity	257
Pulmonary Hypertension	259
Pyloric Stenosis	261
Restrictive Lung Disease	263
Rheumatoid Arthritis	265
Rigid Bronchoscopy	267
Cerebral Aneurysm & SAH	269
SAB Contraindications	271
Sarcoidosis	273
SBE Prophylaxis	274
Sciatic Nerve Block L4-S3	276
Scleroderma	278
Scoliosis	280
Seizures	282

Seizures: Emergency	284
Septic Shock	286
Serotonin Syndrome	288
SIADH	290
Sickle Cell Disease	292
Spinal Stenosis	294
Epidural Steroid Injections.....	295
Medications for Status Epilepticus	297
Stellate Ganglion Block	299
Systemic Lupus Erythematosus	300
Tachycardia: Emergency	302
Tamponade	304
TCA Overdose	306
Temperature: Emergency	307
Tetralogy of Fallot.....	309
Thoracic Aneurysm	310
Thoracoscopic Surgery.....	312
Acute Spinal Cord Injury	314

Total Spinal	316
Stereotactic Surgery	318
Tracheal Resections	320
Tracheoesophageal Fistula	322
Tracheostomy	324
Transphenoidal Surgery	326
Transtracheal Jet Ventilation	328
Trauma	330
Traumatic Brain injury & Increased ICP	332
TURP & TURP Syndrome	334
Twins	336
Vasculitis	338
Failure to Wean DDx	339
Wegner's Granulomatosis	340
Wide Complex Tachycardia	341
WPW	343
Wrist Block and Hand Block(Never use Epi!)	345

AAA

High risk surgery with the potential for **perioperative complications** including cardiac (MI/HF/death), and renal (ARF)

1. Potential for large fluid shifts, temperature fluctuations, blood loss and hemodynamic instability requiring invasive monitoring and vasoactive medications
2. Hemodynamic, metabolic, and end-organ effects of **aortic clamping/unclamping** with potential for ischemic insults to heart, brain, kidneys, and spinal cord
3. **Comorbid disease** (CAD / DM / CKD / HTN / Smoking/Advanced age)
4. Post-operative pain management

Anesthetic Goals/Conflicts:

- Optimize perioperative myocardial O₂ supply-demand relationship by
 - minimizing HD changes of AoX and unclamping
 - minimizing stress response to induction, emergence, and post-op pain
- Minimize distal ischemic complications specifically
 - renal dysfunction
 - visceral ischemia
 - spinal cord ischemia
- Adequate post-operative pain control

Hx: Determine comorbidities, assess end organ perfusion/sx's, identify clinical risk factors, functional capacity
Assess renal function (best predictor of PO Renal dysfx). Determine cross clamp location, aneurysm anatomy

PE: Assess peripheral pulses, BP, U/O. Focussed cardiopulmonary exam, document neurodeficits

Investigations: CBC/Coags/Lytes/Crt/ECG/Echo as per AHA guidelines/CT for aneurysm anatomy/X-clamp location

Optimization: For ruptured: optimize volume, hgb, cross match, coagulation. Elective: cardiology consult for risk stratification, consider BB for intermediate or high-risk patients, hold ACEi. Discont ASA/Plavix/Coumadin and bridge as necessary. Consider EVAR for high-risk patients not likely to tolerate open procedure. Consider autologous blood donation or ANH

Anesthetic Options: GA + TEA for elective cases, Avoid epidural in unstable hemodynamics (no morbidity/mortality benefit). GA / Regional for EVAR.

Room Setup: 5lead, temp monit, foley, 4U PRBCs, fluid warmers, cell-saver, invasive lines, vasopressors, antihypertensives, forced air warmers. PAC/TEE if severe LV dysfx or supra-celiac X-clamp.

Intraoperative Mgt: Stable induction, have pt prepared and surgeon available if ruptured. Prior to X-clamp, minimize fluids, give heparin 100U/kg. Mannitol .25g/kg prior to cross clamp for renal protection. May need afterload reduction (BB/NTG/↑anesthetic) if high X-clamp, distal perfusion techniques. Anticipate hypotension with clamp release, volume resuscitation, ↓anesthetic, pressors, reverse heparin.

Post-op: Ventilate if ruptured/large fluid shifts, pulmonary comorbidities, obese esp with supraceliac clamp. Otherwise extubate, HDU.

Timing of procedure: Between 5.5-6.0 cm, risk of surgery = 1 year risk of rupture, clear benefit > 6.0 cm. 1 year risk of rupture = 9.4%, 10.2%, 32.5% for aneurysms bw 5.5-5.9 cm, 6.0-6.9cm and > 7.0cm respectively.

Achondroplasia

1. Potential difficult airway
 - a. difficult BMV, subglottic stenosis, facial anomalies, cervical spine instability (odontoid hypoplasia)
2. Neurologic complications:
 - a. Spinal stenosis, hydrocephalus (cervical kyphoscoliosis)
3. Cardiopulmonary complications
 - a. Kyphoscoliosis, OSA and central sleep apnea, RLD with Cor-pulmonale
4. Difficult neuraxial anesthesia: kyphoscoliosis, narrow epidural space, prolapsed discs, deformed vertebral bodies
5. Difficult IV access, monitoring and positioning

Anesthetic Goals/Conflicts:

- Safe establishment of airway
- Identification and optimization of cardiorespiratory complications
- Goals for pHTN if applicable

Acromegaly

1. Potential difficult intubation and ventilation
 - Large tongue, mandibular hypertrophy, thickened vocal cords / glottic stenosis
2. Potential for increased ICP, brain mass – pituitary tumor
3. Coexisting Disease
 - Cardiac dysfunction: HTN, LVH, diastolic dysfunction, acromegalic cardiomyopathy; Conduction defects; CAD
 - Resp: OSA in 70% of males with potential for RV failure (Cor pulmonale)
 - CNS: Susceptible to peripheral neuropathies → ensure correct positioning
 - Misc: Glucose intolerance; vascular ischemia (hand) Osteoporosis; Osteoarthritis
4. Postoperative: Post-extubation subglottic edema

Anesthetic Goals/Conflicts:

- Optimize perioperative endocrine function (stress dose steroids), consult endocrinology
- Assess and Manage any inc. ICP, avoiding aggravating factors
- Provide still field for microscopic surgery
- Controlled emergence (minimizing bucking / coughing / vomiting to decrease risk of bleeding and CSF leak)
- Monitor for postoperative complications eg: DI, SIADH

Addison's Disease (Adrenal Insufficiency)

1. Potential life-threatening Addisonian crisis
 - SHOCK, dehydration, hypotension, N/V, anorexia, acute abdomen, hypoglycemia, fever
 - Highest risk postoperatively
2. Cardiovascular abnormalities
 - Hypotension with dec SVR and dec LV stroke index
 - Cardiac conduction abnormalities d/t hyperkalemia
 - Hypovolemia (2-3L)
3. Electrolyte imbalance
 - Hyponatremia, Hyperkalemia, Hypoglycemia
4. Pharmacologic considerations
 - Risk of hyperkalemic arrest with succinylcholine
 - Decreased response to circulating catecholamines
5. Perioperative steroid replacement

Anesthetic Goals/Conflicts:

- Anticipate and prevent cardiovascular collapse secondary to Addisonian crisis with appropriate supplemental steroid dosing
- Preoperative correction of fluid and electrolyte abnormalities

Hx/Px: assess disease severity – dental caries, reduced exercise tolerance, postural hypotension, arrhythmia, hypovolemia, muscle weakness, fatigue, abdominal pain, N/V, anorexia, confusion, seizures (hyponatremia), weightloss, azotemia, hyperpigmentation (primary AI only), hypoglycemia, infections; adequacy of steroid replacement – 20mg/d prednisone x 5 days at risk for HPA suppression (5-20/d x 4 weeks)

Inv: CBC, Electrolytes, BUN / Cr, ACTH stimulation test (stop all steroids besides dex x 24 hrs, test cortisol 30 – 60 min post ACTH (250ug), normal is level > 25ug/dL; ECG, CXR (cardiomegaly), ECHO

Optimization: Correct hypovolemia, hyperkalemia, hyponatremia, hypoglycemia, Steroids – hydrocortisone 300mg/d (adequate mineralocorticoid activity) – add fludrocortisone 0.05-0.1 mg/d PO once hydrocortisone is tapered to 15-20 mg PO q am and 5-10 mg PO q pm, acute adrenal insufficiency - IV fluids (NS or D5/NS) 2-3 L or more, Correct electrolytes (Hyperkalemia, hyponatremia, hypoglycemia, Metabolic acidosis), Identify and correct precipitating factors

Anesthetic Options: Local, regional, general

Anesthetic Setup: Standard emergency drugs, Hydrocortisone, Standard CAS, Consider arterial and PAC catheterization if cardiac filling pressures indicated / major surgery

Management of Anesthesia: No specific anesthesia regimen superior, Avoid etomidate (adrenal suppression), Myocardial sensitivity to drugs (narcotics / barbiturates), Muscle weakness / weight loss may require a reduced muscle relaxant dose, May not see changes in HR despite decreased SVR, Check electrolytes, glucose intraoperatively; emergence may be prolonged

Post-op: CXR for pneumothorax if adrenalectomy (up to 20%), Pancreatitis risk with left adrenalectomy, Consider ICU d/t risk of Addisonian crisis postoperatively, monitor for respiratory weakness post-op

Airway Syndromes

1. Considerations for the pediatric patient (physiology, pharmacokinetics, cooperation)
2. **Potential difficult intubation and/or ventilation**
 - dynamic A/W status as patient grows or disease progresses
3. Possible co-existing Pathology
 - Potential aspiration risk
 - Potential for unstable or immobile cervical spine
 - Developmental Delay
 - Obstructive sleep apnea
 - pHTN and cor pulmonale
 - hydrocephalus with inc. ICP
 - Multiple congenital anomalies
 - CHD
 - Metabolic D/O – hypoglycemia

Anesthetic Goals/Conflicts:

1. Identify co-existing Pathology:
 - Difficult intubation / ventilation; Aspiration risk; Cervical spine stability; Presence of OSA; Associated anomalies
2. Plan A/W management
 - Appropriate equipment & personnel
 - Minimize anesthetic related post operative respiratory depression

Goal of Preop assessment is to identify pre-existing pathology

Hx: Determine airway anomaly and assoc'd syndrome, assess for aspiration risk, OSA, unstable c-spine, Associated conditions (dev delay, hydrocephalus, congenital cardiac disease)

PE: Careful airway exam. Predictors of difficult BMV (midface hypoplasia, macroglossia), predictors of difficult intubation (small mandible, decr'd neck ROM, MP score). Good cardiac exam – CHD, pHTN. Check for ease of IV access.

Investigations: Dictated by procedure. Glucose of neonate. Consider c-spine x-rays for stability, ECHO to r/o congenital cardiac disease. Sleep study/oximetry if suspected OSA.

Optimization: Aspiration prophylaxis if appropriate (ranitidine 0.5 mg/kg IV; metoclopramide 0.1 mg/kg) no preop sedation if risk of airway obstruction, antisialagogue (glycopyrrolate 5-10mcg/kg or atropine 10-20 mcg/kg).

Room Setup: Standard monitors and IV placed prior to induction or airway management. Preoxygenate if possible. Difficult a/w cart with FOB. Consider ENT in the room, neck prepped and draped, rigid bronch available.

Induction: Awake vs. SV induction (IH vs. TIVA), consider lidocaine neb pro-op to topicalize, lidospray to cords. BACK UP!

Intraoperative Mgt: Minimize long acting respiratory depressants.

Post-op: Often more difficult airway after the surgery – similar preparation as preop; Consider post-op ventilation, HDU.

Complications: Loss of airway, aspiration.

Special: Syndromes assoc'd with potential difficult BMV or intubation: Treacher Collins, Pierre Robin, Apert, Down s., Crouzon, Goldenhar, Klippel Feil, Beckwith-Wiedemann, Hurler syndrome, laryngeal webs, cystic hygroma, choanal atresia

Amyloidosis

1. Multisystem infiltrative disease with potential for:
 - a. **Difficult Airway:** Macroglossia, laryngo-tracheo-bronchial tree involvement.
 - b. **CVS:** Restrictive cardiomyopathy, complete heart block, risk of sudden death, autonomic neuropathy
 - c. **Resp:** Rare pulmonary interstitial disease
 - d. **Renal:** Nephrotic syndrome and renal failure
 - e. **GI:** Increased risk of aspiration secondary to autonomic/peripheral neuropathy
2. Amyloid associated illnesses
 - a. Multiple myeloma, RA, hypothyroidism, chronic infection or inflammation
3. Considerations for medical therapy:
 - a. Steroids/Chemotherapy

Anesthetic Goals/Conflicts:

Amyotrophic Lateral Sclerosis

Degenerative disease of motor ganglia in anterior horn of the spinal cord and spinal pyramidal tracts (upper and lower motor neuron death), and muscle atrophy

1. Risk of **Aspiration** - Bulbar weakness
2. **Respiratory dysfunction** - weakness +/- chronic aspiration
3. **Autonomic instability** – orthostatic hypotension and resting tachycardia
4. **Altered response to NMB** - Hyperkalemic response to succinylcholine - NdMB sensitivity
5. Meds: Pyridostigmine, riluzole (liver dysfunction)

Anesthetic Goals/Conflicts:

- Anticipate need for postoperative ventilation
- Maximize respiratory function with muscle strength, secretion management, pain management
- Prevent aspiration
- Avoid hyperthermia
- Conflicts: RSI vs. avoidance of NMB, regional vs. neurological deficits

Hx: Evidence of respiratory embarrasemnet, pneumonia, ability to cough, functional capacity.
Bulbar dysfunction, swallowing difficulty, dysphagia, dysarthria, gag reflex
Autonomic symptoms: orthostatic hypotension, syncope, resting tachycardia.
Medications: Riluzole – reduce damage to motor neurons by decreasing release of glutamate, can be hepatotoxic, pyridostigmine

PE: focused neurologic exam / respiratory exam / cardiac (orthostatic BP)

Investigations: Usual bloodwork, consider PFTs/ABG/CXR/ECG

Optimization: Neurology consult, physiotherapy, aspiration prophylaxis

Anesthetic Options: All options ok, regional/neuraxial preferred, RSI, judicious use of NMBs

Room Setup: Assistant for RSI, CAS + PNS, consider arterial line.

Intraoperative Mgt:

Post-op: Fully reversed, may require respiratory support

- **Special:** Usual age 40-60, men:women 1.5:1
- Association with lung carcinoma
- Upper and lower motor neuron dysfunction
- Fasciculations, asymmetric muscle weakness, autonomic dysfunction, leg cramps
- Sparing of sensory apparatus, coordination, intellect, extraocular muscles, sacral PNS innervating bowel/bladder sphincters

Anaphylaxis

Anesthetic emergency characterized by Hypotension, Hypoxemia, and inc. Airway pressures

DDx - Tension PTX, Dynamic hyperinflation, PE, Bronchospasm, Aspiration, Pulmonary embolism, Transfusion reaction, Mediastinal mass, Carcinoid

Emergency Management

- Stop administration of antigen and inform surgeon – prepare to terminate procedure
- Scan monitors: rate, rhythm, BP, EtCO₂, SaO₂, PIP, Temperature
- Hand ventilate with 100% O₂, discontinue anesthetic agents
 - Secure the unsecured A/W – edema, difficult intubation
- Temporize with vasopressors and fluids
- Examine patient for flushing, urticaria, wheezing, and adequacy of CO
- Move quickly to administration of **Epinephrine**, 10-20ug boluses (1-3ug/kg) titrated up to 500ug
 - 0.3 – 0.5 mls SC of 1:1000 (300 – 500 mcg)
 - 10ug/kg (0.1ml/kg 1:10000) in PALS

Secondary Management

- **Catecholamines**: Epinephrine infusion 5-10ug/min (1ug/kg/min in PALS), Levophed 5-10ug/min
- **Bronchodilators** for bronchospasm
- **Antihistamines**: Benadryl 25 – 50 mg IV q4-6h reg (0.5-1mg/kg), Ranitidine 50 mg IV q8h reg
- **Corticosteroids**: Hydrocortisone 100 mg IV q6h reg, methylprednisolone 1mg/kg IV
- Inc. HD monitoring, refractory shock – vasopression, glucagon (1-2mg q5min), bicarb, TEE
- Serum tryptase (within 1-2 hrs), monitor in HDU x 24hrs, A/W prior to extubation

Presentation: CV (74%), cutaneous (70%), bronchospasm (44%)

Hx: After anaphylaxis episode: a detailed history is important to determine what agents were administered and what was the temporal sequence

PE: Cardiovascular collapse: persistent hypotension, pulmonary hypertension, RV dysfn, tachycardia. Resp: lower resp obstruction, laryngeal edema/obstruction (may persist 5-32 hours despite vigorous therapy). Derm: flushing, pruritus, urticaria, angioedema; GI – cramps, N/V, diarrhea; Heme - DIC

Investigations: After resuscitation: red-top tube for mast cell tryptase (preferably within 1-2 hrs of reaction) Repeat 24 h later. Consider blood and urine for histamine concentrations.

Optimization: pre-treatment with steroids and anti-histamines NOT effective in preventing anaphylaxis; test dose Abx and other potential allergens; latex free environment

Options: Neuroaxial - Patients under neuraxial anesthesia may be partially sympathectomized, requiring even larger doses of epinephrine.

Post-op: ICU setting. These patients can relapse – don't send them home for at least 24 hrs. Consultation with immunology re: biochemical testing

Special: Muscle relaxants, latex, antibiotics.

Ankle Block

FOOT SURGERY, NOT ANKLE! NEVER USE EPI!

No Specific Contraindications, disadvantages include high failure rate, slow onset 10-25mins and calf tourniquet pain not covered (ankle tourniquet ok).

Anatomy: 5 nerves, 3 superficial, 2 deep

Complications: Nerve inj (19% transient), 0.4% permanent, local pain 40%, hematoma, infx, LA toxicity or cardiac arrest < 0.01%

Technique: CAS monitors, leg on pillow to elevate foot, 3 x 10cc LA (25G needle)

Posterior Tibial N: Lies posterior to posterior tibial artery, gives off lateral and medial plantar. Insert needle in groove behind medial malleolus and advance until bone contacted. Withdraw 1-2mm and inject 2-3mls local. Withdraw again to skin, fan lateral and medial with 2mls each time.

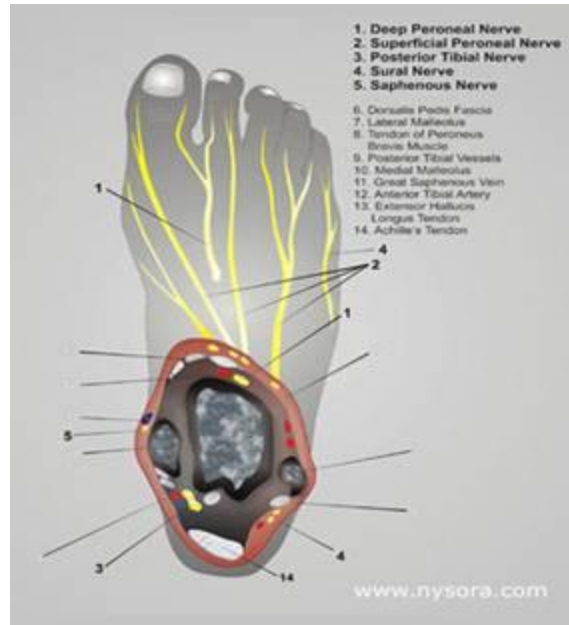
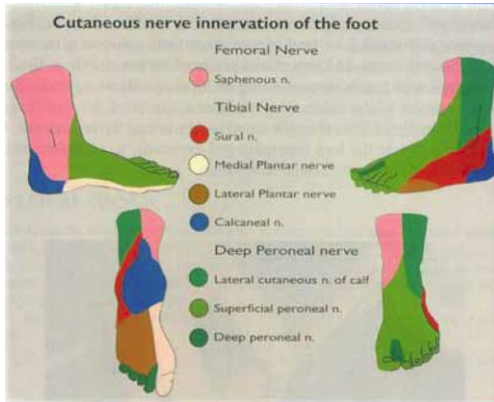
Deep Peroneal: Lateral to EHL tendon and medial to anterior tibial tendon. Needle perp. to skin until it contacts bone, withdraw 1-2 mm, inject 2-3 cc

Superficial Peroneal: From same site as DP block, skin wheal to sup aspect of lateral malleolus ~ 10mls

Saphenous Nerve: From same site as DP block, skin wheal to sup aspect of med malleolus ~ 10mls

Sural Nerve: Located midway between lateral asp. of the Achilles tendon and the sup asp of the lateral malleolus. Point needle anteriorly towards fibular, inject 5-7mls in a fan like pattern

Rescue with either popliteal or sciatic NB.



Ankylosing Spondylitis

1. Potential for difficult airway
 - Decreased C-spine mobility
 - Possible TMJ disease
2. Potential for cervical spine instability with AA subluxation
3. Axial spine fusion
 - Neuraxial anaesthesia may be technically difficult
 - Care with patient positioning
4. Multisystem disease with extra-articular features:
 - Cardiac: AI, cardiomyopathy, conduction defects, pericardial effusion
 - Respiratory: RLD with Pulmonary fibrosis, pHTN, apical fibro-bullous disease (1.5-15%)
 - Neuro: Spondylolisthesis (cord compression), uveitis
 - Renal dysfunction – NSAID nephropathy
5. Medications - NSAIDS, Steroids, MTX, TNF-alpha
 - a. Marrow suppression, platelet dysfunction, renal impairment, steroid coverage

Anesthetic Goals/Conflicts:

- Anticipate difficult airway
 - Trauma/Neuro: Need to rapidly secure difficult A/W in an unstable patient
- Laparoscopic may be optimal given restrictive disease but AI and apical bullae may complicate

Hx/Px: Airway for ease of intubation; AAI; assess axial mobility – positioning, neuroaxial; identify comorbid disease - functional capacity, AI, CHF/cor pulmonale, palpitations, RLD, evidence of pHTN; Meds

Investigations: CBC, Lytes, BUN, Cr, ECG (conduction Dz, pHTN), CXR, +/-PFTs / ABG, ECHO

Optimization: Aspiration prophylaxis, Laparoscopic procedure preferred for RLD, aggressive multimodal analgesia; There is no clear consensus regarding the management of anti-TNF-a blockers in the peri-operative period

Anesthetic Options: Neuraxial techniques may still be used but likely to be difficult. Brachial plexus blocks are relatively contraindicated given RLD; GA with ETT (AFOI, awake DL, lightwand), LMA

Room Setup: Difficult airway cart, CAS + 5, consider A line. Transcutaneous pacer if conduction Dz; further invasive lines may be indicated depending on extra-articular features; SSEPs for spine surgery

Intraoperative Mgt: Consider comorbidities (AI, pHTN...) Careful positioning/padding; Rapid desaturation with RLD; Caution with inc. vent pressures with bulla (pneumothorax);

Post-op: Low threshold for post-op ventilation if significant restrictive lung (RF – poor pre-op resp func, upper abd/thoracic surgery, long procedure) – HDU

Complications: failed intubation (LMA); respiratory failure; failed regional (may need to control difficult A/W), tension pneumothorax

Parturient: no improvement in symptoms with pregnancy; most have vaginal delivery; difficult regional; conflict = difficult regional vs. Difficult A/W & aspiration risk

Anorexia, BMI <17.5

1. Delayed gastric emptying and risk of aspiration
2. Fluid and electrolyte abnormalities
 - a. Hypovolemia (dehydration)
 - b. Hyponatremia, hypokalemia
3. Cardiac Dysfunction
 - a. Low-output cardiac failure - decreased cardiac muscle and contractility
 - b. Potential cardiac arrhythmias - electrolyte abnormalities, prolonged QT
 - c. Autonomic disturbances
4. Malnutrition: Anemia, thrombocytopenia
5. Medications: Antidepressants

Anesthetic Goals/Conflicts:

- Prevent aspiration – prophylaxis
 - Conflict RSI vs. hemodynamic instability
- Identify underlying cardiac dysfunction
- Restore electrolytes and volume pre-operatively

Aortic Stenosis

1. Increased risk of **perioperative cardiac complications**: Ischemia/MI/arrhythmias/CHF
2. Identify severity of disease and **high risk markers** (angina, syncope, CHF)
3. Cardiac physiologic changes
 - a. **fixed LVOT** obstruction with limited ability to inc. CO
 - b. hypertrophied ventricle with **diastolic dysfunction** (reduced ventricular compliance)
 - i. Sensitive to volume depletion, Dependent on atrial kick, subendocardial ischemia (\uparrow muscle mass, \downarrow coronary perfusion pressure)
 - c. **altered myocardial oxygen supply / demand**
 - d. **systolic dysfunction** (impaired contractility) occurs late in disease
4. **Co-existing disease**
 - a. CAD / other valve disease / pHTN / Advanced Age
5. **Ineffective CPR**

Anesthetic Goals/Conflicts:

- Hemodynamic goals of Ao Stenosis: HR 60-90 (avoid tachycardia; avoid bradycardia), Strict NSR, maintain or augment preload, maintain contractility, **avoid decreases in afterload** (LV perfusion)
- Monitor for ischemia, and optimize favorable myocardial oxygen supply/demand relationships
- Pregnancy
 - inc. risk of CHF d/t inc. volume, ischemia with dec. afterload and tachycardia
 - early slow epidural to limit tachycardia, avoid spinal d/t dec. afterload

Hx: Determine sx's: angina, syncope or CHF (50% mortality <5, 3, 2 yrs respectively without Sx). Determine valve area Normal AVA 2.6-3.5cm², Mild >1.5cm², gradient <25mmHg, Mod AS 1.0-1.5cm², gradient 25-40mmHg, Severe <1.0cm², Critical <0.7cm². Functional capacity. Associated CAD/pHTN/arrhythmias

PE: Narrow pulse pressure, pulsus parvus (reduced pulse volume) et tardus (slow) usually with AVA<0.7cm. Displaced apical impulse, murmur of Ao stenosis (SEM late peaking crescendo-decrescendo, radiating to the neck) Reduced or silent S2. Evidence CHF. S4 (atrial kick into non-compliant ventricle). S3 (filling into non-compliant ventricle). Rales, wheezes, elevated JVP, hepatosplenomegaly.

Investigations: CBC, LFTs, Coags, BUN, Cr, CXR, ECG: LVH +/- strain, LBBB, Echo for AVA/gradient/EF/pHTN, subvalvular vs valvular. Cardiac Cath: Assess coronaries and AV gradient.

Optimization: Cardiology Consult. Consider AVR repair/replacement prior to elective sx. Volume resuscitate vs diuresis for CHF. Rate Control.

Anesthetic Options: Any that maintain hemodynamics (avoid SAB), slow titrated epidural. Severe AS maybe a relative contraindication to neuraxial anesthesia.

Room Setup: 5 lead ECG/invasive lines, PAC relative contraindication dt risk of arrhythmias, TEE. Short acting BB's, phenyl, lido/amiodarone for ectopy, defibrillator pads.

Intraoperative Mgt: Opioid based induction, judicious etom/keta/benzo, avoid excessive drop in SVR or contractility (volatiles assoc. with junx rhythm. Avoid tachycardia on emergence.

Post-op: Monitor for ischemia, adequate analgesia.

Note acquired vWF due to proteolysis of largest multimers of vWF due to high shear forces through stenotic valve.

Aortic Regurgitation

AR can be acute or chronic resulting in pressure and volume overload of the LV and reduced forward CO

1. Increased Risk of perioperative cardiac complications (CHF/MI)
2. Hemodynamic alterations associated with AR and associated hemodynamic goals
 - a. Acute – volume/pressure overload, sympathetic stimulation, increased LVEDP / ischemia and arrhythmias, **cardiogenic shock**
 - b. Chronic – ventricular dilation and hypertrophy, pulmonary hypertension, LV/RV failure
3. Associated co-morbidities:
 - a. Other valvular pathology (MS of rheumatic heart disease)
 - b. Ischemic heart disease
 - c. Endocarditis
 - d. Aortic dilation / dissection
 - e. Connective tissue diseases (rheumatoid arthritis, ankylosing spond.)
 - f. Marfan's syndrome
4. Management of medical therapy

Anesthetic Goals/Conflicts:

Fast, full, and forward

- Maintain forward flow: High N HR (~90bpm), NSR, maintain, adequate preload (may require augmentation), decrease afterload (maintain adequate CPP), maintain contractility

Hx: Evaluate underlying etiology, onset, severity, symptoms (**CHF**/orthopnea/PND), arrhythmias. Assess for comorbidities: **Aortic stenosis**, **CAD**, MCTD, **pulmonary hypertension**.

PE: Assess volume status, JVP, edema, rales. Displaced LV impulse = cardiac enlargement. Wide pulse pressure, decreased diastolic blood pressure, bounding perph. pulse. De Musset's sign – head bobbing with systole, Corrigan's sign – waterhammer / collapsing.

Auscultate for murmur: Diastolic "blowing" murmur at LSB. Abdominal distention and pain – splanchnic ischemia. PE findings pHTN.

Investigations: usual BW, ECG – LVH, conduction disorders, CXR – cardiomegaly **ECHO**-EF/severity of AR, PAP.

Optimization: Cardiology consult, Consider valve replacement or valvuloplasty prior to elective surgery

Class 1 indications for repair/replacement: 1) NYHA III-IV HF w/ N syst fnx, 2) NYHA II w/ N syst fnx but progressive dilatation 3. Patients with angina 4. Patients with mild-mod LV dysfunc 5. Patients undergoing cardiac sx for other reason

consider light anxiolysis to avoid increase in SVR. Ensure adequate afterload reduction. Hold diuretics and ACEi. Manage anticoagulation for a. fib. Arrange post-op monitored care

Anesthetic Options: GA / Neuraxial (anticipate and avoid significant drops in preload) Pregnancy – early epidural to avoid adrenergic inc. in SVR during labour

Room Setup: Intropes (milrinone, dobutamine, epinephrine), nipride/NTG, 5lead, +/- PAC/TEE

Intraoperative Mgt: Induction, preserve preload & contractility / NSR / HR~90bpm / slight afterload reduction. Avoid myocardial depressants or increased SVR. Post AVR may require inotropes

Post-op: CSICU or ICU for post-op cardiac monitoring. Observe for: hypotension, ischemia/infarct, LV failure, cardiogenic shock, pHTN +/- RV failure.

Aspiration

- Preventable perioperative event with no definitive treatment and significant mortality
- Conflict between aspiration risk and:
 - Airway quality
 - Cardiopulmonary reserve
 - Feasibility and tolerance for regional techniques
- Consider aspiration in differential diagnosis of bronchospasm with hypoxemia

Anesthetic Goals/Conflicts:

- RSI and HD instability
- Maintain oxygenation
- Prevent complications: Pneumonia, ARDS, sepsis, barotrauma secondary to high PIP

Hx & Px: RF for aspiration: Hx of difficult airway, H&N surgery/radiation, DM, NM D/O, reflux, dysphagia, peptic ulcer disease, Cardiopulmonary – exercise tolerance, edema, angina

Manifestations: gastric contents in oropharynx, hypoxemia, inc PIP, bronchospasm, copious tracheal secretions, coughing, laryngospasm, rales, chest retraction, dyspnea, CXR changes

Optimization: avoid GA, antacids, H2 antagonist, metoclopramide, ng suctioning prior to induction and extubation, cricoid pressure, consider awake intubation, extubate awake

Anesthetic Options: GA, local, regional (avoid depression of laryngeal reflexes by excess sedation)

Intraoperative Mgt:

- Perform immediate tracheal suctioning prior to positive pressure ventilation
- If ETT is in the trachea, place the patient head down, with right lateral tilt (protect left lung)
- Pass a suction catheter down the ETT
- Maintain oxygenation: PPV with 100% FiO₂, PEEP
- Perform bronchoscopy if particulate aspiration
- Cancel elective surgery. Emergency surgery should be restricted to the minimum procedure consistent with patient safety

Post-op: If patient remains stable throughout event without significant desaturation/hypotension etc. could consider discharge from PACU after 2 hours of observation

- Provide supportive care: fluid mgmt, H2 blockers, intermittent pulm toilet
- Empiric antibiotics if compromised patient, fulminant course, high bacterial load
 - Prophylaxis is indicated for known aspiration of feculent material
- Bronchodilators to relieve large airway closure in less damaged areas of the lung
- Consider ECMO support if oxygenation cannot be maintained

Asthma

reversible expiratory obstruction due to hyperactive bronchi with inflammation, mucous hypersecretion and bronchoconstriction

1. High risk for perioperative respiratory complications including **respiratory failure**
 - FEV1 < 40% indicates severe obstruction,
 - Normal or high PaCO₂ suggestive of fatigue and impending failure
2. **Perioperative Bronchospasm**
3. **Barotrauma and Pneumothorax**
4. Potential for Status Asthmaticus & Pulmonary Tamponade
 - Identify patients at risk: previous attacks, freq hospitalizations, steroids, can't speak, inc. WOB, silent chest, confusion, increasing or N CO₂.
 - Ddx Wheezing: FB, aspiration, anaphylaxis, cardiogenic edema, tracheal stenosis or malacia
 - Medical Management Salbutamol/Ipratropium/Epinephrine/Corticosteroids/Aminophylline/MgSO₄/SEVO/Heliox/ glycopyrrolate/atropine
 - Ventilatory strategies and consideration for ECMO

Anesthetic Goals/Conflicts:

- Early, aggressive management of bronchospasm, and frequent assessment for need for intubation and ventilation.
- Indication of intubation: pH <7.2, unremitting hypoxia SaO₂ <90%, progressive exhaustion, decreased LOC. Hypercarbia although a marker of severe disease is not an indication for intubation.
- Avoid Thiopental/Histamine releasing narcotics/NdMR. Watch for tachydysrhythmias due to Rx

Medications:

Salbutamol: MDI 4-20 puffs/hour, Neb 5-10mg q 15mins prn, IV 4mcg/kg load then 0.1-0.2mcg/kg/min

Epinephrine (1:1000) 4-8mcg/min

Ipratropium: MDI 4-20 puffs/hour, Neb 0.5mg q 30-60mins prn

Corticosteroids: Methylpred 40-125mg/ q6h or Hydrocortisone 500 mg IV

Aminophylline: 3-6 mg/kg load and 0.2-0.9 mg/kg/hr infusion

MgSo4: 2-4 grams over 20 mins, then 1gram/hour infusion

Intubations: Ketamine/Lidocaine/Benzo's/Narcotics, avoid STP/Histamine release/NDMBs such as mivacurium/cis-atracurium. Avoid Cholinesterase inhibitors.

Ventilator: FiO₂ = 1, TV 6-8ml/kg, RATE 6-8/min, PEEP <5, Keep PIP < 50 cm/h20, Square wave flow (increases VI). May need to disconnect patient for dynamic hyperinflation and chest compression. If severe bronchospasm on intubation and can't ventilate, confirm tube placement, r/o pneumo and then give IV adrenaline. Maintain with Volatile, consider ECMO!

Bronchospasm:

1. Optimize preop with bronchodilators
2. Avoid histamine release
 - Morphine, Atracurium
3. Deep plane of anaesthesia prior to airway manipulation
 - Consider bronchodilating anaesthetic agents: ketamine, sevoflurane
4. Extubation plan
 - Deep extubation +/- LMA
 - Opioids prior to emergence – remifentanyl

ASRA Consensus (2002)

General: Use extreme caution in neuroaxial blocks on patients taking more than one anticoagulant

Thrombolytics:

- Don't do neuraxial technique. If administered inadvertently, fibrinogen level may be helpful

Unfractionated Heparin

- Low dose SC prophylactic dosing not a contraindication but hold until after administration of block
- Check platelets after > 4 days of UFH (HIT)
- Intraoperative IV dosing (e.g. vascular surgery) acceptable 1 hour after needle
- Remove catheter with 2 conditions: 1) 2-4 hours after last heparin dose; 2) Patient's coagulation status documented. Restart anticoagulation 1 hour after catheter removal
- Bloody/difficult insertion + UFH may increase risk but not contraindication to proceeding

LMWH

- Don't monitor Xa; peak effects 2 hours after administration.
- If bloody tap – inform surgeon, avoid LMWH for 24 hours
- Low dose (prophylactic) LMWH: delay needle for > 10-12h
 - Enoxaparin 0.5 mg/kg every 12 hours
 - Dalteparin 5000 units every 12 hours
- High dose (treatment) LMWH: delay needle for > 24h
 - Enoxaparin 1 mg/kg every 12 hours
 - Enoxaparin 1.5 mg/kg daily
 - Dalteparin 120 U/kg every 12 hours
 - Dalteparin 200 U/kg daily, or
 - Tinzaparin 175 U/kg daily

- Post operative BID LMWH (high dose): delay at least 24h after needle; not compatible with catheters left insitu and may start 2h after catheter removal
- Post operative daily LMWH (low dose): delay at least 6-8h after needle; compatible with catheters left in situ but must be removed >10-12 h after last dose and restarted > 2h after removal

Oral Anticoagulants (Warfarin)

- Discontinue therapy 4-5 days preoperatively, document normal INR (<1.5)
- If warfarin initiated > 24h preop, check INR prior to block
- Document INR < 1.5 prior to catheter removal, monitor daily if on therapy
- Monitor neurological status minimum 24h after catheter removal, longer if INR > 1.5

Antiplatelet Agents

- NSAIDs (including ASA) do not increase risk of spinal hematoma
- Discontinue clopidigrel > 7 days; Ticlopidine > 14 days before needle
- Glycoprotein IIb/IIIa inhibitors – Eptifibatide (integrellin) and Tirofiban (Aggrastat) delay > 4-8h after administration; Abciximab (ReoPro) delay > 24-48h after administration
- Avoid neuraxial technique in patients on more than one antiplatelet agent

Herbal Drugs

- No data and no contraindication to block (do not increase risk of hematoma on their own)

Thrombin Inhibitors (Desirudin, lepirudin, bivalirudin, argatroban)

- Increased risk of bleeding, but no specific recommendations

Fondaparinux (Arixtra)

- Minimal data, but increased risk of hematoma
- Recommend single atraumatic pass, no indwelling catheters

Brachial Plexus Blocks 1/2

Interscalene: *for shoulder surgery, ulnar sparing*

Specific Contraindications: Unable to tolerate reduced FEV1 by 25% (interscalene) ie FEV1 < 1L; Contralateral vocal cord paralysis

Complications: 100% Phrenic, Pneumo 0.2%, Horners, Intravascular injection, 13-24% hypotension/brady, inadvertent SAB, Epidural block.

Anatomy: Roots/Trunks

Approach: Palpate interscalene groove with head supine and rotated 30 deg away. EJ crosses the groove at the level at the cricoids cartilage. Skin wheel at the level of the CC, 22g 1.5" needle inserted perpendicularly in slightly medial and caudal direction. Stimulating Phrenic = Too anterior, Trapezius = posterior. Look for motor activity of the arm, wrist or hand, but deltoid OK. 30-40mL local.

Supraclavicular: *for any upper extremity surgery that does not req the shoulder*

Specific Contraindications: avoid bilateral due to risk of bilateral pneumos or phrenic nerve block.

Complications: Phrenic Nerve (50-60%), Horners, Nerve Injury 0.02-0.4%), Cardiac arrest 0.01%, Hematoma, local pain (40%). Highest incidence of pneumothorax, however should be less than 5%

Anatomy: Trunks at the lateral border of Ant. Scalene, most reliable U/E block

Approach: Palpate interscalene groove at its most inf point, just post to subclavian pulse (SP); the latter can be felt in a plane just medial to the midpoint of the clav. After a skin wheal, a 22g 1.5" needle is directed just ↑ and post to the SP and directed caudally at a very flat angle against the skin. Obs for muscle contrac. of the forearm. 25-40mL. If U hit rib, the needle is withdrawn and reval path. The 'plumb-bob' techn is another SC approach. The needle entry site is immed. sup to the clavicle, just lat to the point where the SCM is attached to the clavicle. The angle of needle entry is 90° to the table. If you contact rib, try manipulating in an ant to post direction or walk along rib.

Infraclavicular: *Misses skin of axillae and prox medial arm (intercostobrachial, Medial brachii cut nerves)*

Anatomy: *Cords, beyond the first rib* **Specific contraindications: None**, *safer than supraclavicular*

Complications: Pneumo(rare), hemo, and chylothorax (with a left-sided block) are possible and occur at a higher rate than with the supraclavicular approach. Phrenic = rare.

Approach: When performing, the patient lies supine with the head slightly turned away from the side of the procedure. The operative limb is abducted to 90° and the axillary pulse is identified. The midpoint of the clavicle is identified and 2 cm caudal to this point a needle is inserted at a 45° angle and directed toward the axillary art pulsation. With a 4-in, 21-gauge insulated nerve stimulator needle, motor activity in the hand is sought. Or you may use the coracoid approach which is 2cm medial and inf. to the coracoid process. Needle insertion is perp. to floor. If no twitch aim cephalad then caudad. Do not accept musc. N as it may leave the sheath at this point in 50% of pts.

Axillary: *Musc nerve has already left the sheath at this point and is in coracobrachialis, good for procedures distal to elbow. Can block with 5-10ml in CB abv artery, fanning technique or at elbow.*

Anatomy: Terminal Nerves

Complications: Hematoma, IV injection, Nerve injuries

Approach: The pulse of the axillary artery is identified as high (proximal) in the axilla as possible. Using an "immobile needle" technique, a 22-gauge, 1.5-in needle is inserted until bright red blood is aspirated. The needle is then slightly advanced or withdrawn until blood aspiration ceases. Injection can be performed posteriorly, anteriorly, or in both locations in relation to the artery. A total of 40 mL of local anesthetic is usually injected; distal pressure on the sheath during the injection may promote better cephalad spread of the solution within the sheath.

Brachial Plexus Blocks 2/2

Intercostobrachial Nerve Block (T2): *for anesthesia to medial arm/tourniquet pain*

Approach: The intercostobrachial nerve derives from the T2 somatic intercostal nerve, whereas the medial brachial cutaneous nerve derives from C8 and T1. Both become superficial and cutaneous at the pectoral ridge over the humeral head. They are easily blocked, with the arm abducted, by means of a linear injection (field block) from the deltoid prominence superiorly to the most inferior aspect of the medial upper arm (Figure 17-3). A total of 5 mL of local anesthesia is used.

Nerve Blocks at the Elbow:

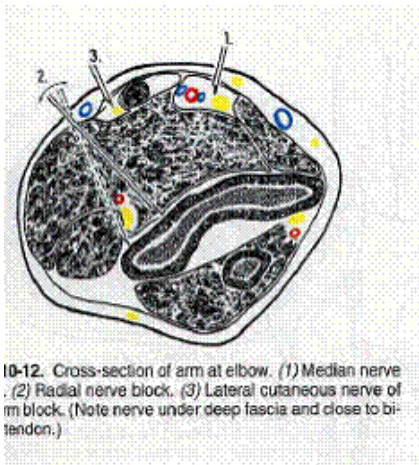
Ulnar Nerve: Flex elbow 30degrees, 2 cm proximal to groove bw medial epicond and olec. Process. 5ml of LA.

Median Nerve: Intercondylar Line, Medial to Biceps Tendon and 1 cm medial to brachial artery at this IC line. Elicit paras. or motor resp. or hit periosteum and withdraw 0.5-1cm. Inject 3-5 ml.

Radial Nerve: Same Intercondylar line, 2 cm lateral to BT. Nerve is deep, can elicit parasthesia move in a fan shape or hit bone and withdraw 0.5cm. Inject 5ml. Aim towards lateral epicondyle on insertion.

Lateral Cutaneous Nerve of the Forearm: Branch of MSC N. Inject just below fascia lateral to BT and medial to radial nerve. 2-3ml LA.

Medial Cutaneous Nerve of the Forearm: Branch of medial cord. SC infiltration from biceps tendon to medial epicondyle.



Brain Death and Organ retrieval

1. Confirm the diagnosis of brain death and confirm wishes of patient and family
 - NDD by 2 physicians not involved with transplant (see below)
2. Physiologic Consequences of Brain death
 - Hemodynamic instability (myocardial dysfunction, vasomotor tone, hypovolemia -)
 - Pulmonary dysfunction - ARDS and Hypoxemia (pulmonary edema - Neuro vs. cardiac, VAP)
 - Neuro-endocrine dysfunction
 - DI (70%), hypokalemia, Hypothyroid, hypocortisolemia, Hyperglycemia
 - Coagulopathy / DIC (brain release of thromboplastin)
 - Poliokothermia secondary to hypothalamic dysfunction
3. Etiology of Brain Death and secondary injuries
 - Trauma (potential for multi-organ involvement, pulmonary / cardiac contusions)

Anesthetic Goals

- maintain end-organ perfusion (monitoring, fluids, vasopressors & ventilatory support)
 - SBP > 100 mmHg, pO₂ > 100 mmHg, U/O 100 mL/h (1-1.5 ml/kg/h), Hb > 100 g/L, CVP 5-10 mmHg, FiO₂ < 40% for lung retrieval
- Strategies for organ preservation using free radical scavengers including mannitol, superoxide dismutase, and the free radical synthesis blocker allopurinol
- Consider hormone replacement therapy (improve solid organ retrieval)
 - Methylprednisolone 15 mg/kg q24h
 - Tetra-iodothyronine (T4) IV: 20 mcg bolus followed by 10 mcg/h infusion
 - Vasopressin: 1 unit bolus followed by 2.4 units/h infusion

Minimal clinical criteria for NDD: etiology of NDD in absence of conditions mimicking NDD, Deep unresponsive coma & bilat absence of motor response (excludes spinal reflex), No corneal/pupil responses (pupils mid-size or greater) with no brain stem reflexes (gag/cough, vestibulo-ocular, facial motor response), Positive apnea test ($\text{PaCO}_2 \geq 60$ or $\geq 20 \text{ mmHg}$ inc.) Absent confounding factors. Minimal $T = 34^\circ \text{C}$. Ancillary test if Unable to determine min criteria: 4 vessel angio of common/internal/vertebral arteries.

Brain death hemodynamics - initial ischemia results in unopposed vagal stimulation (brady, blocks, hypotension, low CO), progression to midbrain results in vagal stimulation with marked sympathetic activation (tachy, arrhythmias, HTN), finally complete brainstem ischemia - loss of vagal tone with unopposed sympathetic activation, Herniation of brainstem - loss of sympathetic activation with profound hypotension

Hx/Px: Review history preceding NDD (etiology, e.g. trauma), secondary injuries, current meds/ventilation to maintain organ perfusion, Vitals/Temp, U/O

Investigations: CBC, Lytes, BUN, Cr, Group & Screen, ABG (looking for anemia, electrolyte abnormalities (DI), renal insufficiency, acidosis). Imaging: CXR (lines & tubes, pulmonary edema, aspiration etc.), ECG (rhythm, ischemia), ECHO (EF, wall motion abnormalities, contusions)

Optimization: Lung protection ventilatory strategy, (Vt 6-8, plat < 30 mmHg, PEEP to minimize FiO_2 , $\text{SaO}_2 > 95\%$, colloids > crystalloid), triple hormone therapy, glycemic control, euthermia

Anesthetic Options: volatile & narcotic with inotrope/vasopressors for hemodynamic ctrl only (no Awareness)

Room Setup: CAS, 5 lead, A-line, CVC, Foley, temp probe

Intraoperative Mgt: Vasopressors (epinephrine, vasopressin) to support blood pressure, DA and phenylephrine suggested to improve splanchnic perfusion. Vasodilators (phentolamine, alprostadil [lung retrieval]) to improve perfusion during cross-clamping, heparin prior to x-clamp, Active warming

Direct chronotropes (**isoproterenol, DA**) to treat brady as brain dead patient unresponsive to vagolytics

Post-op: appropriate disposition of remains

Bradycardia

Does the patient have a **pulse**? → if not, immediate ACLS

Most important Question is **sinus bradycardia** or not?

DDx

1. Hypoxia, hypercarbia
2. Drugs
 - Anesthetic drugs → SCh, anticholinesterases, opioids, Neuraxial blockade
 - Cardiac drugs → β -blockers, CCB, Clonidine, Digoxin, pheynlephrine
3. Cardiac
 - ischemia
 - conduction system disease → SSS, heart block
4. Nerves
 - Vagal mediated → pain, oculocardiac, peritoneal stretch, ECT
 - Baroreceptor mediated → ICP, HTN, carotid sinus manipulation
5. Endocrine
 - hypothyroidism
 - hypothermia

Emergency Management

1. Inform surgeon, Scan monitors: rate, rhythm, BP, EtCO₂, SaO₂, temperature
2. Hand ventilate with 100% O₂
3. Examine patient for pulse or signs of adequate perfusion
4. Develop DDx and treat as per ACLS protocol

Bronchiectasis

1. Risk for severe Respiratory Complications
 - a. Auto-PEEP & pulmonary tamponade
 - b. Mucus plugging d/t impaired mucociliary activity
 - c. Recurrent lung infections / abscess
 - d. Massive hemoptysis
2. Chronic Hypoxemia & Hypercarbia
 - a. pHTN & RVF
3. Associated therapy: Postural Drainage, Abx's, Chest Physio.
4. Underlying etiology: Cystic Fibrosis, congenital cartilage defn, HIV, TB, infection, inflammation, Rheumatoid arthritis

Anesthetic Goals/Conflicts:

- Optimize pre-operative lung function with postural drainage and Abx therapy
- Prevent contamination of good lung with purulent sputum (consider lung isolation)
- Avoid instrumentation of the airway or nasal intubations (chronic sinusitis)

Bronchopleural Fistula

1. Possible life-threatening emergency from ineffective PPV, tension pneumothorax or lung flooding
 - a. Requirement for lung isolation
 - i. Minimizes air leak and facilitates ventilation
2. Prevent soiling of contralateral lung if abscess/ empyema present
3. Comorbid disease / etiology for BPF
 - a. Lung abscess/ empyema
 - SIRS, MOF, EtOH abuse, IVUDU, steroids, DM
 - b. Post lung resection
 - COPD, arrhythmia, malignancy, CAD
 - c. Trauma
 - d. Spontaneous pneumo/ bullous disease

Anesthetic Goals / Conflicts

- isolation of affected side to support ventilation and prevent cross-contamination
- prepare for and be ready to resuscitate from cardio or respiratory collapse
- facilitate early extubation post-thoracotomy

Hx: acute or chronic; stable or unstable; post-op resection vs. infective vs. trauma; airleak, dyspnea, fever, pleuritic pain, purulent sputum or drainage, Comorbidities - 4Ms, COPD (severity, meds, exacerbations, smoking), RHF (SOB, syncope, jaundice, fatigue, edema), functional capacity

PX: VS, ?SIRS, A/W - ease of intubation/lung isolation; Resp - WOB, Tracheal deviation, subcu emphysema; Comorbid disease - COPD (inc AP diameter, prolonged expiration, wheeze); Estimate the loss of V_T through the fistula (bubbling through the chest tube), Quantify the difference between inhaled and exhaled tidal volumes (spirometry); CVS - pHTN/RHF: loud P2, RV heaves, TR murmur, elevated JVP, hepatic congestion, peripheral edema; Trauma: other injuries

Inv: CBC (sepsis), Lytes, Bun, Cr (paraneoplastic syndromes), INR/PTT (epidural), ABG, x-match; CXR/CT (pneumothorax, chest tube, bullae, empyema, chronic lung disease), ECHO (RHF), ECG (RVH - R > S in V1, p-pulmonarale, atrial arrhythmia, demand ischemia if septic), PFTs (baseline)

Optimization: chest tube, drain empyema, aspiration prophylaxis, antisialogogue (FOB), Resuscitate

Anesthetic Setup: 5 lead, +/- TEA, Artline, +/-CVC, FOB, multiple ETT (DLT, SLT, blockers), CPAP,, HFJV, Chest tube tray and thoracic surgeon in room

Management: D/C chest tube suction (dec. leak), SV lung isolation with DLT ideal (AFOI vs. asleep SV induction vs. RSI with DLT / bronchial SLT, if PPV - low V_t , low pressures, watch for contralateral lung contamination; HFJV allows ventilation with lower Pk pressures; surgeon can pack the lung once the chest is open; early extubation, good analgesia (TEA, Paravertebrals, intercostals, PCA)

Complications: ·Tension pneumothorax, Inability to ventilate with hypoxemia and hypercarbia (Consider briefly clamping chest tube), Outpouring of pus and lung flooding, Complications from OLV: hypoxemia, Sepsis, Pain, Persistent air leak

Burns (>10% BSA 3rd degree or 25% 1-2nd degree)

1. Trauma Pt / Emergency
2. Potential Difficult A/W with inhalational injury (ALI)
 - a. Coexisting CN & CO Toxicity necessitating 100% O₂ and early potentially hyperbaric chamber
3. Hypovolemia: Volume Resuscitate with Parkland formula – 4cc/kg/%BSA
4. Multi-organ dysfunction:
 - a. Cardiogenic shock (circulating mediators, inc SVR, dec.CBF)
 - b. ALI/ARDS, A/W sluffing, ARF, Rhabdomyolysis, Sepsis, hypothermia
5. Altered Pharmacology
 - a. Sux hyperkalemia > 24 hrs, resistance to NdMRs
 - b. Susceptibility to myocardial depressants
 - c. High analgesic requirements
6. Recurrent Procedures: Difficult IV Access & monitoring; bld loss; pain; remote location

Anesthetic Goals/Conflicts:

- ATLS approach to all patients
- Early and safe airway management: Avoid Sux > 24 hrs – 2 years after injury
 - Assume inhalational injury and provide 100% O₂, investigate for cyanide and CO toxicity
- Volume resuscitation
- Avoid End-organ damage, U/O 1ml/kg, ARDS ventilation strategy
- Provide adequate analgesia – multimodal approach

ATLS: Assess for inhalational burn, early intubation, 1.0 FiO₂, stop burning process (brush chemicals off, copious water), large bore IV access in non-burned area (groin), volume resuscitate.

Transfer: >10%, extremes of age, sensitive areas (face, hands, perineum), comorbidities

Hx: AMPLE history, tetanus status, Type & location burn – chemical (alk worse than acid), thermal, electrical (deep muscle necrosis, rhabdo, ARF); Associated trauma (covert injury). Inhalational injury - dyspnea, hoarseness, carbonaceous sputum, singed facial hair. CN toxicity (H/A, dizzy, tachycardia, tachypnea, lethargy, Sz, coma); CO Toxicity (H/A, dizziness, confusion, N/V, visual changes, CNS dysfunction).

PE: Vitals +temp, ABCDE, A/W for ease of intubation U/O, C-spine. CNS exam for CO toxicity vs head trauma. CVS: Volume status, cap refill Resp: focused airway exam for inhalational injury. Burn area (%BSA - Rule of 9's; palm = 1%TBSA); burn severity

Investigations: CBC, Lytes, Coag Profile, urine myoglobin, ABG (lactic acidosis with CN toxicity), Co-oximetry, Serum Cyanide (tox >0.2mg/L, lethal >1mg/L), ECG, CXR, Diagnostic FOB

Optimization: 100% O₂, volume resuscitation as per Parkland formula 4 cc/kg/%BSA – 50% in 1st 8hrs, 50% in next 16 hrs. Consider HBO for CO (>30%); CN- toxicity – HBO, amyl nitrate, Na nitrite (5mg/kg), Na thiosulfate (150mg/kg), hydroxycobalamin. Maintain U/O 1cc/kg/hr – Consider mannitol if myoglobinuria, Alkalinize urine to inc. solubility (correct met acidosis). Consider inotropes for volume resistant shock. ARDS ventilation strategy. Early enteral feeding.

Room Setup: CAS +5lead, temp, Hot OR, Art line (sampling), CVC (fld status), needle electrodes, foley, vasopressors, PRBC. Large bore IV's, difficult airway cart. Avoid early surgical airway due to poor outcomes.

Intraoperative Mgt: Regional vs GA. Avoid Sux > 24 hrs, consider larger dose of NdMRs (peak resistance 2-6 wks, starts 48hrs) Difficult A/W - AFOI vs. SV induction if uncooperative; RSI if OK; Avoid ++ propofol due to myocardial depression. Consider Ketamine. ++ analgesia; lung protection; volume resuscitate.

Post-op: Burn unit; HDU; ICU; multi-modal analgesia

C1 Esterase Inhibitor Deficiency (Hereditary Angioedema)

1. Potential airway emergency with complete airway obstruction
2. Disease of acute airway edema
 - a. refractory to conventional treatment of airway edema (**corticosteroids, epinephrine, antihistamines**)
 - b. precipitated by emotional stress, trauma, oral surgery, or direct laryngoscopy

Anesthetic Goals/Conflicts:

- Prevent recurrent episodes with long-term prophylaxis
 - **anabolic steroids, anti-fibrinolytics**
- Prevent acute perioperative episode
 - Avoidance of airway instrumentation (regional anesthesia favoured)
 - short-term prophylaxis with **C1 esterase inhibitor infusions (25 units/kg one time dose), FFP (2-4 units)**
- Treatment of an acute attack
 - Early tracheal intubation, preparation for surgical airway, treatment with C1 esterase inhibitor infusion or FFP

Caesarian Section

1. Potential Emergency - no time for optimization, aspiration risk
2. Pregnancy
 - a. potential difficult airway, full stomach
 - i. Mallampatti >1, short neck, receding mandible, prominent incisors (overbite)
 - b. physiologic changes including
 - i. dec. FRC – rapid desaturation
 - ii. anemia
 - iii. dec. anesthetic requirements
 - c. aortocaval compression
 - d. potential massive bleeding
 - e. maintenance of fetal oxygenation
3. Complications
 - a. Postpartum Hemorrhage - atony, products, accrete, coagulopathy, inversion
 - b. Neuroaxial - High spinal, PDPH
 - c. Embolism - PE, VAE, AFE

Anesthetic Goals/Conflicts:

- Determine urgency of situation - Continuous fetal monitoring
- Administer safe, time-sensitive anesthetic with emphasis on mother
- Conflicts
 - Difficult A/W vs. STAT section
 - Hemodynamic instability vs. Regional anesthesia

Hx: Urgency of situation; reason for C/S; AMPLE Hx; Ob Hx

PE: airway, cardiopulmonary exam, fluid status and back exam for ease of neuraxial technique

Investigations: CBC, diff, G&S, coags if applicable (PIH or prophylactic anticoagulation)

Optimization: Aspiration prophylaxis; LUD; IV fluids if necessary

Room Setup:

- Standard; emerg drugs and equipment available for GA if neuraxial fails
- Difficult a/w cart if difficult a/w anticipated
- Oxytocin, nitro available

Intraoperative Mgt:

- For neuraxial: frequent BP checks after spinal
- Oxytocin after delivery of neonate
- Good communication with mother and surgeon
- For GA: anticipate potential difficult ventilation/intubation

Post-op:

- PPH; Aspiration (Extubate awake); pain management

Special:

- Anesthetic complications: Hypotension, high spinal, failed spinal, PDPH, awareness
- Surgical complications: Hemorrhage, atony, difficult extraction

Carcinoid

Carcinoid is the most common GI endocrine tumor (1-2 per 100,000); 2-5% of patients will exhibit carcinoid syndrome: flushing with diarrhea, hemodynamic instability +/- bronchospasm; carcinoid heart disease is present in 20-40% of patients with carcinoid s

1. Malignancy (mass, medications, metastases, metabolic)
2. Risk of perioperative carcinoid crisis – hypotension & bronchospasm
 - Flushing, diarrhea, hemodynamic instability (serotonin – HTN, histamine - hTN, bronchospasm, hyperglycemia)
3. Associated carcinoid heart disease (20-60%)
 - Right-sided valvulopathy, 10% L sided valvular disease (MR, AR)
 - constrictive pericarditis, SVT, Intramyocardial metastases
4. Other endocrinopathies
 - Cushings, acromegaly (bronchial carcinoid)

Anesthetic Goals/Conflicts

- Avoid perioperative carcinoid crisis
 - Avoid triggers: Avoid SNS (hypoxia, hypercarbia, hypovolemia, sympathomimetics), histamine release, pain/anxiety, tumour manipulation
 - Premedicate with octreotide (prevent vasoactive mediator release)
- Treatment of perioperative bronchospasm
 - Avoid B-agonists, epinephrine, theophylline
 - Responds to octreotide, corticosteroids, histamine blockers

Hx: Carcinoid Symptoms (flushing, syncope, headache, hypertension, hypotension, nausea, vomiting, diarrhea, bronchospasm); Mass effect (malnutrition, obstruction – endobronchial, GI); Cardiac dysfunction (palpitations, syncope, edema, HTN); location of tumour; S/S of Cushing's, acromegaly; medical therapies

PE: vitals + posturals, volume status, Resp – Wheeze endobronchial lesion or bronchospasm, CVS - valvular Dz (TR-inc. JVP, canon V, RV heave, S3; PS-large A wave, split S2, SEM LUSB right sided), RVF; Derm: Pellagra (niacin def: dermatitis diarrheal dementia), hyperkeratosis, hyperpigment, venous telangiectasia

Investigations: CBC, coags, lytes, BUN, Cr, Mg, Ca, alb, LFTs, G&S, CXR; ECG +/- ECHO; U/A: 5-HIAA

Optimization: Consult endo/cardio, anxiolysis, preop octreotide (50-300 mcg SC 30 minutes preop or 25-100mcg IV three minutes preop – infusion of 100ug/hr may be required). Possible long acting IM formulation.

Anesthetic Options: All techniques OK for asymptomatic pts – Epidural good for postop analgesia – avoid epinephrine; GA is indicated for symptomatic pts or with tumor manipulation

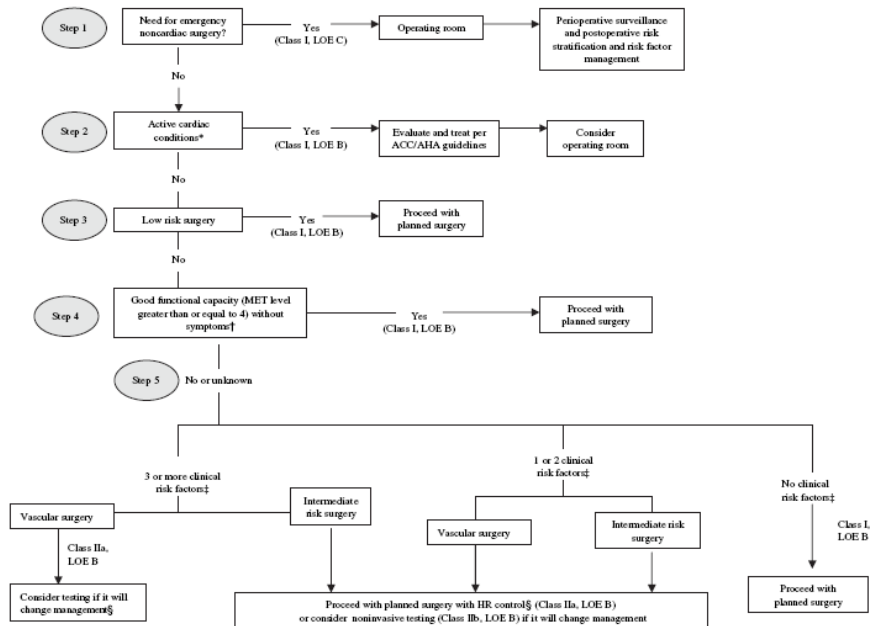
Room Setup: CAS +5, foley, art line (preinduction), CVP, large bore IV, fluid warmer, Baer hugger. Avoid SNS agents (indirect, beta agonists, reflex activation - epi, norepi, ephedrine, dopamine, isoproterenol); Phenyl, esmolol, phentolamine for HD derangement; octreotide; dilute vasopressin; avoid histamine release

Intraoperative Mgt: Titrated and deep induction - Goal is stable hemodynamics. Avoid hypotension (reflex SNS). Maintain normothermia. Communicate with surgeon and pre-empt hemodynamic shifts following tumour manip with doses of octreotide – 25-50ug bolus (no ceiling – inc. until desired effect); frequent lytes & glucose. Bronchospasm is best managed with octreotide (other agents include steroids, antihistamines).

Carcinoid Crisis: stop stimulus, 1.0 FiO2, fluids, phenylephrine, vasopressin, octreotide 100-200ug boluses titrated to effect; vasopressin, H1 or H2 blockade, serotonin antagonists (ondansetron)

Post-op: Good multimodal analgesia. Aggressive prophylaxis of N&V. HDU for true carcinoid syndrome or intraoperative crisis. High risk of delayed awakening secondary to serotonin (decreased MAC ...); Wean octreotide post-op (endocrine consult)

Cardiac Assessment for Non-cardiac Surgery



Hx: Stepwise approach

Step 1: Determine urgency of surgery

Step 2: Identify unstable syndromes (5): Recent MI < 30d, Unstable angina, decompensated HF, Severe valvular disease, Severe dysrhythmias

Step 3: If no unstable syndromes and low risk surgery, proceed ... **Step 4:** Assess functional capacity: 1 MET = ADLS, 4 METs = light housework, ie washing dishes, >4 METs = climbing 1 flight of stairs, walking at 4mph or 6.4 km/hr. 1 MET is energy consumed by the body at rest and is equal to 3.5 ml/kg/min.

Step 5: Assess clinical predictors (5): Stroke, stable angina, compensated HF, renal failure, DM.

Step 6: Determine path depending on number of predictors and risk of surgery as per guidelines.

Cardiac Risk: Vascular ~5%, Intermediate 1-4%, Low < 1%

Investigations: Echo Class 1 for CHF, diastolic, continuous, holosystolic, late systolic murmurs, ejection clicks, radiation to neck, or murmurs with infarction, syncope, endocarditis.

MIBI(dobutamine/persantine): More sens/spec than stress test for ischemia

Dobutamine Stress Echo: Best predictor of perioperative cardiac morbidity: cautions with serious arrhythmias, obesity, severe hyper/hypotension.

Optimization: Consult Cardiology, Consider angiography, Cancel Surgery, Modify surgical procedure (less invasive), consider pre-op stenting.

For PTCA surgery should be delayed 2 weeks to allow healing, and before 8 weeks (before restenosis)
DES may require anti-platelet therapy for 6-12 months, vs BM stents which req 4 weeks.

Cardiac Transplant:

1. **Denervated Physiology**
 - **Pre-load dependent, altered response to medications:** direct-acting (+); indirect-acting (-), **pacemaker** in 20%
2. Allograft function
 - **Accelerated CAD:** silent ischemia secondary to denervation, **Rejection**, **Arrhythmogenic**, cardiac transplant vasculopathy
3. **Co-existing end-organ disease**
 - renal dysfunction, HTN (~90%), DM, Malignancy (~30%)
4. **Immunosuppression** therapy
 - steroids (stress dose), cyclosporine, tacrolimus, azathioprine
 - inc. risk of infection; Anemia; Thrombocytopenia; hepato-nephrotoxicity
5. Increased risk of alloimmunization
 - Use irradiated CMV negative blood

Anesthetic Goals / Conflicts

1. Hemodynamic Goals
 - Preload: normal or high preload - transplanted heart increases CO by increasing SV
 - Rhythm: avoid pro-arrhythmic states
 - Afterload: maintain perfusion to potentially ischemic myocardium
2. Use direct-acting sympathomimetics (isoproterenol & dilute epinephrine must be available)
3. Avoid infection — adherence to strict sterile technique

Hx: Heart transplant Hx (indication, surgical & medical complications, pacemaker) / **Functional capacity** (rejection, arrhythmias, CHF, CAD – dyspnea may be only symptom, no angina) / Medications (immunosuppressants - Cyclosporine / Tacrolimus: HTN, renal dysfunction, hepatotoxicity, seizure threshold, Azathioprine: bone marrow suppression) / co-existing disease (HTN, DM, renal dysfunction, malignancy) / infections

PE: Vitals / Airway – cushingoid with inc. soft tissue / Resp – rule out infection / Cardiac – s/s of CHF (crackles, inc. JVP, hepatomegaly, HJR, edema, S3/S4)

Investigations: Labs - dec. K, Mg (diuretics, dysrhythmias), inc. Cr (anti-rejection drugs and renal insufficiency), inc. LFTs (anti-rejection drugs), Pancytopenia (anti-rejection drugs or sepsis), glucose (steroids, DM), coags (dysfxn from drugs) / ECG - RAD, incomplete RBBB, pre-1994 - two P waves (native P unrelated to QRS), Q waves / CXR – failure / ECHO – LV/RV fxn / Dob stress ECHO for CAD (Exercise Stress Test not useful d/t blunted HR, MIBI not useful d/t diffuseness of disease) / Endomyocardial Bx

Optimization: LV fxn – adequate preload, manage rejection & ischemia / Co-existing dysfunction – HTN, DM, CRF / transplant MD to manage transplant medications / Steroids / Abx for prophylaxis if valvopathy

Anesthetic Options: Local / Regional – check coags, maintain preload, direct acting vasopressors / GA – more predictable changes in preload & afterload, caution with renally excreted drugs, assess depth with BP not HR, avoid hyperventilation (cyclosporine and tacrolimus lower seizure threshold), Azathioprine antagonizes NMDA activity

Room Setup: 5 lead, +/- A-line, CVP based on Surgery, TEE based on preop fxn, PNS, crash cart, Drugs - Phenyl, isoproterenol (2-10 mcg/min) and dilute epinephrine (10 mcg/ml)

Intraoperative Mgt: Aseptic, hemodynamically stable induction, use BP to monitor depth, avoid myocardial depression with high volatile / Ensure adequate reversal

Post-op: continue anti-rejection Tx ASAP – consult transplant team Re: levels

Cardiogenic Shock

Cardiogenic Shock: SBP < 90mmHG x 30 mins + Cardiac Index < 2.2L/min/m² + PCWP > 15mmHG

1. Emergency situation with potential for perioperative mortality (>50%)
2. Etiology
 - a. Acute MI - maximize myocardial O₂ supply / demand
 - i) Medical therapy, IABP, VAD, invasive monitoring
 - ii) Complications: CHF/Acute MR/Wall Rupture/Dysrhythmias
 - iii) Early revascularization (PCI/CABG)
 - b. Systolic and/or diastolic HF, **RVF**, Valvular disease, Arrhythmias
3. Co-morbid illnesses: HTN, DM, hyperlipidemia, Smoking, Advanced age, CVA, CKD
4. Risk of bleeding 2° to thrombolytics, GIIb/IIIa inhibitors, LMWH/heparin, clopidogrel

Anesthetic Goals/Conflicts:

1. Resuscitation stabilizing ABC's, optimizing O₂ supply / demand, & maintaining end organ perfusion
 - Early consideration for IABP/VAD/PCI/CABG
 - Hemodynamic goals: to maintain/augment contractility, NSR, avoid tachycardia, reduce afterload, and maintain adequate preload
2. Ventricular interdependence – fluids, inotropes, dec. PVR (avoid PPV ect.) in RVF
3. Rule out other causes of shock - Hypovolemic, Distributive, Obstructive
4. Diagnose mechanical complications that may necessitate urgent surgical intervention
 - MR, VSD, Free wall rupture
5. Consult CVT & Cardiology - optimal revascularization technique given risk of postoperative bleeding

Hx: Confirm etiology – cardiogenic vs. others - Focused cardiac history, sx of CP, CHF, dysrhythmias, functional capacity. CRFs: DM/HTN/lipids/smoking, pvs revasc. + interventions + investigations. Check for contraindications for thrombolytics: pvs hemm. Stroke, known CNS neoplasm, active bleeding, susp. Aortic dissection, severe uncontrolled HTN, recent trauma, non-compressible vasc punctures, recent trauma. Check for contraindications to IAB: Severe vasc dx, AI, aortic aneurysm, irreversible cardiac/brain dmg.

PE: Vitals, U/O, poor pulses and cap refill, cool, cyanotic extremities, inc. JVP, new murmurs S3 +/- S4, pulsus paradoxus from R heart failure; MR – high pitched apical holosystolic murmur; VSD – harsh holosystolic murmur LSB, O2 step-up on PA; Rupture – PEA arrest, tamponade (JVD, muffled HS, pulsus paradoxus)

Investigations: CBC/Lytes/Ca+/Mg+/LFTs (congestion), Troponin, lactate, SVO2/ ABG, ECG (arrhythmia, ischemia), CXR (effusions edema), **ECHO** (valvular, VSD, rupture, effusion, EF), Consider urgent Angiography

Optimization: Acute MI - Cardiology, MONA, If hemod stable - ASA, heparin / LMWH / BB blockers (avoid if CHF), ACE, NTG (for recurrent angina). Thrombolysis vs PTCA (90 mins) vs emerg CABG

Shock: Nitrates and BBs contraindicated in shock. Invasive lines, IABP preoperatively, fluid challenge to PCWP 15-20mmHg for optimal CO, dopamine, dobutamine, Epinephrine, Milrinone. Optimize Hgb. Early intubate to reduce “WOB”; FFP / octaplex if recently anticoagulated; Aspiration prophylaxis

Room Setup: CAS 5lead + invasive lines (PAC); IABP; crash cart; Inotropes; Perfusion services; blood; TEE

Intraoperative Mgt: Modified RSI (hemodynamics vs full stomach), ketamine/etomidate/opioid/roc.

Post-op: ICU, opioid infusions for pain control in ICU vs boluses. Post-op cardiac monitoring.

Complications: Arrhythmias (afib most common >10%), bradys, ventricular arrhythmias, Vfib 3-5% peaks within 4 hours of MI, MR due to pap rupture, Free wall rupture = 2nd most common cause of death post-MI (15-30%) pks 1 week post MI.

Cardiomyopathy

Classification: Dilated/Restrictive/Hypertrophic/Arrhythmogenic RV cardiomyopathy (fibrofatty replacement of RV myocardium with sparing of LV/septum), risk of sudden death, RHF/unclassified

1. Risk of peri-operative Systolic/diastolic dysfunction with impaired CO
2. Considerations for underlying etiology
 - a. Dilated: Ischemia, HTN, Viral, ETOH, toxins, Idiopathic
 - b. Restrictive: Amyloidosis, Sarcoidosis, Hemochromatosis, Idiopathic
 - c. peripartum : Autoimmune, Idiopathic
 - d. HCM: inherited, idiopathic
3. Risk of perioperative complications:
 - a. MI, Ischemia, hypotension, arrhythmia, systemic embolism
4. Risk of dysrhythmias and considerations of pacemaker / AICD
5. Risk of systemic embolism, and considerations of anticoagulation

Anesthetic Goals/Conflicts:

- Dilated: Maintain preload / avoid dec. contractility / maintain NSR / dec. afterload
- Restrictive: Maintain preload / maintain NSR / avoid brady / maintain afterload
- Peripartum: Maintain preload / avoid dec. contractility / maintain afterload while pregnant, dec. postpartum / maintain NSR / Titrated epidural (be mindful of anticoagulation)

Hx: Functional capacity, etiology, type of CM, investigations, sx's of CHF, substance abuse (EtOH/cocaine), medications, pacemakers/AICD settings, hx of embolic complications, hx of arrhythmias, conduction defects, valvular dysfunction. Systemic complications related to infiltrative disorders.

PE: Pulse (prominent in HOCM), Displaced apical beat, LV heave (HOCM), S3 for CHF, S4 for infiltrative disorders. Regurgitant murmurs for dilated CM, cresc-decrescendo SEM b/w apex and LSB for HOCM increasing with valsalva/standing (\downarrow preload). Exam findings of CHF/pHTN. Increased JVP with restrictive and fail's to fall during inspiration (Kussmaul's). Rapid x and y decent also seen in restrictive CM. Neuro.

Investigations: CBC / Lytes (diuretics) /Cr (hypoperfusion) Coags/CXR (LV/LA enlargement)/ECG – HOCM (LVH, q waves, ST changes, arrhythmias), Dilated LVH/ST changes/BBB's, PVCs, Restrictive – BBBs, low voltage Echo – HOCM (SAM 25%), Dilated, decreased EF, restrictive, diastolic dysfunction, increased wall thickness, \downarrow EF.

Optimization: Cardiology consult, ? CTU for infiltrative/pacemaker/AICD management/ BB for HOCM

Anesthetic Options: Caution with spinal/epidural with HOCM/consider regional

Room Setup: Crash cart, pacing pads, invasive lines preinduction, 5 Lead ECG, TEE, PAC, inotropic meds

Intraoperative Mgt: See hemodynamic goals above, consider cardiac induction, avoid SNS with HOCM.

Post-op: HDU for cardiac monitoring/ischemia/hypotension/arrhythmias. Post-op pacemaker interrogation.

Peri-partum CM: 4 criteria, develops within 6 months of preg after delivery, no identifiable cause, new diagnosis with no prior heart disease, ECHO shows findings of dilated CM (EF<45%). Unknown etiology, Possibel RF – multiple gestation, obesity, advanced maternal age, breast feeding; management similar to any form of HF. 20-80% Mortality.

CEA

1. High risk of peri-operative complications:
 - a. Ischemic/hyperperfusion neurologic injury
 - b. cardiac ischemia
 - c. airway obstruction from hematoma / patch disruption
2. Significant peri-operative hemodynamic changes
 - a. X-clamp: HTN, tachycardia, inc myocardial O2 demands
 - b. Carotid sinus manipulation: bradycardia, hypotension
3. Co-existing medical illness (CAD, DM, HTN, PVD, CKD, smoking, advanced age)
4. Medications (ASA, plavix, antiHTN)

Anesthetic Goals/Conflicts:

- Maintain stable hemodynamics to optimize perioperative cerebral perfusion
- Protect brain and heart from ischemic injury
- Smooth emergence: avoid coughing, bucking, straining on emergence
- Awake patient at end of surgery for neuro assessment

Carotid Stenting

- Remote location, comorbidity, perioperative complications (HD instability, Ischemic injury, a/w obstruction, MI), monitor for hyperperfusion syndrome postoperatively
- Sedation vs. GA

Hx:

- Carotid stenosis: asymptomatic, symptomatic, hx, freq, manifestations of TIAs/CVAs. Uni vs bilat
- Comorbidities: CAD – MI is leading cause of periop morbidity post CEA, HTN – Inc risk of neuro deficits after CEA with pre-op HTN, PVD, DM, COPD, smoking
- Medications for CAD and CVA (antiplt, antiHTN)

PE:

- Carotid bruits, pre-existing neuro deficit, baseline BP

Investigations:

- CBC, lytes, BUN, Cr, G&S, EKG, review doppler U/S to assess extent of stenosis

Optimization:

- Beta blockade, cont antiplatelet therapy, consider discontinuing ACEi, ARBs

Anesthetic Options:

- GA, regional, LA + MAC (no diff in postop stroke with RA vs GA)
Room Setup: CAS (5 lead EKG), A-line, cerebral monitor (EEG, stump, SSEP, transcranial Doppler)

Intraoperative Mgt:

- Induction / Maintenance: minimize risk of hypoperfusion and cerebral ischemia
- Emergence: minimize coughing (hematoma), traheal lido, IV lido, narcotics, deep extubation. Have nitroglycerin/nitroprusside infusions, labetalol, hydralazine ready

Post-op: Complications – thrombosis, intraop CNS ischemia, ICH, hyperperfusion syndrome / respiratory depression / airway obstruction – hematoma, RLN injury / hypertension - denervated carotid body / hypotension – baroreceptor hypersensitivity / Periop MI

Cervical Plexus Block

Indications:

- Neck surgery including carotid endarterectomy

Nerves blocked:

- C2,3,4 nerve roots

Contraindications:

- General: Infection, Coagulopathy, lack of consent, true local anesthetic allergy, lack of resuscitation equipment
- Specific: Contra-lateral recurrent nerve injury (?contralateral phrenic nerve palsy?), severe lung disease (FEV1 < 1L)

Equipment:

- Routine monitors and prep supplies
- 1.5 inch 25 gauge needle, 1.5 inch 22 gauge needle for insertion

Technique:

- Identify the mastoid process, Chassaignac's tubercle and the posterior border of the SCM. Draw a line from the mastoid to Chassaignac's tubercle. The insertion points for C2, C3 and C4 can be estimated as being 2,4 and 6 cm below the mastoid along this line. Then infiltrate the skin under this entire line and then, at each of the three points along the line insert your 22 gauge needle until the transverse process is contacted (perpendicular to skin with a slight caudad angulation). At each level aspirate and then inject 4 cc.

	Onset (min)	Anesthesia (hrs)	Analgesia (hrs)
1.5% Mepivacaine (+HCO ₃ ; + epinephrene)	10-15	2-2.5	3-6
2% Lidocaine (+HCO ₃ ; + epinephrene)	10-15	2-3	3-6
0.5% Ropivacaine	10-20	3-4	4-10
0.25% Bupivacaine (+ epinephrene)	10-20	3-4	4-10

- Glossopharyngeal branches need to be blocked as well for a CEA. This can be done by having the surgeon infiltrate the carotid (NYSORA).

Complications:

- Direct trauma: pneumo, esophageal perforation, carotid or IJ puncture, hematoma
- Local anesthetic effects: inadvertent epidural, brachial plexus, intrathecal, intravenous or vertebral artery injection with associated seizures, phrenic nerve block, bradycardia or RLN dysfunction (60%)

Chronic Obstructive Lung Disease

1. High risk for perioperative respiratory complications including **respiratory failure**
2. Physiologic changes
 - a. Chronic hypoxemia / hypercapnea
 - i. **Cor pulmonale** and RV failure
 - b. Reactive airways disease
 - c. Bullous lung disease with the potential need for **lung isolation**
 - d. Potential for hyperinflation and pulmonary tamponade
3. Comorbid disease
 - a. CAD, DM, HTN, smoking, OSA, Obesity, Cancer, Cystic Fibrosis, Bronchiectasis
4. Increased sensitivity to respiratory depressant effects of anesthetic agents

Anesthetic Goals/Conflicts:

- Ensure optimization of COPD – delay elective cases as required
 - Manage acute infections, steroids, bronchodilators
- Optimize ventilation strategy
 - Prevent dynamic hyperinflation and barotrauma
 - Long I:E, low Pk pressure, low V_T slow rate, permissive hypercapnia
- Minimize peri-operative respiratory complications
 - Avoid use of respiratory depressants
 - Consider neuraxial or regional anesthesia

Hx: Determine disease severity and functional capacity; Dyspnea, wheeze, cough and sputum production; CHF Sx; Fever; Home O₂; Meds; Recent exacerbations; ETT; ICU; Steroids; Co-morbidities

PE: Resp: Tachypnea; Barrel chest; Resp distress (accessory Ms); A/E bilat; Prolonged Exp; Wheeze; Crackles; **CVS:** JVD; HJR; Hepatomegally; Pedal edema; RV heave; S3 or S4; Loud P2

Investigations: CBC, LUTES, BUN/Cr, CXR, EKG Also consider: ABG, sputum C+S, PFT; ECHO (RV dysfx)

Optimization: Postpone surgery 4-6 weeks after exacerbation; +/- respirology; antibiotics, steroids (stress dose), bronchodilators, d/c smoking in advance (8 wk to Dec risk); avoid sedatives

Anesthetic Options: RA preferred but risk of high neuraxial block & ISB will cause Phrenic paralysis → dec in FEV1 30%; GA results in dec. FRC, depression of respiratory drive; Consider TEA

Room Setup: CAS + 5 Leads; Temp; PNS; Spirometry; A-line (CO₂); TEE, PAC for Cor pulmonale; OLV equipment

Intraoperative Mgt: Deep GA; Use Ketamine/propofol/Sevo; Lung protective strategies; Bullous disease (SV induction vs standard induction with OLV (unilat & severe bilat);

Post-op: Extubate awake; Pain control; PAR; Extubation criteria include: VC > 10 cc/kg, Vt > 6 cc/kg, NIP > -20 cmH₂O, pO₂/FiO₂ > 200, A-a pO₂ gradient on 100 % O₂ < 350 mmHg

Complications: Auto-PEEP (pulm tamponade)→ D/C fom Ventilator; Bronchospasm – volatile, B agonists, Mg, Ketamine; pneumothorax – chest tube, possible lung isolation; Post op resp complications

Chronic Renal Failure

1. Increased risk of aspiration
2. Dysregulation of volume status, acid-base, and electrolytes
3. End-organ dysfunction:
 - a. Autonomic dysfunction: hemodynamic instability
 - b. Cardiac: LV dysfunction, HTN, CAD, CHF, pericarditis
 - c. Hematologic: anemia / thrombocytopenia
4. Altered pharmacokinetics
 - a. Decreased drug excretion
5. Etiology of renal failure

Anesthetic Goals/Conflicts:

- Optimize electrolytes, volume status, co-morbidities
- Avoid precipitating acute on chronic renal failure (euvolemia, avoid nephrotoxins)
- Coordinate perioperative dialysis if dialysis dependent
- Avoid compromising dialysis access (AV fistulas, indwelling IV lines, PD ports)
- Recognize increased risk of renal failure in certain surgeries (cardiac, aortic , vascular)
 - a. **Conflict: RSI and HD instability (hTN, hypovolemia)**

Hx: Etiology and co-morbidities: HTN, CAD, DM, severity of CRF, **U/O (normal, oliguric, anuric)**, end-organ dysfunction (exercise tolerance, angina, CHF, palpitations, dialysis (mode, frequency, complications, access, duration, dry weight), GERD, bleeding tendency: GI, epistaxis

PE: Vitals - orthostatic, IV access (avoid subclavians), AV fistulae (avoid IVs and BP cuff), generalized edema, A/W edema, LVH, dysrhythmias, pericardial rubs, volume status, pulmonary edema, tachycardia (autonomic dysfunction)

Investigations: CBC (anemia, dysfxnal plt), lytes (hyperK, hyperPO₄, hypoCa, hyperMg, hypoNa), serum glucose, serum proteins (hypoalbuminemia), BUN (not a reliable indicator of GFR unless protein catabolism is normal and constant), Cr, ABG (for acidemia), U/A, CrCl - <60 x 3mon = CKD

Imaging: EKG (LVH is common, arrhythmias on the basis of electrolyte abnormalities), +/- ECHO

Optimization: Defer if in ARF, Aspiration prophylaxis, dialysis timing (if chronic, dialyze day before. If acute wait til postop if possible – reduced hemodynamic instability), Empty PD pts, diabetes management, blood conservation strategies (Uremic bleeding: cryoprecipitate, DDAVP (0.3 mcg/kg IV), if borderline function and high risk surgery for postoperative RF: generous preoperative hydration, possible use of mannitol intraoperatively

Anesthetic Options: Local, regional, GA OK. Regional may be difficult b/c of AV fistulae, also dysfxn'l plt. Reflux risk makes sedation or an LMA less attractive

Room Setup: CAS (5 lead EKG), +/- A-line, CVP

Intraoperative Mgt: Avoid nephrotoxins (aminoglycosides, dye, NSAIDs, ACEi, metformin), careful attention to dose and choice of opioids (avoid Demerol – judicious doses of morphine / hydromorphone – fentanyl OK), Check K+ prior to sux, NdMB – cis-atracurium, avoid hypervolemia, delayed emergence

Post-op: postop morbidity (acidosis, hyperkalemia, infections, hTN / HTN, bleeding, dysrhythmias, clotted fistulas). Complications: ARF, volume overload, electrolyte abN, periop CV complications

Cocaine Intoxication / Pregnancy

1. Risk of **Aspiration** – full stomach
2. Multi-system effects
 - a. Airway – septal necrosis, thermal epiglottitis
 - b. CNS – **seizures**, hemorrhagic/ischemic stroke, **SAH**, delirium, **paranoia**, cerebral edema
 - c. CVS – HTN, **MI**, **Dysrhythmia**, Aortic dissection, cardiomyopathy (chronic use)
 - d. Resp – aspiration, **pneumonitis**, **bronchospasm**, pulmonary edema
 - e. Renal – ARF (infarction, rhabdomyolysis)
 - f. Heme – **thrombocytopenia**, DIC
3. **Interaction with Anesthetic** - potential for SNS stimulation (avoid ketamine, atropine), MAC inc. with intoxication, normal with chronic use, variable response to vasopressors (use direct agents, small dose)
4. **Co-intoxicants** - EtOH, MJ, heroin, opioids, amphetamines
5. **Complex pain management**
6. Potential IVDU and blood-borne infections
7. Cocaine effects in pregnancy
 - a. Maternal - **placental abruption**, dec. uteroplacental perfusion, spontaneous abortion, premature labor, premature ROM, decreased plasma cholinesterase (dec. cocaine metabolites)
 - b. Fetal – increased congenital abnormalities, IUGR, cardiomyopathy, MI, intra-cerebral bleeding, CNS irritability

Anesthetic Goals/Conflicts:

- Supportive and hemodynamic management of acute cocaine intoxication
- Conflicts: Potentially full stomach (RSI) vs hemodynamically stable induction
- Uncooperative patient / Thrombocytopenia with regional techniques

Hx: Hx/duration of use, co-intoxicants, infectious disease, sequelae of use: stroke, MI, HTN, cardiomyopathy, pulmonary edema, bowel ischemia, renal failure, hepatic failure (hepatitis), bleeding, easy bruising. + Obstetric hx: prenatal care, abstinence, spont abortion, abruption, PROM, fetal well being, anomalies, IUFD, cardiomyopathy. R/o coexisting PIH

PE: Standard PE - vitals, focused on symptoms, FHR

Investigations: CBC, plts, lytes (RF), Coags if suspect liver failure, X-match (risk of abruption), Toxicology, TSH, ECG, CXR (pulm edema, infx, dissection), ECHO (cardiomyopathy), fetal U/S, NST, HR

Optimization: - **Delay if possible with acute intoxication – duration ~120 min**

HTN: 1st line benzo's 2nd line NTG/SNP/alpha blockade (phentolamine 1mg IV q3mins/hydralazine. No BB's

HD stable VT or SVT: 1st line Benzo's 2nd line Lido(competes for Na⁺ channels), HCO₃- 1-2meq/kg shows benefit in animals. CCB is controversial, verapamil 2.5-5mg IV over 2 mins q5-10 max 20 for rate control.

Vfib or unstable VT: Defib/CPR > unknown role for Epi, Vasopressin preferred, Lido + HCO₃ as per above, unknown role for amiodarone.

Chest Pain: O₂, monitors, 1st line Benzo's + NTG 2nd line phentolamine, ASA. 3rd consider CCB/labetolol.

Anesthetic Options: All possible if cooperative, consider thrombocytopenia, hypotension with neuraxial Consider HTN with SNS activation

Room Setup: CAS + 5lead, large bore IV, **artline**, Temp (hyperthermia), vasoactive meds, FHR mont Nitro 0.5-1mcg/kg/min, SNP 0.3-10mcg/kg/min, verapamil 2.5-5mg over 2 mins q5-10mins (max 20).

Intraoperative Mgt: Increased MAC, **deep laryngoscopy**, **pre-treat HTN**, Avoid SNS drugs (ketamine/atropine/potent volatiles), used direct vasoactive meds (smaller dose phenyl)

Post-op: Ongoing monitoring, risk of arrhythmias, MI, withdrawal, hard to manage pain

CO Poisoning/Smoke Inhalation

1. Potential for evolving respiratory compromise
 - loss of airway from edema/obstruction
 - ALI / ARDS
2. Coexisting injuries - Burns & trauma
3. CO and/or CN poisoning
4. Complications
 - Sepsis, Rhabdomyolysis, lactic acidosis, Renal failure, Thrombocytopenia, Consumptive coagulopathy, Electrolyte disturbances

Anesthetic Goals/Conflicts:

1. Rapidly assess need to establish definitive airway - 1 or more are present:
 - i) Stridor
 - ii) Use of accessory respiratory muscles
 - iii) Respiratory distress
 - iv) Hypoxia or hypercapnia
 - v) Deep burns to the face or neck
 - vi) Blistering or edema of the oropharynx
2. Support oxygenation with 100% O₂, consider HBO chamber early
3. Volume resuscitation as required

Hx: Events surrounding the inhalation injury, Closed-space environment, Type of fuel (plastics), Sx's of dyspnea, change in voice,

PE: Vitals (inaccurate SaO_2 with COHb), A/W exam: singed nasal hairs/eyebrows, cutaneous burns on head/neck/torso. Carbonaceous sputum. Resp: edema, wheeze. CVS: dysrhythmias.

Investigations: CBC, lytes, BUN, Cr, glucose, lactate, ABG: PaO_2 , SaO_2 , carboxy-Hb level (co-oximetry) CN level, Anion gap. CXR (often initially normal)
FOB (96% PPV of findings if COHb > 10%, closed-space fire, and carbonaceous sputum. Look for: erythema, edema, ulceration of the airways, and carbonaceous debris.

Optimization: Early intubation, High FiO_2 (especially if concomitant CO or CN poisoning), Parkland formula - 4 ml/kg / BSA burned, Give $\frac{1}{2}$ in first 8 hrs and the rest over the next 16 hours (underestimates requirements of infants < 10 kg - use 6 ml/kg/% burned per 24 hrs); overly aggressive resuscitation can worsen supraglottic edema, Bronchodilators. Steroids are ineffective and can increase the risk of infection

Anesthetic Options: depends on pt's condition, often early ETT/ $\uparrow\text{FiO}_2$

Room Setup: CAS monitors, uncut ETT, FOB/Difficult Airway cart

Intraoperative Mgt: $\uparrow\text{FiO}_2$ for CO treatment

Post-op: post-op ventilation until recovery from airway/lung injury and edema

Complex Regional Pain Syndrome

1. Chronic pain with its associated psychological, cognitive, and behavioural effects
2. Requires accurate diagnosis while ruling out other pathology
3. Initial presentation represents a relative medical emergency
 - a. Need for early, aggressive, multimodal therapy
4. Medications associated with CRPS
 - a. Opiate tolerance
5. Primary Goal is return of function

Assessment:

- General Categories: Sensory, Motor, Vasomotor (temp, colour), and Sudomotor (fluid balance)
- **Hx:** initiating event, severity and duration of symptoms, previous treatments and their impact, rule out other etiologies (malignancy, infection etc...), functional impact
- **Px:** Vitals, allodynia, hyperalgesia, skin colour and temperature, hyperhidrosis, presence of skin atrophy, nail and hair changes, edema, joint stiffness, muscle weakness, dystonias

Etiology: Trauma, neurologic insults, HSV, MI;

Risk Factors: female, trauma, nerve injury, WCB, surgery

Investigations: EMG, sweat tests, 3 phase bone scan, XRay, MRI/CT, diagnostic sympathetic blocks

Treatment:

Early referral to specialist, Multiple modalities with goal of facilitating physio/OT - TCA, gabapentin, opioids, non-opioids (prazosin, clonidine, phentolamine, NMDA antagonists), TENS, IVRA, sympathetic blocks, neuraxial treatment (SCS, intrathecal pumps), surgery (sympathectomy)

Conn's Syndrome (hyperaldosteronism)

- 1) Hypertension and end-organ dysfunction:
 - a. Cardiac dysfunction, CVA
- 2) Fluid and electrolyte abnormalities
 - a. Volume overload
 - b. Hypernatremia, Hypokalemia
- 3) Medications: Spironolactone

Anesthetic Goals/Conflicts:

- Perioperative normalization of fluid and electrolyte status
- Perioperative control of hypertension

Unstable C-spine

1. Urgent/Emergent airway management with risk of aspiration
2. Difficult airway management: limited cROM, other head and neck trauma
3. Prevention of secondary spinal cord injury
 - Airway management, transfers and positioning
 - Hard collar, manual in-line stabilization, Mayfield pins, full spine precautions
4. Predisposing Comorbidities: Congenital /Acquired / Trauma
5. Acute spinal cord injury (if appropriate)
 - Neurogenic shock
 - Respiratory insufficiency
 - Succinylcholine contraindicated
 - Loss of thermal regulation

Anesthetic Goals/Conflicts:

1. Adequate preoperative identification and optimization of unstable cervical spine if elective surgery
2. Safely secure airway with prevention of secondary spinal cord injury through immobilization during airway management, transfers and positioning
3. Potential conflicts: Uncooperative, intoxicated or pediatric patient vs. awake FOI

Hx: Identify etiology and screen for associated comorbidities, aspiration risk fx, if trauma other injuries

PE: Vitals, airway exam (mouth opening, dentition, TMD, neurological symptoms with neck mov't if appropriate), usual CVS and respiratory exams

Investigations: Consider any of lateral neck film (flex/ex if appropriate), 3 views (lateral, AP, open mouth odontoid), CT neck. Ant ADI > 4-5mm abnormal. MRI useful for ligamentous injuries.

Optimization: Aspiration prophylaxis or fasting as appropriate, glycopyrrolate

Anesthetic Options: Spine stabilization during airway management and positioning through manual in-line stabilization (MILS), awake FOI, Mayfield pins (after intubation). FOI with NETT may be technique of choice; DL with MILS also acceptable for emergency cases. DL associated with maximal movement at odontoid-C1/2. Cricoid controversial (risk of aspiration vs. displacement of c-spine).

Room Setup: Difficult airway cart, skilled assistants, consider ENT surgeon present.

Intraoperative Mgt: Dexamethasone may decrease airway edema

Post-op: Consider postop ventilation/ICU in head up position or extubation over tube exchanger depending on degree of airway edema, prone positioning and instrumentation

DDx: Congenital (Down's syndrome - 15%, odontoid abn, mucopolysaccharidoses), Acquired (RA-30%, Still's disease, ankylosing spondylitis, psoriatic arthritis, Crohn's/UC, Reiter's Syndrome) and Trauma (odontoid #, other bony #, ligamentous disruption, 5% of TBI have a c-spine injury)

No c-spine imaging acceptable after trauma if: A & O; no head injury; no intoxication; no neck pain; no abn neurology; no distracting injury; neck examination normal

Croup/ Laryngotracheobronchitis

Acute but self-limiting viral infection causing narrowing of subglottic structures and rarely airway compromise requiring intubation

1. Emergency
2. Pediatric patient
3. Complications
 - Association with bacterial tracheitis
 - Airway obstruction

Anesthetic Goals / Conflicts

1. safely secure airway if necessary
2. avoid precipitants of complete airway obstruction
3. r/o other conditions

Hx & Px

6 mo to 6 yo; onset 12 hours to 3 days; low grade fever/ generally do not appear toxic; barking cough; coryza, rhinorrhea

Investigations

AP neck films: "steeple" sign (not specific); CBC, blood cultures

Optimization

- intubation rarely istula
- humidified air/cool mist
- nebulized epi 0.5 ml/kg of 1:1000 max 5 ml (racemic no longer available) q15-20 min
- dex 0.6mg/kg PO
- nebulized budesonide (2 mg [2 mL solution] via nebulizer)
- heliox

Disposition

1. PICU
2. Can generally be extubated in 4-7 days after confirmation of leak, resolution of other symptoms
3. Extubate in OR after visualization

Cushing's Syndrome (hypercortisolism)

- 1) Difficult airway: Obesity / OSA
- 2) Coexisting Disease
 - Cardiac:
 - HTN / Volume overload (increased renin and glucocorticoid vascular reactivity)
 - LVH, pHTN/RVF, systolic and diastolic dysfunction
 - CNS: Psychosis
 - Metabolic:
 - Hypokalemic metabolic alkalosis – mineralcorticoid effect of glucocorticoids
 - DM – insulin deficiency
 - Osteoporosis
- 3) Potential difficult IV access
- 4) Perioperative Steroid replacement
- 5) Pharmacologic considerations: Sensitivity to NMB, catecholamines
- 6) Considerations of pituitary tumours (4M's)

Anesthetic Goals/Conflicts:

- Minimize risk of adrenal insufficiency during perioperative stress, particularly during resection of pituitary

Cyanotic Heart Disease

- Right to Left Shunt ($Q_p:Q_s < 1$) (TOF, tricuspid/pulmonary atresia, TGV, truncus arteriosus, TAPVR, hypoplastic Lt Heart)
 - Shunt dependent on RVOT obstruction and PVR / SVR
 - Optimize CO and tissue oxygenation by balancing SVR and PVR
 - **Chronic hypoxemia**
 - pHTN & cor pulmonale
 - Polycythemia - risk of thrombosis with HCT > 55, avoid dehydration and Fe deficiency
 - Risk of **paradoxical air embolus** (prevent air in IV, avoid N₂O)
 - Treatment: Maintain PDA, palliation with BT shunt + Glenn / Fontan vs. primary repair
- Complications
 - General – dec. growth, developmental delay, increased metabolic rate
 - Cardiac - hypertrophy, arrhythmias, RV failure with ischemia, volume overload with CHF
 - Pulmonary
 - Dec. PBF: TOF, Tricuspid or Pulm atresia w/o VSD
 - Inc. PBF: TGV, hypoplastic L heart, TAPVR, Truncus
 - Heme (polycythemia, hyperviscosity, coagulopathy – dec. Vit K)
 - CNS (brain abscess)
- Assess anatomy/surgical repair/residual shunts and ventricular function
- SBE prophylaxis
- Associated syndromes (Down's) + defects (craniofacial, skeletal, GI / GU)

ANESTHETIC GOALS:

1. Hemodynamic goals:
 - **TOF**: full preload, high SVR, low PVR, low contractility, low HR, avoid dehydration
 - **BT shunts**: PBF dependent on MAP and PVR – maintain $SpO_2 < 85\%$ - balance of systemic and pulmonary blood flow – avoid high FiO_2 / hyperventilation– pulmonary vasodilation
 - **Fontan**: PBF / CO depends on preload and PVR - **Full preload, low PVR**, normal SVR (prevent R – L shunt), N contractility, and **NSR** (dec. pulmonary venous congestion)
 - **Consider factors that increase PVR**: hypercarbia, hypoxia, acidosis, SNS stimulation, lung hyperinflation (PVR is lowest when lung is at FRC → large V_t and low freq), increased HCT
2. Avoid air bubbles (important for R to L shunts)
3. Avoid hypothermia (left shift of O_2Hb curve - less available O_2 , Plt dysfunction, hyperviscosity and metabolic acidosis)

Pathophysiology: Incidence: 8:1000 live births; 25% have other abnormality; 8.5% syndromic (most commonly w/ endocardial cushion defect, VSD, TOF)

Hx: Clinical diagnosis, surgical repair, residual lesions; **Functional status;** weight gain if infant; NYHA classification; Prolonged intubation (subglottic stenosis); Strokes (hyperviscosity syndrome in cyanotic lesions); Associated syndromes (Down's, VACTERL, DiGeorge); Medications: inotropes, diuretics, afterload reducers, digoxin (0.8-2 ng/mL therapeutic)

Px: weight, height, VS, SaO₂, cyanosis, clubbing; signs of CHF (elevated JVP, pedal edema, crackles, tachypnea, hepatomegaly in infants), BP discrepancies (coarctation); inc. WOB (nasal flaring, increase RR, chest retractions, accessory muscle use); Shock – cap refill, peripheral perfusion

Inv: If repaired lesion, doing well, on no medications → only routine investigations dictated by the surgical procedure; If uncorrected lesion: **CBC** Polycythemia in cyanotic lesions (Hb = 200 g/L) - Consider phlebotomy; Thrombocytopenia; **Coags** (coagulopathy 2nd to low levels of vitamin K dependent factors); **Lytes** if on diuretic, digoxin, history of arrhythmia; **ABG** if cyanosis or respiratory failure; **Imaging: EKG, CXR, ECHO:** define anatomy of lesion, exclude other lesions, **cath**

Optimization: Clear fluids to 2 hrs preoperatively, optimize preload, SBE prophylaxis, anxiolysis

Anesthetic Options: Local vs. regional vs. general depending on lesion and procedure

Anesthetic Setup: Emergency drugs; CAS monitors; **NIBP and IV on opposite side of shunts;** capnography: **dead space will underestimate PaCO₂ in R → L shunts;** Consider A-line, CVP

Management: Regional - Consider the type of cardiac lesion (decreased SVR in TOF undesirable); Improves peripheral blood flow, decreased DVT, reduced perioperative blood loss; Coagulation status

General anesthesia: Slower inhalation, faster IV induction, potential for overdose in R → L shunts; Ketamine useful: minimal myocardial dysfunction, **maintains SVR, little effect on PVR;** Avoid N₂O; Avoid high PAPs and PEEP in patients with decreased pulmonary blood flow; PEEP may be of value in patients with high pulmonary blood flow (truncus arteriosus, TAPVR); Early extubation may be appropriate in patients with uncomplicated anesthetic and surgical courses

Disposition & Monitoring: Depends on lesion/repair/procedure; Most will require some type of post-op monitoring

Cyanotic Neonate

1. **O₂ responsive** - Hyaline membrane disease, Meconium aspiration, GBS pneumonia, PTX, Diaphragmatic hernia
2. **Not O₂ responsive** - PPHN, Truncus Arteriosus, TAPVR, TGA, Ebstein's anomaly, Right heart obstruction including TOF (may present late unless severe RVOT obstruction)
3. **PDA dependant lesions**
 - Systemic Flow: Coarctation, Interrupted aortic arch, Hypoplastic left heart, Critical aortic stenosis
 - a. Shock: Poor distal perfusion with closure of ductus
 - Pulmonary Flow: Tricuspid/Pulmonary atresia, RVOT obstruction (pulmonary stenosis, TOF)
 - a. Cyanosis: R to L shunt with ductus closure
4. **Management:** Depends on age of presentation and clinical manifestations
 - R to L shunts - goal is to increase pulmonary blood flow
 - a. If duct dependent: start PGE
 - b. If not duct dependent; balance between PVR and SVR
 - Shock – goal is to improve systemic cardiac output
 - a. If duct dependent: start PGE
 - CHF - Implies L to R shunt with increased pulmonary blood flow and volume overload - need to decrease pulmonary blood flow
 - Supportive – Intubation, Glucose: can become hypoglycemic d/t hepatic congestion, Consider bicarbonate to improve metabolic milieu, PGE1

Cystic Fibrosis

1. **Risk of aspiration** – GERD, Mechanical ileus
2. **Risk of perioperative resp dysfunction**
 - **Mixed obstructive and RLD with potential for pHTN, RVF, and cor pulmonale**
 - Thick secretions; chronic pneumonia; bronchiectasis; bullous disease
 - Inc. risk of periop pulmonary complication: hypoxemia, bronchospasm, PTX, massive hemoptysis, resp failure requiring ventilation
3. **Other Co-morbidities:** Malnutrition with anemia or chronic disease
 - Coagulopathy - Vit K deficiency, obstructive hepatobiliary dysfunction
 - Pancreatic insufficiency with DM
 - Meds: O₂, insulin, Bronchodilators, Steroids, mucolytics, Abx
4. Postop: pain management; aggressive resp therapy; HDU/ICU

Anesthetic Goals/Conflicts:

- Minimize periop pulmonary complications: optimization of preoperative respiratory function, hydration, and control of secretions; Lung protection ventilation strategies; avoid bronchospasm;; pain control
- Minimize lung contamination (hemoptysis or abscess)
- Avoid precipitants of pHTN
- Conflicts: emergency surgery in CF with active infection & regional anesthesia in the setting of potential coagulopathy

Hx & PE: severity of Cardiopulmonary disease – vitals with SaO₂, inc. WOB, dyspnea, cyanosis, Clubbing, orthopnea, adventitia, hyperinflation, infection, pHTN & RV failure (edema, inc. JVP, S3/S4, P2, heave), functional status; **GI Disease** – cachexia, GERD, hepatic dysfunction (jaundice, coagulopathy), bowel obstruction; Other Organs – DM

Current Treatment: physio, O₂, bronchodilators, mucolytics, steroids, Abx, insulin/PO hypoglycemics

Investigations: CBC; Lytes; Ur; Cr; Glucose; Coags; LFT; Sputum C/S; ABG; CXR/CT; ECG plus ECHO if evidence of pHTN; PFTs (inc. RV, FRC; dec. FEV₁, PEF, FEV₁/FRC, VC)

Optimization: Consults (resp, cardio, endo, peds, ICU); Delay elective surgery if active infection; Pulmonary function – chest physio and postural drainage, Abx, Bronchodilators, steroids; cardiac meds; correct coagulopathy; aspiration prophylaxis

Anesthetic Options: LA vs RA vs GA or GA/RA

Room Setup: CAS monitors + 5-Lead ECG, PNS, Art line, +/-CVP & TEE if pHTN & RV dysfx;

Meds: vasopressors, pulm vasodilators, bronchodilators, large ETT, suction catheter, DLT, FOB, Chest tube

Avoid: Anticholinergics; ketamine, nasal intubation

Intraoperative Mgt: PreO₂ with RSI; spont ventilation if bullous disease; use short acting NMB and anesthetics (remi) ; frequent suctioning; lung protective ventilation strategy (minimize PIP, long E time); Avoid precipitants of pHTN; avoid long acting resp depressants

Emergence: Crisp emergence; completely reversed & suctioned prior extubation; pain control with adjuvants;

Post-op: HOB 30-40°, Resume aggressive Chest physio; Monitor in HDU for periop pulm complication

Complications: Hemoptysis; PTX; Post induction cardiopulmonary collapse (hypoxemia, PPV, pHTN, RVF); Hypoxemia; High PAP; Failure to wean

Special: 1:30 carrier; 1:3000 births CF: autosomal recessive mutation of CF gene on Ch 7; Abn CFTR (Cl channel → thick secretion; plugging of Exo glands

Delayed Emergence

DDx:

- Drugs - absolute or relative overdose
 - Volatile, Hypnotics, Narcotics, Nonanesthetics - Phenothiazines, α_2 agonists, TCA, NdMBs, illicit drugs, ETOH
- Infections
 - Encephalitis, Meningitis, abscess, Sepsis
- Metabolic
 - Hypoxia / hypercarbia, **Hypo/hyperglycemia**, myxedema coma, adrenal insufficiency, Electrolytes (Sodium, Calcium, Magnesium), Toxins (Uremia, hepatic encephalopathy)
 - Hypothermia
- Structural
 - CVA, ICH, Tumor, Cerebral edema, Postictal, hydrocephalus, pneumocephalus, hypoperfusion
- Severe pain

Most frequent causes

- Relative Overdose, Incr'd sensitivity (extremes of age), Drug interactions, Hepatic/renal disease,
- Consider opioids, MAOI's, NdMBs, acidosis, Mg, drugs that potentiate NdMBs, recent withdrawal from EtOH or illicit drugs
- Pediatrics
- Hypoxemia, Ingestion, Meningitis, TBI (abuse)

Management:

- Inform surgeon
- Ensure the patient is hemodynamically stable with adequate oxygenation and ventilation
- Scan monitors for HR, rhythm, E_tCO_2 , SpO_2 , cycle BP, E_t agent, temperature
- Ensure that all anesthetic agents, volatile and IV are stopped
- Stimulate obtunded patient, restrain combative patient
- Diagnosis and treat metabolic derangement
 - **Blood glucose**, electrolytes, ABG
- Review medications and dosages - Check for syringe or ampule swap
- Consider reversing specific agents
 - Naloxone – 0.04mg IV titrated to effect
 - Flumazenil – 0.2mg q 1 min titrated to effect (max 3mg/hr)
 - Physostigmine – 1mg q 3 min titrated to effect (max 4mg)
- **Hx & Px including neurologic evaluation**
 - collateral history, chart review (drugs, diabetes, lytes, injuries, infection, seizures, endocrinopathy, renal/hepatic impairment); “at risk” procedure (bypass, open ventricle, CEA, craniotomy). Anesthetic – duration, drugs, doses
 - Focal neurologic findings - PERL, corneals, gag, Limb reflexes
- **Investigations:** CBC, lytes, glc, BUN, Cr, Mg, Ca, PO_4 , LFTs, blood/urine culture, tox screen, TSH, fT4, Serum osmolality, lactate, ABGs, ECG, CXR, CT head, consider LP
- **Early consultation with neurology or neurosurgery**
- If no improvement, arrange transport to ICU for continued care

Diabetes Insipidus

1. Etiology and Co-existing Disease
 - Neurogenic - posterior pituitary surgery, tumour, head trauma
 - Nephrogenic - CRF, drug induced (Lithium), fluoride toxicity, hypoK, hyperCa, sickle cell anemia
 - DDx of hypernatremia- (any cause of excessive water loss, renal disease, mineralocorticoid excess, hypertonic NG feeds)
2. Hemodynamic instability due to volume depletion
3. Hypernatremia
 - Thirst, altered LOC, lethargy, Seizures, Coma, Hypovolemia, Shock
 - risk of ICH from acute, severe hypernatremia
 - risk of correction (cerebral edema, volume overload, water intoxication)

Anesthetic Goals/Conflicts:

- Preoperative normalization of serum sodium when possible: correct < 0.5 mEq/hour
 - IV fluid, DDAVP (neurogenic), Chlorpropamide (nephrogenic)
- Restore intravascular volume
 - replace ongoing losses with hypotonic IV solution
- Treat underlying etiology

Hx: U/O > 100ml/hr of dilute urine with hypernatremia. Search for etiology: surgical history (esp. pituitary), medications (Lithium, glyburide, amphotericin B, methoxyflurane), electrolytes (hypoK, hyperC, sickle cell anemia), toxicities, renal failure, trauma; symptoms of DI & hypernatremia; previous treatment

PE: Vitals, postural BP, volume status, focused neurological exam for localizing signs, signs of trauma, other pituitary abnormalities

Investigations: Serum and Urine lytes, urine osmolality < 300mOsm/L and serum Na > 150, urine specific gravity < 1.002, Renal function, Calcium (hypercalcemia), Other hormonal deficiencies, CT head for CNS etiology; Water deficit = $TBW \times ([Na]/140 - 1)$

Optimization: aim for euvolemic but avoid rapid correction (replace water deficit with hypoosmolar fluid (D5W) over 24-48 hrs, not more than 0.5-1 mEq/L/hr), DDAVP for Neurogenic DI (1-3ug IV bid, 5-20ug IN bid), d/c offending drugs. Nephrogenic DI - chlorpropamide 200-500mg/d (potentiates renal effects of vasopressin, A/E hypoglycemia), clofibrate, carbamazepine- enhances vasopressin secretion, HCTZ- potentiates renal effects of ADH

Anesthetic Options: none preferred. Note: higher MAC with hypernatremia

Room Setup: vasopressin (.1-2U/hr infusion), consider Art line to monitor Na, foley, Consider CVP to monitor volume status

Intraoperative Mgt: Fluid management – NS bolus to euvolemia, maintenance plus 2/3 previous hour U/O as D51/2NS, if hourly fluids >400ml, add DDAVP, consider vasopressin infusion

Post-op: Hemodynamic instability, intracranial hemorrhage, water intoxication from therapy, Cerebral edema

Diabetes Mellitus

1. Potential difficult airway with risk of aspiration
 - a. stiff joint, obesity, autonomic neuropathy (gastroparesis)
2. End-organ dysfunction
 - a. Macrovascular - CAD, HTN, PVD, CVD
 - b. Microvascular - nephropathy, retinopathy
 - c. Neuropathy – peripheral, autonomic
3. Increased perioperative risk
 - a. Related to end organ dysfunction
 - b. Related to DM and its treatment
 - i. Hypo/hyperglycemia, DKA, HONK
4. Periop management of oral hypoglycemic and/or insulin

Anesthetic Goals/Conflicts:

- Identify and optimize end-organ dysfunction
- Optimize perioperative glycemic control – 6.5-10 mmol/L
 - hold oral hypoglycemic, ½ NPH dose – 100cc/hr D5W, avoid extremes of hypo-/hyperglycemia
- Avoid and manage glycemic complications - DKA, hypokalemia, hypoglycemia

OB Considerations: inc. maternal risk (DKA, difficult A/W, aspiration, nerve injury, hypoglycemia, PIH, polyhydramnios, preterm, infection c-section, dystocia,); Fetal risk – CVS, CNS, GI

Hx: DM type and duration, meds, insulin, Glycemic control (average BS, HbA_{1c}), Previous episodes of DKA/HONK; End-organ disease (CAD, HTN, PVD, CKD, CVD), **Functional Capacity**, Neuropathy - autonomic (orthostatic hTN, lack of HR variability) and peripheral (burning pain, parasthesia); Retinopathy (have they seen ophthalmology)

PE: VITALS (postural), Airway assessment (Stiff joint syndrome, prayer sign); Focused physical based on history of associated co-morbidities (cardiac / CNS); **Autonomic neuropathy** - resting tachycardia, orthostatic hypotension, absent beat-beat variation in HR with breathing, prolonged QT

Inv: CBC, lytes, Ur, Cr (renal insufficiency), fasting glucose, ECG; cardiac work-up as per AHA

Optimization: end-organ dysfunction, Management of meds – stop metformin 48hrs preop, hold hypoglycemic, ½ NPH dose and give D5W preop; glycemic control, 1st case of day, involve endocrine if brittle; consider B-blockers as per AHA

Options: Neuroaxial (reduced stress response, but reduced insulin secretion); higher risk of neuropathy with regional (worse with epi); GA

Room Setup: CAS +5 lead; Art line (sampling, neuropathy); Direct acting agents if autonomic neuropathy, glucometer –consider IV insulin infusion to maintain BS 5.0-11 mmol/L; Appropriate airway preparation

Intraoperative Mgt: Glucose intra-op monitoring – avoid hypoglycemia; Appropriate padding (prone to neuropathy)

Post-op: dependant on case and comorbidity

Complications: Periop MI, ARF, hypoglycemia, DKA, HONK, autonomic instability, infection, sepsis

DKA & HONK

DKA in type I DM, NKH in type II DM - Both due to precipitating event: hypovolemia, trauma, infection, MI, CVA, pancreatitis, drugs (diuretics). HONK - no ketones due to residual basal insulin secretion which impairs lipolysis.

1. Emergency situation
 - a. aspiration risk, limited time for optimization
2. Metabolic derangement
 - a. Hyperglycemia with dehydration, hyperosmolarity and coma
 - b. Metabolic acidosis
 - c. Electrolyte disturbances – hypokalemia, hyponatremia
3. Considerations of DM (neuropathy, nephropathy, airway, CAD)
4. Risk of cerebral edem with rapid reduction in serum osmolality

Anesthetic Goals/Conflicts:

- Volume replacement with NS until end-organ perfusion restored
 - 1-2 L in DKA; 3-8L in HONK
- Humulin R 0.1U/kg bolus then Humulin R 0.1U/kg/hr infusion
- Continue insulin until anion gap resolved – switch to D51/2NS when BS 15 mmol/L
 - Monitor Na & replace total water deficit over 24-48 hr – urine output as a guide
- Start KCl infusion (40mEq/L) when U/O > 0.5ml/kg/hr, and K < 4.5
- Monitor glucose q30-60min; lytes, AG and Phosphate q 60 min – phosphate will need repletion
- Identify etiology (sepsis, MI, poor compliance, new diagnosis)

Hx: Standard DM history when applicable; usually precipitated by poor patient compliance with insulin; hx of any precipitating factors; symptoms – polyuria, polydipsia, wt loss, lethargy, visual changes, stupor, coma, Sz, N/V, abd pain, fruity odor on breath

PE: Vitals (posturals - osmotic diuresis and vomiting); Kussmauls respirations (severe acidosis); Decreased LOC, coma

Investigations: CBC (polycythemia), lytes (Hyperglycemia (HONK > DKA), metabolic acidosis with anion gap ($\text{pH} < 7.3$, $\text{HCO}_3^- < 15$) hyponatremia with hyperosmolarity, hyperkalemia initially → hypokalemia with treatment, hypophosphatemia), Cr (ARF), osmolarity, urine ketones,

Optimization: treat the DKA before O.R. unless an emergency

Intraoperative Mgt: continue to manage the DKA with appropriate infusions

Post-op: HDU for intensive monitoring of electrolytes

Complications: Hypokalemia, Hypophosphatemia, Cerebral edema

Disseminated Intravascular Coagulation

Widespread systemic activation of coagulation → intravascular thrombosis & consumptive coagulopathy

1. Emergency situation with high mortality requiring urgent evaluation and management
2. Multisystem complications
 - a. Bleeding (ICH, tamponade, hemothorax, hematuria, surgical wounds etc.)
 - b. Thromboembolism (CNS ischemia, ARF, ARDS, PE, liver failure)
3. Considerations for underlying etiology
 - a. Sepsis
 - b. Trauma
 - c. obstetrical conditions (AFE, inutero death, abruption, pre-eclampsia)

Anesthetic Goals/Conflicts:

- Diagnose and treat underlying cause
- Replace consumed coagulation factors/platelets and lost RBCs as required
- Support multi-organ system failure

Hx: AMPLE, details of critical illness

PE: Vitals, GCS, Airway, CV-Resp exam, look for bleeding, end-organ failure – dec. LOC, shock, ARDS, ARF, liver dysfunction

Investigations: CBC, coags, fibrinogen, FDPs, D-dimer, ABGs, ECG, CXR; DIC is suggested by a clinical condition consistent with DIC, thrombocytopenia ($< 100 \times 10^9/L$), prolonged PT and aPTT, presence of FDP/D-dimer

Optimization: Correct underlying etiology and physiologic derangement, $Plt > 50$, FFP to keep $INR < 1.5-2$, Cry to keep fibrinogen > 1.5 , PRBC to maintain perfusion

Room Setup: Standard CAS, large bore IV, fluid warmer, +/- Artline & CVP

Intraoperative Mgt: GA, Neuraxial contraindicated. Potential conflict of need for RSI with possible hemodynamic collapse on induction. Need for continued supportive management, keep up with consumptive coagulopathy, keep warm, repeated intra-op bloodwork. Replacement of factors/blood when needed.

Post-op: Ongoing coagulopathy, likely need SPAR/ICU setting

Special: Complications include massive hemorrhage, ongoing bleeding, and multi-organ failure

Difficult Airway

Expected difficult intubation 2° to history and/or physical

- Previous anesthetics, Hx of OSA, radiation to head and neck, tumours of head and neck, previous long-term intubation (stenosis); short “bull” neck, prominent incisors, limited ROM of neck or TMJ, pregnancy, congenital syndromes, airway infections, trauma, anaphylaxis, morbid obesity, obvious anatomical abnormalities, stridor, subcutaneous emphysema, blood in oro- nasopharynx
- Assess for difficult surgical a/w (obesity, tumor, burns, dec. neck mobility)
- Consider alternatives to GA
 - Airway management will still be a problem if complications arise
- Prepare basic airway equipment plus contingency plan
 - Multiple blades and ETT sizes, stylet, bougie, lightwand, glydscope, LMA +/- fastrac,
 - Equipment for transtracheal jet ventilation
 - Readily available and connected to O₂ source
 - FOB; Cricothyrotomy set and skilled clinician; Consider CPB standby
- Perform awake intubation
 - Judicious IV sedation
 - Conflict btw cooperative patient and awake patient
 - Topicalize airway
 - 0.2 mg glycopyrrolate
 - 5cc 4% cocaine with 15cc 4% lidocaine in atomizer
 - Base of tongue, tonsillar pillars, posterior pharyngeal wall, hypopharynx
 - Lidocaine to vocal cords

- Awake direct laryngoscopy - If adequate view, induction, paralytics, intubate
- Fiberoptic laryngoscopy - Induction once ETT confirmed in position
- Lightwand - Upright patient

Failed intubation – two failed attempts by experienced clinician

- Emergency situation
- Call for help and difficult intubation cart
 - Multiple blades and ETT sizes, stylet, bougie, lightwand, glydscope, LMA +/- fastrac,
 - Equipment for transtracheal jet ventilation
 - Readily available and connected to O₂ source
 - FOB
 - Cricothyrotomy set and skilled clinician
- Attempt to mask ventilate with 100 % O₂
 - Adequate
 - wake patient and either cancel or proceed as with expected difficult intubation
 - if NdMR given optimize position, equipment, and clinician
- Inadequate mask ventilation (oral airway, two person)
 - LMA placement → adequate?
 - If inadequate move to emergency cricothyrotomy, or tracheostomy

Complications: damage to airway, bleeding, airway obstruction, hypoxemia, esophageal intubation, gastric distention and regurgitation/aspiration, C-spine injury

Down's Syndrome

Incidence: 1 in 800 livebirths.

1. Airway abnormalities
 - a. Difficult BMV — macroglossia, Choanal atresia / narrow nasopharynx, prominent tonsils & adenoids (population risk of difficult intubation – 0.5%)
 - b. Subglottic stenosis — require a half-size smaller ETT than predicted by age
 - c. Possible unstable C-spine — 31% A-A (20% asympt) and A-O instability
2. Congenital Heart Disease (40%)
 - a. AV canal defects (50%), VSD (~25%), secundum ASD, PDA, Tetralogy of Fallot (4%)
 - b. Accelerated CAD, adult onset valvular disease, SBE prophylaxis, Bubble-free IVs
3. OSA — sensitive to respiratory depressants; risk of pHTN and RV failure
4. Uncooperative patient — Developmental Delay, Early onset Dementia
5. Associated conditions: DM, Hypothyroid, Obesity, Cataract's, Recurrent Otitis Media, Immune Deficiency, Duodenal atresia, difficult IV access

Anesthetic Goals/Conflicts:

- Identify presence of A-A instability and manage the A/W safely
- Identify and manage comorbidity that inc. perioperative risk
 - OSA, post-op stridor – minimize respiratory depressants, post-op monitoring
 - CHD, pHTN, DM

Hx: History of OSA, C-spine instability (neck pain, altered fine motor, gait, B&B, vertigo, syncope). Cardiac evaluation, functional capacity, mental capacity, previous surgeries. Co-existing disease: Cataracts, recurrent OM, hypothyroid, DM, Duodenal Atresia, TEF, Hirschsprung's disease, leukemia, GERD/aspiration

PE: A/W examination, AAI > neurologic symptoms (spasticity, gait, neck tenderness), cardiac exam: heart failure, **pHTN** (Loud P2, RV Heave, JVP), **PDA** – Harsh Holosystolic murmur LSB (VSD) vs continuous at LSB.

ToF – Cyanosis, clubbing, palpable LSB heave (RVH), systolic ejection murmur (LUSB), loud A2, IV Access

Investigations: BW & TSH as dictated by Sx, Flex/ex c-spine (no screening, new symptoms, ENT procedure), ECG, ECHO

Optimization: Cardiac Consultation, Resp consult for sleep study/overnight oximetry. Neck xrays preoperatively; if neuro sympts – delay and refer to NSx; c-spine precautions; Midazolam (0.5mg/kg max 20mg) may have unpredictable response – monitor for A/W obstruction, IM Ketamine for uncooperative patient, antisialogogue (glyco 0.01mg/kg), EMLA cream for IV placement, SBE Prophylaxis.

Room Setup: Based on medical condition, airway adjuncts (macintosh maybe better than miller for tongue management) smaller ETT tubes for subglottic stenosis. Invasive monitoring for CHD

Intraoperative Mgt: Regional probably not feasible with uncooperative patient, IH vs IV, c-spine precautions – manual inline stabilization, Bubble-free IV's, Prone to Brdycardia – Atropine 20ug/kg, MAC unchanged in Down's Syndrome. Careful head / body positioning (lax joints) Avoid long acting opioids, use multimodal analgesics, full reversal.

Post-op complications: high incidence of agitation – family presence, Monitoring for OSA, airway obstruction, stridor, bronchospasm, Severe bradycardia

Drowning

1. Trauma
 - C-spine injury & aspiration, occult life-threatening injuries, hypovolemia, hypothermia, Intoxication
2. Hypothermia: Rewarming, Arrhythmias, Hypovolemia, Coagulopathy
3. Multi system organ dysfunction
 - ALI/ARDS
 - Hypoxic brain injury
 - Hypoxic cardiomyopathy, shock, arrhythmias
 - Acute renal failure (ATN)
 - Electrolyte abnormalities (hypo/hyperK)
4. Mechanism of drowning: Trauma / Intoxication
 - Children: Lack of supervision, Abuse,
 - Adults: MI, arrhythmia, hypoglycemia, CVA, Seizure, intoxication

Anesthetic Goals/Conflicts:

1. Primary Resuscitation to ensure adequate oxygen exchange and perfusion pressure
2. Prevent secondary injury: C-spine precautions
3. Correct hypothermia

Hx: AMPLE, mechanism of drowning (trauma, stroke, MI, intoxicants etc), location and duration of drowning (water temp), arrest time and resuscitation measures to date

PE: Vitals including temperature, airway, Resp (aspiration, contusion, ARDS), Cardiac (arrhythmias), neurological (hypoxic brain injury, intoxication)

Investigations: CBC, lytes (hypokalemia d/t shift), Ca/Mg (hyper in salt water near drowning), CK (Rhabdo), coagulation profile, Tox screen, ABG, ECG, CXR

Optimization: Resuscitation – intubation, ventilation, correct acidosis and lytes, re-warming

Room Set-up: CAS monitors + 5L ECG + arterial line + CVL (for vasopressors/inotropes), large bore IV access (coagulopathy, bleeding), core temperature monitoring, warming devices (see below)

Intraop Management: Consider RSI for aspiration risk but watch for increased ICP, continue rewarming, lung protective ventilation

Post-op: HDU, likely post-op ventilation

Warming:

ATLS recommendations:

Limit to 1 shock for pulseless VF/VT if temp < 30°C, give meds with longer intervals

34-36°C: passive rewarming, active external rewarming

30-34°C: passive rewarming, active rewarming of truncal areas only –electric warming devices, hot water bottles, heating pads, radiant heat sources, warming beds/blankets)

<30°C: Active internal rewarming > Warm IV fluids, humid oxygen, peritoneal lavage (KCL-free fluid), Extracorporeal rewarming, esophageal warming tubes>> discontinue when core temp > 35°C

ECMO

1. Critically ill patient with multi-organ system failure, at high perioperative risk
 - hypoxia and hemodynamic instability prior to bypass
2. Indications and underlying pathologic process
 - Etiology of respiratory or cardiac failure
3. Anatomy of ECMO circuit (VA / VV)
 - Contraindications to ECMO
4. Complications related to ECMO
 - Embolism: air, MI, CVA
 - Tamponade
 - Atelectasis, pneumothorax
 - ARF
 - Sepsis
 - Hemorrhage, consumptive coagulopathy
5. Intensive monitoring for complications, adequacy, and weaning from ECMO

Anesthetic Goals/Conflicts:

1. Avoidance of complications; specifically bleeding
 - Minimize procedures, avoid removing lines
2. Close monitoring of all body systems and avoidance of secondary injury
3. Others as determined by underlying pathologic process

Hx: Identify indications for ECMO (acute, reversible, severe hypoxemia with failure of conventional therapy, failure to wean from CPB, neonatal PPH/RDS/CDH/mec asp, post-traumatic resp failure, post lung tx), identify multi-organ dysfunction, Identify contraindications to ECMO (mech. Ventn > 7d, irreversible underlying disease or cardiac fxn, severe pulm HTN, cardiac arrest, age >60 or <34 wks or <2kg, immunosuppression, contraindication to anticoagulation)

Contraindications: Gestational age <35 weeks, Weight <2000 g, Preexisting intracranial hemorrhage, Congenital or neurologic abnormalities incompatible with good outcome, >1 week of aggressive respiratory therapy, Congenital heart disease

PE: Vitals, ECMO settings, Ventilator settings (when applicable), neurological, CVS, RESP

Investigations: Full labs, coags, recent ABG, CXR, echocardiogram

Anesthetic Options: May be cannulated in OR (post-CPB), under local or sedation in ICU

Room Setup: ICU setting with full invasive monitoring.

Anticoagulation: Heparin 100-150 U/kg, target ACT of 200, keep platelets >100.

Complications: Hemorrhage, ICH, seizures, coagulopathy, multiorgan dysfunction, PTX, tamponade, sepsis.

Special: V-V ECMO has better outcomes in adults than V-A ECMO and is preferable whenever the patient does not require CVS support. Neonatal ECMO is most often VA.

Eisenmenger's Syndrome

1. Reversal of chronic L-R shunt caused by increased PVR to a level that equals or exceeds SVR
 - a. Occurs in approx 50% of pts with untreated VSD, 10% of pts with untreated ASD
 - b. High risk of morbidity and mortality
2. Pathophysiology
 - a. Risk of hemodynamic collapse with profound hypoxemia on induction / PPV
 - i. Inc. PVR, inc. R to L shunt, RV dilation, LV impairment, hypoxemia
 - b. Polycythemia – with thrombosis
 - c. Arrhythmias – Afib / flutter
 - d. Sudden Death
3. Risk of paradoxical emboli
4. Medications
 - a. pHTN medications
 - b. anticoagulation
5. SBE prophylaxis

Anesthetic Goals / Conflicts

- Hemodynamic Goals
 - a. **Maintain SVR**, Avoid Inc. in PVR (limit PAWP, avoid PEEP, early extubation, avoid hypoxia/hypercarbia/acidosis), Full preload, Maintain NST (reduce pulmonary venous congestion)
- Meticulous de-airing of IV tubing

Hx: Establish severity and etiology of disease - functional capacity; syncope, current treatments; hemoptysis;
Px: vital signs including RA SaO₂; Resp - inc. WOB, cyanosis, clubbing, Cardiac – pHTN (P2, RV Heave) RVF (peripheral edema, hepatic congestion); ASD/VSD murmur disappears when Eisenmenger's develops
Inv: CBC (polycythemia) lytes, Ur, Cr, Coags (anticoagulation), CXR, ECG (signs of RVH, pHTN), ECHO

Optimization: Consult respiratory and cardiology; high risk of mortality with anesthesia – defer surgical treatment if at all possible; may benefit from normovolemic hemodilution with phlebotomy preoperatively for polycythemia; optimize pHTN treatment

Options: Dependent on surgical procedure; Irreversible increased PVR contraindicates surgical correction of original defect; minimally invasive with LA preferred, Regional with titrated epidural – no epinephrine to avoid dec. SVR (avoid sedation); GA as required (high risk); Laparoscopic procedures are contraindicated

Monitors: CAS, 5 lead, preinduction arterial line and CVP, available TEE

Anesthetic Management: Absolute maintenance of SVR to prevent inc./ R to L shunting with hypoxemia; Early tracheal extubation is preferable

Pregnancy: vaginal birth is the goal; labor analgesia with a slowly titrated epidural (avoid epi), maintain SVR. C/S can be accomplished with GA or epidural. IV drugs have rapid onset while IH is slow d't R to L shunt

Electroconvulsive Therapy

1. Physiological changes from ECT
 - a. HD instability, risk of arrhythmia, inc ICP, IOP, intragastric pressure
2. Potentially uncooperative psychiatric patient
 - a. psychotropic meds: management & altered response to sympathomimetics
3. Contraindications
 - a. Pheochromocytoma (absolute), inc. ICP, intracranial tumor, recent CVA, cardiovascular conduction defects, high-risk pregnancy, and aortic and cerebral aneurysms
4. Out-of-OR location
5. Complications
 - a. headaches, myalgias, confusion, memory loss, CVA, malignant arrhythmias, myocardial infarctions (67% of ECT mortalities), pulmonary edema, emboli, obstructions, aspiration

Anesthetic Goals

- Attenuate hemodynamic and autonomic response
- Prevent awareness & injury
- Optimize seizure
- Rapid emergence

Hx: Standard anesthetic history (may be difficult to obtain), Indication, Old anesthetic records & previous ECT treatments & doses required, Assessment of cardiopulmonary and neurologic status, **Review medications:** TCAs – block reuptake of Catecholamines → deplete central adrenergic stores → unpredictable response to indirect agents, direct-acting may cause exaggerated response; anticholinergic effects, MAOIs – irreversible complex with MAO → prevents breakdown of norepinephrine, 5-HT, dopamine → indirect agents can cause HTN crisis, direct acting may cause exaggerated response, Lithium – prolongs effects of dMR, certain NdMR, and sedatives (barbiturates); **R/O contraindication to ECT** - CAD, pacemakers/ICDs, afib

Px: vitals including postural BP, A/W for ease of intubation & BMV, inc. ICP, CHF

Inv: labs as directed by comorbidity, ECG (previous MI, arrhythmia), CT if query inc. ICP

Optimization: Aspiration prophylaxis, disable ICD (clinic, magnet), asynch pacemaker

Equipment: CAS, PNS, A/W equipment, Emergency drugs (atropine, vasopressors, vasodilators)

Induction: Preoxygenation, Mild hyperventilation (hypoxia, hypercarbia reduce seizure), Bite block, control A/W if difficult, pregnant, aspiration risk, consider management of HD (atropine, esmolol), **Thiopental** 2mg/kg (↑ seizure threshold, delayed awakening), **Propofol** 2-3 mg/kg (↓ seizure duration, rapid awakening but no difference in outcome, pain on injection), Etomidate may prolong seizure duration (can be useful), Ketamine prolongs seizure duration but exacerbates sympathetic response, avoid benzodiazepines, SCh (0.5mg/kg), NdMR if SCh contraindicated (intubate and ventilate)

Post-op: monitor in PACU, Supplemental O₂, acetaminophen, NSAIDs may alleviate ECT-induced myalgia

Complications: Confusion, agitation, amnesia, headache, Rare - Aspiration, myocardial ischemia, neurological vascular events, fracture/dislocation, status epilepticus, death (Current mortality rate is 1 in 10,000-30,000 treatments)

Epiglottitis

1. Emergency with potential for complete airway obstruction
 - a. ENT, difficult A/W cart, urgent transport to OR, avoid agitating patient
 - b. Risk of aspiration
2. Potential sepsis with need for fluid resuscitation
3. pediatric patient
4. Postoperative management
 - a. disposition, treatment of infection, need for specialized pediatric care

Anesthetic Goals/Conflicts:

- Rapid assessment and diagnosis transport to OR
- Safe and timely A/W management, **avoiding precipitants of airway obstruction:**
 - position changes, crying, airway exam
 - KEEP CHILD CALM
- Early antibiotics once IV access secured (this may have to wait until airway secured)
- **Conflicts:**
 - Need for fluid resuscitation vs need to avoid agitating child
 - Risk of aspiration vs need to maintain spontaneous ventilation

Differential: croup, foreign body, abscess, caustic aspiration, anaphylaxis

Assessment: Classic presentation of "Toxic, drooling child", often maintaining upright sniffing position (tripod); Generally age 2 – 7; Acute, rapidly progressive onset: 2-4 hrs; Fever, sore throat may be initial symptoms; If high suspicion - AMPLE history and immediate transport to the OR

Px: signs of fatigue, impending failure which would precipitate urgent transfer to OR. Assessment of volume status

Investigations: Diagnosis is clinical. If any concern go to OR; if stable and no signs of impending A/W obstruction – CBC, bld cultures, lateral neck xray

Optimization

Oxygen, Fluid resuscitation; Antibiotics to cover HiB and beta-hemolytic strep; Steroids; ENT; PICU

EARLY TRANSFER TO OR, ENT, DIFFICULT AIRWAY CART, TRACH/CRIC KIT AVAILABLE

Management: **Moribund:** awake DL; **Stable child:** SV GA, IH – 4% ET sevo, TIVA – Propofol infusion at 200 u/k/m, Remi 0.1-0.2 u/k/m; DL when unresponsive (may take ~10min); ETT placed (use 0.5-1.0 size smaller); Topicalize A/W prior to rigid bronch (lido 3mg/kg)

Disposition: Keep intubated for 2 days or until response to medical Rx observed and cuff leak/ETT leak occurs. Extubate in OR using same spontaneously ventilating technique and direct observation of larynx

Increased EtCO₂

DDx

- Dec. Elimination
 - Rebreathing
 - Increased Dead-space
 - Inspiratory valve failure (if PPV, if SV, could be either IV or EV)
 - CO₂ absorber exhaustion
 - Alveolar hypoventilation
- Inc. Production
 - Sepsis
 - MH / NMS / Serotonin Syndrome
 - Thyrotoxicosis
 - Cocaine
 - Pheochromocytoma
 - Transfusion reaction
 - Hyperthermia
 - Reperfusion
- Exogenous (e.g. laparoscopy)

Anesthetic Management

- Emergency situation - simultaneous diagnosis and treatment
- Inform the surgeon and call for help
- Scan my monitors: rate, rhythm, BP, EtCO₂, SaO₂, temp, PIP
 - CO₂ waveform
 - eliminate rebreathing as etiology
 - high fresh gas flow
 - hand ventilate
- Ensure adequate minute ventilation - decompress belly if required
- Rule out other etiologies

Femoral Nerve Block (L2,3,4)

Indications: Analgesia for hip or knee surgery. Combined with Sciatic for entire lower extremity.

Contraindications: Usual + possible compartment syndrome

Anatomy: Lateral to femoral artery, beneath Fascia Lata and Iliaca, anterior to iliopsoas. Ant branch gives of sensory to anterior, anteromedial and medial aspects of thigh. Posterior branch gives motor to quads and sensation to knee, and medial leg (saphenous).

Complications: Vessel puncture, nerve injury, infection, LA toxicity

Technique: Standard CAS Monitors, Supine, along femoral crease, lateral to femoral artery, 5cm needle, perpendicular to skin, goal is patellar twitch, inject 20 ml LA. If Sartorius twitch, go slightly lateral and deeper. 3 in 1 block is the same approach, but needle insertion slightly cephalad, 40 ml LA w/ distal pressure. Unreliable in blocking LFCN 62% and obturator 52%. Fascia Iliaca block: Trisect inguinal ligament, insertion site is 1cm caudal to the point bw lateral and middle third, 5cm blunt needle, feel for 2 pops., inject 30ml. LFCN w/ FI block ~90%, Obturator 38%.

LFCN block: Supine, 2.5cm inferior and medial to ASIS, 4 cm needle inserted perpendicular to skin, 1 pop through fascia lata, 10 ml injected above and below fascia lata in a fan wise approach. For sensory block of anterolateral thigh to knee.

Obturator Nerve: Pt is upine, leg slightly abducted. Landmarks 1.5 cm inferior and lateral to pubic tubercle. 10 cm needle, perpendicular to skin, contact bone (inferior ramus of pubis), withdraw, redirect slightly laterally and caudad to enter obturator foramen, advance 2-3 cm, look for adductor twitch.

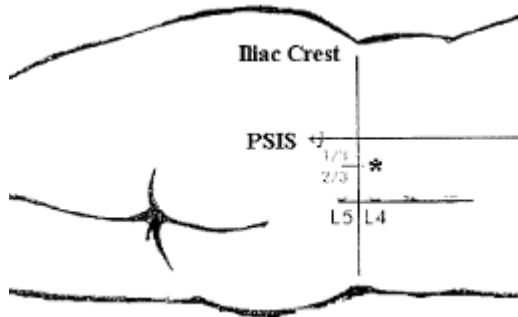
Lumbar Plexus Block (Psoas Compartment Block): *Analgesia for hip and knee surgery*

Contraindications: Usual

Technique: Pt is lateral, knees flexed. Landmarks are 1. Midline 2. Parallel line along PSIS 3. Line between iliac crests. Insertion site 2/3 from midline to PSIS along iliac crest line. Nerve roots lie at a depth of 7-10cm almost always 2 cm past transverse process. Fascial click into perineural sheath. Patellar twitch at 0.5-1 mA. Inject 40 ml.

Trouble Shooting: If hit TP, redirect cephalad and go 2 cm deeper. If no twitch fan in cephalad-caudad plane. If paravertebral muscle twitch, go deeper, if psoas stim, pull back. If hamstrings, too caudad.

Complications: Nerve injury, retroperitoneal hematoma, injury to structures deep to LP (kidney, major vessels, GI). IV, Subarachnoid, epidural, LA toxicity.



Fetal Distress

1. Emergency situation requiring immediate maternal and IU fetal resuscitation
2. Etiology of the fetal compromise:
 - a. Aortocaval compression
 - b. Maternal morbidity (Abruptio / Hge / Ut rupture/PIH/hTN/Shock/ Sepsis)
 - c. Fetal morbidity (Cord prolapsed/Ut hypertonus/IUGR)
3. Anesthetic plan for C/S — based on degree fetal compromise and maternal condition
4. Preparation for neonatal resuscitation — Pediatrician present

Anesthetic Goals/Conflicts:

1. Resuscitation of mother to optimize UPP (O₂, iv fluid, LUD, stop oxytocin, ?tocolytics)
2. Clear communication between services (anesthesia, OB, pediatrics)
 - Rapid assessment & initiation of delivery plan
 - Facilitate prompt delivery without compromising maternal safety
3. Be prepared for neonatal resuscitation (pediatrician, etc.)
4. Conflicts
 - Hypotension with RSI (hypovolemic) vs. Aspiration with titrated induction
 - Difficult A/W vs. STAT C/S
 - Hypotension with SAB with hypovolemia

Immediate Resuscitation: O₂, LUD, Fluid Bolus, vasopressors, Stop uterine contractions (oxytocin, NTG 50-100 ug bolus)

Hx: Etiology of distress – Maternal, fetal (Cord prolapsed, Footling breech, Massive abruption, Uterine rupture, Increased uterine tone, PIH, Hypotension/ shock/ sepsis); AMPLE Hx; obstetric hx

PE: maternal VS, FHR (baseline, variability, and decels), maternal A/W, uterine tone

Investigations: don't wait if severe distress – CBC, x-match, coags and fibrinogen for DIC

Optimization: Continued maternal resuscitation as directed by etiology; Asp. Prophylaxis, topicalize A/W as indicated, continuous FHR monitoring

Anesthetic Options: GA vs SAB vs insitu Epidural; Normal A/W - RSI GA; Diff. A/W - AFOI or SAB (begin topicalizing A/W while attempting SAB)

Room Setup: NTG for uterine relaxation, pressors, oxytocin, hemabate; Diff. A/W cart, large bore IV, continuous FHR, OB/paeds in room

Induction: Position Pt to optimize LUD and A/W management; De-nitrogenate with 100% FiO₂; prepped and draped, surgeon scrubbed, Cricoid, Thiopental 3-5 mg/kg (Ketamine 1-1.5 mg/kg), Sux 1.5mg/kg

Intraoperative Mgt: consider TIVA/NO₂ after the baby is out (decrease volatile after delivery); orogastric tube prio to emergence

Post-op: Extubate when awake; HDU/ICU/NICU; Postop pain – NSAIDS, PCA

Complications: Aspiration; Failure Intubation (BMV +/- LMA, optimize and re-attempt, wake pt vs. continue with LMA); HD compromise; Neonatal resuscitation Pregnant Patient considerations

Fontan's Circulation

1. Univentricular physiology – completed repair around 3 yrs of age
 - a. Passive pulmonary flow (dependent on venous pressure - PVR)
2. Cardia Dysdunction
 - a. arrhythmias: **SVTs**, VTs - defib pads preoperatively
 - b. Ventricular dysfunction - 70% by 10yrs (pericardial and pleural effusions)
 - c. Late forming pHTN – d/t elevated pulmonary perfusion pressures
3. Risk of hypoxia with fenestrated Fontan – R to L shunt
 - a. Paradoxical emboli - airless IV's
4. Co-morbid illness: Protein losing enteropathy, Thromboembolism (30% at 10yr - anticoagulation)
5. Consideration of SBE prophylaxis

Anesthetic Goals/Conflicts:

- Maintain full venous return, avoid pHTN triggers, avoid dehydration
- Hemodynamic goals:
 - **Full preload**
 - normal SVR – prevent R – L shunt
 - low PVR – avoid hypercarbia, excessive PPV
 - normal contractility, and **sinus rhythm** (dec. pulmonary venous congestion)
- Treat hypotension with pheylephrine (increases SVR > PVR)

Foreign Body

1. Potentially life-threatening emergency
 - Potential perioperative airway obstruction
 - Barotrauma (ball-valve phenomena)
 - Bronchospasm
2. Co-morbid disease
 - Neurologic disease (aspiration risk)
 - Intoxication
 - Post-obstructive pneumonia (if delayed)
3. Rigid bronchoscopy
 - Shared airway
 - Maintenance of anesthesia
 - Ventilation and oxygenation during bronchoscopy
4. Pediatric patient

Anesthetic Goals/Conflicts:

1. Minimize risk of aspiration (prophylaxis, fasting)
2. Minimize risk of airway obstruction
 - Minimize distal displacement of FB through avoidance of PPV
 - Minimize ball-valve obstruction
3. Facilitate retrieval of FB (Immobile patient with minimal coughing)
4. Effective communication with Surgeon

Hx: Aspirated object/substance (if known; sharp vs. organic/inflammatory), time of aspiration, symptoms of airway obstruction or compromise (stridor, drooling, tachypnea), signs of infection (fever, productive cough, hypoxemia); risk fx for aspiration, last meal

PE: Vitals – including RR/O₂sat (respiratory distress) + temp (infection) + weight, airway exam, respiratory exam for distress (retractions, tracheal tug, stridor, wheezing, crackles) and cvs exam.

Investigations: minimal if obstructing. Consider CXR (90% of objects are radiolucent, so not sensitive), CBC (infection), ABG (unwell, pneumonia)

Optimization: O₂, ENT immediately available; Aspiration prophylaxis if urgent – delay for fasting guidelines if not acutely obstructed; Heliox, bronchodilators, racemic epi to temporize; Antisialagogue for pediatric; IV abx if infection; Position: Upper airway - position of comfort/sitting upright/leaning forward; Distal airway: affected lung down, to protect normal lung

Anesthetic Options: May do adults under sedation local if flexible FOB. Peds and rigid bronchoscopy must be done under GA. With adults, obesity or other conditions which make SV difficult/impossible under GA, consider intubation w/ PPV, may have to leave bougie, extubate during brief periods for rigid bronchoscopy

Room Setup: Difficult airway cart, FOB, jet ventilator and help available. Warming if peds. Resuscitation drugs.

Intraoperative Mgt: ENT in room; IV vs. IH induction with SV; PPV may be necessary. TIVA does not depend on surgical technique. Consider intubating after retrieval of FB prior to emergence (minimize risk of aspiration).

Post-op: risk of laryngeal edema x 24hrs – O₂, racemic epi, steroids, Abx, chest physio, possible postop vent

Complications: Bronchospasm (ventolin, deepen anesthetic); inadequate ventilation (reposition bronch, consider PTX); A/W obstruction (consider PTX, push FB distal, thoracotomy); PTX; tracheobronchial trauma with hemorrhage; pneumonia

Foreign Environment

1. Three step approach
 - a. Patient – ASA, comorbidity, A/W, monitoring requirements
 - b. Procedure – Duration, invasiveness (pain), special requirements (monitoring, paralysis), complications
 - c. Environment – equipment, patient access, personnel, hazards (radiation, magnet), temperature, interference

Anesthetic Goals

- Provide same standard of care of patient in the OR
 - anesthesia equipment, monitors and procedures
- Identify and mitigate all environmental hazards
 - Ionizing radiation, ferromagnetic radiation, contrast media
- Identify reasons why the patient requires GA or anesthesia-administered sedation
- Familiarize yourself with the remote environment, staff and location of all necessary emergency equipment and drugs

Preparation: ensure the presence and proper function of all necessary equipment – central O₂, cylinder, suction, lighting, gas scavenging, electrical outlets, resuscitative equipment; Identify bulky and immobile equipment, assess need to monitor the patient remotely

Hx & Px: Assess patient for comorbidities, potential complications and conflicts with procedure (sedation vs. GA, paralysis, limited access to patient, remote monitoring)

Monitors: CAS monitors + those dictated by the procedure and the patient

Specific Procedures:

Angiography/intervention – minimal sedation vs. GA, contrast agents (nephropathy, allergic rxn – fish allergy), ensure lines / tubes free to allow the table to move

CT – trauma, acute situations, resuscitate prior to scan, oral contrast

Radiofrequency Ablation – Rx for tumors (liver, lung, adrenal etc..) likely endstage disease (4Ms), beware of complications (PTX, BPF, Hemorrhage), pacemaker contraindicated (heat / burns)

MRI – Peds, limited access, remote monitoring, need to exclude ferromagnetic components, interferences with monitors (ECG artifact – place electrodes close together), pacemakers contraindicated, burns possible from various monitors – run cables in straight lines (no coils), if emergency – stop sequence, rapidly remove patient from MRI/scanner room (need for resuscitative equipment that is not magnet safe)

G6PD

G6PD deficiency is a enzymopathy that can result in hemolysis secondary to oxidative damage to susceptible red blood cells; X-linked; common in African Americans, Africans, Asians, and Mediterranean populations

1. Chronic hemolytic anemia
2. Need to **avoid precipitants of hemolysis**
 - a. Oxidative drugs
 - b. Infection
 - c. Metabolic abnormalities (eg. DKA)

Anesthetic Goals/Conflicts:

Avoid precipitants of hemolysis:

- Acetaminophen – safe in therapeutic doses
- Salicylates – safe in therapeutic doses
- Antibiotics: Nitrofurans; Penicillin; Streptomycin; Chloramphenical; Isoniazid
- Sulfonamides
- Antimalarial Drugs
- Miscellaneous: **Probenecid; Quinidine; Vit K analogues; Metheylene Blue; Nitroprusside**

Hx: episodes of acute hemolytic anemia (usually asymptomatic in steady state; triggers can ppt hemolysis);
Hx neonatal hyperbilirubinemia; Favism (d/t ingestion of fresh fava beans; ages 1-5yrs)

PE: Pallor; Jaundice; ?hepatomegally

Investigations: CBC (hgb may fall to 30-40); Diff; Blood film (Heinz bodies-clumps of ptn; With hemolysis: microsperocytes; eccentrocytes –bite cells; reticulocytosis)

Optimization: Hematology consult

Anesthetic Options: No limitations

Room Setup: CAS monitors

Intraoperative Mgt: avoid oxidant drugs; Anesthetic agents are not known to ppt hemolysis

Post-op: standard

Complications: Acute hemolysis: early post op (2-5 days) evidence of hemolysis may indicate G6PD; self limited as only older RBCs are affected

Special: Avoid drugs that can result in methemoglobinemia (prilocaine, Lidocaine, bezocaine) because treatment with methylene blue is contraindicated

Guillain Barre Syndrome

Acute idiopathic inflammatory demyelinating polyneuropathy characterized by ascending progressive muscle weakness and areflexia, usually associated with spontaneous remission.

1. Risk of **aspiration** – weakness of pharyngeal muscles
2. **Respiratory failure** – intercostal muscle weakness/post-op ventilation
3. **Autonomic instability** – compensatory CV responses may be absent, exaggerated response to stimuli or hypovolemia, tachycardia, hypo/hypertension, arrhythmias
4. **Altered response to NMB** - Hyperkalemic response to succinylcholine - NdMB sensitivity
5. Increased risk of venous **thromboembolism**, raised ICP (rare)
6. **Acute Medical therapy**: IVIG / Plasmapheresis (Steroids not helpful!)

Anesthetic Goals/Conflicts:

- Minimize aspiration risk
- Maximize respiratory muscle strength (minimize / avoid NdMB)
- Maintain hemodynamic stability
- Conflicts: RSI without Sux/decreased NdMB vs hemodynamically stable induction

Hx: Onset of symptoms, respiratory compromise, cough, bulbar symptoms, cardiovascular instability, arrhythmias. Treatment. Functional capacity. AMPLE Hx.

PE: Focused cardiorespiratory exam, neurologic exam.

Investigations: Usual investigations, PFTs / VC, ECG, CXR

Optimization: Delay elective surgery, Neurology consult, Plex/IVIG, aspiration prophylaxis, DVT prophylaxis.

Anesthetic Options: GA, PNB, Neuraxial all plausible.

Room Setup: CAS / PNS / consider invasive monitors, vasopressors for hypotension, assistance for cricoids.

Intraoperative Mgt: Consider RSI, avoid sux, judicious NDMRs, ensure reversal, direct acting agents for hypotension, avoid stimulants on induction.

Post-op: Arrhythmias / DVT / PE / Respiratory embarrassment.

Special: M > F, bimodal distribution in young adults and elderly, 1:33,000, starts in legs, ascending flaccid paralysis, 5% mortality, children less severely affected. Rx: IVIG 0.4mg/kg x 5days, plasmapheresis, steroids not useful.

HCM

Myocardial hypertrophy resulting in a small and hyperdynamic left ventricle - risk of ischemia, sudden cardiac death and fixed or dynamic LVOT obstruction

1. Potential for dynamic outflow obstruction in 25%
 - a. Precipitated by inc. contractility, dec. preload, and/or dec. afterload
2. Complications
 - a. Tachyarrhythmias
 - b. Hypertrophy, diastolic dysfunction and inc. MVO_2 – myocardial ischemia
 - c. Mitral regurgitation
3. Associated medications – BBs, antiarrhythmics, anticoagulants, diuretics
4. Pacemaker or AICD

Anesthetic Goals/Conflicts:

1. Avoid acute LV outflow tract obstruction
 - a. Maintain **full preload** and adequate afterload to stent LVOT open while **avoiding any inc. in myocardial contractility**
2. **Avoid tachycardia** while maintaining **strict NSR** (diastolic dysfunction)
3. Be prepared to treat lethal arrhythmias and avoid precipitating arrhythmias
4. Maintain myocardial oxygenation and **monitor for ischemia**
 - a. Optimize oxygen delivery
 - b. Maintain **adequate afterload**
 - c. Consider invasive monitoring

Hx: Many pts are asymptomatic - Hx of SOBOE (90%), angina (~30%) presyncope, syncope. Afib/flutter/SVT (25%), PVCs/VT/brady (20%), MR, Hx of CHF. Prior cardiac arrest, pacemaker settings. Assess for risk of SCD and need for AICD (pts with prior cardiac arrest, sustained VT or 2 or more risk factors: family hx of SCD <45 yrs, Flat (failure to increase SBP by 25mmHG) or hypotensive (decrease SBP > 15mmHg) response to exercise in patients <40years, non-sustained VT during 48hr holter monitoring, LV wall thickness >30, resting peak instantaneous gradient >30mmHg).

PE: Displaced apical beat, S4, Harsh SEM bw apex/LSB (worse with valsalva and standing) radiates to axillae. CHF, ↑JVP, R sided S4 with R heart involvement. Murmur of MR.

Investigations: CBC/Lytes, ECG – arrhythmias, BBB, LVH (Deepest S in lead V1 or V2 + tallest R in V5 or V6 > 35 and or a R wave in lead aVL >12), LAD, q waves, “Giant t-wave syndrome” = sharply negative T-waves in V3-5 are typical of apical HCM. CXR may demonstrate LV/LA/RA enlargement. ECHO: asymmetric hypertrophy, SAM, gradient, systolic & diastolic dysfunction, MR, LA size, check for provokable LVOT obstruction, MIBI, angiography.

Optimization: Ensure adequate volume status. Cardiology consult, consider AICD/Pacemaker placement, consider septal alcohol ablation prior to elective procedure. If systolic dysfunction evaluate for transplantation. BB / CCB (verapmil 75mcq/kg, may repeat 150mcq/kg in 15-30mins, max dose 20mg) for LVOT obs, consider anxiolytic for tachycardia. Diuretics for CHF, antiarrhythmic therapy to restore NSR or cardioversion.

Anesthetic Options: GA generally well tolerated. Neuraxial techniques are acceptable and well tolerated if HD goals met - OB: GA, epidural, CSE with intrathecal opioid (spinal contraindicated), avoid oxytocin bolus

Room Setup: Invasive lines, alpha agonists, BBs/CCBs, antiarrhythmics, pacer, TEE/PAC in high risk pts.

Intraoperative Mgt: See hemod goals above. Deep plane of anesthesia prior to airway manipulation, consider phenylephrine infusion and volume preload. Avoid ketamine. Consider arrhythmias with CVP/PAC placement

Post-op: Avoid tachy/pain on emergence, observe in HDU, maintain hemodynamic goals.

Complications: Hypotension, acute LVOT obstruction, arrhythmias

Hemophilia A (F VIII), B (IX), & vWD

1. High risk of perioperative bleeding associated with specific factor deficiency
 - a. F VIII – Hemophilia A (Classic) – sex linked recessive
 - b. F IX – Hemophilia B (Christmas Disease) – sex linked recessive
 - c. von Willebrand Disease
2. Sequelae of bleeding in enclosed spaces: Joints, Intracranial, Pericardium, Thorax
3. Potential contraindication to neuraxial anesthesia and analgesia
 - a. Labour Epidural in parturients ok if FVIII & vWF >50%
4. Consultation with hematology for factor optimization, identification of inhibitors, difficult cross match
5. Coexisting viral infections: HIV, HBV (less now with recombinant products)

Anesthetic Goals/Conflicts:

1. Optimize factor activity and coagulation profile in perioperative period
 - DDAVP / Humate P / cryoprecipitate
2. Techniques for minimizing perioperative blood/Factor loss.
3. Manage bleeding episode with appropriate Factor replacement.

Hx: Bleeding Hx – easy bruising, petechiae, mucosal bleeding, epistaxis, menorrhagia, family bleeding Hx, hx of cancer or collagen vascular disease. History of prolonged bleeding after Sx (dental work, tonsillectomy)

PE: Bruises, petechiae, oral mucosa, lymph nodes, hepatosplenomegaly. Airway – hematoma MSK - Joint deformity

Investigations: CBC, INR, PTT, cross match. Assay for activity level of factor, factor antibodies (anti-FVIII). Most sensitive test for vWD is ristocetin cofactor activity. Other Inv. as dictated by procedure and patient co-morbidity

Optimization: Consult hematology. Plan OR early in the week/day. Consider antifibrinolytics periop (**3-5 days**)

Hemophilia: Assay factor levels **48h** prior to OR and restore levels to >50% for major surgery (maintain 5-10 d), dental extraction (maintain >12hrs), delivery/puerperium (maintain 3-4 d). > 30% for minor surgery (maintain 2-4 d).

Rpt factor assay after administration and within 2h of OR to confirm factor activity. Monitor level intra-op as dictated by clinical situation. No anti-platelet meds. **Hemophilia A:** Severe <2%, Mod 2-10%, mild >10%. ↑PTT, Normal INR. DDAVP (may ↑FVIII), Recombinant F VIII (1U/kg ↑FVIII 2%), Recombinant F VIIa for inhibitors, Cryo if nothing else available (the only fractionated blood product containing meaningful amounts of F VIII and vWF, FFP has ~.7-.9u/ml FVIII). VIII T_{1/2} = ~12hrs in adults, ~6hrs in Peds **Hemophilia B:** ↑PTT. rFIX (1U/kg ↑FIX 1%, half is absorbed by collagen in the vasculature), rFVIIa (for inhibitors), FFP if nothing else available (cryo does not contain FIX). FIX T_{1/2} = 8-24 hours. **Pregnancy:** Consider fetus affected in carriers and minimize trauma to fetus esp if male **vWD** Subtype 1 (70-80%), Nstructure, dec. quantity; Responds to DDAVP (3-5 fold inc. in vWF; dose = 0.3 mcg/kg (max 20 mcg/dose and rpt 24h). Subtype 2a (20-30%) Abnormal structure, normal or dec. quantity; Requires F VIII-vWF concentrates (Humate P) in addition to DDAVP. **DDAVP contraindicated in subtype 2b**, as this promotes thrombocytopenia. Subtype 3 (rare) Little or no vWF. Bleeding pattern same as Hemophilia A. Require treatment with F VIII-vWF concentrates, platelets if thrombocytopenic. DDAVP no benefit. Emergency: 1st humate P (50iu/kg →consult heme), cryo, Plt concentrates; **Pregnancy:** Factor VIII, vWF, ristocetin cofactor early in pregnancy and at 34 weeks. During pregnancy, prophylactic tx if FVIII level <25%. During labour, maintain levels 50% of normal, if c-sec 80% normal. Post partum, follow levels and tx if <25% or significant hemorrhage. **vWF:** Type I or IIA, DDAVP 0.3ug/kg with labor q12h. Non responders, tx with humate P (40iu/kg). Regional: LEA OK if FVIII and vWF > 50%. **Anesthetic Options:** surgery done in ctr capable of rapid Factor assays. Neuraxial – requires 70-100% of Factor activity, reasonable platlets: vWD: >50 % activity of F VIII/vWF **Room Setup:** CAS, Large bore IV, Temp probe, blood warmer, rapid infuser, cell salvage, Arterial line for sampling, Factor (recombinant, human derived) available, X-match prior to OR – may be delays for antibody investigation **Intraoperative Mgt:** Careful positioning/laryngoscopy. **Post-op:** Mild Hemorrhage (early joint/muscle, epistaxis, hematuria, dental bleed) target 20-30% activity. Major Hemorrhage (advanced joint/muscle, hematoma neck/tongue, prophylaxis after severe trauma) target 40-50%. Life-threatening Hemorrhage (intracranial, surgical, GI bleed, major trauma bleed) target 50-100%.

HIV

1. **Multisystem disease:**

- CNS: Dementia, peripheral neuropathies, myopathys, visual loss, mass lesions with inc. ICP
- Airway: upper a/w obstruction with Candida, possible difficult intubation
- Resp: Pnuemonia, Lymphoma, Primary pHTN, pleural effusions
- CVS: Autonomic neuropathy, pancarditis (IE in IVDU), accelerated CAD
- Renal: End stage nephropathy
- Heme – Anemia, coagulopathy (ITP), lymphopenia

2. **Immunocompromised:**

- Opportunistic infections - Meningitis, encephalitis, pneumonia/TB, esophagitis, enteritis
- Malignancy – Lymphoma, Karposi Sarcoma

3. **Medications:** Bone marrow suppression, renal failure, peripheral neuropathy, p450 activation

4. **Chronic pain / Substance Abuse**

5. **OB and HIV:** dec perinatal transmission with AZT (25% - 8%), elective C/S, Regional OK (document peripheral neuropathy, coagulation, strict sterile technique, blood patch OK – d/w patient)

Hx & Px: duration since Dx, Current treatment (prophylaxis), Screen for comorbid disease: opportunistic infections (CNS – Dementia Resp – CD4 < 200 PCP, Cryptococcus, CMV), Vital incl temp, Focused resp (SpO2, cough, crackles), CVS (chest pain, rub, dec. exercise tolerance), peripheral neuropathy, GI disturbance (dysphagia, diarrhea)

Inv: CBC, E7, CD4, ECG, CXR, Consider PFTs, ABG, ECHO, MRI/CT Head

Oprimization: Adequate prophylaxis, treat infections

Options: GA or regional OK

Anesthetic Setup: CAS monitors, strct asepsis, otherwise as required by comorbidities and procedure

Complications: As predicted by comorbidities

Hyperkalemia

1. Underlying etiology
 - Shift - acidosis, meds
 - Impaired excretion - renal failure, ureteric obstruction, Addison's, lupus
 - Excess intake or release - rhabdo, hemolysis, transfusions, burns, tumour lysis
2. Physiologic sequelae of hyperkalemia: weakness, arrhythmias which may progress to malignant arrhythmias
3. Need for continuous monitoring

Anesthetic Goals/Conflicts:

- Prevent/treat arrhythmias
- Reduce serum potassium levels
- Reduce total body potassium if elevated

Hx: Meds, Past Med Hx, allergies, fatigue, weakness, paresthesiae, palpitations, pain or history of trauma (rhabdo), recent transfusions.

PE: Vitals, cardiorespiratory exam, neuro (decreased DTRs, weakness), evidence of renal failure (bruising, petechiae, edema, presence of fistulae), palpate compartments.

Investigations: 12 lead EKG, Lytes, BUN, Cr, Mg, Ca, Dig level (if on dig), ABG, urine myoglobin, urine R&M

ECG changes: Early: Peaked Ts, QT shortening, ST depression

Later: Increased PR, BBB, decreased P wave

Late: Widening of QRS eventually to sine wave then VFib, Asystole

Treatment: Calcium chloride 5-10cc (stabilize myocardium), glucose/insulin 25-50g and 10 units (shifts intracellular), Lasix 1 mg/kg (increase K excretion), B agonism – ventolin 5-20 mg (shifts K intracellular), alkalinize – bicarb 1 amp or 3 amps in 1 L D5 (shifts K intracellular), kayexylate 15-30 g po or 30-60 g pr or calcium risonium (exchange resin to remove potassium from body – note kayexylate results in increased sodium which may not be desirable if CHF, renal failure or hypernatremia are part of clinical picture).

Failure to respond to above medical therapy or severe hyperkalemia (> 7 or >6 with physiologic derangement) should prompt consideration of urgent dialysis.

Meds which can cause hyperkalemia include: Amiloride, Angiotensin II inhibitors, ACE Inhibitors, Pentamidine, Spironolactone, Succinylcholine, Triamterene, Trimethoprim, NSAIDs, Heparin

Hyperparathyroidism

1. Underlying etiology (parathyroid tumour, PTH producing tumour, chronic hypocalcemia & hyperphosphatemia - CRF, acute pancreatitis)
2. Potential difficult and dangerous airway secondary to mass effect and osteopenic bone
 - a. pathologic fractures mandible and vertebral bodies, inc. aspiration risk
3. Physiologic changes of HYPERcalcemia
 - a. CNS: ↓LOC, hallucinations, psychosis
 - b. CVS: HTN, hypovolemia, conduction blockade, long PR, Short QT
 - c. Resp: potential respiratory muscle weakness with RLD, poor clearance of secretions
 - d. Other: Renal failure - nephrolithiasis (70%); N/V, abdo pain, pancreatitis; weakness (titrate NdMB to effect); anemia
4. Considerations of cancer and associated syndromes
 - a. MEN 1: hyperparathyroid, pancreatic islet cell tumors, pituitary hyperplasia or tumor
 - b. MEN 2A: hyperparathyroid, medullary thyroid CA, pheochromocytoma
5. Prevention of pathologic fractures during positioning
6. Post-op airway obstruction after parathyroidectomy
 - a. hematoma, laryngospasm, hypocalcemia, RLN injury, tracheomalacia

Anesthetic Goals

- Management of hypercalcemia
- Monitor ECG and Ca concentrations perioperatively
- Prevent pathological fractures
- Airway vigilance

Hx: Underlying etiology, symptoms of hypercalcemia; symptoms of neck mass (positional dyspnea, stridor)

Px: Vitals; volume status, airway (mass effect), muscular atrophy; fractures/deformities

Investigations: Ca, Lytes, Cr, PO₄, Mg, albumin, PTH, ECG (long PR, QRS, short QT, arrhythmias), +/- CT neck

Optimization: Endocrine consult; Management of hypercalcemia - IV rehydration (2-6L) followed by Lasix(40-80mg) after euvoemia - goal of 3-5 L urine/day; If severe add - Bisphosphonate (etidronate 7.5mg/kg IV OD or 20mg/kg PO OD); Calcitonin 200 IU nasal spray/day; IV steroid (inhibit GI Ca absorption); Phosphate repletion; Mithramycin to antagonize PTH (prompt dec. in Ca) – results in thrombocytopenia, hepatotoxicity, nephrotoxicity; Hemodialysis if CRI/RF

Options: No particular anesthetic technique is indicated

Management: AFOI if difficult A/W or significant osteopenia; watch for hypotension with induction; MAC may be reduced with CNS symptoms; careful positioning; unpredictable response to NdMB – use a nerve stimulator; maintain normocarbemia (acidosis results in inc. ionized Ca, alkalosis results in dec. ionized Ca & hypokalemia – unopposed Ca)

Complications: Cardiac arrhythmias 2' to hypercalcemia – serial monitor Ca, Mg, PO₄; A/W obstruction – B/L RLN injury, tracheomalacia, hematoma; Hypocalcemia - laryngospasm, arrhythmia, Sz; Hypomagnesemia, pneumothorax

Hypoparathyroidism

1. Etiology (thyroidectomy, parathyroidectomy, DiGeorge, hypomagnesemia, excess phosphate)
2. Physiologic changes of hypocalcemia
 - CNS: decreased LOC, **seizures**
 - Resp: **laryngospasm, bronchospasm**
 - CVS: **decreased contractility, dysrhythmias**, hypotension
 - MSK: **muscle spasms**, altered response to NdMB (use PNS)
3. Hyperventilation induced alkalosis causes ↓ serum Ca (↑ Ca protein binding)

Hx: identify cause and look for symptoms of hypocalcemia (decreased LOC, confusion, delirium, seizures, perioral paresthesia, laryngospasm, bronchospasm, hypotension, syncope/presyncope, palpitations. Cramps, spasms, heterotopic ossification)

Px: Vitals (orthostatic), Resp – bronchospasm; CVS – CHF, hypotension, Muscle spasm - Chvostek's (masseter twitch with facial tap), Trousseau's (muscular contraction of the hand with BP cuff inflation)

Investigations: CBC, Lytes, Ca, Mg, PO₄; ECG – prolonged QT

Optimization: Consult endocrine; replete serum Ca & Mg; dec. dietary PO₄, PO₄ binders early

Intraoperative management: No particular anesthetic technique is indicated

Unexplained intraoperative hypotension should either prompt laboratory testing or empiric treatment for hypocalcemia in addition to your normal approach to hypotension

Hypertension

Most common periop comorbidity in surgical pts (~20-25%), and causes accel end-organ dysfnx (CAD/PVD/CVD/CKD) and increased periop morbidity

1. Increased perioperative morbidity
2. Potential for end-organ dysfunction
 - CAD +/-LV dysfunction
 - CRF
 - PVD
 - CVD
3. Labile perioperative hemodynamics
 - Exaggerated response to endogenous and exogenous catecholamines
 - Relative intravascular volume depletion-hypotension on induction
4. Perioperative medication management
5. Potential secondary causes of hypertension
 - Renal (CKD, renal artery stenosis), OSA (30%), Endocrine (pheochromocytoma, Cushing's, hyperaldo, hyper/hypothyroid, hyperparathyroid)

Anesthetic Goals/Conflicts:

- Maintain perioperative BP within 20% normal
- If SBP > 180, DBP > 110 – try and delay for w/o of secondary causes / optimization

Hx: Document baseline, severity, duration, lability and control of HTN. Determine end-organ complications of severe HTN (CAD/CKD/CVD/CHF). Inquire about secondary causes (**Pheo**/Thyroid, Hyperaldosteronism, Cushings). Medical Rx and compliance. Co-morbid illnesses (DM/Smoking/OSA).

PE: Vitals, BP both arms, postural. Carotids for bruits. LVH >> displaced apex, loud S2. CHF >> audible S4, basilar crackles, raised JVP. Renovascular bruits.

Investigations: Lytes if on diuretics or co-morbid CKD. Hypokalemia ? hyperaldosteronism. 12-lead ECG (associated LVH / ST changes, q waves).

Optimization: Endocrinology/Cardiology consult if concerned about secondary causes of HTN. Consider cancelling elective surgery if evidence of end-organ dysfunction or SBP > 180/110. If untreated HTN consider IV/PO medications perioperatively (note POISE study results). Hold ACEi ~ 48hrs for cases with anticipated major hemodynamic shifts/CPB. Consider holding diuretics for procedures associated with bowel prep/major fluid shifts. Continue all other antihypertensives and resume post-op.

Anesthetic Options: Any

Room Setup: 5 lead, consider invasive monitors, antihypertensives: BBs/NTG etc. Usual vasopressors. Vasopressin for refractory hypotension with patients on ACEis.

Intraoperative Mgt: Any, observe intravascular depletion and sensitive to exogenous catecholamines. Minimize intubation time < 15s, generous opioids, anticipate lability, avoid ketamine. Maintain BP ~20% of baseline.

Post-op: Monitor for ischemia, adequate analgesia, r/o bladder distention, continue antihypertensive ASAP.

Hypertension: Emergency

- Emergency situation which requires simultaneous diagnosis and treatment
- Inform the surgeon and ensure no surgical factors
- My initial differential diagnosis includes:
 - Hypoxemia / hypercapnea
 - Drugs: administered, illicit, errors and withdrawal
 - Pain / light anesthesia
 - Patient factors including endocrine
- I would scan my monitors for HR, ECG, rhythm, CO2 tracing and **temperature**
- Provided I am adequate oxygenating and ventilating the patient, I would deepen the anesthetic and do a target physical examination:
 - Pupils (inc. ICP)
 - Diaphoresis and flushing (carcinoid, pheo, thyroid)
 - Rigidity (MH, serotonin syndrome)
 - Peripheral perfusion
 - Bladder distention (autonomic dysreflexia)
 - Hyperthermia (thyroid storm, MH, serotonin syndrome)
- Scan machine, infusions and recent meds administered
 - Drug error (bolus or infusions)
 - Awareness – TIVA disconnect, circuit disconnect
 - tourniquet

DDx

1. Hypoxia / hypercapnea
2. **Drugs**
 - Intentional or unintentional administration → vasopressors, cocaine, MAOI, stimulants
 - Withdrawal → EtOH, BDZ, opioids, clonidine, β -blockers
3. **Pain / light anesthesia**
 - surgical site
 - remote (e.g. distended bladder, tourniquet)
4. Patient factors
 - pre-existing HTN
 - **increased ICP**
 - **autonomic hyperreflexia**
5. Endocrine
 - hyperthyroidism
 - pheochromocytoma
 - carcinoid syndrome
 - Serotonin Syndrome
 - malignant hyperthermia
 - NMS
6. Obstetrical Hypertension
 - PIH
 - Cocaine

Hyperthyroidism

1. Goiter - Difficult airway
2. End-organ dysfunction of Hypermetabolic state
 - CVS: tachycardia, high output CHF, atrial fibrillation
 - Resp: respiratory muscle weakness
 - CNS: anxiety, hyperactivity
 - MSK: skeletal muscle weakness, fatigue, tremor
 - Other: exophthalmos (graves); Electrolyte disturbances; Altered pharmacokinetics
3. Thyroidectomy - Postoperative complications:
 - Tracheomalacia, Hematoma, RLN palsy, pneumothorax, Hypocalcemia from hypoparathyroidism (tetany, laryngospasm)
 - Risk of AMM with retrosternal goiter – positional dyspnea
4. Antithyroid drugs and their adverse effects
 - Agranulocytosis, thrombocytopenia, aplastic anemia, Lupus-like syndrome, hepatitis, cholestatic jaundice, hypoglycemia
5. Risk of thyroid storm (see below)

Anesthetic Goals/Conflicts:

- Render patient euthyroid before elective surgery – resting HR should be < 85
- Avoid SNS stimulation
 1. Medications - pancuronium, ephedrine, atropine, epinephrine, ketamine
- Monitor for signs of thyroid storm (temperature, hemodynamics)
- Diagnosis and management of thyroid storm

Hx: Etiology - Graves' disease (thyroid stimulating autoantibodies), excess TH replacement, toxic nodular goiter, thyroiditis, TSH-secreting tumors (rare); Symptoms of hyperthyroidism - anxiety, emotional lability, weakness, tremor, palpitations, heat intolerance, increased perspiration, and weight loss despite a normal or increased appetite

Px: Vital+ temp & postural (HTN, tachy, hyperthermia); A/W for BMV, intubation, surgical (masses); CNS - hyperactivity, agitation, confusion, lid lag; CVS - arrhythmia, CHF (high output), volume status, shock; MSK - proximal muscle weakness, tremor

Inv: CBC, lytes, Cr, Calcium, TSH, free T4 & T3, ECG (sinus tachy, afib, prolonged QTc), CXR +/- CT chest (neck mass); ECHO

Optimization: euthyroid prior to elective surgery; if emergent - esmolol infusion (100-300ug/kg/min), propranolol, PTU, steroids, sodium iodide; Endocrine consult; continue antithyroid meds; benzodiazepines for anxiety

Options: local, regional, GA

Room Setup: CAS +5 lead, temp, Art line, foley +/-CVC (volume status); TEE for LV dysfunction; protect protuberant eyes

Anesthetic Management: avoid SNS - Deep anesthesia prior to stimulus, avoid ketamine, pancuronium, ephedrine, hypercarbia; AFOI if neck mass (consider armoured ETT); judicious NdMB (weakness); monitor for thyroid storm; treat hypotension with direct acting agents (phenylephrine); ensure reversal prior to emergence

Disposition: HDU/ICU if high risk for thyroid storm

Complications: Thyroid Storm - usually presents 6 to 18hrs post-op - 72 hr duration; Arrhythmia: beta blockers, lidocaine, digoxin; CHF - digoxin; Airway obstruction (thyroidectomy): hematoma, tracheomalacia, RLN; Hypoparathyroidism - Hypocalcemia (stridor, neuromuscular excitement)

Thyroid Storm

1. Emergency situation with a high mortality
 - Supportive measures: fluid resuscitation, Cooling
 - Esmolol 0.1-0.3 mg/kg/min, Propranolol 10-40mg IV, 1 mg/min IV
 - Propylthiouracil 100 – 400 mg po/ng/pr q6h
 - Potassium iodide 5 gtts po/ng q6h or Sodium iodide 0.25g IV q6h
 - Hydrocortisone 100-200 mg IV q8h
2. End-organ dysfunction
 - CNS: decreased LOC (may require A/W management), CVA
 - CVS: high output CHF, A. fib, MI
 - Resp: muscle weakness and hypercarbia
 - Metabolic: hypermetabolic state and electrolyte abnormalities
3. Differential diagnosis
 - pheochromocytoma, MH, NMS / serotonin syndrome, sepsis, light anesthesia, cocaine toxicity
 - rhabdo distinguishes MH from thyroid storm

Anesthetic Goals/Conflicts:

- Restore intravascular volume, cool, invasive monitoring
- Excess Sympathetics – Esmolol, Propranolol
- Reduce peripheral conversion – PTU, Steroids
- Reduce release of thyroid hormone – Steroids, iodide Sodium iodide: 0.25mg IV/PO/NG q6h
- Reduce synthesis of thyroid hormone (PTU, methimazole, steroids)

Hx: Precipitants of thyroid storm - surgery, sepsis, anesthesia, labour, I-131 therapy, DKA, withdrawal of anti-thyroid meds, trauma, PIH; DDx: MH (rhabdo - CK, plasma and urine myoglobin, elevated K), Sepsis (Blood C+S)

PE: hyperthermia, tachycardia, hypercarbia, CHF, dehydration, hyperglycemia, changes in LOC, shock and death

Inv: CBC, lytes, Creatinine, TSH, fT4, T3, TSH, ECG, CXR, +/- echo

Management: Rapid diagnosis; Inc. Monitoring; Supportive management – active cooling (Demerol for shivering, IV fluid replacement (art line, CVC), glucose and electrolyte replacement, oxygen, Steroids – hydrocortisone 100mg IV q8h; PTU – 200-400mg PO/PR q6h; methimazole 20-25mg PO (60-100mg PR) q6h; Iodine one hour after PTU - Na Iodide 1gm IV, Iugol's solution 4-8 gtts PO, PR q6h; B-blockers for SNS – Esmolol 100-300ug/kg/min, propranolol 10-40mg ng (1mg/min IV); plasmapheresis; Digoxin IV for CHF – amiodarone may make crisis worse (esp if given prior to PTU)

Post-op: ICU setting, most likely to occur 6-18 hr post-op

Hypotension

Main DDx of Intra-op hypotension:

- Hypoxemia
- Hypovolemia (Preload) – Hemorrhage, surgical obstruction to venous return, ischemic reperfusion
- Cardiogenic – rate (vagal), rhythm, contractility, ischemia, valves
- Obstructive - PE, AFE, VAE, pHTN, PTX, tamponade
- Distributive - anaphylaxis, SIRS, neuraxial, neurogenic
- Drugs - relative anesthetic overdose
- Less common etiologies:
 - Endocrine (Addisons, Myxedema, Carcinoid), Metabolic (hypoCa, hypoglycemia)

Anesthetic Management

- Emergency - simultaneous diagnosis and management - Inform the surgeon and call for help
- Dec. anesthetic, hand ventilate with 100% O₂ and temporize with vasopressors +/-fluid, inotrope
- Cycle BP and scan the monitors for HR, rhythm, ST segment, SaO₂, EtCO₂, PAP
- **Feel for a pulse:** if no pulse → ACLS protocol. If pulse present → targeted physical exam
- Reassess DDx based on findings

Targeted PE: Urticaria, flushing, angioedema, tracheal deviation, s/c emphysema, air entry, JVP, CVP, PCWP, peripheral perfusion, check surgical field for blood loss, IVC compression etc.

DDx

Post-induction hypotension:

Anesthetic: relative overdose, relative hypovolemia, anaphylaxis, arrhythmia **Patient:** cardiac compression due to mediastinal mass, PTX, tamponade

Obstetrical Hypotension: hemorrhage, High/total spinal, AFE, PE, aortocaval compression, Cardiomyopathy
Medications (oxytocin)

Neurosurgery Hypotension: Arrhythmia (posterior fossa or brainstem surgery), Hypovolemia (mannitol, lasix), Hemorrhage, VAE, Neurogenic (if SCI); **Management:** lower HOB, flood field, Bone wax

Trauma Hypotension: Hemorrhage (Occult), Tension PTX, Tamponade, Fat embolus, Cardiac contusion, Pulmonary contusion, Neurogenic shock, Drug intoxication (cocaine), Rare: Anaphylaxis, arrhythmia, sepsis

Post-pneumonectomy Hypotension: Surgical – Hemorrhage, Cardiac herniation, Tension PTX (stump disruption, BPF); Anesthetic - High TEA, Sedation; Patient -Arrhythmia (afib), MI, pHTN/RVF; **Management:** Operative side UP, physical exam: A/W, PTX, CVP, check chest tube for blockage, turn of TEA, sedation, CXR, ECG, CBC, ABG. Cardiac herniation: to OR, d/c PEEP, minimize Paw, turn off suction to CT, 1-2L of air into thorax, inotropes prn

Laparoscopic Hypotension: Vagal response to peritoneal distension, Compression of IVC, Hemorrhage, VAE, Tension PTX, Hypercarbia-induced arrhythmia

Refractory Shock: Ingestion/toxidrome, Adrenal insufficiency, Hypocalcemia, Hypovolemia (severe)

Hypothyroidism

1. Etiology of hypothyroidism and adequacy of treatment
 - a. associated AI disease, previous radiation, surgery, hypothalamic / pituitary dysfunction
2. Potential difficult airway - Enlarged tongue +/- goiter from chronic thyroiditis (Hashimoto's)
 - a. Decreased gastric motility with risk of aspiration
3. Multisystem effects
 - a. **CNS:** exaggerated effects of sedatives & NdMB
 - b. **CVS:** hypodynamic circulation, ↓CO, CHF (diastolic and systolic), pericardial effusion, inc. QT
 - c. **Resp:** Potential for mass lesion, pleural effusions, impaired ventilatory response to hypoxemia & hypercarbia, exaggerated ventilatory-depressant response to drugs
 - d. **Metabolic:** hypothermia, hyponatremia (SIADH), hypoglycemia
 - e. **Endocrine:** adrenal suppression (cortical atrophy)
4. Potential for myxedema coma → may develop in previously asymptomatic patients
 - a. mortality >50%, precipitated by stress (surgery, infection, trauma, MI, CVA)
 - b. Exaggerated features of hypothyroidism
 - Dec. LOC, inc. sensitivity to NdMB & sedatives, myocardial & respiratory depression
 - high risk for delayed emergence and need for post-op ventilation
 - c. Treatment of myxedema coma
 - IV T3 0.2mcg/kg q6h (onset 6-24 hrs) or T4 300-500 mcg IV load then 100mcg IV q24
 - Hydrocortisone 100mg IV then 25mg q6h (common association with adrenal suppression)
 - Risk of myocardial ischemia with IV T3/T4 supplementation in those with CAD

Hx: Inquire about etiology - autoimmune diseases, RAI, radiation, thyroidectomy; Determine cause. Look for symptoms of over or undertreatment (hyperthyroid = palps, anxiety, weight loss, heat intolerance, diarrhea; hypo = dry skin, brittle nails, brittle hair, cold intolerance, constipation, fatigue, depression, weight gain, edema). Evaluate for GERD, positional dyspnea or cough, SVC syndrome; heart failure symptoms.

Px: Vitals (orthostatic) volume status. A/W – large tongue, hoarseness, goiter, radiation injury. Eyes for positioning. Resp - effusions, hypoventilation; CVS – hypovolemia, bradycardia, HTN, CHF. DTRs (reduced)

Investigations: CBC, lytes (SIADH, gluc), TSH, free T3/T4, ABG if resp depression; ECG (low voltage, long PR, QRS, QT, VT torsades), CXR (effusions), ECHO (contractility, effusion) +/- CT (mediastinal mass)

Optimization: Delay elective case if symptomatic; Consult Endo +/- Cardio (risk of MI with CAD); Aspiration prophylaxis; Avoid preoperative sedation; Supplemental O2 and ventilatory support as indicated; Drain symptomatic pleural effusions; Restore intravascular volume; Euthyroid prior to elective surgery - thyroxine PO titrated to achieve normal TSH over 6-8 weeks; Emergency Surgery - Preoperative thyroid and glucocorticoid replacement (levothyroxine 400-500 ug IV load then 50-200ug/day, T3 has more rapid onset - liothyronine 0.15 – 0.3 ug/kg IV q6h, Hydrocortisone 100 mg IV then 25 mg IV q6h)

Options: Regional is acceptable option if CNS, ventilation, and cardiac status are appropriate

Room Setup: CAS+5lead, temp; nerve stimulator; Art line; forced air warmer; PAC/TEE if indicated

Management: anticipate hypotension – consider ketamine; judicious NdMB – full reversal; consider ephedrine for hypotension – need some B agonist given cardiac dysfxn, may be refractory to catecholamines; multimodal analgesia (limit opioids); high risk for delayed emergence

Postop disposition: Dependent on degree of cardiorespiratory compromise. Low threshold for ventilation & HDU; monitor for fluid and electrolyte derangements

Perioperative Hypoxemia

1. **Low FIO₂** – machine, circuit
2. **Airway** – obstruction, malpositioned ETT
3. **Hypoventilation** – A/W, Bronchospasm, **PTX**, **light anesthesia** / pain, dec. LOC (ventilator drive)
4. **V/Q mismatch** – pre-existing lung disease, pulm edema (CHF), **atelectasis**, **aspiration**, infection, Cardiac arrest (dec. pulmonary perfusion), Obstruction (PE, VAE, AFE, FE)
5. **Anatomic Shunts** – Cardiac lesions (PFO, ASD, VSD, PDA)
6. **Low S_vO₂ – Low CO**, anemia, hemorrhage, high VO₂, hemoglobinopathies

Anesthetic Management

- Emergency - simultaneous diagnosis and management - Inform the surgeon and call for help
- Scan monitors: rate, rhythm, BP, EtCO₂, SaO₂, PIP
- Hand ventilate with 100% O₂ - increase PEEP, use larger volumes (recruitment maneuvers)
- **Check position of ETT**: pass suction catheter, FO bronchoscope (mucus plug, aspiration)
- Examine patient - cyanosis, rash, pulse, tracheal position, chest movement, B/L air entry, wheeze
- Support / Monitor Circulation
- Develop DDx and treat

Investigations: ABG (A-a gradient, Hemoglobin), CXR, ECG

Pediatric Hypoxemia

Aspiration (esp. FB), Laryngospasm, Post-obstructive pulmonary edema, Shunting (undiagnosed CHD), Endobronchial intubation (especially if small)

Obstetrical Hypoxemia/Dyspnea

APE, PE, Aspiration, High spinal, Pulmonary edema (cardiomyopathy or valvulopathy, autotx), Anemia

Trauma/Burns Hypoxemia

Airway obstruction, Airway disruption, Aspiration, PTX (simple or tension), CO toxicity, Pulmonary contusion, Hemothorax, Tamponade, Fat embolism, ARDS, Eschar around chest

OLV Hypoxemia

Malpositioning of ETT/DLT/blocker, Shunt through non-ventilated lung (inhibition of HPV), Atelectasis, PTX, low CO with potential RV failure

- **Management** – 100% FiO₂, confirm correct placement and lung isolation, PEEP dependent lung, CPAP operative side, Clamp PA

Massive Transfusion

TRALI, ABO incompatibility

Artifact

Poor peripheral perfusion, Hypothermia, Methemoglobinemia

Increased Airway Pressure

Definition: *an increase in PIP of more than 5 cm H₂O; or a PIP greater than 40 cm H₂O*

DDx

1. Machine - stuck expiratory, inspiratory, APL, O₂ flush valve, kinked scavenger, failed check valve
2. ETT - malpositioned, blocked (mucous, FB), kinked, cuff herniation, size
3. Inc airway resistance
 - **bronchospasm**
 - **light anesthesia**
 - **anaphylaxis**
 - foreign body
 - mucous/secretions
 - URTI
4. Decreased lung compliance
 - ALI / ARDS, **aspiration** / pulmonary edema
 - restrictive lung disease
5. Pleura – **PTX**, hemothorax, pleural effusion
6. Dec. chest wall compliance – kyphoscoliosis, muscle rigidity, MH
7. Increased abdominal pressures
 - abdo compartment syndrome, obesity, insufflations, retractors, trendelenberg

Management:

- Emergency which requires simultaneous diagnosis and management
- Inc. FiO_2 to 1.0, inform the surgeon and call for help
- Initial Differential Dx:
 - Machine - Disconnect - assess lung compliance with ambu bag, patency of circuit
 - ETT - Check placement with laryngoscope and pass suction catheter to ensure patency
 - if marked obstruction: deflate cuff and recheck, extubate (consider exchange catheter), mask / LMA ventilate to increase SaO_2 then reintubate, consider FOB examination if difficulties
- If patient problem, initial management includes:
 - Deepen anesthetic with volatile (Sevo) or IV (e.g. Lido or Ketamine)
 - Ensure paralysis
 - auscultate bilaterally for symmetry, breath sounds, wheezes, rales, crackles
 - Asymmetry
 - endobronchial tube - examine and reposition ETT
 - pneumothorax - assess BP, HR, palpate trachea, percuss chest
 - Wheezing or silence: bronchospasm – deepen, ventolin, epinephrine
 - Crackles: pulmonary edema - PEEP, lasix, morphine, NTG...
 - If hypoxemic or ↓ BP, initiate epinephrine (can bolus or put 1 mg in 1000 mls and run as an infusion)
- exclude other causes: MH, light anesthesia, inadequate muscle relaxation, opioids, surgical

Ethics/ Informed Consent

Principles of medical ethics:

- **Autonomy:** right to self-determination
- **Non-maleficence:** Obligation to “do no harm” intentionally
- **Beneficence:** moral obligation to act for the benefit of others “do good”
- **Justice:** obligation of fairness, entitlement to care & equity in its delivery
- **Fidelity:** right to confidentiality

Informed Consent:

Decision Making Capacity: : *ability to make a particular decision at a specific time*

Voluntariness: Participate without coercion

Disclosure: The goal of disclosure is to provide information relevant to the decision-maker and the decision to be made (professional practice standard vs reasonable person standard vs subjective person standard (opera singer))

Recommendation: What the anaesthesiologist would recommend based on professional opinion.

Understanding: Patient needs to understand the risks and benefits of the proposed procedure

Decision: The patient should be encouraged to form a decision or be involved in the decision making process

Autonomous authorization: To respect the patients autonomy, the patient should give his/her consent for the procedure based on informed consent as an expression of the patients self determination

Approaches to pediatric consent

Age	Decision-Making Capacity	Technique *
<6 years	None	Best interests standard
6–12 years	Developing	Informed permission / Informed assent
12–18 years	Mostly developed	Informed assent / informed permission
Mature minor	Developed, as legally determined by a judge	Informed consent
Emancipated minor	Developed, as determined by a situation	Informed consent

Assent

1. Helping the patient achieve a developmentally appropriate awareness of the nature of his or her condition
2. Telling the patient what he or she can expect with tests and treatment
3. Making a clinical assessment of the patient's understanding of the situation and the factors influencing how he or she is responding, including whether there is inappropriate pressure to accept testing or therapy
4. Soliciting an expression of the patient's willingness to accept the proposed care

Informed Consent (7) Components

1. Decision Making Capacity: The ability to make a decision at a specific time which includes capacity to understand problems, proposed Rx, alternatives, options to refuse treatment, and foreseeable consequences, and express a preference based on rational, internally consistent reasoning.
2. Voluntariness – Pt participates willingly w/o coercion or manipulation
3. Disclosure – To provide pt with info relevant to decision. (3) standards of disclosure: The professional practice standard, the reasonable (objective) person standard, and the subjective person standard (eg opera singer). Negligence related to informed consent is determined if “Materiality” assesses whether the info given met the std of care, “Causation” then assesses whether sharing the omitted info would have caused the pt to choose a different option
4. Understanding – Patients need to understand the risks and benefits, distress does not seem to compromise the ability to recall risks, particularly among parturients. Recall and understanding are not correlated.
5. Recommendation – Anesthesiologists should offer an opinion
6. Decision – The Anesthesiologist should make substantial effort for to educate the patient prior to making a decision rather than to accept at face value the patients refusal to be educated. If the patient chooses a technique which the anesthesiologist believes to be inappropriate, they are not ethically obligated to provide care in non-emergent situations.
7. Autonomous authority – Obtaining informed consent is how we acknowledge the responsibility to respect a patient's right to self-determination.

Controversies:

1. **Emergencies:** Assume patient wants life-saving measures unless declared otherwise. Determine if intervention is reversible, if so, proceed. If irreversible make all attempts to clarify patients wishes in advance.
2. **Moral Objections:** Anesthesiologist is not obligated to subjugate their morales, however they must make a reasonable effort to find a competent and willing replacement. They should perform care in life-or-death circumstances.
3. **Confidentiality:** May disregard if a patient makes a credible threat to harm someone else.

Pediatric informed assent: "Informed assent" acknowledges that although most pediatric patients cannot legally consent to medical care, pediatric patients should share in decision making to the extent their development permits. Help the patient understand a developmentally appropriate awareness of the nature of her condition, what he/she should expect with proposed Rx, assess patients understanding, and solicit an expression of the patient's willingness to accept the proposed procedure. Generally < 6 years don't have decision making capacity > surrogate decision makers. 6-12 years DMC is developing, use informed assent, permission. 12-18 years, mostly developed DMC, Informed assent/permission. Mature Minor, developed as legally determined by judge "informed consent." Emancipated minor, developed as determined by situation "informed consent"

IVRA

Indications: Anesthesia to entire extremity distal to tourniquet: limited to 60-90mins.

Contraindications: Usual + infection at site of needle insertion, coagulopathy (relative), pre-existing neuro deficits (relative), Raynaud's or Scleroderma, Sick Cell due to tourniquet, open wounds, obesity (may exceed capabilities of tourniquet), partial heart block (tourniquet release may precip. complete HB) ie. RBBB/LBBB, bifascicular block).

Complications: Slow onset, may require 20 min, local anesthetic toxicity, inadequate block (better exsanguination = better block), hematoma (avoid multiple punctures), skin tears (minimize shear forces with Esmarch bandage, for fragile skin elevate arm for 3 mins prior to applying bandage + brachial artery compression. Post op pain, ecchymosis, nerve injury related to ischemia, usually transient.

Technique: Standard CAS monitors , 20-22g IV, Esmarch bandage, double-cuff pneumatic tourniquet. Exsanguinate arm for 1-3 mins (elevate, then apply esmarch). Inflate tourniquet 100-150mmHg above SBP (at least 250mmHg). Remove Esmarch, confirm pallor and pulselessness. Then inject local . anesthetic. Lidocaine 3mg/kg or 40 mL of 0.5%

Bupivacaine contraindicated due to CVS toxicity, Chloroprocaine contraindicated due to risk of thrombophlebitis.

Adjuvants: Guanethidine 10mg for 1st Rx, then 20mg for 2nd U/E, 40mg for L/W

Reserpine 1-1.5mg (total)

NSAIDs for improved analgesia 20-60mg

Clonidine 1mcg/kg (not available in Canada)

Deflation: <20 mins = don't

20-40 mins = deflate for 10s, inflate for 1 min, deflate (delays onset but not peak serum levels)

>40 min: deflate

For longer cases and tourniquet pain inflate distal cuff (over anesthetized area) then deflate proximal cuff.

For expected long cases, deflate after maximum time limit reached, allow limb to reperfuse x 5 mins, then repeat Bier Block with 50% original dose.

DDx Post-op Jaundice

Prehepatic:

- Hemolysis, Hematoma, Blood transfusion

Intrahepatic:

- Drug induced : ETOH, Toxins
- Infectious: Hepatitis ABC
- Shocked Liver
- Sepsis
- TPN (acalculus choecystitis)
- congenital conjugation defects
- Hypoxia

Posthepatic

- Gallstone, mechanical obstruction or acalculus cholecystitis

Tests: CBC/Lytes/Haptoglobin/Coombs/Smear/LFTs/Bili/GGT/Alk-P/Hepatic U/S / Hepatitis Serology/
Toxicology Screen (EtoH/Tylenol)

Considerations of fulminant hepatic failure: Considerations of maintaining hepatic perfusion pressure, correcting coagulopathy, avoiding toxins. Recognize increased risk of Post-op ventilation and encephalopathy and ICU. Consider altered PK/PDs.

Jehovah's Witness

Jehovah's Witnesses are an international religious organization that rejects much of modern mainstream Christianity in favour of what they believe is a restored form of first-century Christianity.

1. Risk of **perioperative morbidity and mortality secondary to massive blood loss** and patient refusal of allogenic blood products (RBCs, WBCs, platelets, plasma)
2. **Legal and ethical issues of consent** specifically regarding JW minors and in emergency scenarios
3. Considerations of **pre-operative optimization of hematocrit** (eg iron and Erythropoietin)
4. Considerations of **intra-operative blood conservation** techniques including hypotensive techniques, antifibrinolytics, hemodilution, cell saver

Specific obstetrical considerations

1. In cases of **mother vs. fetus**, courts have ruled in favour of blood transfusions when fetus considered viable
2. Consider (and discuss) **hysterectomy** for life-threatening hemorrhage
3. Epidural blood patches are generally accepted (Watchtower)

Anesthetic Goals/Conflicts:

- Maximize pre-operative HCT, minimize blood loss (antifibrinolytics, controlled hypotension, hemodilution), discuss cell salvage techniques (cell saver), factor VIII!
- Consider Regional Technique, tourniquets
- Document Refusal of Blood Products
- Conflicts: Parents vs. pediatric patients incapable of giving consent (courts have uniformly intervened to deny the ability to refuse transfusion therapy), Pediatric patients nearing the age of consent

HX: Cardiopulmonary status, previous anemia, personal beliefs, cell-saver.

Optimization: If elective, delay surgery until hematocrit/red cell mass is optimized with iron +/- erythropoietin (300U/kg SC x 3 injections/week for 3 – 4 weeks). D/C Anticoagulants. Heme Consult, blood utilization program. JW Hospital Liaison. Legal counsel if dealing with minors. Consider pre-operative angiographic embolization. Venofer (IV iron sucrose 100mg iron) – Side effects include hypotension, GI symptoms, muscle cramps, headaches

Intraoperative: Arterial line, minimize venipuncture, +/- cell saver, controlled hypotension, regional, meticulous surgical technique, tourniquet, antifibrinolytics, hgb solutions if available, avoid coagulopathy

Tranexamic acid – reversibly binds plasminogen. S/E: hypotension, N/V, abd cramps, thromboembolic, retinal degeneration with prolonged use.

E-aminocaproic acid – reversibly binds plasminogen, 6-10x less potent than TXA. Side effects include hypotension, sinus bradycardia, GI symptoms, CNS symptoms, anaphylactic reactions (paraben hypersensitivity), agranulocytosis, and rhabdomyolysis (rare)

Aprotinin - Inhibits many serine proteases including; trypsin, chymotrysin, **plasmin (inhibition of fibrinolysis)**, and **kallikrein (inhibition of factor XIIa** – anaphylactic/toxic reactions.

Topical Collagen – causes platelet aggregation and initiates clotting cascade.

POST-OP: Severe anemia > Consider sedation, ventilation, temperature control, iron supplementation, ICU.

L to R shunt

1. Consideration primary lesion ASD or VSD ,or PDA (L –R shunt)
2. Consideration of eisenmenger syndrome
 - a. PTH
 - b. RV dysfunction
3. Physiological interaction with pregnancy
 - a. ↑ afterload during labour can ↑ L-R shunt and result in pHTN and RV failure
 - b. dec. SVR → exacerbate the severity R-L shunt if preexisting pHTN

Anesthetic Goals / Conflicts

- Hemodynamic Goals
 - Maintain Rate, Rhythm, preload, and contractility
 - Avoid extremes of afterload
 - Avoid air bubbles
- Pregnancy
 - Slowly titrated epidural (dec. SVR – reversal of shunt – hypoxia)
 - Assisted 2nd stage – RV failure
 - Avoid inc. pHTN - hypoxemia, hypercapnea, acidemia, hypothermia, pain

Laryngotracheal Trauma

1. Emergency case
 - a. Risk of aspiration
2. Trauma patient with associated injuries:
 - a. c-spine
 - b. CHI
 - c. major vascular
 - d. thoracic (PTX, pneumomediastinum)
 - e. esophageal
3. Potential for airway obstruction:
 - a. evolution of underlying process
 - b. manipulation of tenuous airway (laryngoscopy, cricoid)
 - c. PPV and neuromuscular blockade
 - d. May require emergency surgical airway

Anesthetic Goals / Conflicts

- Identify the injury and evaluate extent
- Avoid PPV and neuromuscular blockade until airway controlled distal to injury
- Identify associated injuries

Hx: high index of suspicion for occult injury – airway, vascular, pulmonary, esophageal (esp with penetrating neck injury); AMPLE hx – mechanism of injury

Px: 25% of patients have no external evidence of injury – neck trauma, subcutaneous air leaks & emphysema, dyspnea, hoarseness or voice change, hemoptysis, stridor, dysphagia, cervical pain, flattening of thyroid cartilage, ecchymosis in neck

Inv: CXR – pneumothorax, pneumomediastinum, subcutaneous air; c-spines – paravertebral air; CT neck – quantify disruption, associated injuries; Laryngoscopy / Bronchoscopy / esophagoscopy are mandatory; CTA or angiography to assess for vascular injury

Anesthetic Setup: If stable, transfer to OR; difficult airway equipment (FOB); equipment and personnel for immediate rigid bronch, tracheostomy

Airway management: if time, delineate injuries prior to airway instrumentation; consider AFOI (difficult topicalization); consider awake trach; if GA required – SV (inhalational, TIVA) vs. RSI (NO Cricoid or PPV); Confirmation of tracheal intubation – EtCO₂, CXR, FOB

LASERS (Light Amplification by Stimulated Emission of Radiation)

1. **Patient safety and potential complications:** atmosphere contamination, perforation of a vessel or structure, embolism, inappropriate energy transfer.
 - **Atmospheric Contamination** (mean size 0.31um) small enough to reach alveoli. Note most surgical masks filter particles down to 3um. Potential mutagenic/carcinogenic biproducts.
 - **Tissue and Vessel Perforation:** Vessels > 5mm are not coagulable by laser, pneumothorax. With Nd:YAG laser perforation or bleeding may not be apparent until edema and necrosis become maximal several days post-op
 - **Embolism:** Nd:YAG laser system associated with venous gas embolism due to the gas coolant
 - **Energy Tx** to inappropriate locations (reflected or transmitted through air)
2. **Operating room safety** and appropriate precautions (eyewear, appropriate masks, window covers and warning signs)
3. Prevention and possible emergency management of **airway fires** (low FiO_2 , avoidance N_2O , specialized ETT, potential for jet ventilation, intermittent laser use).

Patient Safety: Eyes taped closed, cover with saline soaked gauze

OR staff Safety: Laser specific lenses, wraparound goggles, all windows covered and warning signs

ETT Tube Fires: Incidence 0.5-1.5% - Any hardocarbon material (tissue/plastic/rubber) can ignite

Puncturing cuff and O₂ enriched gas increase chance of fire.

3 Preventative strategies: 1) Reduce flammability of ETT 2) Removal of flammable materials from A/W using metallic venture jet ventilation cannula 3) Reduction of O₂ content of inhaled gas

Ease of ignition with Nd:Yag: PVC > Red Rubber > silicone

Ease of ignition with CO₂: PVC > Silicone > red rubber

Options: Wrap ETT with reflective tape, protecting ETT cuff with laser resistant cuffs, saline filled cuffs with methylene blue for early detection, covering cuff with pledgets, Metal ETTs (Laser Flex), Jet Ventilation, intermittent Apnea. Reduce FiO₂ < 0.4. Avoid volatiles as they can form toxic compounds in the presence of an airway fire (not inherently flammable).

Airway Fire Protocol: 1) Remove source immediately 2) OR staff notified, call code 3) Flammng material extinguished in bucket of water/saline (keep available) 3) Ventilation resumed with 100% O₂ once extinguished by mask 4) Direct laryngoscopy/Rigid bronch/FOB to assess damage +/- saline lavage 5) Reintubation if any a/w damage 6) Tracheostomy if severe 7) Assess oropharynx for burns 8) CXR 9) Consider steroids?

Lithium Toxicity

Toxicity occurs with serum levels > 2mEq/L, with signs of skeletal muscle weakness, ataxia, sedation, widening of QRS.

1. Multisystem effects of toxicity:
 - a. CNS: Sedation, decreased LOC, Seizures
 - b. CVS: Wide QRS, AV block, hypotension
 - c. Resp: potentiate NdMB
 - d. Renal: Nephrogenic DI >> Fluid and electrolyte imbalance
2. Treatment:
 - a. Medical emergency requiring Hemodialysis
 - b. Diuresis – Loop or osmotic diuretics
 - i. Thiazide diuretics increase lithium resorption in proximal tubule

Anesthetic Goals/Conflicts:

- Avoid NSAIDS and ACEi's which decrease lithium excretion
- Supportive management, correct fluid and electrolyte abn's of DI

Liver Failure

1. Underlying etiology and associated concerns
 - Viral hepatitis, drugs (ETOH, Tylenol), Autoimmune, Hemochromatosis
2. End-organ Dysfunction
 - CNS – encephalopathy
 - CVS – hyperdynamic (inc.CO, dec. SVR), cardiomyopathy, portal hypertension
 - Resp – chronic hypoxemia (V/Q mismatch, intrapulmonary AV shunts), RLD (ascities)
 - Renal –hepatorenal syndrome, CRF
 - Hem – anemia, coagulopathy (thrombocytopenia, dec. clotting factors), immunodeficiency
 - Endo – hypoglycemia, hyponatremia, lactic acidosis
 - GI – esophageal varices
3. Altered pharmacology (inc Vd, dec. protein binding, dec. hepatic clearance)
4. TBW excess with dec. effective circulating volume (dec. albumn)

Anesthetic Goals/Conflicts:

- Identify and optimize multi-organ dysfunction
 - Delay elective cases until optimized
 - Correct hypovolemia, coagulopathy, acute hepatitis is a contraindication to surgery
- Universal precautions

Hx: determine etiology & associated comorbidities (hemochromatosis – restrictive cardiomyopathy, ETOH – dilated cardiomyopathy); Identify end-organ dysfunction – encephalopathy, varices, hepatopulm/renal syndromes, dyspnea, ascites/SBP; Ongoing treatment and response to date.

PE: Vitals, postural BP, GCS, temp, volume status. Cardiopulmonary exam assessing for high output heart failure, portopulmonary HTN, pleural effusions (supine vs upright sat can indicate hepatopulmonary syndrome), stigmata of chronic liver disease (caput, spider nevi, clubbing, asterixis, hepatosplenomegaly), icterus

Investigations: CBC (anemia, thrombocytopenia), lytes (hyponatremia), BUN, Cr (renal failure), coags, Ca, Mg, Cross Match, glucose, albumin, bili (Child-pugh), CXR (pleural effusions), ECG (pHTN), PFTs (restrictive), ECHO (PAP, EF, cardiomyopathy)

Optimization: Consultation with GI/hepatologist – treat encephalopathy, evaluate for varices, Correct coagulopathies (vit K, FFP), electrolytes, **anemia**, volume deficit. Risks stratify with Child-pugh, Aspiration prophylaxis, Optimize nutritional status. If RLD is severe, then thoracentesis or paracentesis may be required.

Anesthetic Options: local, GA, Regional – contraindicated with massive hemorrhage, inc. infect risk – if required, single shot (coagulopathy may recur)

Room Setup: CAS + 5, temp, nerve stim, pre-induction A-Line, Blood warmer, large IV access with rapid infuser, CVP, PAC/TEE rarely (if varices banded for the latter), ICP monitoring can be discussed in setting of fulminant hepatic failure, PRBC, pressors and infusions

Intraoperative Mgt: RSI vs. Hemodynamic instability, Anticipate altered pharmacokinetics – use propofol, fentanyl, remifentanyl, cisatracurium. Follow glucose, colloid for volume, follow U/O

Post-op: High dependency unit. Low threshold for postop ventilation

Complications: Delayed emergence (encephalopathy, inc. ICP, drugs), ARF, Hemorrhage (surgical vs. medical, variceal bleed – octreotide 25-50 ug/kg/hr, vasopression, blakemore tube), Sepsis, transfusion reactions, ETOH withdrawal

Liver Transplant

1. Urgent Case
2. Considerations of ESLD
 - Underlying etiology
 - Physiologic & metabolic derangement – encephalopathy, high output cardiac failure, pHTN, chronic hypoxia, coagulopathy, renal failure, varices
3. Risk of massive transfusion – Perioperative coagulopathy and management
4. Hemodynamic instability
 - Liver manipulation
 - IVC clamping
 - Post-reperfusion syndrome (acidosis, ↑ cardiac output, ↓ SVR, ↓ BP)
5. Risk of hypothermia
6. Postoperative disposition (ICU)

Anesthetic Goals/Conflicts:

1. Optimize end-organ dysfunction – volume resuscitate, correct coagulopathy
2. Preparation for major blood loss
 - Correct coagulopathy, Good IV access, cell-saver, fluid warmers, rapid infuser, Coordination with blood bank, consider antifibrinolytics
3. Preparation for 3 stages of liver transplantation and hemodynamic effects
 - Dissection, Anhepatic, Reperfusion/neohepatic

Hx: determine etiology & associated comorbidities (hemochromatosis – restrictive cardiomyopathy, ETOH – dilated cardiomyopathy); Identify end-organ dysfunction – encephalopathy, varices, hepatopulm/renal syndromes, dyspnea, ascites/SBP; Ongoing treatment and response to date.

PE: Vitals, postural BP, GCS, temp, volume status. Cardiopulmonary exam assessing for high output heart failure, portopulmonary HTN, pleural effusions (supine vs upright sat can indicate hepatopulmonary syndrome), stigmata of chronic liver disease (caput, spider nevi, clubbing, asterixis, hepatosplenomeg), icterus

Investigations: CBC, lytes (hyponatremia), BUN, Cr, coags, Ca, Mg, Cross Match, glucose, albumin, bili (Child-pugh), CXR (pleural effusions), ECG (pHTN), PFTs (restrictive), ECHO (PAP, EF, cardiomyopathy)

Optimization: Consultation with GI/hepatologist – treat encephalopathy, evaluate for varices, Correct coagulopathies (vit K, FFP), electrolytes, **anemia**, volume deficit. Risks stratify with Child-pugh, Aspiration prophylaxis, Optimize nutritional status. If RLD is severe, then thoracentesis or paracentesis may be required.

Room Setup: CAS + 5, temp, nerve stim, pre-induction pre-induction A-Line, Blood warmer, 2-3 large IVs with rapid infuser, CVP, PAC/TEE rarely (if varices banded for the latter), ICP monitoring can be discussed in setting of fulminant hepatic failure, PRBC (10 units to start), pressors Calcium, and infusions

Intraoperative Mgt: Induction: RSI/ETT. Maintenance: Balanced anesthesia. Maintain relaxation with Cis (or atracurium). Minimize crystallize. Albumin 5% or, less optimally, PS/VV for fluid resuscitation. Monitor lytes

Stages: Dissection: Results in bleeding/hypovolemia – volume resuscitate and maintain renal perfusion

Anhepatic: Clamping results in dec. preload, dec. CO, dec. renal perfusion, dec. citrate clearance (with associated citrate toxicity), fibrinolysis – volume load, vasopressors, consider veno-veno bypass

Neohepatic/reperfusion: most unstable period, abrupt increased in K⁺, H⁺, dec. temperature, release of vasoactive substances. Postreperfusion syndrome – hypotension, bradycardia, arrhythmia – preemptive bicarb, Calcium, hyperventilation, insulin/glucose, vasopressors, ?free radical scavengers (methylene blue)

Post-op: Conservative management involves transferring to ICU ventilated and weaning over 6-8 hours.

Local Anesthetic Toxicity

1. Prevent and recognize toxicity
 - a. Toxic doses, monitoring, mild signs and symptoms (Analgesia, Lightheadedness, Tinnitus, Numbness of tongue)
2. Emergency management of CNS toxicity
 - a. seizures, coma and respiratory arrest
 - b. airway management and hyperventilation
3. Emergency management of CVS toxicity
 - a. arrhythmias, hypotension, and cardiac arrest
 - i. ACLS, escalating doses of Epinephrine, Vasopression
 - ii. Intralipid therapy (1.5ml/kg may rpt q5 to max 3ml/kg followed by 0.25ml/kg/min)
 - iii. Early consideration fo CPB

Anesthetic Goals/Conflicts:

- Prevention of toxicity: aspiration, test doses, slow infusion
- Avoid exacerbating factors: acidosis, hypercarbia, hypoxia
- Prompt administration of possible antidote: Intralipid 20%

Presentation: initial sx of **CNS toxicity** - tinnitus, visual disturbance/diplopia, lightheadedness, metallic taste, circumoral numbness - Progression to myoclonus, grand mal seizures, coma & respiratory arrest

Cardiotoxicity usually follows neurotoxicity; ~10% may present with arrhythmias, hypotension and CVS collapse rather than seizures - Arrhythmias include conduction delay, BBB, prolonged PR interval, complete heart block, sinus arrest, or asystole - ventricular ectopy, and malignant arrhythmias such as ventricular tachycardia, torsades de pointes, and ventricular fibrillation

Toxic doses: Chloroprocaine 12mg/kg, Cocaine 1.5-3mg/kg, Bupivacaine 2-3mg/kg, Lido 4.5-7mg/kg (w/ epi), Ropivacaine 3mg/kg

Rates of Absorption: Arterial > venous > Tracheal > Intercostal > Caudal > Paracervical > Epidural > Brachial Plexus > Sciatic/Femoral > Subcutaneous > Topical

Prevention: Aspirate, give incremental doses, test doses with epinephrine (15mcg should increase HR by 10 bpm, SBP by 15mmHg, or lead to a 25% decrease in T-wave amplitude in lead II (peak in peds), wait 40-60 seconds, max BP response at 90 seconds. When using tissue depots, limit dose and use epinephrine

Optimization: Benzo's raise seizure threshold, avoid hypoventilation

Management: Stop the injection / Maintain oxygenation and ventilation / avoid hypoxemia, hypercarbia, and acidosis – Thio, midaz, prop for Sz – Mild CVS depression (brady, hTN) ephedrine, atropine - Profound CVS depression and malignant dysrhythmias, ACLS, escalating epi, vasopressin, amio, intralipid – avoid Ca channel blockers

Note: Intralipid may cause pulmonary vasoconstriction, pancreatitis.

Long QTc Syndrome

1. Hemodynamic compromise / collapse from rapid polymorphic VT (Torsade de Pointes) and sudden cardiac death
2. Optimize QTc
 - a. B-blockade, Lt stellate ganglion block
 - b. Avoid
 - i. Medications: Butyrophenones (Droperidol), Quinidine, TCAs, ketamine, Lidocaine
 - ii. Electrolytes: Acute hypokalemia, hypoMg, hypoCa,
 - iii. SNS activation: hypothermia, hypoxia, hypercarbia, acidosis, stress, anxiety, auditory stim
 - iv. Valsalva
3. Consider underlying etiology
 - a. Congenital (catecholamine dependant) vs. acquired (pause dependant)
4. Pacemaker / AICD

Anesthetic Goals/Conflicts:

- Recognize & optimize patients with prolonged QTc
- Avoid prolongation of QTc
 - SNS stimulation, physical stress, anxiety, auditory stimuli
 - bradycardia in acquired long QT
 - Medications
- Rapidly recognize and treat TdP

Hx and PE: FMHx of sudden death, associated congenital abnormalities, syncope, arrhythmias

Investigations: Lytes (K, Ca, Mg); ECG (prolonged QTc (F >480 msec, M>470 msec)

Optimization: EP study; B-blockade; Left SGB if refractory to medical therapy or ER surgery; Correct Lytes (K⁺, Mg²⁺, Ca²⁺); Continue antiarrhythmics; Cardioversion/defib pads on patient; Anxiolysis

Anesthetic Options: Local; GA; RA

Room Setup: Resus drugs (phenyl and ephedrine); esmolol; Mg²⁺; ACLS drugs; DEFIB & CRASH CART

Intraoperative Mgt: Propofol shortens Qtc; Deep prior to a/w instrumentation; TIVA optimal; Volatiles prolong QT but used safely; Avoid N₂O and abrupt rise in Des (SNS +); Consider deep extubation; Avoid reversal atropine, glycol & antiemetics (droperidol & ondansetron) they all prolong QTc;

Post-op: Monitored bed; quiet atmosphere; Good pain control (Methadone prolongs QTc); consider Phenytoin in severe QTc prolongation (it shortens QTc)

Drugs: Prolongs QT: thiopental, ketamine, Iso, Sevo, Sux, pancuronium, Sufentanil, Neostigmine, edrophonium, atropine, glycopyrrolate, Epinephrine, Norepinephrine, class I & III antiarrhythmics, haldol, droperidol, quetiapine, risperidone, SSRIs, Macrolide Abx, 5-HT agonists, cisapride

No QT prolongation: Propofol, etomidate, methohexital, Halothane, vecuronium, atracurium, alfentanil, fentanyl, midazolam, phenylephrine

Lower limb Revascularization

1. Considerations of a vasculopath
 - a. comorbidities: HTN, CAD, DM, renal insuff, CVA, COPD
 - b. increased risk periop CV event (stroke, MI)
 - c. inc HD monitoring/tight HD control
2. Type of anesthetic and suitability - GA vs regional
3. Etiology of occlusion/Urgency of surgery
 - a. Acute (emergency case, risks limb viability)
 - b. Chronic vascular atherosclerosis –high risk pt with time for optimization
4. Prevention and recognition of perioperative complications
 - a. MI, CHF, HTN
 - b. Mitigate stress response – adequate analgesia
 - c. Graft patency - IV hydration, avoid hypothermia, spinal anesthetic
 - i. Acute thrombosis and Graft dehiscence

Anesthetic Goals:

- Prevention of periop complications – ischemia, CHF, CVA, renal insufficiency
 - Optimization of oxygenation, perfusion of end organs
 - Adequate intra-op, post-op analgesia
 - HD control, volume status
- Promoting graft patency
 - Early recognition of postop graft thrombosis
 - Adequate hydration, perfusion, warm limb to avoid vasoconstriction

Hx & Px: Indication for surgery - claudication, ischemic rest pain or ulceration, gangrene; Etiology - acute arterial occlusion (embolic source? Afib, recent MI, prosthetic valves, aneurysm, paradoxical embolus) vs. chronic vascular insufficiency/atherosclerosis; thorough assessment for comorbid disease; contraindications to regional

Inv: CBC, lytes Cr, BUN, Type and screen, coags, ECG +/- echo, PFT, baseline ABG, CXR as appropriate

Optimization: aspiration prophylaxis if emergent, diabetic, if elective consider need for cardiology/resp workup/optimization

Monitoring: 5 lead ECG with ST analysis, artline, +/- CVC, large IV,

Anesthetic Plan: consult w/ surgeon Re: length of case, expected blood loss, cell salvage, Spinal, Epidural, GA all reasonable, depends on procedure and pt comorbidity

Intra-op considerations: Intraop IV Heparin (Delay heparin 1 h after needle, Remove catheter 2-4 h after last heparin dose and patient's coagulation status evaluated, Re-heparinize 1 h after catheter removal, Bloody/difficult tap may increase risk; no data to support mandatory delay, discuss with surgeon), Potential uncontrolled bleeding, HD swings – laryngoscopy, emergence, tunnelling for graft, Ischemic Reperfusion Syndrome (hypotension, hyperkalemia, acidosis, myoglobinuria - ATN)

Complications: Optimize hemodynamics to prevent myocardial ischemia, Ensure adequate analgesia, Monitor graft patency (Acute thrombosis – urgent take back, expect significant blood loss with thrombectomy, Graft dehiscence – massive bleeding, hypovolemic shock requiring resusc and urgent take back)

Lung Isolation

1. Indications
 - Relative vs. Absolute (see below)
2. Relative Contraindications
 - High aspiration risk
 - Severe hypoxemia (intolerant of brief periods of apnea)
 - Tracheal stenosis or obstruction
 - Difficult airway
3. Technique
 - DLT
 - Bronchial blocker
 - Endobronchial ETT
4. Complications
 - Trauma (laryngeal, tracheal laceration)
 - Tube malposition
 - Cuff herniation/obstruction

Anesthetic Goals/Conflicts:

- Rapid and accurate placement of lung isolation device
- Common conflicts: aspiration, difficult airway

Absolute Indications

A. Prevention of contamination

1. Unilateral pulmonary hemorrhage
2. Unilateral infection (prevention of contamination)

B. Control of distribution of ventilation

1. Giant unilateral bullae
4. Bronchopleural/bronchocutaneous fistula
2. Tracheobronchial tree disruption
5. Surgical opening of major conducting airway
3. Life-threatening hypoxemia d/t unilateral lung disease

C. Unilateral bronchopulmonary lavage (alveolar proteinosis)

Relative Indications

1. Surgical Exposure (high priority): thoracic aortic aneurysm, pneumonectomy, upper lobectomy, mediastinal exposure, thoracoscopy
2. Surgical Exposure (medium priority): middle / lower lobectomy, esophageal resection, procedures on thoracic spine
3. Post CPB status after removal of totally occluding chronic unilateral pulmonary emboli
4. Significant hypoxemia from unilateral lung disease

Predictors of low arterial oxygen saturation during OLV: 1) Side of Surgery (right side has 10% more blood flow than left) 2) Poor PaO₂ on Two Lung Ventilation 3) Pre-operative percentage of predicted FEV₁ (inverse correlation) 4) Supine position

Management of hypoxemia on OLV

Manual ventilation, FiO₂ 1.0, notify surgeon

Check position of DLT/blocker with FOB

CPAP to non-dependent lung, PEEP to ventilated lung

Insufflation of non-dependent lung with 1-2L/min oxygen

Intermittent 2 lung ventilation, Clamp operative lung PA to eliminate shunt

Lung Transplant Recipient

1. Assessment of graft function
 - a. rule out chronic rejection (BAL, biopsy) & active infection (immunosuppressed)
2. Assessment of non-transplanted lung function
 - a. differential lung compliance
 - b. potential for pHTN, cor pulmonale, and RVF
3. Physiology of denervated lung
 - a. impaired cough reflex and mucociliary function
 - b. inc. risk of bronchoconstriction
4. Knowledge of anastomotic location, with placement of ETT under direct vision
5. Immunosuppression and resulting end-organ dysfunction
6. Considerations for the planned surgical procedure

Anesthetic Goals / Conflicts

- Minimize injury to allograft and native lung
 - meticulous aseptic technique
 - avoid instrumentation of lung
 - lung protective ventilation
 - avoid excessive intraoperative fluids
- prompt recovery of resp function (early extubation)

COMPLICATIONS OF LUNG TRANSPLANT

1. Primary Graft Failure (15-35%)
2. Pneumonia
3. Acute Graft Rejection (50%)
4. Bronchial Stenosis
5. Chronic Graft Rejection (aka Bronchiolitis obliterans)

History and Physical

- What surgery?
- Function of the allograft/SLTx vs DLTx
- Evidence of bronchial narrowing, other disease

Investigations

- Usual labs –esp CBC, kidney function
- CXR - evidence of rejection or infection (but may be normal in presence of both)
- Spirometry and ABG mandatory

Optimization: postpone if evidence of infection; stress steroids; prophylactic abx

Anesthetic options: neuraxial/regional may be preferred if possible

GA: careful placement of ETT - avoid site of anastomosis

- Prone to infection, early extubation, judicious fluids, prone to bronchoconstr'n
- If SLTx, consider different lung compliance in native vs transplanted lung

Complications: hypoxemia, trauma to native or transplanted lung

Malignant Hyperthermia

Anesthesia induced-hypermetabolic state characterized by rigidity, rhabdomyolysis, hyperkalemic arrest, ARF, DIC and cerebral edema

1. Recognize susceptible patients and provide a **trigger free anesthetic** (volatiles/Sux)
2. **Early recognition, declaration of emergency and continuous therapy** (dantrolene, cooling, ICU)

Anesthetic Goals/Conflicts:

- Avoid triggers (volatiles and Sux) in MH susceptible patient
- Early recognition and Rx: D/C triggering agents, correct hypoxemia / hypercarbia by hyperventilating on 100% O₂ at >10L/min, reverse hypermetabolic state with dantrolene, correct metabolic acidosis with HCO₃⁻, treat hyperkalemia, dysrhythmia control (avoid CCBs!), Cool patient until Core < 38 degrees.
- Continue management after acute episode to prevent secondary complications

Hx: Personal or FmHx of MH, intolerance to caffeine containing foods, previous testing, hx of unexplained fevers or cramps. 3 associated disorders: CCD (Central Core Disease), King-Denborough syndrome, Evans myopathy. Generally normal PE unless they have associated myopathy.

Investigations: Electrolytes, Cr, CK (70% of MH patients have elevated resting CK), urine for myoglobin, ECG may have ventricular dysrhythmias), Coags, ABG. Special: Caffeine-halothane contracture test = gold standard, sensitivity 98-100%, specificity of 73-93% . Genetic testing has low sens ~25%.

Optimization: Dantrolene prophylaxis not recommended, avoid triggers

Room Setup: CAS monitors, central temperature monitor, 5 lead ECG, urinary catheter, large bore IV, consider arterial line. MH anesthetic machine or clean machine with 100% O₂ at 10L/min for 10mins. Replace all disposable circuits, fresh gas outlet hoses, CO₂ absorbers. Remove Sux. Use of expired gas analyzer can help demonstrate that all volatiles have been removed. Dantrolene (~36 ampules = 720mg)

Intraoperative Mgt: N₂O considered safe, TIVA, MH may present after surgery

Post-op: If uneventful anesthetic, pt can be discharged 4 hrs after surgery provided they are accompanied by a responsible adult who has been educated about MH

Mgt of MH Crisis Initial Management: 1) Declare emergency 2) Notify Surgeon to finish ASAP 3) Call for MH Cart 4) D/C volatiles and Sux 5) Hyperventilate with 100% O₂ at >10L/min

Dantrolene 2.5mg/kg IV q5-10mins push, may req 10-30mg/kg, cont until signs of MH resolved. Dissolve each bottle (20mg) in 60 cc sterile warm water. Each bottle has 20mg dantrolene + 0.3mg mannitol

Supportive Rx: Establish IV Access, increase monitoring (temp/foley/art/CVC), Labs: ABG's, lactate, CK, SvO₂, CBC, Lytes, urine myoglobin, **sepsis workup**, **TSH**, coags, volume resuscitation. Cool patient to target core temp of 38°, ice packs to surface, gastric and urinary lavage, cold IV. HCO₃⁻ 2-4MEQ/kg for urine alk and acidosis, Treat Hyperkalemia (OK to use calcium with caution)

Dysrhythmias: Lido 1-1.5mg/kg, Procainamide 3-15mg/kg, CCBs contraind, forced diuresis with Lasix/Mannitol

Post-op: Recrudescence in 25% in the first few hours, Dantrolene 1mg/kg q4-6hrs or 0.25mg/kg/h for at least 36hrs. Measure CK q4-6hrs. Watch for DIC, renal failure. Refer patient and fm for testing!

Marfan's Syndrome

Connective tissue disorder affecting cardiovascular, skeletal and ocular systems. Particular relevance with associated valvular defects, thoracic aneurysms, kyphoscoliosis and emphysema.

1. **Airway** - TMJ laxity with risk of dislocation / Potential C-spine (C1/ C2) laxity/ instability
2. Respiratory insufficiency
 - RLD/**pHTN**/cor pulmonale due to kyphoscoliosis, pectus carinatum/excavatum
 - Emphysema / bullous lung disease – inc. risk of **spontaneous pneumothorax**
3. Significant risk of CVS disease and perioperative complications
 - **Arrhythmias & conduction** defects
 - Aortic **aneurysm and dissection** (due to cystic medial necrosis) – minimize SNS
 - MI (due to dissection of coronary arterioles)
 - MVP, **MR, AR**
4. Technical difficulties with **positioning** and **neuraxial techniques**.

Pregnancy:

- Risk of 3rd trimester aortic dissection due to estrogen mediated inhibition of collagen/elastin deposition in aorta.
- Screening TTE and pre-conception elective repair if aortic root > 4cm
- Beta blocker therapy during preg/labour and delivery – minimize sympathetic stimulation.
- Difficult epidurals (kyphoscoliosis) > GA and C-section may allow optimal hemodynamic control

Anesthetic Goals/Conflicts:

- Gestational HTN and risk of rupture, risk of pneumos with PPV

Hx: Focused history for CVS involvement, previous investigations, sx's of AI/MR. Hx of restrictive lung disease, spont pneumos, pHTN. Functional capacity. Neurologic sx's from cervical instability. Ocular sx's (lens displacement).

PE: Focused cardiac exam. Murmurs of AR ("blowing" diastolic mumur LSB), MR holosystolic mumur at apex. Evidence of CHF. Skeletal abns: pectus, scoliosis, reduced elbow ext, pes planus, joint hypermobility, high palate with dental crowding. Resp: Increased WOB, hyperinflation.

Investigations: Usual BW, CXR: cardiomegaly, dilated vessels, bullous disease. 12lead: conduction abns / BBB. Echo – for root dilatation, valves, EF, PAP. Consider PFTs.

Optimization: cardiology / resp consult. Beta blockade, anxiolysis. Appropriate hemodynamic manipulation based on underlying lesions or ventricular dysfunction.

Anesthetic Options: GA/ Neuraxial (maybe difficult) / regional all appropriate if hemod. goals achieved. Consider avoiding PPV due to risk of pneumo if hx of emphysema or bullous disease.

Room Setup: 5 lead +/- invasive lines, +/- TEE/PAC, Beta blockers, NTG/Nitropride/Inotropes, + Chest tube kit (32-40F)

Intraoperative Mgt: Avoid increases in SBP/catecholamine surges. Observe peak airway pressures. Ensure adequate analgesia on emergence and full NMB reversal.

Post-op: May require monitored setting based on underlying cardiorespiratory reserve. Observe for perioperative pneumothoraces, aortic dissection/rupture/tamponade/coronary artery dissection. Worsening MR / MVP.

Massive Hemoptysis

1. Emergency procedure with no time to optimize (full stomach, resuscitation)
2. Difficult airway r/t hemorrhage with the need for immediate lung isolation
3. Shared airway and potential for airway obstruction, acute asphyxiation and aspiration
4. Potential for hemorrhagic shock requiring resuscitation and massive blood transfusion
5. Considerations of underlying disease/etiology
 - TB (infectious precautions); bronchiectasis (chronic infection = 90%)
 - Neoplasm (4 M's)
 - Cardiovascular etiologies (mitral stenosis, AV malformations, PE)
 - Coagulation
 - Trauma
 - Iatrogenic (PAC insertion, post-operative)

Anesthetic Goals/Conflicts:

- Mobilization of resources
- Efficient and rapid airway management with lung isolation
- Volume resuscitation
- Effective communication with surgeon and facilitation of surgical access for bronchoscopy (rigid or flexible), thoracotomy, or angiography

Hx: AMPLE; Dx, onset, progression, known location of bleed? Etiology (TB, Bronchiectasis, Neoplasia), recent procedure (iatrogenic), contraindications to surgery include inoperable pulmonary carcinoma, failure to localize site of hemorrhage, and presence of severe bilateral pulmonary disease

Px: VS, Stable or unstable, airway for ease of intubation/DLT/obstruction, volume status, IV access, LOC

Inv: CBC, lytes, Ur, Cr, PTT / INR, ABG & crossmatch, CXR, CT to localize, ECG (pHTN), baseline PFTs, rigid bronch (single most important technique to identify cause of active bleeding), FOB if not actively bleeding

Optimization: Avoid sedation, bronchial artery embolization (contraindicated if collaterals to spine),

Anesthetic Setup: Discuss plan with Surgeon, large bore IVs, Blood products immediately available, Vasopressors, High FiO2, suction, bleeding lung down (prevents contamination), early lung isolation (DLT, endobronchial SLT, blocker), Thoracic surgeon with rigid bronch, HFJV, fogarty catheter (place down bronch)

Management of Anesthesia: bleeding lung dependant prior to isolation, then reverse after isolation; Acute airway obstruction or treatable cause - rigid bronchoscope (iced saline, vasoconstrictors, bronchial blocker, packing, Nd:YAG laser); not treatable with rigid bronch – rapid lung isolation (awake vs. asleep laryngoscopy; difficult topicalization; intubate in semi-fowlers; possible RSI with ketamine and Sch / rocuronium; endobronchial SLT vs. blocker vs. DLT) SLT maneuvers include – advance endobronchially - ETT goes down bleeding bronchus (attempt to reposition ETT into nonbleeding bronchus - try ventilating alongside endobronchial ETT by inserting an additional small ETT through glottis -consider placing Fogarty catheter down ETT and occluding bronchus, then withdrawing ETT into trachea); ETT goes down nonbleeding bronchus (suction ETT to remove residual blood, ventilate with 100%, if oxygenation continues to be a problem, prepare to insert DLT

Complications: Can't ventilate / high airway pressures: (Massive airway clot, Tension pneumothorax, light anesthesia), Aspiration, Hypoxemia, Hypotension, Cardiac arrest

Massive Transfusion

Replacement \geq 1 blood/24 hrs (~10 units PRBCs in adult), or 50% blood vol/3 hrs, or 4 units/1 hour with ongoing losses, or 6 units in 1 bleeding episode with ongoing losses

1. Early recognition of potential for massive transfusion and mobilization of resources
 - Blood Bank, Lab, Hematopathology, Help for transfusion-related duties in OR/ER/LDR
2. Consider transfusion-sparing modalities — cell saver, antifibrinolytics, Factor VIIa
3. Monitor hemoglobin (>70), platelets >50 (>100 with ICH), INR <1.5 , PTT within 1.5 of lab's normal, fibrinogen >1 , and replace appropriately. Octaplex to reverse Coumadin.
4. Monitor electrolytes including K^+ , Ca^{2+} and Mg^{2+}
5. Avoid hypothermia
6. Obstetric patient – etiology (fetal demise, AFE, placental abruption) may contribute to DIC

Anesthetic Goals/Conflicts:

Acute phase resuscitation - Maintain hemodynamics - volume, crystalloids, pressors; Oxygenation - RBC transfusion; Hemostasis - factors, platelets, euthermia

Maintenance phase resuscitation: time to base resuscitation on labs - standard lab tests have poor correlation with in vivo coagulopathy.

Hx: Bleeding Hx, previous transfusion, inherited coagulopathy, medications (ASA, coumadin, etc.). Obstetric Risk factors: Placenta Previa, Prior C-section, Multiple gestation, Chorioamnionitis, Placental Abruption, Abnormal fetal presentation

PE: Vitals + Temp. Surgical bleeding, medical bleeding with dec. clot formation (nose, gums, IV sites)

Investigations: CBC, INR, PTT, fibrinogen, Mg, Ca, Lytes, LFTs, Lactate, mixed venous

Optimization: Prevention - Preop Fe \pm EPO, position to dec. venous engorgement, normothermia, controlled hypotension, antifibrinolytics, tourniquet, cautery. RBC conservation - ANH, Hypervolemic hemodilution. Cell salvage (obstetric concern of fetal debris/AFE causing anaphylactoid Rx – use after delivery of fetoplacental unit. Inform Blood Bank & Laboratory

Anesthetic Options: GA for massive transfusion

Room Setup: CAS+5lead, A-line, CVL, temp, large bore i.v.'s, rapid infusor, warmers, Foley, pressors/Inotropes

Intraoperative Mgt: PRBC: Hct 0.70 in 250mL, **FFP** – all coagulation factors, dec FV and FVIII (15-30%), Factors replaced if INR / PTT > 1.5x. **Cryo**– has fibrinogen, fibronectin, factor VIII, vWF and factor XIII (fibrinogen < 1.0 g/L), 1 unit FFP has 0.5g of Fibrinogen & 1u of cryo = 0.25g. **Platelets** For surgical hemostasis goal is PLT > 50 or > 100 for intracranial or neuraxial stuff. **Recombinant Factor VIIa** reduces the number of units transfused in cases of massive transfusion. **Octaplex** (prothrombin complex concentrate of F II, VII, IX, X) for rapid Coumadin reversal + VitK.

Post-op: ICU to monitor for tx compl, HD stability, coag abnormalities, electrolyte imbalance, acid-base status. ETT & PPV cont until temp and HD goals are met and stabilized. **Complications** : Infx, Hemolytic transfusion rxn, Non-hemolytic (Febrile, Delayed transfusion rxn, Anaphylactic, TRALI / TACO, transfusion-associated Graft vs Host disease). Hyperkalemia; hypocalcemia, Hypomagnesemia. Hypothermia, Coagulopathy: Diluted factors (< 30% activity) and plts with crystalloid, colloid and RBCs

Mediastinal Mass

1. Potential for catastrophic cardiopulmonary collapse on induction
 - a. airway and CVS (RVOT) compression
 - b. May require pre-induction CPB setup
2. SVC syndrome
 - a. Upper airway edema, Lower extremity IV access
3. Comorbid disease
 - a. Myasthenia gravis/Eaton-Lambert (Thymoma), Thyroid, Lymphoma
 - b. Tumor 4 M's (mass effect, metastasis, metabolic, medications)
4. +/- Considerations for mediastinoscopy – **relative contraindication to mediastinoscopy**
 - a. Shared & difficult airway
 - b. Complications (hemorrhage, inn. art. compression, PTX, TB injury, VAE)

Anesthetic Goals/Conflicts:

- Optimize – biopsy peripheral tissue or mediastinoscopy under local, steroids, radiation, chemo,
- Maintain airway patency
 - Awake FOI with armoured ETT, spontaneous ventilation until ETT distal to obstruction, gentle PPV, judicious use of muscle relaxants
 - Assisted expiration may be lifesaving in complete obstruction (pulmonary tamponade)
- Maintain hemodynamics
 - careful positioning - lateral decubitus or prone if cardiovascular collapse
 - **maintain preload** (RV may be volume dependent)
- Preparation for urgent resuscitation - rigid bronch, VVBP, positional changes, epinephrine, Heliox

Hx: Airway compression (positional dyspnea, cough, stridor, hoarseness), **SVC Syndrome** (H/A, upper body edema/plethora, cough, dyspnea), **Right Heart Compression** (positional syncope/dyspnea, hepatosplenomegaly). **Comorbid Disease** based on DDx (thyroid, thymoma, MG/ELS, lymphoma (esp adolescents), neuroblastoma in children)

PE: Vitals (hypoxemia, postural hTN), H&N (edema/plethora, tracheal deviation, masses), CVS (syncope with valsolve, quite HS/JVD for pericardial effusion, pulsus paradoxus), RESP (WOB, stridor, **supine dyspnea**)

Investigations: Labs, CXR, CT scan (>50% tracheal comp ↑risk), +/-ECHO, PFTs not useful

Optimization: Consider pre-operative steroids, chemo, radiation to decrease mass depending on diagnosis if too high risk (recognizing that this may impair definitive diagnosis), check for extrathoracic LN sites for biopsy especially if lymphoma, treat pulm infections, consider preop Airway / SVC stents

Anesthetic Options: Always consider local/sedation first, otherwise GETA

Room Setup: CAS + 5L ECG, arterial line, vasoactive drugs, lower extremity IV if SVC syndrome, consider having rigid bronch & CPB available.

Intraoperative Mgt: If asympt with no radiologic evidence of heart/airway compression proceed with routine induction and maintenance. If positional sympt/compression, consider awake FOI with positioning of ETT distal to obstrx with ENT/rigid bronch/CPB backup. Maintain SV during induction and carefully transition to PPV & muscle relaxation. Consider inhalational vs slow TIVA for uncooperative patients or kids.

Post-op: Needs intensive monitoring in HDU to monitor for airway obs (mass or if resected, tracheomalacia) and airway edema.

Special: Intraop emergencies - Acute airway compression or inability to ventilate (reposition, return to SV, rigid bronch, CPB, consider dynamic hyperinflation), Cardiovascular collapse (reposition, SV, fluids, inotropes, CPB)

Mediastinoscopy

1. Limited intra-op access to the airway
2. Significant intra- and post-op complications relating to
 - a. compression or trauma to important structures - stroke – innominate artery compression; tracheobronchial compression or laceration; hemorrhage – aorta, SVC, PA; RLN injury
 - b. pneumothorax
 - c. venous air embolism
3. Short procedure requiring still patient
4. Comorbid conditions
 - a. COPD / RLN
 - b. Myasthenia gravis/Eaton-Lambert (Thymoma), Thyroid, Lymphoma
 - c. CAD
 - d. Smoking

Anesthetic Goals/Conflicts:

- Hemodynamically stable induction of anesthesia with airway securement
 - AFOI, SV induction, standard
- Optimal surgical conditions (still patient)
- Minimize potential for complications (e.g. stroke from innominate artery compression)

Indications: tissue dx for mediastinal nodes – NOT for AMM tumors (ant. Mediastinotomy)

Contra: previous mediastinoscopy, radiation, Relative – SVC syndrome, tracheal deviation, CVD, TAA

Hx and Px: S/S of AW obstruction (stridor, hoarseness, wheezing); Positional Sx (SOB, Stridor, cough) SVC syndrome (edema, venous congestion of H & N and UE, Altered mental status (high ICP); Hypotension; Hypoxia; Myasthenic (Eaton-Lambert) syndrome in patients with oat-cell carcinoma; Stroke; Underlying diagnoses and investigations/therapy (chemo and end-organ effects, radiation); evaluate for co-morbidities (EtOH, smoking/COPD, CAD, CVD, 4Ms)

Investigations: CBC, E7, Cx Match; ECG – RV strain; CT- distortion/compression; PFTs ; Echo - if indicated

Optimization: Antisialogogue (glyco); position patient to minimize a/w obstruction; Avoid sedation

Anesthetic Options: Local Anesthetic – depending on pt's comorbidity (AMM, CVD, limited pulmonary reserve) GA with muscle relaxation and PPV - preferable, still patient, more control, more flexible surgical manipulation, dec. risk of VAE

Room Setup: CAS and 5 lead EKG; difficult a/w cart; large bore IV's (above and below diaphragm); a-line or SaO₂ monitor on R side (innominate artery compression) & NIBP on L side; +/- CVP/PAP/precordial dopper; PNS with ELS; Blood in room; Rigid bonch; Armored ETT

Intraoperative Mgt: tailor induction to suit specific airway needs (AFOI vs. SV induction vs. RSI vs. surgeon with rigid bronchoscopy in OR prior to induction); topicalize airway to minimize coughing strain at emergence short-acting NMB (consider TIVA with remifentanyl); head-up position may minimize venous engorgement and improve surg conditions, but increased risk of VAE; minimal need for post-op opioids; extubate in OR

Complications: Hemorrhage (Aorta, PA, SVC – surgical tamponade, Lung Isolation, resuscitate below the diaphragm, Rt thoracotomy); Tracheobronchial compression (reposition scope); PTX (usually post-op); bradycardia (Vagal); VAE; Stroke (compression of innominate); RLN paralysis (usually Lt, A/W if Bilateral)

Metabolic Acidosis

- 1) Underlying etiology (AG vs non-AG)
- 2) Other associated metabolic derangements
- 3) Related multiorgan dysfunction
 - malignant arrhythmias
 - impaired myocardial function
 - altered seizure threshold
- 4) Altered pharmacology
 - Augments / prolongs NdMB
 - Respiratory acidosis inhibits neostigmine reversal of NdMB

Anesthetic Goals/Conflicts:

- Treatment of underlying etiology
- Treat associated metabolic abnormalities
- Anticipate/manage physiologic sequelae of metabolic derangement
- Patient with severe metabolic acidosis with limited respiratory reserve
 - bicarb administration when minute ventilation is already near patient's maximum

Hx: Identify etiology - Organ hypoperfusion and shock (Obtundation, dyspnea, angina, abdominal pain)
Toxidrome (altered LOC, visual/balance disturbances, CNS irritability, N&V, palpitations, muscle weakness)

PE: Vitals + temp, volume status, focused neuro (GCS, cranial nerves), peripheral perfusion (peripheral pulses), hyperventilation (fatigue may herald rapid deterioration), Kussmaul's breathing, abdominal exam

Investigations: ABG, Lytes, BUN, Cr, Ca, Mg, Glucose. CBC. Urinalysis. osmolality. specific toxins.

Optimization: Identify and treat cause prior to an anesthetic. Bicarb (1 mEq/kg) or Tris-Hydroxymethyl Amino-Methane (1.1 x base deficit x body weight = cc required) if significant physiologic derangement. Dialysis for acidosis refractory to medical management or acidosis with significant physiologic derangement

Anesthetic Options: GA. Regional likely not tolerated 2' to physiologic derangement

Room Setup: CAS + 5. Art line (for serial sampling), Warming blanket, Nerve stimulator (impact on NdMR)

Intraoperative Mgt: Agents used for maintenance/induction dependent on etiology of acidosis. Anticipate exaggerated response to induction agents. Ventilation should aim for pH > 7.2 to optimize enzyme function.

Post-op: Low threshold for high dependency unit.

Causes of AG metabolic acidosis: MUDPILES CART = Methanol, Uremia, DKA, Paraldehyde/Phenformin, Iron/Isoniazid, Lactate, Ethylene glycol, Salicylate, Cyanide, Arsenic, Rhabdomyolysis, Toluene

Causes of Non-AG metabolic acidosis: GI losses, pancreatic fistulae, renal bicarb loss, renal dysfunction, hypoaldosteronism, hyperventilation, ingestion (ammonium chloride, acetazolamide, hyperalimentation, ketoacidosis while on insulin)

Other key points: $AG = Na - Cl - HCO_3$. Normal is 12 with range of 8-16.

Adjustment of AG for hypoalbuminemia $\rightarrow (Normal\ Albumin - Observed\ albumin) \times 0.2$ (some sources used 0.25 = Actual anion gap)

Osmolar gap = $2 \times [Na] + glucose/18 + BUN/2.8$

Microlaryngoscopy

1. Potential difficult airway with risk of perioperative airway obstruction
2. Shared airway with possible jet ventilation
 - a. barotrauma, TIVA, gas exchange
 - b. need for vocal cord paralysis
3. Unprotected airway with risk of loss of airway and aspiration
 - a. debris, blood, gastric contents
4. Laser complications
 - a. Airway fire, ocular/cutaneous burns, VAE, air contamination
5. High risk for perioperative myocardial ischemia / infarction

Anesthetic Goals/Conflicts:

- Safe induction and airway management
 - AFOI, awake look, spont vent, ENT laryngoscopy
- Maintain adequate oxygenation and ventilation
- Prevention of barotrauma and Laser related complication
- Unobstructed, motionless surgical field

Hx: extent of lesion, location, and airway obstruction – hoarseness, dysphonia, stridor, dyspnea, dynamic obstruction; etiology – previous anesthetics; contraindications to jet ventilation (airway obstruction, restrictive lung disease - obese, ped, bullous lung disease, aspiration risk); coexisting diseases - CAD

PE: careful airway exam, positional changes if airway obstruction, standard PE

Investigations: imaging (CT), nasopharyngoscopy, CXR, PFTs, blood work and further tests dictated by comorbidities – “safe” small ETT with regular PPV, jet ventilation via suspension “ventilating laryngoscope”, jet ventilation via bronchoscope (for sub-glottic masses), apneic technique with alternating ETT or BMV, high frequency PPV via a catheter

Room Setup: Laser precautions (goggles, masks, notice on doors, smoke evacuator, eye protection, saline bucket, Laser Shield ETT with Methylene blue for cuff); Jet ventilator – rigid bronch; TIVA; Standard monitors +/- art line

Intraoperative Mgt: If difficult A/W – awake DL, AFOI, SV induction (inhalational vs. TIVA); if no A/W concerns – IV induction, Sux, TIVA; DL prior to handing patient over to surgeon; sux boluses (bradycardia). Limit FiO₂, communication with surgeon is crucial

Post-op: head-up to decrease edema, Dex, monitor for PTX

Complications: A/W obstruction – rigid bronch, cricothyroidotomy; Dec. chest excursion – suction, check for PTX, A/W fire: 4 E’s = extract, eliminate, extinguish, evaluate – reintubate and observe; Barotrauma, VAE, hemorrhage, HTN / tachycardia

Mitral Regurgitation

MR can be acute or chronic and results in volume overload and decreased forward cardiac output. In acute MR, no compensatory hypertrophy and lack of compliance results in CHF / cardiogenic shock.

1. Increased risk of perioperative cardiovascular complications including CHF and MI
2. The pathological hemodynamic changes of mitral regurgitation:
 - **Chronic – LA volume overload** and decreased forward cardiac output / **LV dysfunction** / atrial **arrhythmias** due to LA dilatation / **pulmonary hypertension** and RV dysfunction
 - **Acute** – sudden LA and LV overload without compensatory hypertrophy leads to reduced forward cardiac output and simultaneous pulmonary congestion
 - may require emergent surgical / anesthetic management
3. Associated co-morbidities including:
 - Other valvular pathology (MS, AR) / Endocarditis / Connective tissue disease
4. Underlying Etiology: (1) Leaflets/commissures: Rheumatic, endocarditis, MVP (2) Tensor apparatus: rupture papillary muscle (ischemia), dysfunction (fibrosis), rupt. of chordae (3) LV cavity or annulus: LV enlargement (myocarditis/cardiomyopathy), calcified mitral ring, marfans
5. Medical therapy (ACEI, BB, digoxin, CCBs), anticoagulants for Afib

Anesthetic Goals/Conflicts:

Fast, full, and forward

- Maintain forward flow: Adequate preload, high N HR~90bpm, NSR, slight reduction of afterload, maintain or increase contractility.

Hx: Onset, severity of disease. **NYHA class** (1=no limitation w/ ordinary activity, 2=mild limitation of activity, comfortable at rest or mild exertion, 3=marked limitation, comfortable only at rest, 4= confined to chair, sx's at rest) Sx's of CHF:orthopnea/PND. Comorbid illness: CAD, Mitral Stenosis, pHTN, **afib**, endocard.

PE: Elevated JVP, edema, rales. Displaced LV apical impulse (chronic), holosystolic apical murmur radiating to axillae. S3 / S4. If associated MS, may have diastolic murmur. Findings of pHTN.

Investigations: Usual BW, troponins, blood cultures (if endo), **ECG:** dysrhythmias, LVH +/- RVH/strain, **CXR:** pulmonary vascularity and congestion, **ECHO:** EF, severity, LV + atrial size, thrombus. +/- angiogram.

Optimization: Cardiology consult, consider MVR/replacement>> Class 1 indications include : Acute sympt MR, NYHA II-IV sx's with N EF, Sympt or asympt with mild LV dysfx (EF 0.5-0.6) and dilatation / optimize CHF

Anesthetic Options: GA, neuraxial (as long as hemodynamic goals met) early epidural in pregnancy

Room Setup: 5 lead, Art, +/- TEE/PAC / +/- IABP/Perfusion services, Inotropes (milrinone/dobutamine), NTG/Nitride, AChs for brady, NO for pHTN.

Intraoperative Mgt: Observe hemodynamic goals, consider mitral stenosis if rheumatic heart disease. Avoid hypercapnia/hypoxia and pain on emergence (increases PVR). May require inotropic support post MVR/replacement.

Post-op: MVP: empty LV causes inc. MVP and acute MR / **RV failure:** Avoid precipitants of pHTN / **SAM:**inc. SVR, volume expansion and decreased contractility / **Ischemia:** CAD vs. hypotension / **Arrhythmia:** cardioversion vs. IV drugs / **Hypotension:** preload vs. afterload vs. contractility / **Air embolism:** keep lines free of air bubbles

Pregnancy and MR: MR with NYHA 1-2 and N LVEF are low risk for mom and baby. NYHA III-IV sx's, MR with pHTN or LV dysfx considered high risk. Maintain specific hemodynamic goals, early epidural, art line, ACEi contraindicated due to adverse effects, hydralazine ok.

Mitral Stenosis

1. Identify severity of disease
 - a. mod. area 1-1.5cm² (symptomatic), critical area <1cm² (CHF, pHTN, RVF)
2. Hemodynamic complications of Mitral Stenosis - CHF (inc. LA pressure with underfilled LV), atrial arrhythmias, pHTN with RVF, systemic embolization (TIA's/CVA's)
3. Precipitants of decompensation – inc. CO and dec. diastolic time
 - a. Pregnancy, thyrotoxicosis, sepsis, Afib, fever
4. Co-existing disease: Associated valvular disease (Ao valve, TR), rheumatic fever
5. Medications: anticoagulation, diuretics, BBs, digoxin

Pregnancy: moderate to severe MS usually inc NYHA status by 1 or 2 classes

Invasive monitoring +/- PAC (for unexplained hypotension) / Judicious fluid management, BB for Tachycardia / Early titrated epidural / Avoid pushing (low forceps) / C-section of obstetric indications / Management of autotransfusion – intubation & PPV / oxytocin, methylergonovine, and hemabate (PGF₂-alpha) all inc. PVR

Anesthetic Goals/Conflicts:

- Hemodynamic goals: Slow HR 60-80 bpm, Strict NSR, maintain preload and contractility, avoid drops in afterload.
- Avoid precipitants of pHTN: hypoxia/acidosis/hypothermia/pain/N₂O

Hx: Hx of dyspnea, CHF, PND, orthopnea, functional capacity, hemoptysis, arrhythmias, anticoagulation, risk of thrombosis. Hx of pHTN (dyspnea, fatigue, angina), Hoarseness d/t compression of L recurrent LN, CNS sx's of stroke/TIA.

PE: Irregular pulses, prominent S2 and a diastolic murmur, decreased pulse pressure, loud S1 (high closing pressure across MV) +/- opening snap. Sx's of pHTN. Tacypnea, crackles, wheezes, hepatomegaly, pedal edema.

Investigations: ECG – Afib common, p mitrale, RVH, CXR: Enlarged LA, pulmonary edema. Echo: Thickened MV, MVA, gradient, presence of thrombus. ?head CT. INR, PTT if on anticoagulants, LFTs.

Optimization: Cardiology consult, consider MVR or percutaneous valvulotomy prior to surgical procedures: Class I indications for valvotomy include: NYHA II-IV symptoms, asymptomatic patients with PAS > 50 mm Hg at rest or 60mm Hg with exercise. Class I for MVR: NYHA III-IV when PMBV is not an option. Mod-Sev MR. Medical management: Beta blockers, digoxin, diuretics, anticoagulation.

Anesthetic Options: Narcotic based GA +/- regional, controlled epidural, avoid spinal. Strict NSR, slow HR avoid exacerbation of pHTN.

Room Setup: 5 lead ECG, A line, consider TEE>PAC, prepare for cardioversion, vasoactive meds.

Intraoperative Mgt: Observe hemodynamic goals, control sympathetic outflow, avoid tachy/pain on emergence. BB for tachycardia, early cardioversion, Consider NO if pHTN.

Post-op: Monitored setting, observe for hypotension, MI, ischemia, CHF. If MVR

Note post CPB these patients often have depressed myocardial fnx despite N LVEF. Anticipate, augment preload, reduce SVR, inotropic support.

Mucopolysaccharidosis (hurler's and hunter's)

1. Potential Difficult airway: Macroglossia, infiltration of tissues, short neck
2. Potential unstable C-spine - AAI
3. Developmental delay, growth retardation
4. End-organ dysfunction
 - a. Cardiomyopathy, valvular disease
 - b. Hepatic dysfunction, Neurologic dysfunction
 - c. Hemorrhagic diathesis due to plt dysfunction
5. Perioperative risk of hypoglycemia (glycogen cannot be hydrolyzed in hepatocytes)
6. Metabolic acidosis d/t inability to convert lactic acid to glycogen (avoid ringer's)

Anesthetic Goals/Conflicts:

- Perioperative monitoring of serum glucose, minimization of fasting times when possible
- Pre-operative identification and optimization of cardiac system
- Safe establishment of airway
- Avoid resp-depressants

Multiple Sclerosis

Autoimmune, demyelinating CNS disease with multisystem effects

1. Demyelination results in:
 - Increased risk of **aspiration**
 - **Respiratory failure**
 - **Autonomic dysfunction** - hemodynamic instability
2. **Altered response to neuromuscular blockers**
 - Hyperkalemia with Succinylcholine if symptomatic
 - May be sensitive to NdMR or resistant (b/c upregulation of NAChR)
3. Potential for **exacerbation of MS**
 - Surgical stress
 - neuraxial technique (spinal > epidural) – unknown why
 - hyperthermia
4. **Immunosuppressive medications** (steroids, interferon, MTX)

Anesthetic Goals/Conflicts:

- Prevent exacerbations - Avoid hyperthermia and neuraxial anesthetics
- Minimize aspiration risk - Aspiration prophylaxis
- Maximize respiratory muscle strength
- Maintain hemodynamic stability
- Conflicts – RSI vs. Hemodynamic stability, Neuroaxial for labour or C/S

Hx: Functional capacity, respiratory insufficiency, hemodynamic / autonomic instability, bulbar dysfunction.
Course of disease, medical therapy.

PE: Focussed cardiorespiratory exam, cough, resting tachycardia, neurologic exam.

Investigations: Usual bloodwork, PFTs / ABG, CXR.

Optimization: Delay elective surgery for symptomatic disease, consider neurology consultation, aspiration prophylaxis, stress dose steroids.

Anesthetic Options: Avoid spinal and high doses of LA, epidural is not associated with exacerbation. GA and PNB's Ok.

Room Setup: CAS monitors, 5 lead ECG, PNS, consider arterial line, temp monitor (avoid hyperthermia), assistant for cricoids, vasopressors for hypotension.

Intraoperative Mgt: Consider RSI vs hemodynamically stable induction. Judicious NDMR. Ensure reversal. Avoid emotional stress / pain.

Post-op: Monitoring for post-operative respiratory insufficiency and or neurologic dysfunction.

Special: Presents with ascending spastic paresis (Legs>arms), optic neuritis, gait disturbances, limb paresthesias, L'hermette's sign F>M, non-smokers, Caucasians. Relapses in 3rd trimester with exacerbation 1-3 months post-delivery. Most common neuro-demyelinating disease 1:1000. Dx by IgG in CSF, MRI. Rx = Steroids = mainstay, Interferon B for RRMS, Glatiramer acetate = myelin mimic protein that blocks myelin destruction, Azathioprine: decreases rate of exacerbations but not course, others: MTX.

Muscular Dystrophy

Hereditary disease (x-linked recessive) of painless degeneration and atrophy of skeletal muscles with preserved innervation, often accompanied by developmental delay

1. Aspiration Risk – dec. gut motility, laryngeal muscle weakness
2. Coexisting disease
 - a. Resp - Pre/post operative respiratory insufficiency, RLD (d/t scoliosis) – pHTN & RVF, OSA, recurrent pneumonia
 - b. Cardiac – Cardiomyopathy (sensitivity to myocardial depression), MR (MVP), Arrhythmias
3. Altered pharmacology
 - a. Susceptibility to Anesthetic-induced Myodystrophy (Sux/Volatiles)
 - i. Hyperkalemia (rhabdomyolysis)
 - b. Sensitivity to NdMR (usual dose but prolonged action)
4. +- Considerations of a pediatric patient

Anesthetic Goals/Conflicts:

- Minimize risk of aspiration
- Minimize risk of cardiopulmonary insufficiency / failure
- Trigger free Anesthesia - Avoid succinylcholine + volatile anesthetics
- Conflicts: RSI (NdMB) vs titrated induction

Hx: Personal or FmHx of MH/Rhabdo, Cardiac - functional capacity, CHF, orthopnea, PND; Resp - home O2, recurrent lung infections, chronic aspiration, OSA, Bipap, nocturnal ventilation, hospitalizations

PE: Vitals + BMI; Airway - Macroglossia, Resp – Adequate cough, kyphoscoliosis; Cardiac – CHF: crackles, JVP, S3, PHTN: loud P2, RV heave, TR, JVP; Assess for difficult IV access.

Investigations: Usual bloodwork, Lytes to assess K, CXR (chronic aspiration) ECG (tachy, short PR, tall R in V1, and deep q's in limb leads), Echo (fxn & valves), PFTs (FVC <35% poor outcomes, >45% unlikely to req post-op ventilation), ABG, CK 30-300x N even in female carriers.

Optimization: Delay elective Sx to optimize cardiopulmonary status (tx infection, optimize CHF) Avoid sedation (aspiration), aspiration prophylaxis, Consider cardiology consult (CHF, arrhythmias, pacemaker)

Anesthetic Options: Trigger free anesthetic; consider local/regional technique (Muscle biopsy under local), GA - TIVA with low dose NdMB, possible post-op ventilation

Room Setup: CAS +5 lead, temp, foley, invasive monitoring as needed, dantrolene in room, drugs to treat hyperkalemia, PNS for NdMB

Intraoperative Mgt: Non-triggering RSI (NdMB, remi), avoid SUX/Volatiles, avoid myocardial depression with cardiomyopathy, ensure adequate reversal

Post-op: Possible post-op ventilation, Adequate post-op monitoring for 24-48hrs - delayed Resp distress up to 36hrs, Telemetry for arrhythmia

Special: Presents in boys 3-5 years, with gowers sign, proximal weakness. Wheelchair by 8-11 years.

Treatment of MH: Hyperventilate, change machines, circuit and CO2 absorber, Dantrolene 2.5mg/kg (20 mg in 50 mg sterile water), rpt as needed, max 10mg/kg. 2-4 meq/kg HCO3-, Cool, management of hyperkalemia. Management of dysrhythmias, avoid Ca+ blockers due to myocardial depression and hyperkalemia when used with Dantrolene. ABGs.

Myasthenia Gravis

Autoimmune disorder- Ab against nACh-R à decrease in functional Ach-R at NMJ

1. Pseudobulbar dysfunction and increased risk for aspiration
2. Increased risk of perioperative respiratory complications and post-op ventilation
 - risk factors: diagnosis > 6 yrs, daily pyridostigmine dose > 750mg/day, Hx of COPD, VC < 2.9L
3. Association with thymoma and considerations of an anterior mediastinal mass, thyroiditis, RA, cardiac myocarditis, cardiomyopathies, afib, heart block
4. Altered response to NMB – resistance to succinylcholine and increased sensitivity to NdMR
5. Perioperative management of medications
 - Steroids, anticholinesterases, immunosuppressants
6. Risk of myasthenic or cholinergic crisis

Anesthetic Goals/Conflicts:

- Optimize neuromuscular function
- Prevent or minimize complications: aspiration, respiratory failure, myasthenic crisis, cholinergic crisis
- Minimize exacerbation of perioperative weakness.
- Conflicts: RSI vs NMB, RSI vs cardiac involvement, RSI vs. ant. mediastinal mass

Hx: Symptoms of muscle groups involved, bulbar dysfunction, respiratory embarrassment, exercise tolerance, stability of symptoms, medical treatment. Associated comorbidities, thyroid/cardiac, arrhythmias. Presence of mediastinal mass.

PE: Focused cardiorespiratory exam, airway examination, dynamic symptoms due to AMM.

Investigations: Usual bloodwork, spirometry, Echo if suspect myocarditis / cardiomyopathy, CXR for AMM, if RA lateral neck films)

Optimization: Postpone elective cases for symptomatic patients. If acute myasthenic crisis, patient will need IVIG, plasmapheresis, and high dose steroids. Continue pyridostigmine perioperatively. ASPIRATION prophylaxis (sodium citrate, ranitidine, maxeran)

Anesthetic options: Regional or local preferred. Epidural for pregnant patient. GA. Discuss risk of POV.

Room Setup: Assistant for RSI, Pns for NMB, Consider invasive monitoring for AMM / difficult A/W

Intraoperative Mgt: Stress dose steroids, IV induction with remi preferred. May need 2mg/kg Sux or 10% of NDMR dose.

Post-op: Respiratory failure: Myasthenia crisis

Cholinergic crisis: Try to excessive anticholinesterases (also bradycardic, salivation, miosis (SLUDGE) – distinguish by giving edrophonium (Tensilon Test = 1 to 2 mg and titrate up 3mg, 5mg to max of 10mg) which improves symptoms if myasthenic crisis, worsens symptoms if cholinergic crisis)

Residual anesthetic drugs: ms relaxants

Hypothermia; Hypokalemia; antiarrhythmics; Mg; antibiotics; psychotropics;

Special: Dx: Tensilon (Edrophonium), RMG, RIA against Ab RX: Pyridostigmine, IVIG / Plasmapheresis for Myasthenic crisis, Steroids/ Immunosuppressants. Surgery (Thymectomy improves 85%). Rule of 1/3's in pregnancy (get better/same/worse)

Myasthenic Syndrome

1. Association with Small Cell Cancer
2. Sensitive to Succinylcholine and Non depolarizing relaxants
3. Respiratory weakness/RLD
4. Risk of Aspiration
5. Medications: Anticholinesterases don't work well, IVIG, Plasmapheresis, 3-4di-aminopyridine.

Anesthetic Goals/Conflicts:

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Myotonic Dystrophy

Myotonia is the delayed relaxation of skeletal muscle after voluntary contraction, electrical stimulation or mechanical stimulation. As disease progresses, weakness and atrophy become more prominent and loss of DTR reflexes (distal muscles before proximal!!!)

1. Risk of **aspiration** secondary to bulbar weakness
2. **Respiratory insufficiency**, restrictive lung disease and **PHTN**, **central sleep apnea**
3. Cardiovascular involvement and **conduction abnormalities**: 1st degree heart block, atrial and **ventricular arrhythmias**, **cardiomyopathy** and MVP (20%) but rarely sx.
4. Endocrine abnormalities: DM, hypothyroid, hypogonadism, Addison's
5. Sensitive to CNS and respiratory depressants, Avoid **Sux** - Hyperkalemia, Association with **MH** – trigger free
6. Risk of **Myotonic Crisis** with cautery, mechanical stimulation, succinylcholine and cholinesterase inhibitors, post operative shivering. (Rx: Lido 0.5% infiltration, mb stabilizers, phenytoin)

Anesthetic Goals/Conflicts:

- Avoid aspiration and triggers of myotonic crisis, and post-operative shivering
- Treat Myotonia if it interferes with ventilation, be prepared for post-op ventilation
- Conflict: RSI with avoidance of Succinylcholine or cholinesterase inhibitor vs cardiac induction for cardiac co-morbidities
- Avoid long acting opioids due to risk of central sleep apnea

Hx: Functional history. Elucidate respiratory sx's, central sleep apnea, restrictive disease. Elucidate cardiac involvement, symptomatic heart disease or evidence of cardiomyopathy/rhythm disturbance. Inquire about endocrine disease. Bulbar symptoms, dysphagia. AMPLE hx.

PE: Chest excursion, ability to cough, myotonic hand grip (unable to release), Cardiac examination for MVP (systolic apical click +/- late systolic murmur), arrhythmias, RVH (loud P2), failure. Developmental delay, frontal balding, expressionless facial weakness, dysarthria, SCM wasting.

Investigations: Usual BW / ECG / +-ECHO / +- Spirometry / tSH / Electrolytes / CK = N to slight high

Optimization: Aspiration prophylaxis, avoid sedation (CSA) / CPAP / Keep Warm / ?Stress dose steroids

Room Setup: CAS / 5lead ECG / TEMP / Lido 0.5% / Mexilitine / Pheytin and Procainamide 18mg/kg over 20 – 30 mins IV / Quinine 300-600 mg IV

Anesthetic options: Theoretical risk of MH > trigger free preferred. Avoid Sux, Regional / Neuraxial for pain preferred. Avoid long acting opioids for CSA.

Intraoperative Mgt: Avoid myocardial depression. Judicious use of NDMRs to avoid reversal agents. Although Neostigmine is usually ok. IV or propofol may precipitate contracture >> EMLA / lido.

Complications / treatment of a Myotonic Crisis:

- muscle infiltration with dilute 0.5% lidocaine

- phenytoin 18 mg/kg IV over 20-30 mins

- procainamide 18 mg/kg IV over 20-30 mins

- quinine 300 – 600 mg IV, phenytoin, mexilitine and tocainide depress Na⁺ influx, decreasing spread of action potentials.

postoperative cardiopulmonary complications common

NEC

1. Considerations of Prematurity
2. Increased risk of aspiration
 - Bowel obstruction, dilated bowel loops, pneumatosis intestinalis
 - Full stomach
3. Associated multisystem derangements
 - Hypoxia
 - Sepsis / Hypovolemia
 - DIC, thrombocytopenia
 - Metabolic acidosis
4. Associated conditions
 - Birth asphyxia, hypotension, RDS, PDA, recurrent apnea, intestinal ischemia, UV cannulation, systemic infections, early feedings

Anesthetic Goals/Conflicts:

- Optimize multisystem abnormalities of prematurity
- Prevent aspiration (consider RSI)
 - Conflict with sepsis/hypovolemia and hemodynamic stability
- Anticipate and optimize fluid / electrolyte / glucose derangements
- Ensure good IV access (or central line above the diaphragm)
- Ensure continuous temperature monitoring and maintain normothermia
- Correction of coagulopathy

Hx: Obstetrical hx, PCA/prematurity and complications of prematurity (BPD, RDS, PDA, IVH, ROP), NEC hx: abdominal distension, vomiting, bloody or mucoid diarrhea, occult blood loss in stool, lethargy, irritability

PE: Vitals, wt (volume loss), focus on volume assessment (IV access, u/o); Resp – intubated, WOB, FiO₂; CVS – perfusion, cap refill, murmurs; abdominal exam

Investigations: CBC (anemia, thrombocytopenia), lytes/Cr (hypovolemia), glucose, coagulation profile, G & S, ABG, ECHO if indicated, AXR (pneumatosis, intestinalis, dilated loops, free air)

Optimization: Unless intestinal necrosis/perforation, initial management in medical – decompress stomach, NPO, Abx, Fluid/TPN; Volume resuscitation – Crystalloid, blood, FFP, Plts; good IV access +/- CVP

Anesthetic Options: GA – caution d/t hypovolemia/sepsis, RSI for aspiration

Room Setup: Warm room/warming devices, resuscitation drugs (epi) drawn up, extra personnel, neonatal circuit

Monitors: CAS, +/- artline, temp probe, foley

Intraoperative Mgt: muscle relaxant/opioid +/- ketamine, Volatiles may be poorly tolerated, avoid N₂O (destends bowel), FiO₂ to maintain Sats ~90%

Post-op: NICU, post-op ventilation, +/- inotropes

Complications: hypothermia, hypovolemic shock, metabolic acidosis, coagulopathy

Special: Operative indications – Absolute: pneumoperitoneum, gangrene; Relative: clinical deterioration, portal vein gas, erythema abdo wall, fixed abd mass, persistently dilated loop. Non-indications are severe GI hemorrhage, abd tenderness, intestinal obstruction, gasless abd with ascites

Neuraxial Opioid Monitoring

1. Identify risk factors for respiratory depression
 - Sleep apnea
 - Advanced age
 - Co-existing disease (diabetes, obesity, unstable medical condition)
 - High dose opioid, repeated neuraxial doses, concomitant enteral or parenteral opioids and sedatives
2. Select appropriate opioid and dose
 - Lipophilic vs hydrophilic
3. Select appropriate monitoring and disposition for the patient
(based on patient factors, opiate choice and neuraxial technique)

Anesthetic Goals

- All patients should be monitored for adequacy of VENTILATION, OXYGENATION and LEVEL OF CONSCIOUSNESS after receiving neuraxial opioids
- Single shot of hydrophobic (ie fentanyl or sufentanil) = continuous for 20min then q1h x 2h
- Single shot of hydrophilic (morphine) = q1h x 12 hr, then q2h x 12 hrs
- Continuous infusion: continuous x 20min then q1h x 12 hrs, q2h x 12 hrs, q4h until infusion stopped
- Sustained/Extended release epidural morphine: q1h x 12hrs, then q2h x 12hrs, then q4h after 48hrs

Intensify monitoring in the presence of risk factors – Continuous pulse oximetry

Hx: OSA Sx's, concomitant Opioid/CNS depressant use (benzo, EtOH)

Pathophysiology: Neuraxial opioids mechanisms of respiratory depression:

1. Vascular uptake by epidural/subarachnoid venous plexuses & circulation to brainstem resp center
2. Arachnoid penetration and movement into the spinal cord
3. Rostral spread via the aqueous CSF to the brain stem or via direct perimedullary vasc channels

Investigations: BUN/Creat for renal insufficiency

Drug Effects: Lipohilicity (fentanyl) rapid onset of effect & dec. duration of action. In single doses of 10-30ug, has rapid onset (10-20min) and short duration (4-6hrs) with minimal cephalad spread, making it least likely to cause delayed respiratory depression. May cause **early** (0-1hr) respiratory depression. Hydrophilicity (i.e. morphine) inc. duration of action and dec. onset time. Slow onset (30-60min), dose related duration (13-33hrs) and potential for both early and **delayed respiratory depression**. Delayed depression is primarily assoc with hydrophilic opioids because of cephalad spread and typically occurs within 12hrs post-injection (up to 24hrs, with a **peak at 6hrs**).

Treatment:

Supplemental Oxygen - available, administered if dec. LOC or resp depression, routine use may inc. the duration of apneic episodes and hinder diagnosis of hypotension.

Reversal Agents – available, IV access mandatory, administered if respiratory depression develops, ABC approach, infusion will likely be required (2-10mg/24hrs).

NIPPV – may be considered to improve ventilator status.

Neurofibramatosis

Definition: multi-system, AD disorder effecting neural crest cells during development causing a tendency to form multiple soft tumours (neurofibromas) in the skin and CNS

1. Potential **difficult airway**: pharyngeal tumor, laryngeal stenosis, limitation of c-spine ROM
2. Potential **restrictive lung disease** (kyphoscoliosis 30% or pulmonary fibrosis from parenchymal infiltration of tumor)
3. Cardiovascular involvement: **essential hypertension**, Pheochromocytoma 1% incidence, renal artery stenosis, may have **idiopathic hypertrophic cardiomyopathy**, dysrhythmias
4. Altered response to NB's: **Sensitive to Sux**, **unpredictable response to NdMR**
5. Potential **contraindication to neuraxial technique** due to spread of tumor, and potential raised ICP from intracranial tumours, seizures.

Background:

- Three subtypes: NF1, NF2, Segmental, hallmark café au lait spots >1.5cms, > 6
- Autosomal dominant but 50% are new mutations. Often worsens in pregnancy
- NF1: Classic, multisystem neurofibromatosis. 1:3000 early dx, increases severity with age
- NF2: More localized dx(Café spots and neurofibromas ↓ common). Bilateral acoustic neuromas. Also have abn growth of other cell types, ie schwannomas, meningiomas, gliomas, cataracts.
- Segmental: Mosaic form of disorders with neurofibromas in some areas and other areas unaffected.

Hx: Airway issues, hoarseness, previous hx of difficult intubation. Respiratory sx's, functional capacity, history of restrictive lung disease, cor pulmonale. Cardiac involvement: HTN, pheo, RAS, RV outflow obstruction. Hx of headaches, seizures, raised ICP, visual symptoms. Endo- pituitary involvement, pancreatic tumors, thyroid tumors.

PE: Airway exam (hoarseness, dysphonia, stridor), focused cardiopulmonary exam, kyphoscoliosis, fine crackles, clubbing, BP(HTN/perspiration), neurological exam for ICP, visual defects, papilledema decreased LOC + neuro exam for regional technique

Investigations: Usual BW +/- imaging related to symptoms, MRI if planning regional technique. CXR in severe kyphoscoliosis, consider PFTs or ABG. 24-hour urine collection for creatinine, total catecholamines, vanillylmandelic acid, and metanephrines.

Optimization: Consider endocrine consult, MRI if planning regional technique, BP control, respiratory consult if restrictive lung disease?

Anesthetic Options: GA preferred or MRI prior to regional / neuraxial technique. May avoid LMA from laryngeal obstruction by tumor. Consider raised ICP.

Room Setup: Entirely dependent on manifestations of disease, consider difficult airway equipment, antihypertensives, alpha blockade (phentolamine). PNS for unpredictable response to NMB.

Post-op: Seizures, residual NMBs

Neuroleptic Malignant Syndrome

1. Potentially life-threatening emergency with high mortality (4-20%)
 - Altered LOC: Coma which may mandate airway management
 - Autonomic instability: tachycardia, hypertension, cardiac dysrhythmias (most likely cause of death)
 - Hypermetabolic State: fever, rhabdomyolysis, DIC, volume depletion, renal failure and acidosis
 - Tachypnea and potential respiratory insufficiency from hypoventilation/rigidity
2. DDx: MH, infection, drug toxicity/withdrawal, Serotonin Syndrome, heat stroke, status epilepticus, malignant catatonia, thyrotoxicosis, pheochromocytoma
3. Underlying psychiatric condition

Anesthetic Goals/Conflicts:

- Resuscitation and ICU monitoring following trigger
 - Stop offending agents (?Sux, antidopaminergics), supportive treatment, cooling, treat acidosis and electrolyte abnormalities, hemodynamic support
 - Pharmacologic: bromocriptine, dantrolene, benzodiazepines
 - ECT
- Rule out high risk conditions on differential diagnosis
- Trigger free” anesthetic in patients with history of NMS (controversial)

Hx: AMPLE + recent neuroleptic drugs started or increase dosage, psych hx, most common drugs: haloperidol, phenothiazines, butyrophenones, thioxanthenes. Withdrawal of anti-Parkinson meds (dopamine agonists; Symptoms – Mental status changes (confusion, stupor, delirium) motor rigidity, akinesia, bradykinesia, dystonia, mutism, dysarthria, involuntary mov'ts.

PE: Vitals (orthostatic, temp): autonomic dysfxn, CVS: tachy, diaphoresis, arrhythmias; MSK: rigidity that resolves with NdMB (unlike MH); Resp failure (WOB, cyanosis, hypercarbia), CNS: altered LOC, hyperthermia

Investigations: CBC (+/- incr'd WBC), ABG (Met acidosis), CK (rhabdo – correlates with disease severity), coags (risk of DIC), incr'd LFTs, electrolyte abN (hypo PO₄, Ca, Mg; hyper Na, K), pan-culture to r/o sepsis, tox screen, renal function, myoglobinuria. ECG, CXR (aspiration, infection), CT Head

Optimization: Delay elective surgery. D/C any offending meds (Haldol, loxapine, maxeran, perphenazine, droperidol), **rehydrate**, maintain U/O (rhabdo), cool, r/o Ddx, ICU consult, +/- intubation for dLOC, Bromocryptine (2.5-20mg PO TID), muscle relaxants, dantrolene (reduced rigidity and heat production), ECT.

Room Setup: Trigger-free anesthetic to be conservative, inotropes available, avoid the above mentioned drugs (most anti-emetics), CAS + invasive monitors, temp probe, Sux controversial if these pts need ECT. Crash cart available.

Intraoperative Mgt: As above: trigger free. Use NdMBs to aid rigidity.

Post-op: Likely need ICU post-op.

Special: Complications: hyper/hypotension, hyperthermia, hypermetabolic, volume deplete, renal failure, MH, thromboembolism, residual catatonia.

Non-obstetrical surgery for the Parturient

1. Parturient
 - a. Risk of aspiration, difficult airway, rapid desaturation, aortocaval compression, 2 patients
2. Maintenance uteroplacental perfusion
 - a. Avoid hypoxemia, hypotension, acidosis and hyperventilation
 - b. FHR and uterus monitoring
3. Risk of preterm labour
 - a. Obstetrical consultation, tocolytics, Steroids if viable and < 37 wks
4. Surgical considerations of a gravid uterus
5. Appropriate timing related to gestational age
 - a. Exposure to potential teratogenic drugs

Anesthetic Goals/Conflicts:

- Ensure obstetrical involvement and FHR monitoring when possible
- Avoid Teratogens
- Maintain uteroplacental perfusion
 - maintain oxygenation,
 - maternal MAP
 - prevent acidosis, normocapnea

Hx: Gestational age, Obstetrical history, underlying medical condition, adverse pregnancy associated features (PIH/HELLP/hyperemesis/Gestational Diabetes), CVS status, Preterm labor.

PE: Volume status, CVS exam, detailed airway examination, uterine tone/contractions.

Investigations: Review fetal U/S, usual bloodwork, +- PIH bloodwork +- Echo depending on CVS exam

Optimization: Delay elective surgery, essential surgery in early 2nd trimester, aspiration prophylaxis, consider steroids for fetal lung maturation (Betamethasone 6mg q 24hrs x 2days for infants < 37wks), consider tocolytic therapy (Nifedipine/terbutaline (s/e's tachy, hypokalemia, hyperglycemia)/MgSo4/Indomethacin (high risk of ductus closure). OBS consult!

Room Setup: Airway adjuncts, fetal heart rate monitor after 20-24 wks/vaginal probe/consider arterial line for CO₂ insufflation. Left uterine displacement, calf compressors, temperature. Avoid laparoscopic procedures after end of 2nd trimester

Intraoperative Mgt: GA or regional acceptable, avoid N₂O (controversial). Maintain oxygenation, uteroplacental perfusion, avoid hypocarbia (aim 30-35mmHg) and acidosis

Specific Procedures: Laparoscopy – open trocar placement, low insufflations pressures 8-12mmHg; ECT – OB Consult, intubate beyond 1st trimester (aspiration prophylaxis for all), monitor FHR, Not a risk factor for SA; Trauma - Early fetal U/S and FHR, All diagnostic modalities required (primacy of mother), C/S (stable mother, a viable fetus in distress, traumatic uterine rupture, unsalvageable mother with viable fetus, If fetus is pre-viable or dead, optimize mother (i.e. do not go for c-section, vaginal delivery can be performed later)

Post-op: Monitor FHR and uterine contractions, Risk of DVT

Complications: Most serious fetal risk associated with surgery is due to intrauterine asphyxia: Maintain maternal oxygenation, oxygen tension and carrying capacity, uteroplacental perfusion.

The most common causes of maternal hypotension: deep GA, sympathectomy with high spinal or epidural, aortocaval compression, hemorrhage, and hypovolemia

Obesity: BMI >30, Morbid Obesity: BMI >40 kg/m²

1. Physiologic Changes of Obesity:
 - a) Airway – potential **difficult BMV / Intubation / Cricothyroidotomy**
 - b) Respiratory – **Restrictive lung defect** (dec. FRC/ERV/VC), assoc. **OSA**, risk of post-op hypoxemia / ventilation. Potential **pHTN** related to OSA.
 - c) CVS – Increased demand with limited reserve, incr. blood volume, CO, LVH, wall stress
 - d) GI – Increased risk of **aspiration**
 - e) Heme – **Hypercoagulability** (2x risk of DVT)
2. Co-morbid disease: OSA, Obesity hypoventilation, HTN, IHD, CAD, CHF, Type 2 DM,
3. Altered Pharmacokinetics and Pharmacodynamics:
 - a) Increased LBW, altered drug dosing, increased pseudocholinesterase
 - b) **Sensitivity to opioids**
 - c) **Reduced LA requirements** 20-30% for NA techniques
4. Potential technical difficulties: (positioning, monitoring, IV access)

Anesthetic Goals/Conflicts:

- Evaluate and optimize the physiologic impact of obesity: OSA, pHTN, DM, CAD
- Safely secure airway, avoiding aspiration and long acting agents: minimize post-op resp complications
- Avoid thrombotic complications and peripheral nerve injury
- Consider regional technique, post op pain management vs resp depression

Hx: Hx of difficult airway, OSA, CPAP, HTN, DM, hypothyroid, CAD, CHF, functional capacity, pHTN, Stroke, Renal failure, GERD, Meds.

PE: Detailed A/W exam for ease of laryngoscopy and BMV, CVS: BP, Cardiomegaly: displaced PMI, CHF S3/S4, basilar crackles. pHTN: JVD, R parasternal heave, loud P2, Murmur of TR, hepatomegaly, edema). Resp: Focus on restrictive dysfx (rapid RR, shallow resps, ruddy color, OSA (ruddy color, thick neck). Gastro – hepatic dysfunction (hepatomegaly, ascites, spider angiomas, jaundice).

Investigations: CBC: Polycythemia, Lytes, Cr, BUN, glc – if Htn, DM or on diuretics
LFTs, PT, PTT if hepatic dysfunction. ABG if hypoxemia. ECG: Typically shows low voltage, LVH, strain: LA abnormalities. If pHTN: RVH, RBBB, P Pulmonale. Echo / Consider PFTs if severe (not cost effective in asympt obese patients nor utility in optimizing the postoperative mgt.

Polysomnograph: 10 sec or more cessation of flow (**apnea (5/hr)**) or 50% reduction in flow or decrease in sat >4% **15/hr (hypopnea)** is diagnostic of OSA. Apnea/Hypopnea index >30 = **severe**

Optimization: Aspiration prophylaxis, avoid pre-op sedation, antisialagogue for AFI, DVT prophylaxis (SC heparin / compression stockings), Optimize co-existing diseases. CPAP.

Room Setup: Difficult A/W equipment, glucometer, remainder depends on co-morbid disease. OR tables designed for 120-140kg patients. Position and pad carefully.

Intraoperative Mgt: Local/Regional/GA. Avoid long acting agents. Do not use LMA's in morbid obesity. Difficult spinal/epidural , use 20-30% less dose due to increased spread. Doses based on lean body weight esp. NMDs. Use PPV / PEEP, extubate awake.

Post-op: Resp insufficiency, consider OSA protocol, overnight oximetry, semi – recumbent positioning, CPAP / BiPAP.

Obstetrical Hemorrhage

1. Emergency Situation with high maternal and fetal morbidity & Mortality
 - requiring immediate resuscitation
2. Etiology & Risk factors
 - APH: Abruptio, placenta previa, uterine rupture, vasa previa, other
 - PPH: Tone, tissue, thrombin, trauma, turnout Antepartum
3. Hemorrhagic Shock
4. Potential for DIC & massive transfusion
5. Pregnant Patient

Anesthetic goals:

- Intrauterine Resuscitation
 - Optimize uteroplacental perfusion
- Maintain adequate circulating blood volume and coagulation factors
- Facilitate safe and timely delivery
- Clear lines of communications regarding ongoing HD & coagulation status
- Mobilize resources early

Conflicts:

- Need for oxytocin in an increasingly hypovolemic patient
- Risk of preterm delivery vs risk of delaying delivery in compromised mother
- Regional in hypovolemic patient? (ie hypovolemic, unstable patient with difficult airway)
- Bleeding patient with contraindications to many uterotonics (eg Pulm HTN, severe asthma...)

Differentials: **APH** - placenta previa(Multipara, Uterine scar, Risk of placenta accrete); Abruption (HTN, cocaine use, trauma, PROM); Uterine rupture (Uterine scarring, Tumultuous or prolonged labor, Trauma, iatrogenic); Vasa Previa (Severe fetal distress)

PPH – Uterine atony (Uterine overdistension, Augmented labour, Retained placenta, Operative delivery); Retained product; Genital trauma; Placenta accrete; Uterine inversion; Coagulaopathy

History: AMPLE, OBHx, fetal distress, ongoing blood loss, maternal compromise, coagulopathy

P/E: Vitals, A/W, classification of stage of shock

Investigations: CBC, G&S, DIC screen, repeat...US

Optimization: Intrauterine resuscitation, Large bore IV access, Volume resuscitation (blood), Aspiration prophylaxis

Anesthetic options: Directed by - Fetal distress, Airway, Coagulopathy, Hypovolemia

GA/RSI unless airway difficult. Regional contraindicated related to volume status / coagulopathy / prolonged procedure. FOB if difficult airway. Consider TIVA

Setup: CAS monitors, temp, Artline, +/- CVP, rapid transfuser, Emergency drugs

Specific management of OB hemorrhage:

Volume, blood components, uterotonics (oxy, hemabate 250 mcg IM/IU, misoprostol 600-800 pr/po/pb, ergot 0.25 mg by slow IV infusion, vasopressin 20 U in 100 cc injected diffusely into uterus), surgical measures (B-Lynch, vascular clamping/ligation, emergency hysterectomy, packing, massage), interventional radiology, Factor VII

Postop disposition: Following massive transfusion a critical care bed is appropriate or at least a monitored bed with invasive monitoring

Obstructive Sleep Apnea

1. Potential difficult intubation/BMV
2. Increased incidence of peri-operative pulmonary complications
 - a. Increased susceptibility to obstruction with sedatives/respiratory depressants
 - need for post-op monitoring
3. Cardiopulmonary alterations:
 - a. Hypoxia, hypercarbia, polycythemia, systemic/pHTN, RV dysfunction
4. Co-morbid diseases including:
 - a. Obesity (60-90%), diabetes, CAD, HTN and congenital syndromes in children

Anesthetic Goals/Conflicts:

- Identify patients at risk
- Anticipate potential for failed intubation/ventilation
- Avoid long-acting opioids, sedatives or other respiratory depressants
 - NSAIDs, acetamenophen, regional/local techniques to minimize pain (i.e. opioid sparing techniques)
- Monitoring to decrease morbidity associated with apnea post-operatively

Hx: snoring, daytime somnolence, apneic periods during sleep, morning H/A, functional reserve, BiPAP, Home O2, congenital syndrome, history of difficult intubation/ventilation. Hx of Etoh, hypothyroid, sleep meds.

Risk Factors: Male, middle aged, BMI > 30, Alcohol (evening), drug induced sleep, down's syndrome, acromegaly

PE: Room air sat, BMI > 30, neck circumference >17" M (16" F), A/W for ease of intubation/BMV, signs of CHF (JVP, S3/S4), signs of RVF (JVD, right sided S3/S4, systolic murmur of TR, hepatomegaly, signs of PHN [loud P2])

Investigations: CBC (polycythemia), ABG (baseline PaCO2, PaO2), +/- Echo (cor pulmonale), TSH, GH if acromegaly. Overnight oximetry (at home>15/hr desats > 4%). Gold standard is polysomnography (5 or more apneic events per hour or 15 or more hypopneic events per hour during a 7 hr sleep study. Apnea Hypopnea index: Mild AHI 6-20, Moderate 20-40, Severe = >40.

Optimization: Weight loss, CPAP pre-op, smoking cessation, CAD/HTN optimization

Room Setup: Difficult airway cart, art line for repeat ABGs, CPAP in PAR

Intraoperative Mgt: Local>Regional>Neuraxial (opioids-free), GA – ETT > LMA

Avoid long acting resp.depressants, adjuvant analgesia (local, NSAIDS)

Post-op: CPAP, step-down unit, continuous sat monitoring until sats >90% sleeping. At VGH it's a minimum of 3H in PAR. Consider 24H of monitoring if patient demonstrates apneic episodes <90% or severe pre-existing OSA (AHI > 30) or requiring complicated pain management. Patient d/c'd to ward should continue intensive monitoring (RR/SS Q1H x 48h, then Q4h).

Open Eye

1. Surgical Emergency
 - Further expulsion of eye contents risks blindness
2. Full stomach/risk of aspiration
3. Trauma & other associated injuries
4. Considerations for Eye Surgery
 - Shared airway
 - Immobile patient
 - Oculocardiac reflex
 - Smooth emergence with minimal coughing

Anesthetic Goals/Conflicts:

1. Minimize risk of aspiration (prophylaxis, RSI)
2. Minimize increases in IOP
 - Avoid coughing, straining and hypertensive response to laryngoscopy
 - Avoid hypercarbia
 - Use deep anesthesia, barbituates
 - Consider avoiding succinylcholine

Hx: Mechanism of injury, associated trauma, last meal (full stomach), PMHx (may be elderly)

PE: Airway examination

Investigations: As directed by Hx & PE

Optimization: For pediatric patient for which an inhalational induction is necessary, may consider delaying until fasted but generally cannot delay; aspiration prophylaxis

Anesthetic Options: GETA only option

Room Setup: CAS monitors, atropine available (OC reflex)

Intraoperative Mgt: Deep anesthesia and muscle relaxation needed to prevent coughing or movement.

Post-op: Extubate awake with minimal coughing or straining (balance risk of aspiration with smooth emergence)

Pacemakers

1. Indication for implantation
 - a. PM – SSS, AV block
 - b. AICD – VT, Vfib, cardiomyopathy EF < 35%
2. Minimize risk of and prepare for potential for pacemaker / AICD interference & failure
 - a. Magnet
 - b. Pacer clinic interrogation periop
 - i. Disable antitachycardia functions**
 - c. Alternate pacing strategies
 - i. Sympathomimetics
 - ii. Transvenous pacemaker or pacing PAC
 - iii. External defib device
3. Co-existing disease
 - a. Associated CAD / Cardiomyopathy EF<35%
 - b. HTN / CRF / DM
 - c. Medications

Anesthetic Goals/Issues:

1. Identify & optimize underlying cardiac status
2. Anticipate and prevent failure or interference
 - a. Avoid inappropriate inhibition or triggering of pacemaker by electrocautery
 - b. Avoid inadvertent activation of AICD leading to life-threatening rhythm
3. Prevent damage to device

Hx: Indication for pacemaker, pacemaker dependency, last interrogation, type of pace maker, response to magnet, symptoms of pacemaker malfunctioning (CHF/Syncope etc), ICD frequency. Coexisting illnesses, cardiac disease. Type of OR, cautery being used, location of surgery.

PE: Pulse, Location of generator, Rhythm, CHF >> **Investigations:** Lytes/EKG/CXR for type of pacemaker, lead location.

Optimization: Underlying disease, pre-op interrogation if elective, **disable ICD/tachyarrhythmia sensing**, reprogram to demand mode, call manufacturer.

Room Setup: 5 lead ECG (disable 'artifact filter', consider artline for hemodynamic capture, Magnet (avoid in ICD unless necessary >> can disable permanently), Pacing pads (AP positioning, away from generator), Defibrillator, chronotropic meds (Atropine, Isoproterenol (2-10mcg/min), Epinephrine, Dopamine), consider telemetric programmer present if interference expected/hemodynamic instability.

Intraoperative: Bipolar, short bursts, avoid generator between cautery and ground. (with magnet 60% go to 60-100bpm asynch, 25% go to asynch at program rate, 15% brief 60-100 beats pacing event, some may produce no change)

Post-op: Reprogramming and interrogation by pacemaker clinic prior to discharge to ward

Special: Pacemaker Mediated Tachycardia (PMT): Dual Chamber pacemaker w/ magnet defaults to demand mode >> retrograde p waves which are then "tracked" after magnet removal. Tx: Reapply and remove magnet.

- 1 – Chamber Paced 2- Sensed 3- Response (T/I/D/O) 4- Rate Modulation 5 – Arrhythmia Treatment (Paced / Shocked / Dual)
- AICD: I = Shock Chamber, II = Antitachycardia pacing chamber A/V/D, III = Tachycardia detection E/H Electrogram vs Hemodynamic, IV = Antibradycardia pacing chamber A/V/D

Pain

1. Emergency situation requiring immediate management and Dx
2. Classification of the pain
 - nociceptive
 - neuropathic
 - malignant or non-malignant
3. Develop DDx whiling ruling out a medical or surgical emergency
 - Compartment syndrome, nerve compression & ischemia
 - Metastases, infection, inflammation, fracture, visceral (GI, vascular, renal)
4. Develop a comprehensive management plan
 - biopsychosocial assessment (depression, suicide)
 - multidisciplinary resources
5. Specific Management Strategies - **Multimodal approach**
 - Biological - Disease-specific treatment, Physical (Exercise, stretching, heat, massage), Pharmacologic (symptom-related): PO, IV, SC, epidural, intrathecal, regional blocks, Neurostimulation (TENS, SCS), Neurodestructive (Chemical, thermal, surgical)
 - Psychological/Social

Red Flags - thoracic pain, fever, weight loss, bladder/bowel dysfunction, history Ca, gait problems, saddle anesthesia, age <20 or >55

Yellow Flags - negative attitude that back pain is harmful or severely disabling, fear-avoidance behavior, expectation that passive rather than active treatments is beneficial, depression, low morale, social withdrawal, social or financial problems, litigation

Differential Diagnosis for Lower Back Pain:

Mechanical:

- Discs: annular tears, internal disc disruption or herniation
- Sciatica (either referred mechanical or nerve root compression)
- ligaments, periosteum
- spondylolysis, spondylolisthesis
- spinal stenosis

Non-mechanical:

Spinal

- Neoplasia: metastatic (breast, prostate, lymphoma; primary spinal cord; retroperitoneal tumours)
- Infection: osteomyelitis; septic discitis; paraspinal or epidural abscess; HZ
- Inflammatory arthritis: AS, IBD; Reiters syndrome; Psoriatic Spondylitis
- Trauma (fracture)

Visceral

- Pelvic organs: prostates; endometriosis; PID
- Renal: nephrolithiasis; pyelonephritis; perinephric abscess
- Vascular: AAA
- GI: pancreatitis; cholecystitis; perforated bowel

WHO Relief Ladder/Algorithm for Cancer Pain

1. 3-step “ladder” for cancer pain relief
 - a. correct drug, correct dose, at the correct time → 80-90% effective
2. If pain occurs → prompt oral administration of drugs in following order:
 - a. Nonopioids (NSAIDs and Acetaminophen) +/- adjuvants
 - b. Mild opioids (ie. Codeine, oxycodone) +/- adjuvants
 - c. Strong opioids (ie. Morphine, hydromorphone) +/- adjuvants

Adjuvants also used to calm fears and anxiety.

To maintain freedom from pain: give regularly (q3-6h) and not “prn”

Surgical intervention on appropriate nerves may provide further pain relief if drugs are not wholly effective

Anesthetic Considerations for Phantom Limb Pain:

1. Common chronic neuropathic, non-malignant pain - distinct from stump pain
2. Difficult to treat, warranting multidisciplinary involvement including physio, heat, and psychiatry
3. Multi-modal analgesia
 - a. aggressive pre-op pain management
 - b. avoidance of aggravating factors, including cold, stress, stump irritation
 - c. liberal use of regional anesthesia, anti-neuropathic agents, simple analgesics, opioids

Parkinson's Disease

Central dopamine deficiency leading to rigidity, tremors and late dementia.

1. Potential **difficult airway** due to cervical TMJ rigidity
2. Increased risk of **aspiration** secondary to bulbar dysfunction, gastroparesis, esoph dysfx.
3. **Autonomic instability**, NE depletion (med), increased risk of hypotension on induction + regional
4. restrictive lung disease secondary to chest wall rigidity
5. Increased risk of perioperative **A/W obstruction, Resp. failure, exacerbation of Neurologic symptoms** (maxeran droperidol, nozinan), **and delirium**
6. Interactions with **medical therapy**: continue current therapy, MAOI's (type B) and Demerol (seizures rigidity and hypertension), Levodopa (can deplete NE stores).
7. Elderly patient

Anesthetic Goals/Conflicts:

- Safely manage patient's airway: RSI vs. hemodynamic lability, difficult airway.
- Continue anti-parkinson medications perioperatively, avoid anti-dopaminergic meds
- Maximize respiratory function

Hx: Onset and severity of disease, medications, previous anesthetic history.

PE: Particular attention to airway, orthostatic symptoms, neuro exam (pill-rolling tremor, rigidity etc), volume status.

Investigations: Nothing specific

Optimization: Continue anti-parkinson medications (L-dopa only oral, absorbed prox SB) >> NG for long surgery, immediately post-op. Aspiration prophylaxis.

Anesthetic Options:

Room Setup: Appropriate airway equipment, direct acting agents for hypotension, consider arterial line

Intraoperative Mgt: Volatiles or TIVA, be aware of narcotic induced rigidity

Post-op: Increased risk for hypoventilation, respiratory compromise, and post op delirium >> use atypical antipsychotics if necessary (Olanzapine/Quetiapine/Risperadone), worsening parkinson's >> restart meds ASAP.

Pediatric Patient

1. Physiologic changes:
 - a. Altered airway anatomy
 - b. higher risk of laryngospasm
 - c. rapid desaturation on induction or apnea
 - d. Dec. Cardiovascular Reserve
 - increased vagal tone
 - e. altered pharmacokinetics
 - higher MAC, higher TBW
2. Limited or no cooperation
3. Need to communicate with and manage parents

<i>Noraml Heart Rates</i>			
<i>Age</i>	<i>Awake</i>	<i>Mean</i>	<i>Sleeping</i>
0 to 3mo	85-205	140	80-160
3mo to 2yr	100-190	130	75-160
2yr to 10 yr	60-140	80	60-90
> 10yr	60-100	75	50-90

<i>Respiratory Rates</i>	
<i>Age</i>	<i>Rate</i>
Neonate	40-60
1yr old	24
18yr old	12

<i>Normal BP</i>		
<i>Age</i>	<i>Systolic</i>	<i>Diastolic</i>
Birth (12h, < 1000g)	39-59	16-36
Birth (12h, 3kg)	50-70	25-45
Neonate (96h)	60-90	20-60
Infant (6mo)	87-105	53-66
Toddler (2yr)	95-105	53-66
School Age (7yr)	97-112	57-71
Adolescent (15yr)	112-128	66-80

Pediatric Stridor

1. Emergency
 - Inc. risk of aspiration, Limited time for optimization and investigation
2. Airway compromise
 - Potential for catastrophic loss of the airway, hypoxemia, respiratory acidosis, cardiac arrest, negative pressure pulmonary edema
 - a. Mobilization of resources and collaboration with other specialties: ENT, ICU, ER
3. Pediatric patient

DDx

- **Congenital** (generally chronic symptoms) – Nose (Choanal atresia, Septum deformities, Turbinate hypertrophy), Pharynx (Craniofacial anomalies – Crouzon's, Pierre-Robin, Apert's syndromes; Tongue – macroglossia and glossoptosis), Larynx (Laryngomalacia, webs, cysts, hemangioma, stenosis), Trachea (stenosis, vascular rings & slings, tracheomalacia)
- **Infections** – epiglottitis, tracheitis, peritonsillar and retropharyngeal abscess, croup (parainfluenza), RSV, Influenza A and B, Mycoplasma
- **Tumors** – Encephalocele, Teratoma, Lymphoma, Granuloma, Fibroma, Papilloma, Neuroblastoma, Hemangioma, Rhabdomyosarcoma, Cystic hygroma
- **Trauma** – RLN palsy (post PDA repair, thyroid surgery), Post extubation (Croup/ edema, Vocal cord injury or paralysis, Subglottic stenosis), Caustic injury, Inhalational injury, Facial trauma or burn
- **Allergic** – Anaphylaxis, hereditary angioneurotic edema
- **Miscellaneous** – Hypocalcemia, Foreign bodies (airway or esophageal), Spasmodic croup, Exercise, GERD, Juvenile RA with cricoarytenoid involvement

HISTORY AND PHYSICAL MAY BE ABBREVIATED DUE TO URGENCY

Hx: **AMPLE**; onset of symptoms (acute, subacute vs chronic); circumstances (related to feeding); associated symptoms (constitutional, drooling, dysphagia, vocal changes/muffling, hoarseness); previous episodes (chronic or recurrent episodes – congenital, tumor or vocal cord dysfunction); OSA (suggests pharyngeal cause: tonsils or adenoids); PMHx – intubation, PDA/necl Sx, immunization Hx

Px: VS; general (Toxemia, Fever, Hypotension, tachycardia) weight; A/W exam (size of tongue and mandible, craniofacial anatomy, neck edema); Respiratory (WOB/ accessory muscle use, nasal flaring, retraction, Cyanosis, Clubbing: underlying CHD or bronchiectasis, stridor may be heard in inspiration, expiration or during the entire respiratory cycle); Hemangiomas, café au lait spots; Anaphylaxis: rash, hypotension

Inv: CBC: leukocytosis, BldCx; **Imaging:** unstable: skip radiology and evaluate their airway in the OR with ENT; accompany to radiology suite with A/W equipment; Neck radiographs – generally nonspecific; CXR – Mediastinal masses, Vascular rings, R aortic arch, FB; Airway fluoroscopy; CT scan; nasopharyngoscopy

Options: Compromised airways should be evaluated and secured with direct visualization in the OR with ENT present under spontaneous ventilation; **FB:** SV with rigid bronch

Anesthetic Setup: difficult A/W cart, ENT surgeon, skilled help, Rigid bronch, cricothyroidotomy (age > 6)

Monitors: CAS, consider transcutaneous CO2 monitoring for rigid bronch

Drugs: Succinylcholine, Atropine, vasoactive agents if suspicion of severe sepsis, TIVA vs Inhalational

Management: **Moribund:** awake DL; **Stable child:** SV GA, IH – 4% ET sevo, TIVA – Propofol infusion at 200 u/k/m, Remi 0.1 u/k/m; DL when unresponsive (may take ~10min); ETT placed (use 0.5-1.0 size smaller); Topicalize A/W prior to rigid bronch (lido 3mg/kg)

Emergency: PICU, FB removal: consider intubating and extubating awake (aspiration & laryngospasm risk)

Post extubation Stridor: Typically 1-4yrs, max in 4hr, resolution in 24h; DDx; humidified oxygen; Neb epi 0.5 ml/kg –watch for rebound; Dex: 4-8mg IV; Emotional support; Heliox; Admission

Pharyngeal Abscess

1. Urgent/Emergent Procedure with Risk of Aspiration and acute A/W obstruction
2. Difficult airway management
 - a. Distorted Anatomy, trismus, difficult topicalization
 - b. Risk of abscess rupture and lung soilage
 - c. Shared airway
3. Life Threatening Complications
 - a. AW obstruction, abscess rupture & aspiration, sepsis/toxic shock syndrome, mediastinitis
4. Risk Factors / Co-morbidities
 - a. Pediatric, DM, IVDU, HIV, ETOH, ENT malignancy

Anesthetic Goals/Conflicts:

1. Efficiently + Safely secure airway recognizing *evolving obstruction*
 - Consider preoperative abscess needle drainage
 - Prevent abscess rupture and lung soilage
2. Fluid resuscitation and appropriate Abx
3. Potential conflicts:
 - uncooperative patient (peds) vs. difficult airway
 - full stomach vs. potential inhalational induction
 - deep plane of anesthesia vs. potential hypotension from sepsis/ dehydration
 - awake FOB does not visualize ETT passing abscess (potential for rupture by ETT)

Hx: Abcess time course, associated symptoms (drooling, dysphagia, stridor, dysphonia, hoarseness); presence of sepsis; establish risk fx/comorbidities - DM, IVDU, HIV, underlying head & neck malignancy, alcoholism

PE: Vitals (respiratory distress, sepsis); detailed airway examination (mouth opening/trismus - pterygoid muscle spasm, edema, submandibular edema, tracheal deviation, Torticollis / dec neck ROM, Horner's syndrome & cranial nerve palsies); resp exam for infection/empyema; CVS exam for hypovolemia/sepsis

Investigations: Limited impact on management; CBC, Blood Cx, CXR, neck xray, **CT head & neck**

Optimization: Aspiration prophylaxis, Antisialagogue, fluid resuscitation, antibiotics, needle aspiration and decompression by surgeon

Anesthetic Options: SV induction (peds); awake FOI (may be difficult to topicalize); tracheostomy under local (maybe difficult anatomy); blind techniques not recommended. Use slow, gentle technique to minimize risk of abcess rupture.

Room Setup: Difficult airway cart, skilled assistants, ENT surgeon present

Intraoperative Mgt: Discuss plan with surgeon (shared airway); dexamethasone to decrease edema

Post-op: Consider postop ventilation/ICU or extubation over tube exchanger depending on severity, continue abx

Complications: Airway obstruction, aspiration of abcess contents, laryngospasm, sepsis, post-obstructive pulmonary edema, abcess spread (meninges, lung, epidural space, etc), vascular injury/hemorrhage

Pheochromocytoma

1. Prevention and Management of hemodynamic instability:
 - Preoperative optimization, Avoidance of SNS stimulation, histamine release, & unopposed alpha
 - Intra-operative monitoring and management of HTN, tachycardia, arrhythmias
2. Relative intravascular volume depletion
3. End-organ dysfunction
 - Hypertrophic or dilated cardiomyopathy, IHD, CVA, Hyperglycemia
4. Associated endocrinopathies:
 - Hyperparathyroid (MEN2a)
 - Medullary thyroid CA (MEN 2a & 2b)
 - Neurofibromatosis (Von Recklinghausen's)
 - von Hippel-Lindau disease (cerebellar hemangioblastoma, RCC)
5. Post-operative complications:
 - HTN or hypotension, Hypoglycemia, Adrenal insufficiency

Anesthetic Goals/Conflicts:

- Prevent, recognize and be prepared to treat pheochromocytoma crisis:
 - Adequate pre-op optimization - Alpha blockade; Volume resuscitation; Anxiolysis
 - Tight hemodynamic control
 - Avoid SNS surges (anxiolysis, deep induction, Epidural)
 - Avoid histamine releasing drugs(catecholamine release from tumor)

Hx: Triad of diaphoresis, H/A, tachycardia in HTN pt; flushing; orthostatic hypotension; end-organ dysfx (CHF; IHD), endocrinopathies; 5Ps – Pressure (HTN); Perspiration; Pallor; Pain (H/A; CP); Palpitations (associated with tremor, wt loss, fever)

PE: Vitals (including posturals), CHF Signs; volume status; caution with abd exam

Investigations: CBC (polycythemia), Lytes, BUN, Cr, Glucose (hyperglycemia), Ca⁺⁺ (Men 2), CXR, ECG (LVH, ischemia, prolonged QTc, abnormal R waves, ECHO (hypertrophic or dilated cardiomyopathy), MIBI (CAD), PET/CT to localized non-adrenal masses

Optimization: Endo consult; 10-14 days required; correct hypovolemia; Phenoxybenzamine 10-20 mg po bid or Prazosin 1 mg tid or qid until Hct drops by 5%, no BP > 165/90 in hospital x 48hrs (1hr continuous in PACU), orthostatic hypotension (not below 80/45), ECG normalization, <1 PVC q5min (Roizen criteria). B-Block for tumours that secrete epi, or reflex tachycardia (after effective alpha blockade); Steroid replacement for bilateral adrenalectomies, CCB & Mg for refractory HTN; Preg - <24 weeks remove, >24 treat – epidural, C/S

Anesthetic Options: GETA +/- Epidural; no data that RA is better than GA

Room Setup: CAS + 5 Lead; Aline; Foley; CVP; (PAC, TEE); Temp; Glucometer; ER Drugs (use rapid acting titratable meds, particularly during high risk times like intubation (remi, lido), tumour manipulation (phentolamine, NTP) and ligation of venous drainage (fluid, phenylephrine)

Intraoperative Mgmt: communicate with surgeon throughout; Deep plane of anesthesia prior to stimulation (lido, remi); avoid (ketamine, ephedrine, pancuronium, histamine releasing agents, desflurane); Preremoval: HTN, Tachycardia, arrhythmia (Phentolamine 1-5mg IV, SNP 1-2ug/kg IV bolus, NTG, labetalol, lido, Mg); Postremoval hTN (fluids, phenyl, dopamine, decr anesthetic)

Postoperative: HDU; Monitor HDs and glucose may still be HTN post-op (cleared over 7-10days)

Complications: Hypertension; Hypotension; Hypoglycemia; Adrenal insufficiency (if bilateral)

Pneumonectomy

1. **Postresection pulmonary function** (suitability for procedure)
 - Mechanics (ppoFEV₁>40%) / Lung Function (ppoDLCO>40%) / Cardiopulmonary interaction (ppoVO₂ max>15ml/kg/min)
2. Perioperative **respiratory and cardiac complications**
 - Hypoxemia, hypercapnea, atelectasis, pneumonia, ALI, respiratory failure
 - pHTN with RV failure, Ischemia, Arrhythmias (afib)
3. Co-morbid disease
 - Malignancy 4 Ms (Mass, Metastases, Metabolic derangement, Medications), Smoker, COPD, CAD, PVD
4. Considerations of OLV
 - DLETT placement / Physiologic changes - hypoxia
5. Postoperative pain and monitoring for complications
 - Respiratory failure, Arrhythmia, BPF, Herniation

Anesthetic Goals/Conflicts:

- Optimize respiratory function pre-operatively
- Optimize oxygenation during OLV and plan for immediate extubation
- Optimize respiratory mechanics post-operatively
 - pain mgmt, fluid mgmt
- Minimize modifiable complication risks
- hypothermia, arrhythmias, ischemia

Hx: assess RF for difficult EBT; RESP: dyspnea, exercise tolerance, cough, wheeze, positional aw aggravation; pneumonia; CVS: functional status, RV dysfunction; Hx of underlying resp dz; Malingancy → 4 M's

PE: VS; Distress; AW; RESP (COPD, tracheal compression); CVS (CAD, arrhythmias, pHTN, SVC syndrome)

Investigations: CBC, coags, lytes, iCa, ABG, X-match; CXR, ECG, CT, +/- ECHO; PFTs, V/Q scan

Slinger's 3 legged Stool: Resp Mechanics (ppoFEV₁ < 40%) Gas exchange (ppoDLCO < 40%) Cardiopulmonary interaction (ppoVO₂max < 15ml/kg/min) Other factors: RV/TLC ratio > 50%; < 2 flights stairs; 6 min walk < 2000ft; Exercise SpO₂ < 4%; ppoVo₂ max < 10 ml/kg/min may be an absolute contraindication to pulmonary resection

Optimization: Smoking cessation; COPD optimization; CAD optimization; +/- antiarrhythmia prophylaxis

Anesthetic Options: GA +/- TEA; lung isolation → R or L DLT; Bronchial blocker; Mainstem Bronchus intubation with single lumen tube or 2 single lumen tubes

Room Setup: Drugs (inotropes, vasopressors & antiarrhythmics); CAS monitors, 5 lead ECG, pre A-line; CVP; +/- TEE & PAC; Difficult AW cart; FOB; different size DLT & bronchial blocker; DLT size based on tracheal width (mm) → 18 = 41; 16 = 39; 15 = 37, 14 = 35

Intraoperative Mgt: Volatiles inhibit HPV (halothane worst), consider TIVA; epidural LA / narcotics; maintain 2 lung ventilation as long as possible; avoid N₂O; FiO₂ 0.5-1.0, V_T 5-8ml/kg, PEEP dependant Lung, permissive hypercapnia; may need intermittent 2-lung ventilation, intermittent recruitment maneuvers, CPAP or O₂ insufflation to nondependent lung; minimize peri-op IV fluids; Extubate early to ↓ risk of barotrauma / pulmonary infection; for ppoFEV₁ > 40%, normal extubation criteria; for ppoFEV₁ < 30% + poor exercise tolerance, staged weaning from mechanical ventilation is best.

Post-op: HDU/PAR; Pain control; supplemental O₂

Complications: Hypoxia with OLV; ↑ a/w pressures; herniated heart; ruptured bronchus; RLN injury, RV overload; torsion of lobe on operative side; post-pneumonectomy ALI.

Special → Predictors of Hypoxemia during OLV: Side (R>L); Hypoxemia on 2 lung ventilation; Supine; Normal PFT

Popliteal Nerve Block L4-S3

Note: US techniques use high frequency 10-15MHz probe.

Indications: Ankle and foot surgery

Anatomy: Sciatic nerve at the level of popliteal fossa, superficial and lateral to popl. Art.

Common peroneal gives off sup. and deep peroneal nerves and lateral sural nerve. Tibial gives off medial and lateral plantar nerves and medial sural nerve.

Contraindications: Post-op neurological monitoring, risk of post-op compartment syndrome, previous popliteal artery bypass (relative)

Risks: Infection, hematoma, nerve injury, LA toxicity

Approach: Intertendinous (Classic): Prone, Landmarks: poplit. Crease, tendons of semitendinous and semimembranous medially and biceps femoris laterally. Insert 10cm 22g needle 7cm above the crease, and 1 cm lateral to the midway point bw the tendons. Goal 0.2-0.5mA, 0.7mA if peripheral neuropathy!.

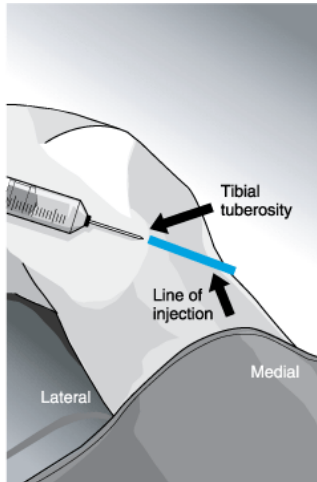
Aim: Plantar flexion or inversion indicative of tibial nerve stimulation which is more reliable than CP (dorsiflexion and eversion).

Lateral: Supine, landmarks are popliteal crease, vastus lateralis (superior) and biceps femoris (inferior). With palpating hand on biceps femoris muscle, insert needle (10cm) perpendicular to skin at point marked 7cm above popliteal crease, midway between tendons. Contact Femur, then withdraw to skin and redirect 30 degrees inferiorly.

35-40mL LA, slow onset 10-25mins

Saphenous NB: *for tourniquet, or supplement popliteal block*

Inject 7-10ml LA subcutaneously from the Tibial Tuberosity, medially.



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Porphyria

1. Risk of Porphyric Crisis
 - a. Avoidance of pharmacologic and physiologic triggers
2. Neurologic dysfunction
 - a. Autonomic - **Hypertension, Tachycardia**, Abd pain, Vomiting, diarrhea, orthostatic hypotension
 - b. Cranial - Bulbar dysfunction (**Aspiration Risk**)
 - c. Peripheral - **Respiratory weakness**, peripheral neuropathies, quadraplegia
 - d. Anxiety, confusion, hysteria, **seizures**, coma
3. CRF with severe **volume depletion** and electrolyte abnormalities
Hypokalemia, hyponatremia (SIADH), hypomagnesemia

Anesthetic Goals/Conflicts:

1. Adequate optimization
 - a. Avoid prolonged fast (dehydration), correct anemia, manage pain/anxiety
2. Avoid triggers:
 - a. Barbiturates, etomidate, steroids, diazepam,
 - b. Fasting, progesterone, estrogen, infection, anemia
 - c. Smoking, ETOH, marijuana, ecstasy, amphetamines, cocaine
3. Be prepared to treat an acute crisis
 - a. Fluids, glucose, hematin, cimetidine, somatostatin, plasmapheresis
 - b. Manage Sz with midazolam/propofol – avoid diazepam, STP, phenytoin

Hx: Determine type of porphyria (acute/inducible), family history, known triggers, current symptoms - focus on CNS (Sz, confusion, neuropathy), bulbar dysfunction, tachycardia, palpitations, CHF, respiratory failure.

PE: Vitals + posturals, volume status, GCS, neuro exam, CVS (HTN / hypotension, tachycardia, CHF)

Investigations: CBC, lytes, BUN, Cr, Glucose, LFTs (if any suspicion of hepatic dysfunction), Mg, Calcium, Coags, ECG (LVH), CXR, +/-PFTs, ABGs

Optimization: Hematology consult, Correct anemia, avoid prolonged fast (IV glucose), aspiration prophylaxis, Correct metabolic abnormalities and volume status, Anxiolysis with midazolam

Room Setup: CAS + 5, art line, aggressive multimodal (regional only if you have a good preop neuro exam)

Anesthetic options: Local, Regional (Preop neuro exam, resp function, bupivacaine), or GA (trigger free)

Intraoperative management: Management dictated by extent of cardiorespiratory dysfunction. Generally – Propofol, Succ, Roc, Narcotic, Volatile, Neostigmine/glycopyrrolate

Acute Porphyria crisis: IV glucose load, fluid bolus (D10NS), Beta-blocker (if hypertensive/tachycardic), Hematin (3-4 mg/kg), octreotide, plasmapheresis (may reduce pain), midazolam/propofol for Sz, Manage electrolyte disturbances

Unsafe Drugs: barbiturates, etomidate, NSAIDs (diclofenac, ketorolac), ACE-I, CCB, Diazepam, Steroids (estrogen, progesterone...), Cephalosporins, Phenytoin, ergotamine

Disbuted: Lidocaine, Maxeran (stemetil OK), other NSAIDs

Posterior Fossa Surgery

1. Risk of inc. ICP / obstructive hydrocephalus
2. Intra –op Complications
 - Injury to vital brainstem structures (CNs IV-XII, CVS/Resp centers)
 - VAE and paradoxical air embolism
 - Hemodynamic instability during brainstem manipulation (arrhythmias, hypotension)
 - Hemorrhage
 - Hypothermia
3. Neurophysiologic monitoring
4. Intraop considerations
 - sitting position
 - Shared airway
 - Prolonged surgical time

Anesthetic Goals/Conflicts:

- Maintain CPP
- Vigilant monitoring of hemodynamics for early signs brainstem injury
- Provide brain relaxation to facilitate surgical exposure
- Prevent and manage complications related to positioning (VAE, hemodynamic instability, tension pneumocephalus, macroglossia, quadriplegia, peripheral nerve injury)

Hx: Establish preoperative neurologic dysfunction – inc. ICP (a.m. headache, N/V), cranial nerve deficits (a/w obstruction, aspiration). Contraindications to sitting position - absolute (Ventriculoatrial shunt; RAP>PCWP; PFO; Cerebral ischemia when upright & awake) & relative (extremes of age; uncontrolled HTN; COPD)

PE: Vitals including GCS, postural BP; Cardiopulmonary for instability & aspiration; Neurological exam for ↑ICP, Cranial Nerve, cerebellar & bulbar dysfunction.

Investigations: CBC, Lytes, BUN, Creat, X-match, Osmolality (Mannitol). Imaging – ECHO to screen PFO; CT head for mass effects/↑ICP/herniation/obstructive hydrocephalus.

Optimization: pre-op dexamethasone for tumor edema, ICP management, volume loading to mitigate positioning hemodynamics, Aspiration prophylaxis

Anesthetic Options: GETA – balanced technique with volatile or TIVA if neurophysiological monitoring (BAER, EMG facial nerve)

Room Setup: CAS with 5 lead (dysrhythmias with brainstem compression), temp probe, Art line transducer on arm (appreciate that Cerebral circulation is above in sitting position), CVP/Bunegin multi-orifice catheter 2 cm below SVC/RA junction (confirmed with TEE/CXR), Precordial Doppler (3rd-6th Right sternal ICS).

Vasopressors/vasodilators (post-op HTN), mannitol, atropine +/-TCP for bradycardia (if in brainstem)

Intraoperative Mgt: Sitting position: SCD's/ G-suit minimize venous pooling, two finger breadths between sternum and chin to ↓potential for macroglossia and cervical cord ischemia, avoid excessive hip flexion (sciatic/ peroneal nerve injury), confirm ETT position with neck flexion;

Post-op: possible **ventilation** d/t A/W edema, CN dysfunction, Cardiopulmonary dysfunction, dec. LOC; HDU to monitor for CVS, resp, neurologic deterioration – inc. ICP, dysrhythmia, central apnea, aspiration

Complications: VAE, brain stem dysfunction (ECG changes are sensitive), tension pneumocephalus (CSF replaced with air – H/A, Sz, confusion, dec. LOC – CT, burr hole), quadriplegia (ischemia d/t cervical flexion)

Preeclampsia and HELLP Syndrome

1. Pregnancy
2. Difficult airway
 - Airway edema of pregnancy exaggerated
3. Complications and organ dysfunction
 - ICH, seizures, cerebral edema
 - Compensated hypovolemia, LV dysfunction, HTN crisis, HD instability and shock
 - Noncardiogenic pulmonary edema (dec. oncotic pressure)
 - Renal dysfunction, Thrombocytopenia, coagulopathy, infrequently DIC
 - HELLP syndrome (Hemolysis, Elevated Liver enzymes, Low Platelets)
4. Considerations of antihypertensive / anticonvulsant therapy
5. Risk of fetal distress and need for operative delivery
6. Decreased UPP, IUGR, abruptio placentae, premature labor and delivery

Anesthetic Goals/Conflicts:

- Control maternal HD - prevent HTN crisis & ICH
- Prevent & manage eclampsia – MgSO₄
- Optimize intravascular volume & avoid pulmonary edema
- Optimize end organ perfusion and oxygen delivery, including UPP

DDx: Pain, Cushing's, hypoxia/hypercarbia, cocaine, withdrawal, NMS, serotonin syndrome, essential hypertension, pheo, thyrotoxicosis, carcinoid

Hx: Rule out other causes, evaluate for end organ dysfunction (evaluation of CNS, cardioresp, coagulation, GI, renal all important); Risk factors – Chronic HTN, primip, Previous Hx, multiples, Age, Race, Obesity

PE: airway airway airway; VS, volume status, heart failure, bruising

Investigations: serial CBCs, G&S, lytes, BUN, Cr, Uric Acid, U/A for protein, LFTs, CXR, 12 lead, ECHO

Optimization: Asp. prophylaxis, close communication with OB & NICU, early IV access/bloodwork, serial CBCs, early labour epidural, MgSO₄ for Sz prophylaxis (6 g IV bolus over 15 minutes, then 1 – 2 g/hr / monitor for toxicity / resp depression, dec. reflexes / antidote – CaGluc 1 amp, potentiates NMB), antihypertensive therapy (Labetalol 5 mg IVP, doubling q5min max 300 mg, Hydralazine 5 – 10 mg IV q10 minutes, NTG 50 – 100 µg IVP, nitroprusside, Nifedipine, Esmolol 1.5 mg/kg to blunt ↑ BP associated with laryngoscopy); platelets (count <50), steroids?

Room Setup: CAS +5 lead +/-art line +/-CVP for CHF, IV x2; difficult A/W cart; Consider blood warmer, immediate access to PRBC, FFP, Plts; Draw up additional induction agent +/- remi, esmolol; Peds and OB

Intraoperative Mgt: Regional if no contraindications (coags, thrombocytopenia, inc. ICP) – volume load with colloid prior to regional (no fluid with GA – aim for 80ml/kg), tight hemodynamic control; GA requires deep induction – Thio 4mg/kg, lido 1.5mg/kg, remi 1-2u/kg (or +/- esmolol 1.5mg/kg), sux 1.5mg/kg; treat hypotension. If bleeding secondary to uterine atony, TIVA is reasonable

Post-op: HDU for 24-48 hrs post-op (hypertension may peak post partum)

Complications: DIC, PPH, pulmonary edema, Seizures, ICH, ARF

Classifications: Chronic HTN: before 20wks; Preeclampsia: HTN > 20 wks SBP>140 or DBP >90 AND proteinuria of >0.3g/24h; Severe preeclampsia: SBP>160 or DBP>110; proteinuria >5g/24h or >3+; CNS dysfunction: blurred vision, altered mental status, severe headache; Liver capsule distension: RUQ or epigastric pain; ↑ transaminases of 2X normal; Thrombocytopenia < 100,000; Oliguria < 500 mls in 24 hours; IUGR; Pulmonary edema or cyanosis; CVA; Eclampsia: above plus seizures

Prematurity

1. Altered airway anatomy
2. Impaired temperature and glucose regulation
3. Other physiologic derangements of prematurity
 - Resp – RDS, BPD, rapid desat, post-op apnea, persistent pHTN
 - CVS – HR/preload dependant CO, Transitional circulation/PDA, bradycardia, CHD
 - CNS - IVH, seizures, ROP
 - GI – GERD, NEC
 - Heme - Anemia, thrombocytopenia
 - Altered pharmacology – inc. V_d , opioid sensitivity, dec. clearance, protein binding, metabolism, dec. MAC
4. Difficult IV access and monitoring

Uncuffed ETT size

2.5 for < 1000g or 28 weeks

3.0 for 1000-2000g or 28-34 weeks

3.5 for 2000-3000g or 34-38 weeks

3.5-4.0 for larger / older neonates

Anesthetic Goals/Conflicts:

1. Ensure optimization of multisystem derangements including respiratory, cardiovascular, hepatic, renal, hematological
2. Anticipate fluid / electrolyte / glucose derangements and optimize preoperatively
3. Ensure continuous temperature monitoring and maintain normothermia

Hx: PCA, Obstetrical hx, PMHx since birth and assess for complications (IVH, retinopathy, PPHTN/PDA, CHD, RDS/BPD, hx apnea, GERD, NEC, hypoglycemia, anemia, thrombocytopenia, etc), meds

PE: Vitals, weight, ins/outs, IV access, ventilator parameters, CVS (cap refill, fontanel, perfusion, murmurs, CHF), RESP (WOB, retractions, wheeze, crackles)

Investigations: CBC, lytes, Cr, coags, bili, glucose, ABG, CXR, AXR, head U/S, ECHO

Optimization: Optimize volume status (esp if CHF), glucose, acidosis, coagulopathy, transfuse (Hb>100 if cardioresp disease), NPO (2hrs clear fluid, 4hrs breast milk), pretreat with atropine/glycopyrrolate, Vit K (1mg)

Anesthetic Options: GA – muscle relaxant + opioid may be tolerated best.

Room Setup: Warm room/forced air warmer, consider NICU ventilator, epinephrine/resusc drugs drawn up to exact doses, pre & post-ductal SpO₂, appropriately sized ETT (leak at 20cm H₂O , circuit

Intraoperative Mgt: Depends on case, avoid SNS stim (risk of IVH), muscle relaxant/narcotic vs. desflurane/remifentanyl for rapid emergence; be aware of impaired metabolism/excretion of drugs, FiO₂ to maintain SaO₂ 88-92%

Complications: PTX, hypoglycemia, paradoxical air embolism

Post-op: Apnea monitoring if PCA < 50-60 wks (risk fx: prematurity, PCA, HCT <30%, hx apnea, chronic respiratory disease e.g. BPD, neurological disease)

Pulmonary Hypertension

Mean PAP > 25mmHg at rest or 30mmHG during exercise

1. Potential for acute perioperative RV dysfunction and hemodynamic collapse
2. Optimize pulmonary pressures and right heart function
 - Avoid hypoxia, hypercarbia, acidosis, hypothermia, sympathetic stimulation (pain), high/low lung volumes
 - Cautious fluid administration
 - Maintain RV perfusion
3. Associated Conditions
 - COPD, obesity, OSA, CHD, valvular disease (MR), CHF, CTD, HIV, recurrent thromboembolic disease
4. Medication
 - Anticoagulation / CCBs / Vasodilators (e.g. sildenafil) / Prostacyclin analogs (e.g. Epoprostenol/Flolan) / Endothelin antagonists (e.g. Bosentan) / Diuretics
5. Need for invasive monitoring, optimized analgesia & post op disposition

Anesthetic Goals/Conflicts:

- Ensure patient is OPTIMIZED – Resp, Cardio, alternatives to OR (medical management etc.)
- Avoid increases in PVR (minimize pain, sympathetic stimulation, hypoxia, hypercarbia, acidosis, optimize airway pressures - **Conflict with hypoxia/hypercarbia vs. PPV**)
- Optimize RV function (careful fluid administration, maintain RV perfusion (afterload))
- Be mindful of ventricular interdependence

Hx: Fatigue, functional capacity, ischemia, RHF, presyncope/syncope, orthopnea/PND, cyanosis, hemoptysis. Underlying etiology, medications, investigations/ECHO.

PE: pHTN: large A wave, Loud P2, RV heave, TR (high pitched pansystolic murmur @ 4th intercostal space in the parasternal region), dec. CO, S3/S4, JVD, hepatomegaly, ascites, dependent edema

Investigations: CBC (polycythemia), elect, coags if on AC's, ABG, ECG – RVH R/S ratio in V1 and V2 of 1 and S waves > than 3mm in V5 or V6, P pulmonale > 2.5mm II/III/AVF. CXR – globular heart, prom. or engorged pulm. vasculature, chronic lung dx. ECHO-TR/PAP, EF, cardiac size, fnx. VQ scan if thromboembolic disease, PFTs, R sided angio= gold standard, can trial nitric oxide and assess resp.

Optimization: Resp consult: Rx resp infections, Rx bronchospasm (bronchodilators, mucolytics, steroids), Inotropes for RVF (dobut/milrin) consider neb 5mg. Ensure optimal preload. Rx: pHTN, heparinize pt if indicated, cont pHTN meds. Must cont. PGI₂ infusion (short half-life) 3-5 mins, can get rebound htn. Start or cont. chronic therapy for pHTN: Nifedipine 30-240mg PO OD, Diltiazem 120-900mg PO OD, Epoprostenol (PGI₂) 2-150ng/kg/min IV or inhaled (60mcg aerosolized?), Sildenafil 50mg PO BID, Bosentan (a dual endothelin receptor antagonist) 125mg bid - S/E: anemia/fluid retention. Home O₂, phlebotomy if HCT >50%

Anesthetic Opt: Regional preferred (sympathectomy), avoid ketamine (↑PVR), IV anesthetics are safe

Room Setup: Pulm vasodilators: NO, NTG, Nirpride, Hydral, Inhaled NO (SE: inhibit plt agg, - inotrope, methHgb), CCB: Nifedipine/Diltiazem, PGE₁, prostacycline (PGI₂), Adenosine, Ach, Inotropes: Dobutamine (0.1-10mcg/kg/min)/Milrinone/Vasopressin if needing inc. SVR w/o PVR increase.

CAS/Invasive lines/PAC/TEE (note PAC risks arrhythm/rupture)

Intraoperative Mgt: Risk of hTN/ CVS collapse, avoid ketamine, hyperventilate, ↑ or ↓ TV w/PEEP ↑PVR. Any tech. is ok, as long as hemodynamic goals met, consider TIVA.

Post-op: HDU, consider RVAD for RHF or ECMO if awaiting Tx.

Pyloric Stenosis

1. Medical, not surgical, emergency
2. High risk for aspiration
3. Metabolic derangement
 - a. Hypochloremic metabolic Alkalosis
 - b. Hyponatremia & hypokalemia
4. Severe dehydration
5. Risk of post-operative apnea
 - a. Persistent metabolic alkalosis
 - b. Considerations of neonate/infant

Anesthetic Goals/Conflicts:

1. Optimize fluid and acid-base deficits prior to anesthesia
 - a. ($\text{Na}^+ > 130$; $\text{K}^+ > 3.0$; $\text{Cl}^- > 90$; $\text{HCO}_3^- < 27$; U/O 1 cc/kg/hr; normal HR/BP/RR)
2. Prevent aspiration – OG suction prior to induction
3. Ensure adequate postoperative monitoring
4. Conflict being difficult a/w and RSI

Initial Goal is to determine the degree of dehydration: <5% - 50cc/kg 5-10% - 100cc/kg >10% - 150cc/kg

Hx: 1st born M; 2nd – 6th wk; projectile nonbilious vomiting (Hx), feeds; Vol. status (tears, diapers, lethargy)

PE: VS; Wt; MM; Ant fontanelle; Sunken eyes; Cap refill; Skin Turgor; Activity (lethargy; olive sign)

Investigations: CBC, electrolytes, BUN, Cr, glucose, ABG, bilirubin unconjugated, U/A; Classic abn: hCl, hNa; hK metabolic alkalosis; HypoK (2' hyperaldosteronism); If severe volume depletion, can have metabolic acidosis (metabolic abn less common now because of earlier presentation); US to confirm Dx.

Optimization: May take 12 to 72 Hrs to correct volume and metabolic abn: IV; Use NS in 20 cc/kg boluses to replace deficit and titrate to clinical criteria outlined above and U/O of 1 cc/kg/hr

Maintenance of D5NS + KCl 20-40 mEq/L at 1 to 1.5x maintenance requirement of 4 cc/kg/hr

Prevention of aspiration: 14F NG suctioned with child in various positions (does not ensure empty stomach);

Pre-operative acetaminophen 20-30 mg/kg rectally.

Anesthetic Options: Generally, GA vs neuraxial anesthesia (SAB: 0.8 mg/kg of bupiv 0.5% vs Caudal: Large doses of 1.6 mL/kg (4 mg/kg) of 0.25% bupivacaine)

Room Setup: Routine + ER meds (atropine, Sux); CAS + T° probe; Neonatal setup (neonatal circuit, warm room, warming blanket and lights).

Intraoperative Mgt: RSI (P 4-6; Sux 2; or Remi 2-4); Continue Maintenance IV; Maintain on Volatile or TIVA; Avoid hyperventilation (worsens resp alkalosis); LA to wound.

Post-op: Monitored bed for apneas for 12-24 hrs (inc. risk with metabolic alkalosis); Analgesia: Caudal; Tylenol; Local anesthetic infiltration by surgeon; Postop narcotics are not required

Complications: Fluid, electrolyte & metabolic imbalance uncorrected; Aspiration; Apnea postoperatively

Restrictive Lung Disease

1. Increased risk of **perioperative respiratory failure, pneumonia, PTX**
 - Cancel elective procedures if there is an acute + reversible processes
 - **higher risk if VC < 15 ml/kg, FVC<50% or 500cc, or pCO₂>45**
2. Potential **difficult BMV** and **rapid desaturation** - dec. compliance, lower SaO₂, dec. FRC
3. Respiratory physiologic changes
 - **Hypoxemia** (V/Q mismatch)
 - **Decreased compliance** - Inc. Pk Pressures - **barotrauma**
 - **pHTN** and RV dysfunction / cor pulmonale-AVOID INC PVR
4. **Etiology / Co-morbid** disease states
 - CTD/ autoimmune disease, IPF, ARDS, Obesity, Neuromuscular, kyphoscoliosis
5. Medications
 - **steroids**, immunosuppressives, **bleomycin**, amiodarone, oxygen
 - May be very sensitive to CNS depressants (opioids)
 - degree depends on etiology / inc. dead space ventilation

Anesthetic Goals/Conflicts:

- Preoperative optimization of pulmonary function
- Either minimally invasive (LA or regional) or maximally supportive (slow wean)
- Lung protective ventilation
 - Low V_T, inc. RR, inverse ratio, pressure control, PEEP
- Avoid precipitants of pHTN
- Optimal postoperative pain management
- encourage postoperative mobilization

Hx: Etiology of RLD; Severity of RLD and treatments; Dyspnea, exercise tolerance, recent infections, hemoptysis, cough, meds (bleomycin), (home O2); Smoking; CVS: Angina, CHF, orthopnea, PND; Supine symptoms (mediastinal mass)

PE: AW; SVC syndrome (facial swelling); ↑WOB; cyanosis ($SpO_2 < 80\%$, $P_aO_2 < 50\text{mmHg}$), clubbing AE: crackles (fine vs coarse) wheezing; pHTN - Loud, fixed, widely split S2, palpable P2; RVH - RV heave, S4; RV failure - JVD, S3, hepatomegaly, ascites, dependent edema; skeletal abnormalities, obesity, abdominal distension causing restrictive lung pattern

Investigations: CBC, lytes, CXR, ABG, EKG (RAE, RVH), PFT (dec VC, TLC, normal FEV1/FVC), consider echo

Optimization: Resp consult, treat infection, drain pleural effusion and ascites, diuretics if fluid overloaded, NG to decompress distended abdomen

Room Setup: pHTN drug, spirometry, difficult A/W cart b/c risk of difficult BMV

Intraoperative Mgt: Minimize drugs that depress ventilation; Consider epidural; Avoid N2O (PTX); May need stress dose steroids; PCV – keep PAP < 30 mmHg, inverse ratio, permissive hypercapnea

Post-op: Risk of Postoperative pulmonary complications /ventilation; Incentive spirometry; Early ambulation

Special: FiO2 to goal O2 sat = 88-92% if history of bleomycin

Rheumatoid Arthritis

- 1) Potential for difficult airway (AAI, limited neck ROM, unstable C-spine)
- 2) Multisystem disease including cardiac, pulmonary, renal, hematologic involvement
 - CVS: pancarditis, AI, pericardial effusions, conduction system defects
 - Resp: RLD, interstitial fibrosis, pHTN, pleural effusions, nodules
 - Renal: CRF
 - Chronic anemia
- 3) Co-existing Diseases
 - SLE, amyloid, IHD, cancer, DM, osteoporosis, PUD, infections
- 4) Medications
 - Corticosteroids, Immunosuppressives: cyclosporine, cyclophosphamide, MTX, NSAIDs, Chronic pain meds
- 5) Technical difficulties with access. patient positioning, & fragile skin

Anesthetic Goals/Conflicts:

- Assume unstable c-spine unless radiographic evidence to the contrary
- Difficult AW should be anticipated
- Careful positioning and documentation of pre-existing neurologic symptoms
- Multimodal analgesia

Hx: Duration of illness (RFs for AA subluxation include male gender, severe arthropathy and longstanding disease, neck symptoms, rheum factor positive), A/W – cricoarytenoid arthritis, evidence of AAI (occipital H/A, dysphagia, dysphonia, diplopia, neck/arm pain, dizziness, U/E numbness); functional capacity, dyspnea, cough, chest pain; joints/systems involved; meds/side effects, bruising/bleeding, fatigue; peripheral neuropathies

PE: A/W, neck ROM, mobility of A/W structures, CVS exam (LV dysfunction, effusions, pHTN, valvular Dz); Resp (pulmonary fibrosis, effusions) Neurologic dysfunction; restricted mobility; access options.

Investigations: CBC, Lytes, BUN, Cr, Coags, ECG, CXR (if significant pulmonary involvement), ABG +/- PFTs, Cspine Flex/Ex views (atlanto-dental interval > 3-4mm is abnormal), MRI of Cspine; ECHO

Optimization: Consider Spine consult, ENT for cricoarytenoid arthritis (awake trach) stress dose steroids, Iron +/-EPO pre-op, blood conservation

Anesthetic Options: GA or regional may be used. Awake FOB is recommended but any technique that minimizes neck flexion may be appropriate; LMA may be difficult. Neuraxial OK (relative sparing of TL spine).

Intraoperative Mgt: AFOB, smaller ETT; Exaggerated hemodynamic responses; Careful positioning; eye drops (Sicca); Aggressive multimodal analgesia. Extubate awake, warm, comfortable, reversed.

Post-op: Dictated by degree of cardiorespiratory compromise; Ventilation may be required d/t RLD

Complications: neurologic deficits, post intubation edema or cricoarytenoid dislocation (stridor)

Other manifestations of disease: Peripheral neuropathies, anemia, thrombocytopenia, bruising/bleeding, renal dysfunction secondary to vasculitis/GN/infiltrative disorders, pleural effusions, interstitial fibrosis, pulmonary nodules, pulmonary hypertension, heart failure (may be ischemic or infiltrative), pericarditis, pericardial effusions, coronary arteritis, heart block, aortitis, airway involvement (with involvement of cricoarytenoids), and many other multisystem manifestations

Rigid Bronchoscopy

1. Shared / unprotected airway
 - a. need for good communication with surgeon
 - b. risk of aspiration
2. Anticipated complications
 - a. A/W obstruction (supra or infraglottic), injury, or edema
 - b. pneumothorax
3. Considerations of jet ventilation
 - a. Barotrauma
 - b. Pulmonary tamponade
4. Comorbidities
 - a. Underlying condition – acute/chronic pulmonary problems, cancer – 4M's
 - b. cardiac disease, smoker, EtOH, elderly
5. Need for deep plain of anesthesia/muscle relaxation

Anesthetic Goals/Conflicts:

- Good pre-oxygenation
- Excellent muscle relaxation
- Maintain adequate oxygenation and ventilation
- SV with insufflation vs. paralysis and jet ventilation
 - a. Depends on ease of A/W access, intraluminal vs. extraluminal compression

Hx: Standard history with focus on respiratory, airway concerns, functional capacity; Eaton-lambert assoc'd with lung ca; Positional dyspnea; EtOHism assoc'd with H&N cancers

PE: Standard cardiopulm exam. Careful airway exam assessing for upper a/w obstruction

Investigations: CBC, ABGs, CXR +/- CT chest, PFTs (don't necessarily need all these test but see if available in chart)

Optimization: Preop respiratory function (inhalers/nebs is appropriate), +/- antisialagogue

Room Setup: Standard monitors, prepare for TIVA, have ETT and appropriate A/W equipment ready, jet ventilation

Intraoperative Mgt: Good pre-oxygenation, TIVA, SV for FB removal / difficult A/W access, muscle relaxation (sux vs. NdMB), good communication with surgeon, timed ventilation with procedure. Hyperventilate in preparation for periods of apnea.

Post-op: Emergence may be stormy with coughing up of secretions or blood. Usually post-op pain is minimal so only use short-acting opioids during the case.

Potential complications:

Hypoxemia, Hypercapnia, hemorrhage, Tacheobronchial injury, airway obstruction (bronchospasm, bleeding, tissue, FB), aspiration, dental damage, pneumothorax

Cerebral Aneurysm & SAH

- 1) Emergency case
 - unprotected airway/decreased GCS
 - unsecured aneurysm with risk of rupture
- 2) Increased ICP with the need to maintain CPP while minimizing transmural pressure
 - Maintain high/normal MAP to prevent critical reductions in CBF
 - Avoid / manage inc. ICP (avoiding transmural pressure)
- 3) Identify and manage Complications
 - Surgical: Rebleeding, vasospasm, hydrocephalus, seizures
 - Medical: LV dysfunction, neurogenic pulmonary edema, SIADH, cerebral salt wasting
- 4) Facilitate surgical exposure - Brain relaxation after dural is open

Anesthetic Goals/Conflicts:

- Optimize O₂ delivery & CPP while avoiding intracranial transmural pressure (HTN, rapid dec. in ICP)
 - With inc. ICP, conflict between minimizing transmural pressure (deep induction) and maintaining CPP (hemodynamic support)
- Avoid secondary injury - hyperglycemia, hyponatremia, hyperthermia, elevated HOB
- Prevention of rebleeding (early surgical management) & vasospasm (nimodipine, pravastatin)
- Facilitate rapid postoperative neurological assessment

Grade I – Asymptomatic or minimal headache/ slight nuchal rigidity; **Grade II** – Mod – severe headache, nuchal rigidity, cranial nerve palsies but not other deficits; **Grade III** – Drowsiness, mild confusion or mild focal deficit; **Grade IV** – Stupor, mod-severe hemiparesis, possible early decerebrate rigidity, vegetative; disturbances; **Grade V** – Deep coma, decerebrate rigidity, moribund appearance

Hx: Focused. Evidence of cardiopulmonary compromise. Timeline of events (rebleed most common in the first 6-12 h). Mechanism (suspicion of aspiration, possible C-spine injury), H&H scale, co-existing aneurysms, co-morbidities that might alter targets for CPP or otherwise complicate management

PE: Vitals including temp, GCS, A/W for ease of intubation, continuous monitoring (arrhythmias), assess extent of inc. ICP, Cardiopulmonary assessment looking for evidence of ventricular dysfunction (S3, S4), pulmonary edema, or suspected aspiration. Focused neuro exam.

Investigations: CBC, Lytes (hypoNa), BUN, Cr, glucose, G&S, ABG, ECG (ST changes, canon T waves, prolonged QT, U waves), trops if suspected ischemic changes, CXR, ECHO if suspicious for LV dysfunction

Optimization: Aspiration prophylaxis, Goal CPP is 60mmHg (ischemia <50, ARDS >70), euvolemic, minimize inc. ICP (caution dropping ICP if unptotected aneurysms) Nimodipine, Pravastatin

Room Setup: CAS + 5 lead, Art (don't delay if severe inc. ICP) CVP (triple H therapy - volume status, vasoactive agents), Temp, glucometer, foley, ICP control (mannitol, lasix), titratable vasoactive agents (? Ups, downs, adenosine). Consider STP for burst suppression if rupture, Lumbar drain may be considered. Possible neurophysiologic monitoring (SSEP/EEG)

Intraoperative Mgt: Imperative to prevent rupture or rebleed during induction. Minimize transmural pressure during stimulating parts of procedure (lido/prop/remi for intubation) TIVA for maintenance (brain relaxation), consider inc. MAP by 15% during temporary clipping, Crisp emergence – avoid coughing

Complications: Hypertension +/- bradycardia = rebleed/rupture – therapeutic hypotension (dec. bleeding to allow surgical exposure and control of aneurysm) burst suppression (cerebral ischemia due to clips– reduce CMR), inc. MAP once aneurysm controlled, hydrocephalus, herniation, vasospasm

Post-op: BP control (labetolol, hydralazine, ACE-I), ICU post-op, triple-H therapy (hypertensive, hypervolemic, hemodilution – may result in pulm edema and myocardial ischemia), Dx for delayed awakening = anesthetic, ictal/post-ictal, bleeding, ischemia, metabolic (hypercarbia, hyponatremia, hypoglycemia). CT early.

SAB Contraindications

1. Contraindications (see below)
2. Level of block needed for surgery
3. Complications of technique
4. Physiological consequences of sympathectomy and ability to tolerate given co-morbid conditions
5. Anesthetic of choice and pharmacological actions

Contraindications:

	Miller	Barash	Chestnut	Toronto notes :)
Absolute	Patient refusal Raised ICP Inability to remain still	Patient refusal	No definitive list - very surprising and frustrating	Patient refusal Lack of proper equipment Lack of trained personnel Lack of IV access Overlying infection Hypovolemia Coagulopathy Raised ICP
Relative	Coagulopathy Overlying infection Severe hypovolemia	Hypovolemia/Shock Increased ICP Coagulopathy/Thrombocytopenia Sepsis Overlying infection		Bacteremia Pre-existing neurological disease Aortic/mitral stenosis Prior spinal surgery Other back problems Unstable psychiatric disease or emotional instability
Other considerations	Pre-existing neurological disease (usually medicolegal consideration)			

Sarcoidosis

Systemic granulomatous disorder that involves many tissues but has a predilection for intrathoracic lymph nodes and lungs

1. Multisystem granulomatous disease:
 - a. CNS: Ocular sarcoidosis may produce uveitis, unilateral facial palsy.
 - b. CVS: Conduction defects, dysrhythmias
 - c. Resp: Endobronchial sarcoid, laryngeal sarcoidosis/stenosis, pulmonary fibrosis, pHTN and cor-pulmonale.
2. Metabolic derangement: Hypercalcemia
3. Medications
 - a. Corticosteroids are administered to suppress the manifestation of sarcoid and to treat hypercalcemia – Stress dose steroids.

Anesthetic Goals/Conflicts:

TABLE 3. Cardiac Conditions Associated With the Highest Risk of Adverse Outcome From Endocarditis for Which Prophylaxis With Dental Procedures Is Recommended

Prosthetic cardiac valve

Previous IE

Congenital heart disease (CHD)*

Unrepaired cyanotic CHD, including palliative shunts and conduits

Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure†

Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization)

Cardiac transplantation recipients who develop cardiac valvulopathy

*Except for the conditions listed above, antibiotic prophylaxis is no longer recommended for any other form of CHD.

†Prophylaxis is recommended because endothelialization of prosthetic material occurs within 6 months after the procedure.

TABLE 5. Regimens for a Dental Procedure

Situation	Agent	Regimen: Single Dose 30 to 60 min Before Procedure	
		Adults	Children
Oral	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin	2 g IM or IV	50 mg/kg IM or IV
	OR Cefazolin or ceftriaxone	1 g IM or IV	50 mg/kg IM or IV
Allergic to penicillins or ampicillin—oral	Cephalexin*†	2 g	50 mg/kg
	OR Clindamycin	600 mg	20 mg/kg
	OR Azithromycin or clarithromycin	500 mg	15 mg/kg
	Cefazolin or ceftriaxone†	1 g IM or IV	50 mg/kg IM or IV
Allergic to penicillins or ampicillin and unable to take oral medication	OR Clindamycin	600 mg IM or IV	20 mg/kg IM or IV

IM indicates intramuscular; IV, intravenous.

*Or other first- or second-generation oral cephalosporin in equivalent adult or pediatric dosage.

†Cephalosporins should not be used in an individual with a history of anaphylaxis, angioedema, or urticaria with penicillins or ampicillin.

Sciatic Nerve Block L4-S3

Indications: For any L limb procedure (may req. saph supplementation), for entire LL with femoral NM. Particularly for below knee procedures or for post op pain management.

Contraindications: Usual + infection at the site.

Distribution of Anesthesia: Post. Thigh, hamstrings and biceps muscles, complete anesthesia below knee except medial strip of skin (saphenous).

Complications: Nerve injury (predisposition for ischemia) avoid tourniquet and epinephrine, hematoma, vascular puncture. LA toxicity, cardiac arrest 0.01%.

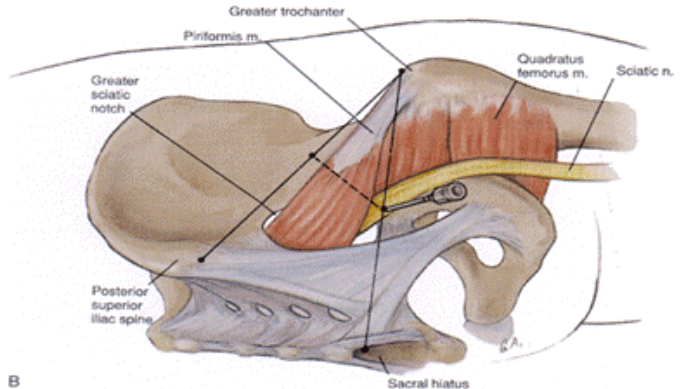
Technique: Standard CAS Monitors, 25-27G, 10-15cm Stimuplex, Sciatic nerve passes from pelvis through the sacrosciatic foramen below piriformis.

Classic approach of Labat: Pt is lateral with operative side up, knee flexed 90 degrees. Line connecting PSIS to greater trochanter, a perpendicular line is then drawn bisecting this line and extending 5 cm caudad. Another line is drawn from the greater trochanter to sacral hiatus. (Note Winnie approach is 1cm below SH). Insert needle to a depth of 5-8 cm (gluteus muscle twitches disappear). Hamstring twitches, dorsiflexion or plantar flexion are acceptable. At 0.2-0.4mA use 20-30ml of LA.

Anterior Approach Classic: Inguinal ligament divided into 3 parts. Transtrochanteric line parallel to Inguinal ligament (Start at greater trochanter and draw parallel to IL). Then draw a line perpendicular to both the inguinal ligament and the TT line at the point where the medial third of the ligament meets the middle third. Use a 15cm long insulated needle and start at 1.5-2mA. Advance need perpendicularly. If the femur is contact, reinsert slightly medially and advance 4-5cm deeper. May rotate the leg internally to help. Or start 1-2 cm medial and aim lateral. – hamstrings not acceptable with ant. approach

When using tourniquet epinephrine should not be used due to risk of ischemia!

Anterior approach of Raj: Line drawn bw greater trochanter and ischial tuberosity
Site of introduction of needle is
Midway bw these two points.



Scleroderma

1. **Difficult airway** (microstomia, ↓ neck mobility, bleeding from nasal & oral telangiectasiae) and high risk of **aspiration** (esophageal dysmotility with ↓ LES tone)
2. Multi-organ Dysfunction (d/t fibrosis):
 - CVS: pancarditis, LV failure, pericardial fluid, conduction disease, HTN, ischemia
 - Resp: RLD (pulmonary fibrosis), pHTN, cor pulmonale and RVF
 - Renal failure & “renal crisis”: accelerated HTN, ARF, hemolytic anemia; ensure ACEi
 - Hypothyroidism
3. Peripheral vasoconstriction with hypovolemia
 - Avoid hypothermia
4. Difficult vascular access / positioning / monitoring (dermal thickening, calcification, contractures)
5. Myopathy (sensitivity to NMBs)
6. Medications: immunosuppressives, steroids, vasodilators (ACEi), pulmonary vasodilators

Anesthetic Goals/Conflicts:

- Anticipate difficult airway and prevent aspiration
 - Difficult airway vs aspiration risk
 - RSI in patient with limited reserve
- Avoid increases in PVR
 - Difficult ventilation (RLD) vs. need to avoid inc. PVR
- Prevention of hemodynamic instability with volume resuscitation and titrated anesthetic
- Prevention of vasoconstriction episodes by avoiding hypothermia and other precipitants
- Possible CI to radial art line in patient with significant cardioresp disease

Hx: Functional capacity. Symptoms of reflux, swallowing problems, biventricular failure (edema, coagulopathies, RUQ pain, PND, orthopnea...), arrhythmias (syncope, palpitations...); Dyspnea, no-productive cough neuropathy; Prior anesthetic history with focus on airway (nose bleeds), access. Medications including steroids last 6 months, cyclosporine (renal tox), cyclophosphamide (lung/renal tox)

PE: Vitals, with postural BP, volumestatus; Airway, access, extent of contractures, reynaud's, cardiorespiratory exam (looking for evidence again of restrictive lung disease, CHF, pHTN and cor pulmonale - peripheral edema, hepatomegaly, ↑ JVP, +ve HJR, HSM, loud P₂, RV heave, pericarditis – rubs, pulsus paradoxus)

Investigations: CBC, Lytes, Bun, Cr, LFTs, Coags (malabsorption), ABG, CXR (falure), ECG (conduction Dz, RVF, pHTN, pericarditis), PFTs, ECHO

Optimization: Consult Rheum, Resp (possibly pHTN specialist), Cardio, Nephro. Trial pulmonary vasodilators. Treat reversible pulmonary disease (eg pulmonary edema, infection...). Aspiration prophylaxis

Anesthetic Options: Regional preferred if possible – epi free local, avoid respiratory muscle block, assess coagulation. If GA then RSI vs FOB, avoid nasal d/t bleeding, difficult surgical A/W

Room Setup: Dependent on extent of organ dysfunction. CAS monitors + 5 lead. Consideration of pre-induction A line despite risks. CVP, PAC, TEE depending on extent of pHTN, RV dysfunction; Pulmonary vasodilators and wide selective of resuscitative drugs should be available (including vasopressors and inotropes). If inhaled nitric oxide or Flolan are considered then specialized equipment will be required. Difficult airway cart. Consider ICU ventilator; Warm room (21°C) & fluid

Intraoperative Mgt: Need to identify goals (avoid inc. pHTN); Volume resuscitate; caution with NdMB; Aggressive multimodal analgesia (may be sensitive to CNS and resp depressants). May require post-op vent.

Post-op: Determined by cardiopulmonary involvement - HDU

Complications: Difficult A/W, hypoxemia, Hemodynamic collapse on induction (hypovolemia, cardiac dysfunction)

Scoliosis

1. Etiology: idiopathic vs. non-idiopathic (neuromuscular Dz, congenital abnormalities)
2. Restrictive Lung Disease:
 - a. pHTN with cor pulmonale; postop resp failure; prolonged ventilation
3. Cardiovascular abnormalities:
 - a. CHD; cardiac conditions associated with NM disease etc
4. Surgical Consideration:
 - a. blood loss; hypothermia; AW edema; Prone/Lat; OLV if Thoracic approach
 - b. Spinal cord integrity: wake-up test / SSEP / MEP's
5. Post-op pain control – clonidine, gabapentin, ketamine, opioids

Anesthetic Goals/Conflicts:

- Avoid exacerbations of pHTN (hypoxemia, hypercarbia, acidosis, hypothermia, light anesthesia & pain)
- Balance perfusion pressure to spinal cord vs. need for mild hypotension to minimize blood loss
- Manage anesthetic agents to allow adequate monitoring of spinal cord integrity (SSEPs / MEPs)
- Vigilance for life threatening complications of VAE or major vascular injury (aortic, vena caval or iliac vessel)
- Optimize for postoperative wean from ventilation

Hx: Scoliosis hx (extent of disease, etiology): functional capacity, recurrent infections; CHD, NM disease, CTD, preexisting CNS deficits; Nutritional status; Surgical Plan – Approach & monitoring to be employed

PE: Vitals, airway, **CV/Resp exam**, RVH & cor pulmonale (increased JVP, peripheral edema, hepatomegaly, +HJR, RV heave, loud P2, wide split S2, unexpected murmurs, cyanosis, clubbing), Neuro deficits, scoliosis

Investigations: CBC, G&S, Coags, ABGs if RLD, CXR for chronic lung disease, spinal xray, ECG, +/- echo if applicable, PFTs

Optimization: Preop Hgb optimization, Respiratory health optimal, Preop Clonidine (3ug/kg) and Gabapentin (10mg/kg)

Room Setup: CAS monitors, 5 lead ECG, a-line, good IV access, fluid warmers, forced air warmer, emergency drugs, TIVA infusions, TXA, SLETT vs DLETT, monitor for VAE (Doppler, TEE)

Intraoperative Mgt: Induction with hemodynamic goals in mind, short-acting NdMBs, Maintenance MEPs→no muscle relaxation, SSEP→ TIVA or low-dose volatile, prepared for prone or lateral position, TXA (100mg/kg bolus and 10mg/kg/hr) adequate analgesia

Post-op: Possible ICU, post-op vent – depends on pre-op cardiorespiratory reserve, intra-op events, length of procedure, adequacy of analgesia, temperature, a/w edema, etc.: pulmonary function is expected to worsen in first 7-10 days

Special: Complications: intra-op blood loss, neuro deficit (stop surgery, ensure adequate oxygenation/ventilation, raise BP to above preop, check Hg, r/o surgical causes), VAE, vascular injury, post-op resp failure (RF: VC <40%)

Seizures

Paroxysmal discharges from abnormally excited neuronal foci, which can be generally classified as: PARTIAL (simple vs. complex) or GENERALIZED (convulsive vs non-convulsive)

1. **Underlying etiology of Seizure:** Drugs, Infection, Metabolic, Structural - Raised ICP, Trauma: (hypoglycemia/hyponatremia/hypocalcemia/hypomagnesemia), Withdrawal
2. Perioperative management of medications / interactions:
 - **Continue anti-epileptic medications** peri-op
 - **NdMB resistance** due to enzyme inducers (phenytoin, carbamazepine, phenobarbital), p450 upregulation.
3. **Risk of perioperative seizures:** Avoid medications that exacerbate/precipitate seizure (Methohexital, ketamine, Cis/atracurium, enflurane, demerol)
4. Risk of **Aspiration** with Seizure

Anesthetic Goals/Conflicts:

- Maintain a physiological pharmacologic and metabolic milieu to minimize risk of perioperative risk of seizure

Hx: AMPLE, seizure history, etiology, type, Hz, duration, medications / doses / side effects, recent serum levels. Etiology: DIMS

PE: Vitals, gingival hyperplasia (dilantin), airway exam, LOC if recent seizure, neuro exam, signs of liver failure, bruising etc, evidence of aspiration pneumonia.

Investigations: Usual b/w, toxicology screen, glucose, tsh, consider antiepileptic serum levels, CT-head, CXR for aspiration.

Optimization: Neurology consult for uncontrolled or new onset seizures, ensure patient continues anti-epileptic medications perioperatively. Correct metabolic derangements. Consider benzodiazepine pre-medication.

Anesthetic options: Regional or GA, possibly lower seizure threshold with LA toxicity, avoid ketamine , cisatracurium/atracurium/enflurane/meperidine etc. Avoid regional in post-ictal.

Room Setup: Usual setup

Intraoperative Mgt: Ideally Propofol or STP induction, consider benzo, may require higher doses of NMDR due to increased metabolism. Emergence = highest time for seizure.

Complications: Seizure Management: ABC, 100% O2, BM ventilation, Vitals, Rapid glucometer, lorazepam 0.1mg/kg or midazolam in 0.5-1mg doses, STP 25-50mg, Propofol 25-50mg doses. If sz does not break >> GA doses, Phenytoin 20mg/kg IV load slowly, Phenobarb 20mg/kg IV, intubate, treat underlying cause. Consider ICP management!! Hyperventilate, Mannitol/Decadron/elevate HOB,

Special: Phenobarb – Agranulocytosis, Hepatic Toxicity, SJS. Phenytoin – Gingival hyperplasia, ataxia, anemia, angranul, SJS, hepatotoxicity. Carbamazepine – Neutropenia, agranulocytosis, hepatotoxicity. Clonazepam- Thrombocytopenia, Valproic Acid – Agranulocytosis, hepatotoxicity, pancreatitis.

Seizures: Emergency

DDx

- Hypoxemia / Hypercapnia
- Drugs
- Infections
 - Encephalitis, Meningitis, abscess, Sepsis
- Metabolic
 - Hypoxia / hypercarbia, **Hypo/hyperglycemia**, myxedema coma, adrenal insufficiency, Electrolytes (hypo/hyponatremia, hypercalcemia), Toxins (Uremia, hepatic encephalopathy)
- Structural
 - TBI, CVA, ICH, Tumor
- Pyrexia

Obstetrical Seizure

- Eclampsia, Drug withdrawal/intoxication (cocaine), ICH (hypertension), Epilepsy

Pediatric Seizure

- Febrile/meningitis/infection, Ingestion, Hypoxemia, Epilepsy, TBI (trauma/abuse), Metabolic (DKA, hypoglycemia)

Seizure during Regional

- Hypoxia/hypercapnia, LA toxicity (intravascular injection), High spinal, Epilepsy

Management

- Emergency Situation – Prevent injury, call for help and inform surgeon
- Scan monitors for HR, Rhythm, E_tCO_2 , SaO_2 , and cycle BP
- Hand ventilate with 100% O_2 - DO NOT hyperventilate → ↓ seizure threshold
- Anticonvulsants
 - Propofol 20-30mg (Thiopental 25-50mg) titrated to effect
 - Midazolam 0.5mg titrated to effect
- If no resolution and difficult ventilation
 - NdMR
 - Higher doses of sedatives
 - Anticonvulsants
 - Phenytoin 10mg/kg IV load - slowly
 - Phenobarbital 1-2mg/kg
 - Investigate etiology
 - Blood glucose, Electrolytes, Toxicology screen
 - Focused neurological exam
 - Infection, trauma, ↑ ICP, drug reaction
- Consult Neurology
- Pregnancy - $MgSO_4$ 6 g IV bolus over 15 minutes, then 1 – 2 g/hr
- ↑ ICP
 - Maintain low normal pCO_2 , Mannitol 1g/kg bolus, Dexamethasone 10-20mg bolus, Lasix 10-20mg bolus, HOB > 30°

Septic Shock

1. Critically ill patient with high mortality
2. Distributive shock with severe relative hypovolemia
 - Early goal directed therapy
 - Potential for cardiovascular collapse on induction of anesthesia
 - Need for critical care monitoring/ICU post-operatively
3. Multi-organ failure
 - ARDS, ARF, DIC
4. Systemic Infection
 - Early treatment with antibiotics, source control

Anesthetic Goals/Conflicts

1. Early goal-directed therapy
 - **Early Abx** – meropenem / Vanco
 - Fluid resuscitation and inotropes/vasopressors titrated to MAP > 65, CVP > 8-12 & SvO2 > 70
 - Peds – fluid titrated as 20ml/kg, monitor cap refill, BP less useful monitor, dopamine is 1st line
 - Parturient – FHR as resuscitative end point
2. **Urgent source control**
3. Parturient Conflicts – HD instability vs. fetal distress/Stat GA, neuroaxial vs. bacteremia/HD instability

SIRS: Two or more of the following – **Temp** <36, >38; **HR** > 90; **RR** > 20; **WBC** >12, <4, or 10% bands

Hx&Px: Confirm Dx – distributive vs. cardiogenic vs. hypovolemic; R/O other etiology – Pancreatitis, anaphylaxis, drug ingestions, transfusion Rx, myxedema coma, adrenal crisis; Source of Sepsis – CNS (GCS, pupils, focal findings, meningismus), Resp (WOB, Sputum, auscultation), CVS (murmurs, CVLs, endocarditis – Septic emboli), Abd (jaundice, acute tenderness, ischemic gut), GU (flank pain, dec U/O, positive U/A, foley) Derm (cellulitis, abscess), Pregnancy (Chorioamnionitis, PROM) ; Identify end-organ dysfunction – LOC, resp failure, decreased peripheral perfusion, ARF; Vitals with postural & temp; assess volume status; IV access
Inv: CBC + diff, plt, lytes, Ur, Cr, Glu; INR/PTT; Bld cultures; group & screen; ABG, lactate, LFTs, amylase; CXR; sputum; ECG; +/-ECHO (TTE vs TEE)

Optimization: Consult ICU; Goal directed therapy – Monitored bed, Adequate IV access, Arterial Line, CVC (IJ or SC); O2 +/- ETT with PPV (dec. WOB / VO2); fluid to keep CVP 8-12; Vasopressors to keep MAP > 65; SvO2 >70% - PRBC to Hct >30%, Dobutamine 2.5ug/kg/min; Early Abx (Meropenem 1gm IV q8h, Vanco 1g IV q12h); Surgery for source control (minimal delay); Consider Steroids if refractory shock; APC if APACHE >24 (stop 2 hrs preoperatively, re-start 12 hrs post); Glycemic control; Early enteral feeding; DVT & stress ulcer prophylaxis

Options: GA; neuroaxial relatively contraindicated (infection, unfavorable hemodynamics, altered coagulation)

Setup: CAS 5 lead +temp, A-line, CVC; adequate IV access; inotropes, infusions; bld products

Management: Aspiration risk; avoid Sux with prolonged immobility / intra-abdominal sepsis; HD stable induction (titrated, ketamine, minimize propofol, avoid etomidate); lung protective vent (Vt 6 mls, Ppl <30, permissive hypercapnia, PEEP titrated to PaO2 >60), Remember goals of resuscitation

Disposition: leave intubated; transport to ICU

Serotonin Syndrome

A potentially life-threatening adverse drug reaction with typical symptoms including agitation, delirium, autonomic hyperactivity, hyperreflexia, clonus, and hyperthermia.

1. Multisystem effects of serotonin excess:
 - CNS: seizure, altered LOC; CVS: Tachycardia and HTN, autonomic instability, arrhythmia; MSK: rigidity, rhabdomyolysis, hyperkalemia and renal failure; Hyperthermia; DIC
2. Avoid drugs that will precipitate Serotonin Syndrome in patients taking MAO inhibitors
 - Demerol, Fentanyl, Ondansetron, Metoclopramide, SSRI's & TCA's
3. Management strategies:
 - Cyproheptadine (5-HT antagonist), Benzodiazepines for rigidity
 - Hemodynamic support - may be altered and exaggerated responses to indirect acting sympathomimetics (avoid ephedrine and dopamine)
4. Psychiatric Patient – Co-operation, Informed consent / Substitute Decision Maker

Anesthetic Goals/Conflicts:

- Stop offending medications and provide supportive care
 - Aggressive cooling, antipyretics, NdMBs or benzodiazepines for rigidity
 - 5-HT receptor antagonists (b-blockers, cyproheptadine)
- Avoid drugs which may exacerbate serotonin syndrome: meperidine, ?fentanyl ?ondansetron/maxeran
- Rule out high risk conditions on differential diagnosis (MH, NMS, thyrotoxicosis)

Hx: Detailed hx to reveal concomitant use of psychotropic meds, new meds, neuroleptics (need to r/o NMS). Symptoms: confusion, agitation, sz's, coma, mydriasis (miosis in NMS), shivering, flushing, hyperthermia, muscle rigidity, myoclonus, hyperreflexia, autonomic instability, GI symptoms (rare in NMS); rarely rhabdo

PE: Vitals (orthostatic, temp) volume status, autonomic instability, CNS changes, muscle tone, reflexes, myoclonus, resp compromise/failure

Investigations: Goal to narrow DDx - CBC, lytes, Creatinine, CK, Coags, pan-culture, tox screen, ECG, +/- CXR, AXR to r/o secretory tumours.

Optimization: Psych and ICU consult, delay elective surgery, discontinue serotonergic meds, activ'd charcoal if recent ingestion

Supportive Care: ABCs, intubation if appropriate; antipyretics, cooling, sedation, paralysis for hyperthermia; benzos for myoclonus, rigidity & agitation, consider phenytoin; NdMBs if benzos ineffective for rigidity; B-blockers (propranolol, esmolol) for 5-HT antagonism, HTN – sedation +/- SNP, hTN – volume +/- NE, phenyl, epi; cyproheptadine for severe symptoms – 12mg NG load then 2mg q2h until symptoms resolve

Room Setup: Standard CAS + a-line, CVP. Avoid meperidine, dextromethorphan, tramadol, ?fentanyl, ?ondasetron, maxeran. Have vasopressors, vasodilators available.

Post-op: Likely ICU setting.

SIADH

Hyponatremia, elevated urine osmolality, excessive urine sodium excretion, and decreased serum osmolality

1. Etiology or Co-existing disease
 - a. Tumor - lung, pancreas, prostate, lymphoma
 - b. CNS – trauma, SAH, tumor, infection
 - c. Pulmonary (infection, CF), Drugs (opioids, oxytocin, chlorpropamide, vincristine), Pain, idiopathic, iatrogenic
2. Hyponatremia and volume status – potential for volume overload
 - a. cerebral edema, seizures, coma
3. Complications associated with treatment
 - a. central pontine myelinolysis from overly rapid correction
 - b. DI from demeclocycline
4. DDx of hyponatremia
 - a. Hypovolemic – CSWS, Diuretics, Addison's, nephritis, RTA, Metabolic Alkalosis, vomiting, diarrhea, burns, pancreatitis, trauma
 - b. Euvolemic – adrenal insufficiency, hypothyroidism, Drugs, SIADH
 - c. Hypervolemic – ARF, CRF, nephrotic syndrome, CHF, cirrhosis

Anesthetic Goals/Conflicts:

- Maintain hemodynamic stability, fluid and electrolyte balance
- Correct underlying reversible etiologies (infection, tumour, medications, iatrogenic)
- Avoid overcorrection or overly rapid correction resulting in CPM

Hx: surgical history (NueroSx), symptoms of hyponatremia/cerebral edema (lethargy, weakness, confusion, altered reflexes, Seizures, coma), urinary frequency & amount

PE: vitals, Volume status (possible overload), Resp for edema, Neuro – areflexia, dec.LOC, pseudobulbar palsy, asterixis, muscle weakness

Investigations: Lytes, BUN, creatinine, and glc. Look for low osmolality (<280 mOsm/kg), elevated UNa (>20 mmol/L) & Uosm >100 mOsm/L; CXR for edema, CT head – edema, hemorrhage

Optimization: Correct symptomatic hyponatremia until asymptomatic, usually 120mmol/L, rate of 1-2mEq/L/h (3% NaCl 1-2ml/kg/hr); asymptomatic 0.5mEq/L/h; with true volume depletion, serum Na will inc. ~ 1mEq/L per liter of 0.9% NaCl infused – once ADH is turned off, serum Na may rapidly correct, may need DDAVP to slow correction; Inc in Serum Na = (infusate [Na] – serum Na) / (TBW+1), Na deficit = TBW x (140-[Na]); eliminate precipitating cause, **free water restriction is mainstay of SIADH treatment (500-1000ml/d)**, Demeclocycline (300-600mg/d) to induce reversible nephrogenic DI, sufficient to decrease TBW by 0.5-1.0 L/day

Anesthetic Options: All feasible – assess Neurologic status

Room Setup: CAS + 5 lead, Art line for serum Na levels, CVP for volume, foley

Intraoperative Mgt: Avoid drugs known to lower seizure threshold, avoid hypotonic fluids, minimize stress response – ADH secretion, avoid drugs that induce ADH release – morphine, barbiturates, Beta agonists

Post-op: Monitor urine output, serum Na, Fluid restriction 500-1000 mL/d, differentiate SIADH from cerebral salt wasting in the neurosurgical population (CSWS is associated with volume depletion, SIADH is eu/hypervolemic)

Complications: Central pontine myelinolysis – S/S = quadriplegia, seizures, coma, and death; RF include ETOH, liver Dz, malnutrition, hypoK, burns, premenopausal women, severe chronic hyponatremia, onset may be delayed 1-2 days after correction

Sickle Cell Disease

1. Chronic hemolytic anemia
 - a. chronic transfusion (Hct>30%), **difficult Cx match**, risk of hemolytic transfusion reactions from allo-immunization
2. Multisystem disease with end-organ dysfunction
 - a. CNS - **Stroke**
 - b. Pulmonary - acute chest syndrome, recurrent pneumonia, possible **RLD** from pulm infarct - **pHTN** and RVF
 - c. CVS - LVH from chronic anemia
 - d. Other – **CRF**, Splenic infarct (may be asplenic and immunocomp), Iron overload
3. Potential for peri-operative exacerbations of vaso-occlusive crises
 - a. acute pain crisis, acute chest syndrome
4. Chronic pain and opioid tolerance

Anesthetic Goals/Conflicts:

- Pre-operative optimization (consult hematology, consider hydroxyurea (increases [HbF]), consider prophylactic blood transfusion)
- Avoid precipitants of crisis
 - Hypoxia; Hypovolemia, Hyperviscosity, dehydration, Acidosis, Hypothermia, Infection, stasis, EtOH
 - Ensure good perioperative pain control

Hx: Exacerbations/Triggers (hospitalizations, frequency); extent of **end-organ damage** (primarily pain, CVA, CHF, pHTN, RVF, RLD, hypoxemia, bronchospasm, CRF, priapism, cholelithiasis, liver infarcts, hemolytic or aplastic anemia, splenic infarcts, hemosiderosis, chronic infection) ; **predictors of post-operative complications** - Inc. age, complications (lung disease), hospitalization, abnormal CXR, African haplotype, pregnancy, infection, type of Sx (Chole=D&C=C/S or Hyster > AbdSx > myringotomy > HipSx)

PE: Vitals with RA SaO₂ ; wheeze, crackles; Vol status, LVF, pHTN/RVF; neuro deficits;

Investigations: CBC, Lytes, Ur, Cr, Coags, Hb electrophoresis, CXR +/-ABG, ECG +/- ECHO, +/- CT head

Optimization: Heme Consult; Hydroxyurea (inc. HbF); Euvolemia; Bld Tx for high risk procedures (Hg>100); Avoid resp depressants; Cancel elective (acute crisis); Delay urgent (to optimize Hb > 100)

Anesthetic Options: GA; RA ok; TEA beneficial for pain mgmt; Tourniquet use Ok

Room Setup: CAS + 5 lead; T probe; Invasive monitoring

Intraoperative Mgt: Standard; Follow above mentioned Goals

Complications: Acute **vaso-occlusive crisis - PAIN** (ppt by cold, dehydration, stress, menses, EtOH, OSA; pain is typical feature, associated with fever, swelling, N&V; Rx: tylenol, NSAIDS, PCA opioids, hydration, temp management); Acute **chest syndrome** (2' to vaso-occlusion, infarction, pneumonia; new lobar infiltrate, fever, inc. WOB, chest pain 2-3 days postop; Rx: as per pneumonia: pulm toilet, mobilization, analgesia, incentive spirometry, physio, Ventolin, steroids, Abx, Bld Tx); **Aplastic crisis; Splenic Sequestration** (rapid RBC trapping & fall of Hct, and hypovolemia/shock, LUQ pain; Rx: volume and pRBC, delayed splenectomy); RUQ Syndrome (hepatic ischemia, fever, jaundice, liver failure; Rx: fluids, analgesic, Bld Tx)

Cholecystectomy – most common procedure, high risk, laparoscopy is OK

Obstetrics – inc. risk of SA, prematurity, previa, abruption, PP infection: inc. pain crisis in 3rd tri – no effect on UBF/fetus, Maternal mortality ~1%, Fetal mortality as high as 20%, keep Hg > 80 for Vag & 100 for C/S.

Spinal Stenosis

1. Geriatric patients (potential for multiple co-morbid illnesses and altered pharmacology and physiology)
2. Chronic pain with potential concomitant behavioural and psychiatric limitations and drug tolerance
3. Need for multimodal approach for pain management
4. Surgical consideration for spine surgery
 - a. Prone position
 - b. Blood loss and conservation
 - c. Fluid shift
 - d. Post op pain
 - e. Potential neurological monitoring
5. Lack of good evidence around standards for diagnostic, pharmacological and surgical modalities

Anesthetic Goals:

- Careful surgical candidates selection
- Optimize co-morbid illness
- Obtain thorough history and physical and exclude other potential DDx
 - Ao aneurysm, vascular claudication, PMR, pyelo, herniated disc, osteoporosis
 - **Key distinguishing feature is intermittent neurogenic caudication**
 - Induced by standing or walking with erect posture
- Document pre-op neurological deficits
- Multimodal pain management – activity modification, passive ROM, PT, gabapentin, NSAIDs, opioids, epidural steroids, surgical decompression

Epidural Steroid Injections

Indications:

- May help some patients with back and leg pain (first line is still ice, NSAIDs, rest → exercise)
- Reserved for patients with **symptoms of radiculopathy**
- Pain that **persists more than 4-6 weeks, sciatica and spinal stenosis**
- Epidural steroid injection should be reserved for patients with **symptoms of radiculopathy** (disc herniation or spinal stenosis with evidence of nerve root impingement)
- Radicular symptoms may be secondary to nerve root inflammation and edema, release of arachadonic acid metabolites, neuropeptides such as substance P, VIP, and CGRP released from the nucleus pulposus through the annulus.

Contraindications:

- Ongoing use of anticoagulant medications, local infection, discitis
- Prominent motor deficit or paresis suggestive of severe root or cauda equine compression (bowel & bladder dysfunction)
- Failure of previous injections
- Imaging studies demonstrating severe spinal stenosis

Technique:

- Epidural steroid injections have been traditionally given through either a caudal or interlaminar route; transforaminal route effective if experienced
- Volume used varies: 5-10ml recommended at the lumbar level , 3-6mls at C-spine.

- Fluoroscopy is recommended in the following:
 - post-laminectomy patients, obese patients, cervical epidural steroid injections, patients who don't respond to the first injection.
- Incorrect needle placement occurs in 20-38% of caudal and 30% of translaminar injections
- The transforaminal approach is especially beneficial in post-laminectomy patients where the drug may not reach the level of pathology due to scarring from previous surgery.
- Injectate - Lidocaine 20-30mg
 - Triamcinolone most common (40-80mg), or methylpred 80mg
 - methylprednisolone is not recommended in cervical transforaminal injections because it precipitates and the precipitant may be unintentionally injected into the vertebral artery.
 - Chase with 2cc NS – avoid seeding the tract with steroid
- Repeat every 2-3 weeks for total of 3 injections

Complications:

- PDPH (1-5%), hematoma, increased radicular symptoms (1%), Infection, unintentional subarachnoid injection, intraneural injection

Outcomes:

- Few well controlled studies but reasonable alternative to risks/costs of surgery
- Most reliable studies suggest that injections provide significant benefits to some patients with primarily radicular symptoms but the benefit is of limited duration (2-3months)
- Transforaminal injections seem to have predictive value in deciding whether a patient might benefit from surgery.

Medications for Status Epilepticus

<u>Generic name</u>	<u>Loading dose</u>	<u>Maintenance dose</u>	<u>Half-life</u>	<u>Therapeutic range (for status)</u>
Lorazepam	0.1 mg/kg at 2 mg/min	Repeat initially to max of 0.3 mg/kg; then dose q 2–3 h	8–25 h	0.2–0.5 µg/ml
Diazepam	0.15 mg/kg at 5 mg/min	Not typically used as maintenance therapy	28–54 h	0.2–0.8 µg/ml
Phenytoin	20 mg/kg at 50 mg/min(max of 30 mg/kg)	1.5 mg/kg tid	24 h (wide variation)	20–25 µg/ml
Fosphenytoin	20 mg/kg at 50 mg/kg (max of 30 mg/kg) ^a	1.5 mg/kg tid ^a but not needed if venous access is safe	24 h (wide variation)	20–25 µg/ml

Phenobarbital	20 mg/kg at 50–75 mg/min (max of 30 mg/kg)	2–4 mg/kg qd	90 h (70 h in children)	30–50 µg/ml
Midazolam	0.2 mg/kg	0.75–10 µg/kg/min	3 h	
Propofol	1–2 mg/kg	2–15 mg/kg/h	2 h	(2.4–4 µg/ml) ^b
Valproate	20–40 mg/kg	4–8 mg/kg tid	15 h	(70–150 µg/ml)
Pentobarbital	10–15 mg/kg	0.5–1 mg/kg/h	10–20 h	(10–20 µg/ml) ^b
Thiopental	100–200 mg	3–5 mg/kg/h	12–36 h	(15–50 µg/ml) ^b

Stellate Ganglion Block

Indications:

- Sympathetically mediated pain (CRPS, PHN, phantom limb, HSV, reimplantation pain)
- Circulatory insufficiency – postembolectomy vasospasm, Raynaud's, Scleroderma
- Long QT syndrome

Contraindications:

- General: Infection, Coagulopathy, lack of consent, allergy, lack of resuscitation equipment or skill
- Specific: Contra-lateral recurrent nerve injury, severe lung disease (FEV1 < 1L)

Equipment:

- Routine monitors, trained assistant, resuscitation equipment, 1.5 inch 25 gauge needle

Technique:

- Place patient's head midline with neck slightly extended. Skin is prepped with antiseptic and the skin injected with local. The C6 transverse process is palpated and the carotid is retracted laterally. Needle is inserted to bone (1-2cm), withdraw slightly and inject 0.5-1 cc of local injected as test dose. The needle is advanced to bone again, retracted slightly again and then further local to a total of 8-10 cc is injected (use Marcaine 0.25% without epi)

Successful Block:

- Horner's, ipsilateral nasal congestion & conjunctiva flushing, vasodilated and warm extremity

Complications:

- Direct trauma: pneumo, esophageal perforation, carotid or IJ puncture;

Local anesthetic effects: inadvertent epidural, brachial plexus, intrathecal, intravenous or vertebral artery injection with associated seizures, bradycardia, RLN (60%) or phrenic nerve paralysis

Systemic Lupus Erythematosus

1. Potential **difficult airway**
 - Deforming arthritis, Cricoarytenoid arthritis, RLN palsy
2. Systemic Complications of SLE
 - CNS - seizure, stroke, mood, organic disease, transverse myelitis
 - Cardiac – **Myocarditis** (conduction dz, CHF), **Pericarditis** (effusions), Non- infectious **Endocarditis** (AI, MR), Accelerated **CAD**, HTN/pHTN
 - Respiratory – **RLD (ILD, pleuritis, effusions)**, **pHTN/RVF**, infection, pulm hemorrhage
 - Hematologic - hypercoagulable (APA), anemia, thrombocytopenia, abnormal bleeding
 - Other – CRF, Nephritic, Nephrotic, vasculitis, arthritis, immobility
3. Complications related to medical management
 - **Steroids** (cushings, hyperglycemia, adrenal suppression), Immunosuppressants / antimalarials, NSAIDs, **Anticoagulants**, ASA
4. Potential for exacerbation of SLE with surgery, stress, infection and pregnancy
5. SLE and Pregnancy:
 - Increased risk of pre-term, IUGR, PIH, possible contraindications to neuroaxial, risk of neonatal lupus and Anti-Ro mediated congenital heart block

Anesthetic Goals/Conflicts:

- Potentially challenging airway and myocardial dysfunction
- Coagulation defects / thromboembolism and neuraxial techniques
- Avoid drugs that exacerbate Lupus – Procainamide, Phenytoin, Hydralazine, Penicilline, Isoniazid, Enalapril, Captopril, Clonidine

Hx: Investigate for end-organ dysfunction as above, in particular renal failure, cardio-respiratory involvement, previous endocarditis (consider prophylaxis), arthritis, thrombo-embolic complications and medical therapy.

PE: Detailed A/W exam, Neck & TMJ ROM, laryngeal function, hoarseness, detailed cardioresp exam for effusions, tamponade (rare), valvular pathology, CHF, Document preexisting neuropathies

Investigations: CBC (anemia, thrombocytopenia), E7 (renal dysfun), ECG (conduction Dz, LVH, pHTN); Coags, X-match may have Ab's, Anti-phospholipid Ag/ Lupus Anticoagulant/Anticardiolipin, +/- factor assay if prolonged PTT, LFTs (hepatitis); CXR (CHF, effusions, infiltrates); PFTs (restrictive), Echo (LV/RV dysfunction, valvular dysfunction)

Optimization: Heme/Rheum/Obs consults; Stress Dose Steroids; SBE prophylaxis

Options: Neuroaxial may be contraindicated (thrombocytopenia, prolonged PTT – not a contraindication if d/t AntiPh Antibody, is a contraindication if d/t factor deficiency)

Room Setup: Based on end-organ dysfunction; Consider TEA if appropriate with lung disease; Consider smaller ETT if cricoarytenoid arthritis

Intraoperative Mgt: Depends on underlying organ dysfunction; Safe and controlled management of potentially difficult airway; Consider potential for myocardial dysfunction on induction; If on cyclophosphamide – prolonged response to SCh and mivacurium due to inhibition of plasma cholinesterase; If renal insufficiency present, avoid renally excreted drugs and renal toxins

Emergency: Fully reversed, AWA/C, May require prolonged ventilation if severe respiratory dysfunction

Post-op: Beware of post-op stridor (steroids), thromboembolic events, CHF & arrhythmias, renal insufficiency, adrenal insufficiency, coagulopathy and hemorrhage, seizures, CNS dysfunction, fulminant hepatitis

Tachycardia: Emergency

Most important question is **sinus tachycardia** or not?

Sinus Tachycardia DDx

1. Hypoxia / hypercarbia
2. Drugs
 - administration → chronotropes, cocaine, MAOI, stimulants
 - withdrawal → opioid, BDZ, EtOH, clonidine, β -blocker
3. Pain or light anesthesia – surgical or non-surgical (full bladder, tourniquet)
4. Shock → hypovolemia, PTX, pericardial, sepsis, anaphylaxis, anemia
5. Endocrine
 - hypoglycemia
 - hyperthyroidism
 - MH / NMS
 - Pheochromocytoma

Emergency Management

1. Inform surgeon, Scan monitors: rate, rhythm, BP, EtCO₂, SaO₂
2. Hand ventilate with 100% O₂
3. Examine patient
 - assess pulse
 - auscultate both lungs and examine trachea
 - examine peripherally and forehead for evidence of anaphylaxis
4. Develop DDx and treat as per ACLS protocol

Non-Sinus Tachycardia DDx

1. SVT: regular
2. Afib: irregular
3. MAT
4. VT / VF

Non-Sinus Tachycardia Emergency Management

1. Determine rhythm and treat as per ACLS
2. Reason for arrhythmia
 - pre-existing
 - ischemia → rate, ACS
 - electrolyte abnormalities

Tamponade

1. Emergency Situation with potential for cardiovascular collapse on induction
2. Pathophysiologic changes
 - a. Impaired diastolic filling
 - b. Fixed stroke volume
 - c. Rate dependent CO
 - d. Maximal sympathetic stimulation
3. Etiologies / co-existing diseases
 - a. Blood: post-cardiac Sx, post-MI, aortic dissection, trauma
 - b. Other: infectious, malignant, radiation, SLE, uremia, autoimmune

Anesthetic Goals/Conflicts:

- If hemodynamically significant, **drain pericardium prior to anesthesia / PPV**
- **Avoid increases in intrathoracic pressure**
 - Maintain spontaneous ventilation, Avoid coughing & straining
- Cardiovascular: ***fast, full and tight***
 - Preload: FULL
 - Contractility: maintain
 - Rate: maintain / possibly increase
 - Rhythm: strict NSR
 - Afterload: maintain
 - MVO2: monitor for ischemia
- ***These patients are maximally sympathetically stimulated***
 - *You need to replace the sympathetic drive removed by your anesthetic*

Hx: Determine underlying etiology (dissection, free wall dissection, trauma, post sx, malignancy, autoimmune (SLE/RA/Scleroderma), infectious, radiation). Hx of dyspnea, fatigue, CHF, hypotension, tachycardia.

PE: Vitals: **hemodynamically unstable?** ↓BP ↑HR, Sx's of CHF. Distant heart sounds, pulsus paradoxus (↓SBP > 10mmHg with inspiration), narrow pulse pressure, possible friction rub. JVD (Note Kussumaul's sign – increase in JVP during inspiration (opposite of normal) occurs with constrictive pericarditis, not with tamponade!) AI if aortic dissection. CVP: Elevated CVP, blunted y descent. PAC- diastolic press equalization ~15-20mmHg, corresponding to pericardial pressure

Investigations: CBC/Lytes/Cr (ATN due to shock), INR/PTT, CXR (enlarged cardiac silhouette). ECG: Electrical alternans, low voltage, ST-T elevation, tachycardia. ECHO: visualize effusion, chamber compression, cardiac output, septal shift, chamber volumes.

Optimization: Large bore IV access, volume resuscitation, pericardial drain, epinephrine infusion, atropine for pericardial manipulation. If unable to drain prior to induction, have patient prepped and surgeon in the room.

Anesthetic Options: Local for pericardial drain/window maintains SV, however can lead to coughing, straining. GA: controlled airway, allows sternotomy/thoracotomy, however risk of CVS collapse on induction/PPV. Early cardioversion for arrhythmias.

Room Setup: 5lead, invasive lines, TEE/PAC, drugs: Epi/NE, pericardiocentesis drain, chest prepped.

Intraoperative Mgt: fluid / PC Drain then GA for definitive Rx. / LA, opioid, small amount of amnestic, +- paralysis / Consider spontaneous breathing induction, can supplement with airway topicalization but do not delay if unstable. Small TV, inc. RR, observe HD goals

Post-op: HDU, observe for recurrence of tamponade. Consider PCA or T Epidural for sternotomy of post-op pain. Complications: Post-tamponade pulm edema: due to increase RV CO, rx w/ NTG, diuretics

TCA Overdose

Mechanism of action: Stimulation of catecholamine release and block reuptake, Central and peripheral anticholinergic agents, inhibit Na and K channels in brain and heart, Direct alpha blocking

1. Multisystem effects: Coma, convulsive, cardiac arrhythmias and acidosis
 - a. CNS: depression, possible seizures (persists ~ 24-48 hrs)
 - i. ACh side effects: Dry mouth, constipation, urinary retention, vision
 - b. CVS: Postural hypotension, Dose related prolonged QT and QRS widening (>100msec)
 - i. Risk of ventricular arrhythmias with QT > 0.16 - serial ECGs (persists for 10 days)
2. Medical Management
 - a. GI decontamination - risk of aspiration
 - b. Seizures – Diazepam, Sodium bicarbonate (reduce free fraction), Phenytoin
 - c. Dysrhythmias – Alkalization, Lidocaine, Phenytoin (avoid class 1a, amiodarone)
 - d. Heart block - Isoproterenol
 - e. Hypotension – Volume, Sodium bicarbonate, Sympathomimetics, Inotropes

Anesthetic Goals/Conflicts:

- Usual HCO₃⁻ is 1-2 MEQ/kg to keep QRS < 100 msec goal pH 7.5-7.55
- ECG – Abnormal QRS, prolonged QRS, abnormal size and ratio of R and S waves in AVR
- R/O hypoglycemia, conintoxication, bHCG on lab, monitored setting.

Temperature: Emergency

DDx hyperthermia

1. Physiologic (e.g. sepsis)
2. Drugs
 - MH / NMS
 - Pheochromocytoma
 - Hyperthyroidism
 - Serotenergic syndrome
 - Anticholinergic syndrome
 - Transfusion reaction
 - Stimulants: cocaine, amphetamines
3. Endocrine: Hyperthyroidism
4. Exogenous
 - Warming blankets, heating pads

DDx hypothermia

1. Increased heat loss
 - Environmental Exposure
 - Drugs → vasodilation
 - Alcohol
 - Toxins
 - Sepsis
 - Iatrogenic: CPB, CRRT, Cold infusions
2. Decreased heat production
 - Endocrine
 - Hypopituitarism
 - Hypoadrenalism
 - Hypothyroid
 - Hypoglycemia
 - Malnutrition
 - Extremes of age
 - Impaired shivering (anesthesia)
3. Impaired regulation: central vs peripheral
4. Other
 - sepsis
 - pancreatitis

Tetralogy of Fallot

1. Complex congenital heart disease characterized by VSD, RVOT obstruction, overriding Ao, RVH
2. Both fixed and dynamic RVOT obstruction
 - Fixed RVOT obstruction – variable R to L shunt & pulmonary blood flow
 - Dynamic RVOT obstruction (infundibular spasm) – inc. R to L shunting & hypoxia
3. Associated abnormalities and conditions
 - paradoxical embolus – avoid air bubbles in lines
 - Thrombophilia 2' to polycythemia
 - 25% have another congenital abnormality
 - Tracheoesophageal fistula and Trisomy 21
4. SBE prophylaxis

Anesthetic Goals / Conflicts

- Hemodynamic Goals
 - Full preload – Stiff RV, stent open RVOT
 - Dec. Contractility to reduce dynamic RVOT obstruction
 - Maintain afterload to minimize R – L shunt and promote pulmonary blood flow
 - Avoid inc. PVR – hypoxia, acidosis, aggressive PPV/PEEP
- Tet -spell – sudden hypoxia / acidosis 2' to infundibular spasm or dec. SVR – inc. R to L shunt
 - 100% O₂ +/- gentam PPV, fluid bolus, sedation (dec. SNS), knee chest position (Inc. SVR & preload), phenylephrine 1-2ug/kg, propranolol 10-20 ug/kg (dec. infundibular spasm)

Thoracic Aneurysm

1. Emergency Case: full stomach, HD unstable patient
2. Potential for OLV
3. Potential for massive blood loss, fluid shifts, transfusion and hypothermia
4. Intraoperative hemodynamic changes with potential for ischemia - heart, brain, kidneys, and spinal cord
 - a. Special monitoring for SC ischemia (SSEP, MEP) and techniques to optimize SC perfusion
 - b. Post-operative organ dysfunction: MI, ARF, SC ischemia
5. Co-morbidities: CAD / DM / CKD / HTN / Smoking/Advanced age
6. Post-operative pain

Anesthetic Goals/Conflicts:

- maintain stable hemodynamics throughout peri-operative period
- maintain favourable myocardial oxygen supply / demand relationship
- watch for evidence of peri-operative organ dysfunction (SC, kidneys)
- peri-operative pain control

Hx: Co-morbidities: active cardiac conditions (AHA guidelines), acute vs chronic dissection, symptoms

PE: Evidence of HF, LV and RV dysfunction, AR, cardiac tamponade (JVD, distant HS, hTN, pulsus paradoxus), carotid bruit, neurologic exam

Investigations: CBC, PTT, INR, X-match, lytes, BUN, EKG, TTE, Consider PFT/CXR, invasive cardiac testing according to AHA, CT/CTA of Aneurysm - review for location, level of cross clamp

Optimization: correct anemia (maintain Hb>9.0 g/dL), avoid tachycardia, optimize volume status, continue beta-blockers, hold ACEI/ARB, hold anticoagulants/antiplatelet agents and bridge if necessary, Consider: cardiology, nephrology consultation

Anesthetic Options: GA +/- OLV, PCA vs epidural for post-op analgesia

Room Setup: CAS (5 lead EKG), IV prox'l to XC, pre-induction A-line, CVP, +/- TEE/PAC/DLETT+FOB, fluid warmer, cell saver, blood, SC monitoring (SSEP, MEP)

Intraoperative Mgt: Induction Titrated (vs. aspiration) if emergency surgery, pt prepped and surgeon in room prior to induction, **Maintenance:** volatiles readily titrateable, consider effect of epidural on

hemodynamics - Prior to cross clamp :avoid over-resuscitation , heparin and mannitol, Cross clamp →

Hypertension (inc afterload), NTG and nitroprusside ready, Removal of cross clamp → **Hypotension**, volume resuscitation prior, dec anesthetic, prepare for **metabolic acidosis** with reperfusion - hyperventilate, HCO₃, staged release of cross clamp will help minimize effects and if unable to control hypotension, surgeon may have to re-apply cross clamp (be ready for rebound hypertension)

Post-op: Switch DLT to SLT, to CSICU intubated, gradual slow emergence

Thoracoscopic Surgery

- 1) Underlying etiology
 - Malignancy – 4 M's
 - IPF or COPD
 - Pleural disease
 - Pericardial disease
- 2) Requires OLV with good lung deflation (unable to CPAP operative lung)
- 3) CO₂ insufflation of the thorax and its potential complications
 - dec. pre-load, inc. LV afterload, potential for CO₂ embolism, risk of sudden cardiovascular collapse

Anesthetic Goals:

- Guided by underlying etiology and comorbidities
- Maintain adequate oxygenation
- Post-operative Pain Control
- Multimodal, TEA, paravertebral catheters

Hx and PE and Investigations:

- Determine severity and complications of underlying disease
- Screen and assess comorbidities
- Assess ease of intubation and OLV technique
- Assess ability to tolerate OLV
 - Side of Surgery (right side has 10% more blood flow than left) / Poor PaO₂ on Two Lung Ventilation / Pre-operative FEV₁ (inverse correlation) / Supine position
- Contraindications:
 - Extensive pleural adhesions, Extensive inflammatory process, Previous pleural fusion, Unresectable lesion, Coagulation defect, Inability to tolerate one-lung ventilation, Severe COPD, Dependence on mechanical ventilation with high peak pulmonary pressures, Hemodynamic instability, Hypovolemic shock, Cardiogenic shock, Ongoing cardiac ischemia, post acute MI

Optimization: Standard for Thoracic and OLV

Room Setup: Standard

Management: GA usually preferred but TEA is possible with local and intercostal nerve blocks

Induction dictated by comorbid illnesses; Maintenance as per usual OLV cases.

Post-op: multimodal pain management

Complications: Related to DLETT/OLV; Cardiac: HD instability, arrhythmias; Conversion to Open (25%); Persistent Airleak > 5 days (5%); "Down Lung" syndrome (inc secretions, atelectasis, re-expansion pulm edema, pneumonia); Bleeding, infection etc.

Acute Spinal Cord Injury

1. **Emergency Trauma with C/T/L-spine injury**
 - Full stomach, Hemorrhage & hemodynamic instability, Intoxication, Additional injuries (CHI with inc. ICP in 25%), Hypothermia
2. **Potentially difficult airway**
3. **Prevention of secondary spinal cord injury (SCI) from hypoxemia or hypotension**
 - Goal MAP > 80-85, Volume resuscitate, HD support (Dopamine, pressors)
4. **Specific considerations of acute spine injury**
 - C-spine precautions and airway protection - High aspiration risk (loss of cough ability (T2-L1))
 - Respiratory insufficiency w/ injury above T7
 - Intercostal paralysis (T1-T11), Diaphragmatic paralysis (C3-C5), Pulmonary edema
 - Severe ANS abnormalities
 - Potential for neurogenic shock (hypotension & bradycardia (vasovagal))
 - Thermoregulation loss & poikilothermia
 - Hyperkalemia w/ SCh from 24 hrs to 6 months post-injury

Anesthetic Goals/Conflicts:

1. **Prevent Secondary SCI**
 - Full spinal precautions – imaging can be delayed until after more urgent management
 - Safe A/W management, Avoid hypoxia and hypotension
2. **DDx: Neurogenic vs hypovolemic shock: lose ability to ↑ HR in response to hypovolemia**
3. **Conflict: SCI, Difficult AW, CHI (↑ICP)vs Uncooperative patient; RSI vs. Aspiration Risk**

Spinal shock (1-3 weeks) = flaccidity and areflexia (has nothing to do w/ HD stability)

Neurogenic shock = sympathectomy w/ PNS dominance; Vasodilation– hypotension responsive to pressors; Bradycardia and loss of baroreceptor reflex arc to hypotension (responsive to atropine)

ATLS approach: 1' (ABCDE) then 2' survey (AMPLE + head to toe exam)

Hx: AMPLE; Old charts; MOI; Associated injuries; Intoxication; Resus Hx; Comorbid Disease

PE: Vitals (HR, BP); C-spine precautions; Monitor; Large IVs; ABCDE; Resp function; Neuro exam

Canadian C-Spine: GCS 15 and stable – Age <65, Normal neuro exam, No dangerous mechanism (fall >3ft; MVC >100km/hr, roll-over, ejection, ATV, bicycle; axial load) – low-risk factors present (simple rear-end, sitting position, ambulatory, delayed neck pain, absent midline pain – active rotation OK – No x-ray

Investigations: CBC; Coags; E7; Cx Match; ABG (resp insufficiency), vital capacity – 15mls/kg; Tox screen; CXR; C-spine (C1-T1, bony alignment, cartilage spaces, soft tissue – 10mm at atlas, 4mm C2-C4, 15mm below C4, AbN if >5mm inc); CT Head/Spine; FAST; ECG

Optimization: ATLS; Oxyg/Vent/Volume; maintain MAP > 80mmHg; Asp prophylaxis; Antisialogue (AFOI); Steroids – methylpred 30mg/kg within 8hrs (controversial)

Anesthetic Options: Usually GA for emergency fixation or decompression

Room Setup: CAS + 5lead, temp, A-line, CVC (Chronotropes, pressors); Foley; Warming; ER drugs; Cell saver; prone patient

Intraoperative Mgt: AFOI if possible (assess CNS); RSI + Inline stabilization +/- Cricoid if uncooperative; Watch for ↑ICP (conflict); Avoid SUX >24H; Maintain SCPP; Prone position (most dangerous time); protective vent strategy if ALI; possible SSEP / MEP monitoring

Emergence: Keep intubated vs extubation for neuro assessment; Be wary of aw swelling;

Post-op: HDU/ICU

Total Spinal

1. Emergency requiring prompt diagnosis and simultaneous management
 - a. discontinue local anaesthetics
2. Supportive management – including sedation
 - a. Airway – consider intubation and ventilation
 - i. Consider PPV may further reduce preload!
 - b. Hemodynamic sequelae (complete sympathectomy)
 - i. severe hypotension, bradycardia (paradoxical Bezold-Jarisch reflex), cardiac arrest
3. Consideration in pregnancy - Above PLUS
 - a. FHR monitoring
 - b. left uterine displacement
 - c. leg elevation +/- reverse trendelenburg if hyperbaric LA used

Anesthetic Goals/Conflicts:

- Support airway with intubation and ventilation
- Support circulation with fluid, vasopressors and atropine
- Avoid awareness with sedation and counsel patient once situation resolves

Intraoperative Mgt:

1. Call a code
2. Stop injection of LA
3. Support airway, consider intubation
4. Support BP with fluids/inotropes: atropine if brady, ephedrine, move quickly to epinephrine
5. Ensure adequate sedation
6. If obstetric patient, ensure adequate fetal monitoring and support uterine perfusion pressure
7. Inform obstetrician
8. Discuss what happened with patient once spinal resolves

Risk factors for unexpected cardiac arrest following spinal: Male, ASA 1, use of beta blockers, resting HR < 60, Age < 50, prolonged PR interval. ? related to high vagal tone

Paradoxical Bezhold Jarsisch reflex

- mechanoreceptors in the heart (LV>>Atria) / afferent c-fibers / efferent vagus
- Activation with nociception → reflex hypotension, bradycardia, coronary artery dilatation
- The paradox - receptors in the wall of the underfilled LV may erroneously STIMULATE - results in paradoxical bradycardia and decreased contractility adding to the sudden arterial hypotension

"Reverse" Bainbridge

- stretch receptors located in the right atrial wall and the cavoatrial junction → ↑ right-sided filling pressure → vagal afferent signals to the cardiovascular center in the medulla → inhibit parasympathetic activity → increased heart rate
- The changes in heart rate are dependent on the underlying heart rate before stimulation.

Stereotactic Surgery

Stage I: localisation of nucleus/seizure foci/tumour. Stage II: implantation of stimulator. Stage III: tunnelling

1. Avoidance of sedatives (burr hole under local anaesthetic)
2. Uncontrolled airway at risk of obstruction with challenging access (key for frame immediately available)
3. Coexisting Disease
 - a. Parkinson's - aspiration risk, autonomic instability, increased perioperative complications, management of medications – held pre-op, avoidance of beta-blockers as this would decrease tremor, avoid antidopaminergic medications
 - b. Seizures – hold anti-epileptics
 - c. Tumor, Chronic pain, Depression, neurodegenerative disease (dystonia, MS),
4. Complications
 - a. intra-cerebral hematoma, Sz,
 - b. hypertension, bradycardia, arrhythmia
 - c. Sitting Position - VAE, postural hypotension

Anesthetic Goals/Conflicts:

- 1) Awake, comfortable and cooperative patient
- 2) Stable hemodynamics (avoid HTN, hydralazine)
- 3) Avoid sedatives as it alters electrophysiologic footprint required for nucleus localization

Hx: standard anaesthetic history and physical with additional attention to the etiologic considerations, and their medications (e.g. anti-parkinson/seizure medications), history of coagulopathy, antiplatelet medications, herbal, co-existing diseases, hypertension

PE: standard physical with special attention to etiological factors requiring surgery

Investigations: CBC, coags, lytes, Group & Screen. CT scan. ECG

Optimization: anti-parkinsonian medications held prior to DBS; avoid anti-dopaminergic meds

Anesthetic Options: Stage II: monitored anaesthesia care if DBS – must avoid all agents which decrease tremor (end-point of stimulation) as the patient must be very cooperative. Stage III: GETA

Room Setup: standard CAS monitors + 5 lead EKG, emergency resuscitation drugs and airway equipment. Antihypertensives and anticonvulsants available

Intraoperative Mgt: MAC for stage II and GETA for Stage III. Monitor for complications: haemorrhage, VAE, seizures, cardiac dysrhythmias – especially bradycardia (stimulation of deep structures near the hypothalamus)

Post-op: minimal pain post-op.

Tracheal Resections

- 1) Difficult airway with the potential for obstruction and disruption with induction and PPV
 - a. Delineation of anatomy (CT/spirometry/ECHO)
- 2) Maintenance of oxygenation and ventilation in the setting of an open airway
 - a. Standard orotracheal intubation / Insertion of a tube into the opened trachea distal to area of resection / HFJV through stenotic area / HFPPV / CPB
- 3) Priority on maintaining postoperative integrity of the tracheal anastomosis
 - a. Immediate extubation
- 4) Etiology and complications of disease:
 - a. 4M's of cancer (mass, metabolic, metastases, medication)
 - b. Potential for anterior mediastinal mass and superior vena cava syndrome
 - c. Pulmonary sepsis
- 5) Severe co-existing pulmonary disease is a contraindication to surgery

Anesthetic Goals/Conflicts:

- *Preoperative assessment to determine*
 - *the nature, location, and extent of trachea to be resected*
 - *presence of pre-existing disease (specifically cardiopulmonary reserve)*
- *Attain Anesthesia without causing airway obstruction*
- *Planned approach with surgical team to securing airway distal to obstruction/ventilation*
- *Avoid post-operative ventilation for risk of disrupting tracheal anastomosis*

Hx: Dyspnea, dynamic symptoms, associated co-morbidities (pulmonary), type of lesion (vascular/tumour), functional capacity, degree of obstruction, contraindications to HFJV (peds, COPD, Bullae)

PE: Dynamic airway obstruction, stridor/wheeze, vascular compression, evidence of heart failure, COPD, Rt heart failure, pHTN (Loud S2, RV heave, elevated JVP)

Investigations: CBC / Lytes / Coag / ABG / ECG / CXR / **CT** / bronchoscopy / spirometry with flow volume

Optimization: Consider pre-op chemo/irradiation/ airway stent; with severe obstruction consider high FiO₂, inc. humidity, steroids, racemic epi, Heliox; minimize pre-op sedation; avoid anitisiologues (inspissations)

Room Setup: Arterial Line (Lt – no compression), SaO₂ on Rt, various ETT tubes (armoured, MLT), FOB, HFJV catheters, Surgeon with rigid bronch, ETT to intubate in the field; Heliox; +/-CVP

Intraoperative Mgt: Close communication between surgeon and anesthesiologist. SV with high FiO₂, AFOI vs. SVGA, SLT (endobronchial intubation) vs. DLT, secure distal to lesion, bilateral ETT tubes, or OLV, or ligatures around PA's to decrease blood flow to non-ventilated lung; if unable to secure distal - HFJV or HFPPV SLT: HJV through small bore ETT tubes or catheters and surgeon works aron small catheter >> Must have enough room for gas egress!! Unable to suction debis with this method. Or you can use HFPPV (TV 50-250ml) through small catheter at rates of 150/min (minimal movement, and contamination of lungs). HFFPV of one lung is usually sufficient! Finally >> CPB >> risk of heparinization and intrapulmonary hemorrhage precludes it's use!

Post-op: Keep head in flexion to decrease tension on suture line. Early extubation desired, but make sure ETT is not near the suture line. Avoid vigorous chest physio

Complications: Trach disruption, RLN injury, a/w edema. Massive hemoptysis (usually fatal)

Tracheoesophageal Fistula

1. Possible difficult intubation & BMV with gastric distension with increased risk of aspiration
2. Possible respiratory distress secondary to aspiration – acute and chronic
3. Co-existing congenital anomalies
 - a. VATER/VACTERL including CHD
4. Neonatal/prematurity considerations
 - a. altered airway anatomy, cardiac, respiratory, metabolic, and physiologic changes
 - b. complications of prematurity – reversion to fetal circulation
5. Post-operative intensive care and pain management

Anesthetic Goals / Conflicts

1. Secure the airway distal to the fistula while avoiding PPV (RSI vs. SV)
 - a. risks of intubating the fistula, inability to PPV, gastric intubations and aspiration
2. Protect the lungs from aspiration preoperatively
3. Identify coexisting anomalies, specifically CHD
4. Diagnose and treat hypoxemia intraoperatively
5. Prevent post-operative pain and complications

Hx & Px: OB hx, PCA/GA, premature, Growth, congenital anomalies (Vertebral, Anal atresia, CHD, TEF, Radial/renal dysplasia, Limb anomalies), CHF (WOB, failure to thrive, heave, murmurs), Shunting (Cyanosis, clubbing), Vitals including pre/post ductal SaO₂

Inv: CBC, lytes, +/- ABG, CXR (pulmonary bld flow, heart shape) +/- ECHO if signs of CHD

Optimization: Prevent aspiration (NPO, HOB elevated, consider G-tube pre-op) treat aspiration (Abx, physio – delay case to optimize), Peds cardio consult to r/o CHD, pouch tube / suction

Room Setup: Multiple cuffed/uncuffed ETT, ENT with rigid bronch, FOB, fogarty balloon catheter, warming blanket / lights

Monitors: CAS, temp, Aline, prepost ductal SaO₂, precordial stethoscope (L Ax to Dx endobronchial intubation)

Management: Suction oral pharynx, pouch +/- gastric tube, avoid PPV (gstric distension – impaired/impossible ventilation, aspiration, impaired venous return), RSI (intentional endobronchial intubation and withdrawal, FOB to confirm) vs. SV (Sevo vs. TIVA), topicalize a/w, rigid bronch to delineate anatomy, +/- fogarty balloon to occlude fistula, ETT distal to lesion; Maintenance with TIVA/Sevo + opioid, titrated FiO₂ to maintain preductal SaO₂ > 90%, NdMB, minimize PIP (reduce gastric distension), avoid hypothermia/hypoglycemia

Emergency/Disposition: likely postop ventilation (preexisting pulmonary complications, tracheomalacia, tracheal wall defect), extubation if term, healthy, otherwise normal, warm, reversed, stable infant, protect anastomosis (neck flexion, avoid reintubation, avoid gastric suctioning below level of repair, post-op pain – epidural/caudal)

Complications: Hypoxemia (malpositioned ETT – (endobronchial, istula), gastric distension and hypoventilation, surgical retraction, aspiration pneumonitis, cardiac shunting etc..) Hypotension (surgical retraction, gstric distension, hemorrhage, CHF), Post-op (GERD, aspiration, leak, esophageal stricture, tracheomalacia, pneumoTx

Tracheostomy

1. Emergency case as dictated by the etiology
 - a. Trauma - facial smash, penetrating neck injury
 - b. Upper A/W obstruction
 - c. ICU pt with prolonged OETT
2. Shared airway
 - a. Potential for catastrophic loss of airway
 - i. Possible difficult A/W
 - b. Potential for airway fire
3. Co-existing disease states
 - a. Critically ill - MOD
 - b. Trauma – CHI, C-Spine injury, occult injuries
 - c. Chronic Tracheostomy – RLD, chronic aspiration, pHTN, Sz, developmental delay, neuromuscular disorders

Anesthetic Goals/Conflicts:

1. Maintain airway patency
 - a. Back-up airway plan
2. Good communication with surgical team
3. Support/Optimize underlying disease state
4. high O₂ (desaturation) vs. low FiO₂ (protect against A/W fire)

Hx: Indication, A/W patency (stridor, dyspnea, wheeze, incr'd WOB), Respiratory reserve, Co-morbidities and implications, Chronic Trach – indication (aspiration, developmental delay, neuromuscular weakness) type of trach tube (size, cuffed, single cannula, custom), recent trach change, need for chronic ventilation, vent settings, comorbid disease (RLD, pHTN)

PE: vitals, a/w patency/swelling, ease of intubation/re-intubation, Grade of original intubation, vent settings, FiO₂, neck circ., cardiopulmonary exam – wheezes, crackles, loud P2, RV heave

Investigations: CBC, coags, ABG, G+S, PFTs, CXR, ECHO / CT scan dictated by history & physical

Optimization: GA vs Awake, perform procedure in OR if possible, , NPO/NG to suction, optimize FiO₂ & vent. settings, optimize co-morbidities, change trach to cuffed (1/2 size smaller), patient position (shoulder roll)

Room Setup: Difficult A/W cart, Cook catheter, \pm Jet ventilator, +/- Art. Line

Intraoperative Mgt: awake with local infiltration, caution with FiO₂

Post-op: HDU observation initially, humidified O₂, caution suctioning of secretions, sterile precautions, cuff pressure 15-20 mm Hg, stoma/trach not fully established for 5 days = higher risk, Laryngoscope and small ETT at the bedside

Complications: loss of A/W – false lumen, hemorrhage, loss of surgical plane; A/W fire; Stoma – infection, hemorrhage, granuloma; Tracheoinnominate fistula – hemorrhage 7 days post-op; laryngeal injury; tracheal stenosis

Transphenoidal Surgery

1. Mass effects
 - a. Neurologic impairment (bitemporal hemianopsia)
 - b. Raised ICP (rare, but possible if causes obstructive hydrocephalus)
2. Neurohormonal effects / Endocrinopathies
 - a. Non-functional adenomas
 - b. Endocrine deficiencies 2° mass – Panhypopituitarism
 - i. (G,L,F,T,A,P) “Go Look For The Adenoma Please”
 - c. Hypersecretory tumors - 60% (prolactin > GH > ACTH, TSH rare)
 - i. Cushing's, acromegaly
3. Surgical Issues / Complications
 - a. Head up positioning-Poor pt & a/w access, bleeding (throat pack), VAE risk
 - b. Neurologic injury- optic nerve or chiasm, cranial nerves III, IV, V, VI
 - c. Potential for massive, difficult to access hemorrhage - cavernous sinus involvement
 - d. Post-operative endocrine dysfunction (DI 40%), CSF leak/meningitis risk
 - e. Crisp emergence-min coughing, N/V

Anesthetic Goals/Conflicts:

- Optimize perioperative endocrine function (stress dose steroids), consult endocrinology
- Assess and Manage any inc. ICP, avoiding aggravating factors
- Controlled emergence (minimizing bucking / coughing / vomiting to decrease risk of bleeding and CSF leak)
- Monitor for postoperative complications eg: DI (40%)

Hx&Px: Sx's of ICP (a.m headache, N/V), mass effects (VF defects – bitemporal hemianopsia), & pituitary deficiency (most non-functional with Sx of **Hyposecretion** in the order (Go Look For The Adenoma Please)

Hypersecretory prevalence (Please Get Active Tumors). Prolactin - galactorrhea, amenorrhea, dec libido/impotence; GH - Acromegaly; ACTH - Cushing's Dz; Endo/neurosurg consults

Inv: CBC, Lytes, Glucose, BUN, Cr, Group & Screen, (look for anemia, ↓/↑glycemia, lyte abnormalities, ↓Na 2° to hypocortisolemia, DI, SIADH, renal insufficiency), Ca – r/o ↑Ca (MEN type I), TSH, T4, ACTH, cortisol level, insulin-like growth factor-1, testosterone, LH, PRL, βHCG – for women with amenorrhea prior to surgery. CT (tumor: sella turcica or suprasellar, mass effects, ICP) Stage I: microadeno (<1 cm) no sella expansion Stage II-IV: macroadeno (>1 cm) may extend beyond sella

Optimization: Endocrine consult, hydrocortisone 50-100 mg pre-induction & historically q6-8h until weaned postop (consider Dex), antibiotic prophylaxis against meningitis, PONV prophylaxis

Anesthetic Options: GETA and NMB for microsurgery

Room Setup: CAS monitors + 5lead, A-line, Large bore IV, Foley to monitor DI (40%), throat pack, VAE risk (precordial Doppler, atrial CVC/Bunegin), +/- Lumbar drain (↑ surgical exposure/↓CSF leak)

Intraop Mgt: FOB if acromegaly or Cushing's (difficult ventilation / intubation); oral RAE ETT (smaller if acromegaly). Balanced technique, TIVA if VEPs monitored (or MAC < 0.8, but VEPs sensitive to volatile), no nitrous oxide (pneumocephalus, VAE), NMB ensures pt still. Crisp emergence for neuro assessment. No bucking/coughing/vomiting), remove throat pack & suction carefully +/- laryngoscopy

Complications: Intraop – VAE, massive hemorrhage – venous vs. arterial, CN damage, thrombosis & CVA; Post-op – DI (40%), SIADH (usually delayed), Adrenal insufficiency (CV collapse – steroid coverage), Bleeding (inc. ICP, brainstem compression, CN dysfunction), CSF leak (risk of meningitis, consider lumbar drain), hypothalamic injury, cerebral ischemia, Stroke

Transtacheal Jet Ventilation

Considerations:

1. Typically emergency situation with potential hypoxia/hypercarbia
2. Generally difficult airway with potential for abnormal airway anatomy
3. Potential complications: pneumothorax, decreased cardiac output, ALI, subcutaneous emphysema with loss of airway
4. Need for subsequent definitive management

Big take home points:

Temporizing maneuver only

Need to ensure adequate exhalation of gas (**place oral/nasal airway and maintain jaw thrust**)

Monitor closely for changes in hemodynamics, signs of barotrauma

Contraindications:

Complete upper airway obstruction

Chronic pulmonary disease (particularly bullous lung disease)

Severe CAD or other cardiac conditions which might result in an exaggerated drop in cardiac output

Severe obesity

Restrictive lung disease

Complications:

Catheter kinking

Local hemorrhage

Subcutaneous/mediastinal emphysema

Esophageal injury

Pneumothorax

Where it fits in difficult airway algorithm:

If unable to BVM and unable to ventilate with LMA then this is a temporizing maneuver while further airway tools, surgical equipment and surgeon are mobilized.

How to do it:

- Extend neck (roll under neck)
- Identify cricothyroid membrane
- Add 15° bend to distal 2.5 cm of 12-16' IV catheter
- Attach 20 cc syringe (\pm fluid)
- 12-16' IV catheter inserted 30° caudad off the perpendicular through cricothyroid membrane
- Once in trachea remove needle thread 14' catheter to hub
- Reconfirm position by aspirating air
- Connect to oxygen source (commercial jet ventilator, E cylinder, anesthesia machine.
- Ventilate with 1:1 IE ratio if using E cylinder, titrate to chest movement if using commercial jet ventilator

Trauma

- 1) C-Spine/TBI
- 2) Aspiration risk
- 3) Potential for multisystem injury (and occult injuries)
- 4) Hypovolemia
- 5) Hypothermia
- 6) Potential toxic ingestion

Anesthetic Goals/Conflicts:

- ATLS resuscitation
 - ABCDE, Monitors, IV access, Volume resuscitation – look for end points SBP > 100, HR <100, UO > 0.5ml/kg/hr, decreasing lactate, reverse acidosis
- Normal INR, PTT, maintain platelets > 50, normal serum Ca
- Temp > 35
- Aspiration risk vs C-spine injury
- RSI in hypovolemic patient
- Cspine injury in uncooperative/combative patient (airway management)

Hx: AMPLE, mech of injury (high energy? Eg ejection, ped struck, motorcycle, >100 km/h, fatality at scene...)

Px: Rapid primary assessment. Vitals + temp, airway patency, trachea (midline), ensure c-spine stabilization, JVP, flail segment obvious, AE bilateral/adequate (ie quickly rule out airway obstruction, flail chest, massive hemo, open pneumo, tension pneumo), adequacy of peripheral perfusion, quality of heart sounds (tamponnade). Then secondary survey looking for pulm contusion, simple pneumo, tracheobronchial injury, aortic disruption, esophageal injury (traversing mediastinal injury), myocardial contusion. Ensure appropriate lines and adjuncts being used (eg foley etc...). Assess for evidence of occult bleeding (abd, femurs...), long bone fractures and assess measures to control hemorrhage. Eventually log roll looking for hidden injuries including TL spine.

Investigations: C-spine, Trauma labs (CBC, Coags, ABG, Lytes, Bun, Cr, Tox Screen, crossmatch, Calcium (if transfusing), CXR (although many of above injuries should not wait for CXR), C-spine films (plain film +/- CT), CT chest/abd/head... depending on site of trauma, angio or Echo depending on clinical findings

Optimization: See goals above. Aspiration prophylaxis.

Room setup: CAS + 5. Art line, CVP (minor trauma may not require), foley, SCDs, fluid warmer +/- rapid infuser, warming blanket, TEE only for special circumstances (eg significant myocardial contusion or aortic dissection). Severe hypothermia may require active rewarming (venovenous) and correction of metabolic/hematologic status prior to surgical management.

Anesthetic options: Regional requires euolemia and correction of coagulation and metabolic status. As result, a GA is generally indicated.

Intraoperative management: Anticipate exaggerated response to induction. Intraoperatively, goals are unchanged. Aggressive prevention/treatment of hypothermia, acidosis, hypovolemia... Watch for fat emboli, particularly in patient with significant pulmonary injury.

Postoperative disposition: High dependency unit.

Traumatic Brain injury & Increased ICP

1. Etiology of inc ICP
 - mass, edema, hemorrhage
2. Monitor & manage inc ICP
 - risk of cerebral ischemia and herniation
3. Prevention of secondary brain injury
4. Complications
 - Seizures, neurogenic pulmonary edema, myocardial dysfunction, DIC, DI, SIADH
5. Considerations of trauma
 - Emergency, Aspiration risk, HD instability, C-spine precautions, life-threatening injuries – overt & occult, intoxication/uncooperative

Anesthetic Goals/Conflicts:

- Conflicts
 - awake intubation (difficult A/W, C-spine) vs. inc ICP
 - HD unstable (abruption, hemorrhage) vs. inc. ICP
 - Non-neurosurgical procedure with coexisting inc. ICP
- Prevent secondary brain injury
 - avoid hypoxia, hypercarbia, hyperglycemia, hyperthermia
 - maintain CPP (60 mmHg), Hgb
 - elevated HOB
- Avoid abrupt increases in BP and ICP

Hx: AMPLE, Etiology of injury/inc. ICP (trauma = ATLS), Stable or unstable, current ICP management, symptoms, identify occult injuries

PE: If trauma, primary & secondary survey, C-Spine precautions, **GCS**, pupils, basal skull #, Cushing's response (HTN, brady), irregular breathing, focal neurologic signs

Inv: CBC, G&S, lytes, urea, Cr, serum osmolality, INR, PTT, ABG to assess E_TCO_2 gradient

Imaging: CXR, C-spine film, +/-pelvic X-ray, CT head (+/- C-spine), FAST U/S (CT) if unstable

Optimization: Secure A/W, mild hyperventilation → PaCO₂ 30 – 35 mmHg, promote venous drainage (elevated HOB, head in neutral position), diuresis: mannitol 0.5-1 g/kg, furosemide 0.25-0.5 mg/kg, consider hypertonic saline: 5 cc/kg 3%, or 2 cc/kg 7.5%, secondary prevention (normothermia, normoglycemia, normocapnia, sodium), ensure adequate resuscitation, large bore IV access, blood products, surgical decompression/EVD

Anesthetic Options: GA

Room Setup: CAS (5 lead EKG), A-line, CVP, temp, foley, ICP monitoring, CSF drain, vasoactive agents, ICP agents (mannitol, lasix), BIS monitor for assessment of function (SR ratio)

Intraoperative Mgt: Secure A/W (RSI vs. awake vs. primary surgical) c-spine precautions, cricoid is controversial, Avoid ketamine and N₂O. Sux ok. TIVA (prop/remi) preferred over inhalational agents. IV/tracheal lidocaine. Maintain CPP 60mmHg (MAP ~ 90mmHg), don't delay for monitoring

Post-op: may keep intubated and ventilated to ICU, or smooth rapid emergence for neuro assessment. Monitor and manage DI/SIADH

Complications: inc. ICP/herniation (HOB, diuretics, coma, NdMB, craniectomy), DIC, SIADH/DI, myocardial dysfunction (ECG changes don't correlate), Seizures, ARDS, ICU prophylaxis (ulcer, DVT)

TURP & TURP Syndrome

2. Coexisting disease common in this population
 - IHD, ARF (post-renal), elderly
3. Considerations of intraoperative complications
 - TURP syndrome (2%)
 - Fluid overload & pulmonary edema; electrolyte abnormalities; hyperglycemia, hyperammonemia
 - Concealed hemorrhage (avg. 2-4 cc/min, but 2.5% require PRBCs)
 - Dysrhythmias (1%)
 - Hypothermia
 - Bladder perforation – 1%
 - Septicemia (usually gram negative)
 - DIC (rare complication associated with prostate cancer)
4. Positioning: Lithotomy → Nerve Injury; Trendelenberg → CVS/Pulm effects

Anesthetic Goals/Conflicts:

- Optimization of co-existing diseases
- Prevention or early recognition of TURP syndrome
- Attention to blood loss and appropriate replacement
- Conflict: preference for neuraxial technique to monitor CNS symptoms vs contraindications to neuraxial

Hx: Headache, N/V, agitation, visual changes, dLOC are signs of TURP syndrome.

Pre-op hx: AMPLE with focus on comorbidities and discussion re: neuraxial anesthesia

PE: Standard pre-anesthetic physical: vitals, CVS (JVP, Arrhythmia), Mental status, resp, back.

Investigations: Lytes (hyponatremia, hyperkalemia), CBC (hemolytic anemia), ABG, Creatinine, coags, Serum osmolality, ammonium, T&S, ECG, +/- echo,

Optimization: As indicated by pre-op assessment, blood available if prostate >40g, Prostatic stenting with laser treatment is an alternative

Anesthetic Options: GA (respiratory support, contraindication to regional), Regional (SAB to T9-10 has advantage of detecting CNS changes, pain with bladder perforation – suprapubic (extraperitoneal) or upperabdominal (intraperitoneal)pain

Room Setup: Emergency drugs, CAS + 5-lead, temp probe, CVP, a-line if severe co-existing disease

Intraoperative Mgt: Regional: T9-10, Lithotomy position → physiologic changes, nerve palsies.

TURP Syndrome: hypertension, bradycardia and mental status changes are classic triad. Resp: pulmonary edema, elevated JVP; CVS: arrhythmias, hypotension later; CNS: pupillary reflex sluggish or absent with glycine toxicity but intact with cerebral edema. **Prevention:** appropriate irrigation agent, minimize resection time, hemostasis, avoid high irrigating pressures (limit bag height to 30-40cm, frequent drainage), avoid hypotonic IV fluids, check lytes in Pts with CRF, metabolic abnormalities (hyponatremia). **Treatment:** Early recognize, inform surgeon, Oxygenation and circulatory support. Consider invasive monitoring, Investigations (Lytes, BUN, Cr, gluc, CBC, ABG, ECG) Treatment Hyponatremia - no treatment, diuresis with furosemide, hypertonic saline (1-2ml/kg/h – do not correct >1.5mEq/L/h). Sz – midazolam, STP, Propofol, consider phenytoin 10-20mg/kg load; **Post-op:** for severe cases: ICU, q1h blood work

Special: Problems in PAR include: post-op delirium, hypotension, respiratory distress. Need to consider these patients' comorbidities. (See seminar)

Twins

1. Parturient
 - a. Exaggerated physiologic changes of pregnancy
2. Increased risk for maternal/fetal complications
 - a. preterm labour; uterine atony and PPH, PIH; fetal distress (especially in 2nd neonate), fetal abnormalities (T-T transfusion), malpresentation and cord prolapsed
3. Management for twin delivery:
 - a. monitoring of 2 fetuses; resus equip for 2 neonates; possible need for C/S or forceps

Anesthetic Goals/Conflicts:

1. Early labour epidural
2. Maintain adequate maternal and uteroplacental hemodynamics

Hx: Standard anaesthetic history, previous obstetrical hx and any problems with current pregnancy, current gestation; Fetal history: number, recent US, position, lung maturity etc.

PE: good airway exam, Vitals, cardiopulmonary exam, lumbar spine

Investigations: CBC, diff, coags, review U/S report(s)

Optimization: labour epidural in place early

Room Setup: standard, monitoring for multiple fetuses

Intraoperative Mgt: Method of delivery depends on presentation of fetuses; Indication for C-section if: Twin A presentation is breech or shoulder, twin-twin transfusion, discordant growth, congenital abNs.

Higher risk for emergent C/S; Mgt as for any OB patient with monitoring for 2 and LUD is especially important; Large IV for risk of PPH; Epidural better than spinal if long C-section is predicted.

Post-op: Increased risk for PPH

Special: Multiple gestation puts mom and babies at increased risk for just about every possible complication of pregnancy. For the list, see the seminar.

Vasculitis

Classified as large, medium and small vessel.

1. Multisystem disease with end-organ dysfunction:
 - CNS: encephalopathy, vision
 - Lung: Pulmonary hemorrhage, cavitation
 - CVS: Aortitis, ischemia from arterial stenosis (claudication, cerebral, RAS, CHF)
 - Kidney: renal failure
2. Medications:
 - Immunosuppressive drugs and end organ damage
 - Steroids and need for stress dosing

Anesthetic Goals/Conflicts:

- Diagnosis by angiography/biopsy
- Consider short course of steroids, immunosuppressants or cytotoxic agents for symptomatic dx

Failure to Wean DDx

1. CNS: Pain / Anxiety
2. Respiratory Mechanics
3. Lung Parenchymal or AW obstruction
4. Primary Cardiac
5. Neuromuscular weakness

Anesthetic Goals/Conflicts:

- Treat pain and anxiety
- R/O Cardiac etiology : Systolic or Diastolic dysfunction
- R/O Neuromuscular weakness: Adequate nutrition, Electrolytes, Phosphate, assess diaphragm function.
- R/O lung parenchymal issues: Bronch, ABG, CXR
- R/O other factors impairing respiratory mechanics ie Abd Compartment Syndrome.

Wegner's Granulomatosis

1. Potential difficult a/w
 - a. Laryngeal stenosis, friable bleeding tissue (gentle, small ETT)
2. Multisystem granulomatous disease:
 - a. CNS: cerebral aneurysm's, peripheral neuropathy
 - b. CVS: Cardiac valve destruction, abn conduction, myocardial ischemia
 - c. Resp: Sinusitis, laryngeal stenosis, epiglottic destruction, VQ mismatch, pneumonia, hemoptysis, bronchial destruction
 - d. Renal: Hematuria, Azotemia, progressive renal failure
3. Possible contraindication to arterial line due to peripheral arteritis
4. Consideration for medical therapy and immunosuppressants:
 - a. Cyclophosphamide (decreases plasma cholinesterase) = mainstay of treatment

Anesthetic Goals/Conflicts:

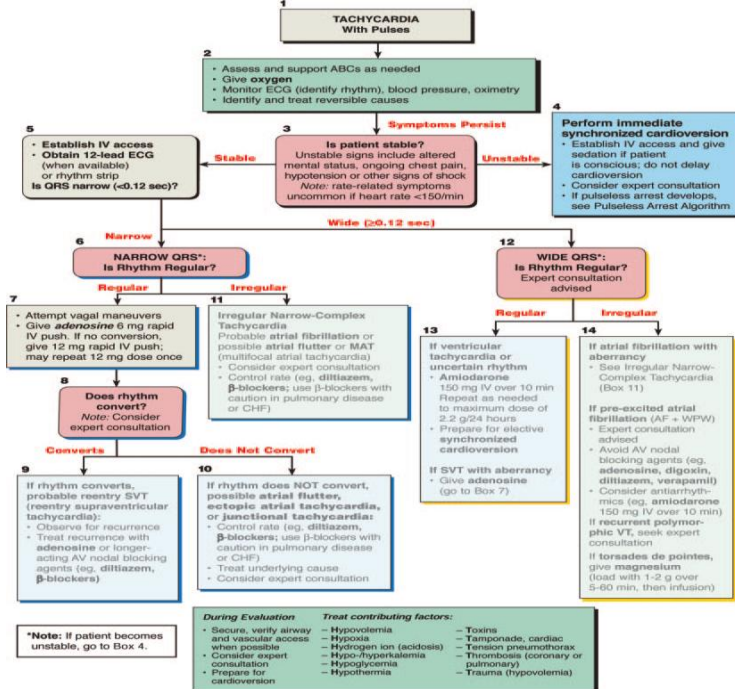
- Careful airway management
- Document neurologic deficits prior to regional techniques

Wide Complex Tachycardia

- Anesthetic emergency with the need to simultaneously diagnose and treat using ACLS treatment algorithm.
- Consider the multiple etiologies
- Consider cardiology consult if applicable

Anesthetic Goals/Conflicts:

- Get early help, call a code
- Notify surgeon and nursing staff, IV, O2 monitor....
- Stable vs Unstable: meds and maneuvers vs. immediate synchronized cardioversion
- Cycle monitors with differential diagnosis in mind



WPW

1. Potential for acute SVT, VF, sudden cardiac death and hemodynamic compromise or collapse
 - a. ACLS, Defibrillation, Adenosine (if no atrial fib or flutter), Global antiarrhythmics (amiodarone, procainamide)
2. Avoid sympathetic stimulation/tachycardia-anxiety, hypovolemia, ketamine
3. Atrial fibrillation and/or atrial flutter
 - a. Avoid AV nodal blockers – adenosine, BB, CCB, digoxin
4. Comorbidities
 - a. Ebstein's anomaly

Anesthetic Goals/Conflicts:

- Identify patients with WPW
- Avoid increased SNS activity, afib/flutter and AV nodal blocking drugs (BB, CCB, Dig)
 - enhanced anterograde conduction through the accessory pathways
- Be prepared to treat tachydysrhythmias with cardioversion, or drugs – amiodarone, procainamide infusion (10 mg/kg at 20 mg/min)

Hx: AMPLE, syncope, palpitations, FMHx sudden death, previous arrhythmias / treatments

Investigations: lytes Mg, ECG: delta wave, short PR, widened QRS (antegrade conduction)

Optimization: continue antiarrhythmic agents (maintain NSR) unless EP studies, anxiolytics preop

Room Setup: procainamide, amiodarone, anxiolysis, Crash cart, defib pads,

Intraop Management: avoid ketamine and pancuronium; avoid volatiles if ablation procedures - inc. accessory pathway refractory time; caution with atropine, glycopyrrolate (tachycardia), ensure adequate analgesia; Cardiac monitored bed post-op

Special:

- only a worry when the accessory pathway conducts Atrium → Ventricle AND when the patient goes into AFIB or AFlutter
 - risk that the rapid atrial rate can be conducted into the ventricle and result in hemodynamic collapse from VFIB/Flutter
 - AV node maximal conduction rate = $\sim 220 - \text{Pt's age}$
 - Accessory pathway maximal conduction rate = NO MAXIMUM
- ECG – very rapid, wide complex tachy (resembling vtach) with irreg, irreg vent complexes
- In this situation, **you should avoid AV nodal blocking drugs** (adenosine, BB, CCB, Dig) as this may result in the impulses being transmitted down the accessory pathway

Safe to use global antiarrhythmics or cardioversion - Amiodarone (adult dose 150 mg bolus, Peds 5mg/kg over 20 min), Procainamide (may get transient increase in conduction through AV node before blocking down) (adult dose is 10mg/kg IV over 15min, peds 15mg/kg)

Wrist Block and Hand Block(Never use Epi!)

Indications: For surgery on hands and fingers, no specific contraindications: contraindication to brachial plexus blockade: rescue of incomplete brachial plexus block

Complications: Minimal, hematoma/infection/nerve injury possible, wrist tourniquet well tolerated
Duration Lido 2% ~ 2-5hrs, Bup 0.5% 5-15 hrs. Use 4-6 ml per nerve! Onset 10-15mins

Median Nerve: Located bw flexor carpi radialis and Palmaris longus. At the level of the wrist, the motor branch has already left posteriorly, therefore can't use nerve stim! Inject at the level of the ulnar styloid process at a depth of 1.5 cm (fascial pop) bw the two tendons. (3-4ml).

Ulnar Nerve: Lies bw ulnar artery and flexi carpi ulnaris. Volar approach: at the level of the styloid, inject 3 mls bw ulnar artery and FCU tendon. For ulnar approach: Introduce from the ulnar side of the tendon approx 5-10mm past tendon, inject 3-5ml. Can elicit parasthesias or use N. Stim (only one!) Can also inject 2-3mls above tendon which blocks cutaneous branches which branch off 5cm above styloid.

Radial Nerve: Sensory block only, field block at the anatomic snuff box made by extensor pollicis longus and EP brevis. Inject using 2 injections in an "X" shape. 4-6ml.

Digital Nerve Blocks: For surgery on fingers, 2-3 ml per side, do not use epinephrine!

The main digital nerves are derived from median and ulnar nerves, accompanied by digital vessels and run on the ventrolateral aspect of the finger. Small dorsal digital nerves run on the dorsolateral aspect of the finger and supply innervations to the back of the fingers as far as the proximal joint. (4 small nerves at the base of each corner)

Technique: 25G 1.5" A 23- to 25-gauge needle is inserted at the medial and lateral aspects of the base of the selected digit. A total of 2–3 mL of local anesthetic without epinephrine is injected on each side near the periosteum.

Complications: Nerve injury is primary complication

Therefore, avoid epinephrine!

