Anaesthetic Quicknotes

Ben Halett & Michael Kluger 2011

Pericardial tamponade

- Def: haemodynamically sig cardiac compression caused by pericardial fluid
- Fluid: pus / blood / effusion / air / blood
- Physiol: ↓ atrial filling and ∴ VR
- Compensation
  - Early (maintain organ perfusion): ↑ EF 70-80%), ↑HR, ↑ SVR
- Causes
  - Blood
    - Trauma – Blunt / penetrating, CVC, CPR
    - AMI – Rupture
  - Serous – Neoplastic, CTD, Uremia, radiation
  - Purulent – Viral / bacterial infection
- Beck's Triad
  - ↑ CVP
  - Quiet / soft heart sounds
  - ↓ systemic arterial pressure
- Clinical Features:
  - Symptoms: Dyspnoea (sitting forward), fatigue
  - Signs: Tachypnoea, tachycardia, low CO (cold, clammy, CR>2sec), pulsus paradoxus (↓ SVP > 10mmHg with inspiration)
  - CVP ~ PAP ~ LCWP equalize
- Treatment:
  - Remove restriction (pericardiocentesis / thoracotomy and window)
- Pericardiocentesis
  - 30-45° head up, advance needle right of xyphisternum towards contralateral (left) shoulder
- Pericardial Window
  - Challenge (↓ diastolic filling, ↓ SV)
  - Anaesthetic options
    - LA
    - Sedation + LA
    - GA
  - Ketamine - ↑ SVR, ↑ HR, maintain contractility (but may ↓ these if already maximal SNS stimulation)
  - Can also add midazolam, have patient sitting up, keep spont venting
  - Have adrenaline running → be prepared for overshoot when effusion drained

Pleural Drainage

- ICC attached
- Aim:
  - Re-expansion of lung
  - Effective drainage of air / blood / fluids
  - One-way flow of air (airtight UWS)
- Parts: ICC, tubing, drain (with under-water seal)
- Drain
  - Chamber 1: collection bottle
  - Chamber 2: Under-water seal (prevents air flowing back into thorax with inspiration. Allows assessment of swing / bubbling = leak)
  - Chamber 3: suction bottle with tube to adjust cmH2O negative pressure

Drug abuse in pregnancy

- Most deny
- High index of suspicion
- Risk factors:
  - Lack of antenatal care
  - Previous prem labor
  - Smoking
- Those who acknowledge use → should offer counseling and treatment
- Cocaine
  - HTN, tachycardia, malignant arrhythmia, MI
  - Cx: prem labour, abruption, uterine rupture, arrhythmia, liver rupture, CVA
- Opioids
  - Present acute intoxication / withdrawl
  - Withdrawl = ↑ SNS activity
  - Avoid antagonists
  - Methadone recommended
  - Clonidine
- Assessment:
  - Routine Hx / Ex / Ix
  - Detailed Hx of drug use, end-organ effects
  - Implications
    - Behaviour (regional vs GA)
    - BP (↑ / ↓)
    - Arrhythmia
    - Aspiration risk
    - Tolerance
    - Drug interactions

Parturient – Urgent LUSCS

- Age
- Gestation
- Gravity / Parity
- Reason for admission
  - SROM / induction / augmentation
- Presenting part
- State of cervix
- Placenta
- BMI
- Airway
- PHx (medical / obstetric / anaesthetic (regional/GA))
- Medication & Allergies
- Fasting
- Antenatal Hx (reflux)

CSE / EPIDURAL

- Use: analgesia / anaesthesia
- Both = superior pain relief during labor cf systemic pain relief
- CSE:
  - cf epi does NOT add sig advantages for analgesia <u>but</u>↑ rate of urinary retention
  - May be useful in complicated cases (i.e. prolonged LUSCS / twins / ↑BMI)
- Epi:
  - does <u>NOT</u>↑ LUSCS rate / back pain
  - ↑ duration of labor
  - ↑ rate of vag instrumental delivery
- CIMPLE
  - Consent
  - IV access
  - Monitoring
  - Positioning (side / sitting)
  - Landmarks
  - Execution & Evaluation
- Epidural
  - I use an 18G touhy
  - Lateral / sitting
  - Pass needle L4/L5 LORTS
  - Feed catheter
  - Test dose: 2ml 2% lignocaine
  - Topup: 0.2% ropivacaine 10-15ml in 5ml aliquots 5 minutely with BP monitoring
  - 50-100mcg fentanyl
  - PCEA
- CSE:
  - 18 touhy + 27 G pp spinal
    - Analgesia: 0.5ml (2.5mg) bupiv + 15mcg (0.3ml) fentanyl
    - Anaesthesia: 2.2 ml 0.5% heavy bupi + 0.3ml (15mcg) fentanyl
  - Remove spinal and feed catheter
- Epidural top-up (LUSCS)
  - 20ml syringe
    - 2ml HCO3-
    - 1ml 1:10,000 adrenaline (5mcg/ml)
    - 17ml 2% lignocaine
  - 5ml aliquots to 15-20ml
- PCEA
  - 0.2% ropivacaine + 2mcg/ml fentanyl
  - Bolus: 5ml
  - Lockout: 15min
  - 4hr limit: 60mls ??

Stridor (Adult)

- Stridor @ rest ~ 50% ↓ airway diameter
- Assessment = routine + focus on stridor
- Stridor:
  - Loud / harsh, high-pitched
  - On inspiration
  - Due to partial collapse of airway
  - Cause: usually extrathoracic → pharynx, larynx, trachea
  - Can be heard during expiration = very severe
- Stridor in adult is uncommon. Chronic = severe underlying pathology
- Urgent potentially life-threatening stridor:
  - Simultaneous assessment and Management
  - High-flow O2 via mask
  - IV access
  - DDx
    - Acute = trauma, infection, anaphylaxis, foreign body, laryngospasm
    - Chronic =
      - Malignancy
      - Inflammatory Cricoarytenoid ankylosis
      - Compression
      - ? vocal cord
- Presentation:
  - Onset: acute / chronic
  - Duration / progression / severity
  - Constitutional signs
  - Drooling, cough, positional changes
- Ix:
  - Pulse Ox, ABG
  - CT / MRI
  - Neck Xray (AP / lat)
  - Nasendoscopy
- Anaesthetic options:
  - Awake trache
  - Inhalational GA with ENT scrubbed

Inhalational Induction (Stridor)

- Patient with stridor @ rest
- Difficult
- Need 2 anaesthetists (least 1 experienced)
- Difficult point
  - Just @ LOC where respiration becomes obstructed
  - Guedel airway → may worsen obx / cause laryngospasm
  - Soft palate + Post pharyngeal wall most important cause of obstruction with ↑ depth
  - ∴ Nasopharyngeal airway is better
- Topicalize nose (co-phenylcaine)
- Induce with full monitoring
  - IV fluids
  - Experienced surgeon scrubbed
    - Rigid bronch checked
    - Trache set open
- Induction
  - 100% O2
  - Sevoflurane ↑ stepwise
  - If apnoea → DO NOT assist! Allow CO2 to rise. Safety lise in spont vent
  - Obstruction → insert 6/7mm NP airway through topicalized nostril
  - Wait → pupil small and central
- When deep
  - Gentle laryngoscopy
  - Can ETT pass?

Severe Stridor

- Awake Tracheostomy under LA
- If:
  - Severe stridor
  - Large tumour
  - Fixed hemilarynx
  - Gross anatomical changes
  - Larynx not visible on nasendoscopy

Problems with AFOI in stridor

- Patient with severe pathological obstruction 2° lesion in peri-glottic region
- Conditions for smooth AFOI
  - Judicious light sedation (dangerous in stridor)
  - Calm patient (obstructed pt is terrified)
  - Perfect LA (not possible with large tumour / mass)
  - Ability to distinguish anatomy
  - Minimal blood / secretions
- Cork in a bottle
  - 4mm scope in 5mm hole = obstruction

Mid Tracheal Compression

- Eg: thyroid / lymphoma
- Tracheostomy NOT and option (mass in the way)
- ∴ inhalational induction is NOT a suitable option (if obstructs, can't do emergency trache)
- CT SCAN
  - If enough clearance above carina
    - IV induction / ? spont vent is better
    - ETT (with bronchoscope)
    - >50% narrowing is high risk
- Rigid Bronch if intubation fails (Thoracic surgeon)

Awake Airway Options

1. AFOI (nasal / oral)
2. Topical airway – gentle laryngoscopy

3. Awake tracheostomy
4. Retrograde technique

Obstructed Airway

- Approach
  - Urgency of intervention
  - Level of Obx
  - General condition of patient
- Obstruction
  - Likely to worsen with anaesthesia / manipulation
  - Lose airway tone / reflexes
  - Trauma / bleeding
- If time allows:
  - Nasendoscopy
  - CT / MRI
  - Lung function tests
  - Echo → if PA involvement suspected
- Assessment
  - Level
    - Oral / supraglotic / laryngeal
    - Mid / lower trachea
    - Stridor / Voice Δ = laryngeal
  - Severity
    - Resp distress
    - Accessory muscle use
  - Lesion
    - Mobile / friable
  - Neck
    - Ease of surgical airway
  - Position
    - Effect of Δ of position

Laryngotracheal Injury

Tracheostomy

- Secure airway with ETT
- Cuff balloon easily accessible
- Suction NGT + pharynx
- Drape (allow access to ETT)
- Prior to Δ to trache
  - 100% O2 3-4min
  - ↑ volatile (deepen)
  - Check level of NMB
- Ensure correct trache size and have ready
- Deflate ETT cuff prior to incision
- Withdraw ETT in upper trachea
- Connect to tracheostomy and test ventilate
- Beware of airway fire (avoid use of diathermy)

Peadiatric Fluid Assessment

See OHA p 764 – not sure about this but seen it elsewhere. Is this dehydration??

FLUID LOSS	5% (mild)	10% (mod)	15% (severe)
Fontanelle	N	Sunken	↓↓
Sk turgor	N	↓	↓↓
M membrane	N	Dry	Very dry
Eyes	Moist	Sunken	↓↓
Pulse	N	↑	↑↑
Resp	N	↑	↑↑ / deep
Urine	< 2ml/kg/hr	<1ml/kg/hr	< 0.5ml/gk/hr
Cap refill	N	≥ 2 sec	↑
Skin	N	Pale	Mottled
CNS	N	Irritable	Depressed

Paediatric Fluid Resus

- Early signs of hypovolaemia
  - Cap refill > 2 sec
  - Cold / blue periphery
  - Thready pulse
- HR not reliable (Δ pain / anxiety)
- Late signs
  - Oliguria (<0.5 ml/kg/hr)
  - CNS depression
- No ↓ BP until > 35% blood volume lost!
- Circulating volume
  - Neonate: 90ml/kg
  - Infant: 85ml/kg
  - Child: 80ml/kg
  - Adult: 70ml/kg
- Fluid Bolus:
  - Crystalloid: 20ml/kg
  - Colloid: 10ml/kg
- Repeat bolus
- If no response to 40ml/kg crystalloid → give blood
- Blood
  - 4ml/kg ↑ count by 10
- If blood loss is >15% circulating volume → give blood
- 3rd space loss
  - Abdo: 6-10ml/kg/hr
  - Throacic: 4-7ml/kg/hr
  - Superficial: 1-2ml/kg/hr
- Maintenance (0.45% NS + 5% Glucose)
  - 1st 10kg: 4ml/kg/hr
  - 2nd 10kg: 2ml/kg/hr
  - >20 kg: 1ml/kg/hr

Paediatric Spinal

- Use:
  - ↓ post-op complication (in high risk former pre-term neonates)
  - ↓ apnoea / bradycardia
  - ↓ post-op respiratory dysfunction
- Considerations:
  - Positioning → sitting / lateral
  - Sedation → awake (sedation negates any benefit for post-op apnoea)
  - Cord → ends L3
  - Intercristal line → L4/5
  - Topical EMLA (60-90 min) +/- LA inj to skin
  - Dose: 0.5ml/kg Bupivacaine 0.5%
- PDPH ? 5-10% esp older children

Paediatric case in the country

- Questions:
  - Right anaesthetist?
  - Right surgeon?
  - Right hospital?
- Generally under 1 year better in major paediatric hospital
- Assessment:
  - Hx – Antenatal / postnatal / prev GA
  - Ex / Ix
- Apnoea risk
  - PCA (Age (wk) + Gestataional age)
    - Term: 46 weeks term
    - Ex-prem: 52 Weeks (College guidelines + Children's WA)
    - Cote: 55-60 week prem
  - ↑ risk with Anaemia, phx of apnoeas, apnoea in recovery, OSA, craniofacial
- Prem = born < 37 weeks

Apnoea monitoring

- Apnoea monitoring (for ANY type of anaesthesia)
  - Line of sight + pneumography + sats + HR for 12 hours
  - Apnoea:
    - Absent breathing for 15 sec
    - < 15 sec if
      - assoc with bradycardia (bpm <100)
      - Sats (↓ 90%)
  - 1st apnoea occurs within 12 hours (continue for another 12 if apnoea occurs)
  - Who needs high-level care
    - Ex-prem < 44 weeks (NICU)
    - Ex-prem 44-52 with poor post-natal history (PICU)
    - Ex-prem 44-52 with major surgery / post-op opioids (HDU)

References:

- **PS 15 - RECOMMENDATIONS FOR THE PERIOPERATIVE CARE OF PATIENTS SELECTED FOR DAY CARE SURGERY – 2010**
- **Women's & Children's Hospital WA**

MAGPIE Trial

- ↓ seizure risk in pre-eclamptic
- ?? check rest

Prasugrel

- NNT 100 ↓ one case of MI due to in-stent thrombisi but ↑ one case of major bleeding + death????

GALA trial

- No benefit of LA versus GA

Hypertension

- Optimal 120/80
- Normal < 130 / < 84
- Stage
  - I 160/100
  - II 180/110
  - III > 180 / > 110
- For stage III
  - Potential benefit in delaying and optimizing weighed against risk of delaying procedure
  - No benefit in delaying is chronic treated HTN if:
    - No previous MI
    - Severe / unstable angina
    - CRI
    - LFH
    - AS
    - Arrhythmia
    - Stroke
- End-organ effects
  - LVH
  - CAD
  - CVD
  - Renal damage
  - CCF

AHA/ACC – Stress testing ????????

- Ambulatory → EST
- If abnormal resting ECG (i.e. LBBB, LVH + strain) → Stress imaging
  - LLB – exercise myocardial perfusion imaging (? Stress echo) has LOW specificity. Use pharmacological stress myocardial perfusion scintography or dobutamine stress echo
- If unable to exercise
  - Pharmacological stress (perssantin, dobutamine thallium)
  - Dobutamine echo

Surgical Risk

Table 4. Cardiac Risk* Stratification for Noncardiac Surgical Procedures

Risk Stratification	Procedure Examples
Vascular (reported cardiac risk often >5%)	Aortic and other major vascular surgery Peripheral vascular surgery
Intermediate (reported cardiac risk generally 1% to 5%)	Intraperitoneal and intrathoracic surgery Carotid endarterectomy Head and neck surgery Orthopedic surgery Prostate surgery
Low† (reported cardiac risk generally <1%)	Endoscopic procedures Superficial procedure Cataract surgery Breast surgery Ambulatory surgery

Proceed with surgery

1. Urgent → go
2. Elective
   a. Active → evaluate / treat

b. Low risk → surgery
c. Intermediate / high + asymptomatic > 4 METS → surgery
d. Intermediate / high with < METs or unknown
    i. Vascular and ≥ 3 RF → consider testing
    ii. Intermetdiate and ≥ 3 RF / 1-2 RF and vascular / intermediate → HR control / non-invasive testing
    iii. No RF → proceed

Child-Pugh

- "ABCDE"
    - A-albumin
    - B-Bilirubin
    - C-Clotting
    - D-Distention (ascites)
    - E-Encephalopathy

Burns

- 15% > in child referred
- Face / neck / hands / feet / perineum need referral
- Resus
    - 3ml × kg × BSA%
    - ½ in 1st 6 hours and rest in 18 hrs

Breaking bad news

- Get story straight
- Have all parties present
- Support person for the patient / family
- Location: quiet unthreatening room
- Talk:
    - State situation – safe / stable /
    - Express sorry for situation
    - Keep it clear and simple
    - Allow time to sink in / reaction / question
    - Take to see patient

Previous PCI

Proceed with elective / non-urgent surgery if:

1.	Balloon	> 14 days	+ Aspirin
2.	BMS	>30-45 days	+ Aspirin
3.	DES	> 365 days	+ Aspirin

Malignant Hypertension

- Primary (Essential)
    - Unknown
- Secondary (Non-essential)
    - Renal → renovascular
    - Endocrine
        - Thyroid storm
        - Phaeo
        - Cushing's (↑ICP)
    - Metabolic
        - MH
        - Pre-eclampsia
- Other
    - OSA
    - Drug Error
    - Meassurement Error
    - Surgery (cross-clamp)
    - White Collar
    - Awareness

SLE

- Chronic multisystem AI disease
- Ab production
- Common: Women of reproductive age
- Clinical
    - **CVS**: 15% pericarditis, Raynaurds
    - **RS**: effusion
    - CNS: > 50% depression / psych, Nerve lesions
    - MSS: Arthritis / arthralgia
    - **Renal**: GN → major cause of morbidity
    - Haem: Anaemia, hypo/hyper-coaguable
    - Skin: Characteristic rash
- Drugs:
    - Rx: steroids
    - Hydralazine can precipitate SLE
- Assess:
    - End-organ damage (extent)
    - Medication (esp steroids)
    - Ix: FBE, Coags, UEC
- Mx
    - Airway: Usu OK. Oral / pharyngeal ulcers
    - Steroid cover if needed

Opioid-abusing patient

- Patients on Heroin are <u>not always</u> opioid tolerant
- Management
    - Analgesia
    - Rx / prevent withdrawl
    - Offer psychosocial assistance

High Airway Pressures

Definition

- ↑ PIP by ≥ 5 cmH_2O OR
- PIP ≥ 40 cmH_2O

Problem

- Equipment
- Patient

- Equipment
    - ETT (Kink/cuff herniation/endobronchial/FB/secretion)
    - Circle (Stuck valve / kink / O2 flush)

    - Machine
    - Bag / vent switch wrong position
    - Wrong outlet
- Patient
    - Respiratory
        - Raised IAP (pneumoperitoneum)
        - Pulm aspiration
        - Bronchospasm
        - Collapse / Atelectasis
        - ↓ chest compliance (remi, MH)
        - APO
        - PNEUMOTHORAX
        - Endobronchial intubation
    - Drug-related
        - Opioid-induced chest wall rigidity (remi)
        - Inadequate muscle relaxant
        - MH / Anaphylaxis
    - Embolic
        - Air / Gas
- Management
    - Initially
        - Simultaneous Ax and Mx
        - Call for help
        - 100% O2
        - Confirm PIP
        - Bag by hand
        - Listen to chest / watch for movement / percuss
    - Equipment
        - Bag by hand
        - Rapid check of valves / connections / switches / tubes to patient (check O2 and sevo)
        - Suction ETT
        - If not happy
            - Remove machine and circle (self-inflating bag)
            - Remove filter
            - When in doubt pull it out (remove ETT and ventilate by hand)
    - Patient
        - Ascultate
        - Check for PTX
        - ? anaphylaxis → adrenaline
        - ? MH
        - More relaxant / anaesthetic depth

Chest Drain

Indication

- Collection
    - Air – PTX
    - Fluid – effusion / blood / puss
- Post-op

Insertion

- Consent
- IV access, monitoring, assistance, location
- Pre-med (BZD / opioid)
- Position: Bed, head-up, arm up, rotated away
- Time out (confirm side)
- Safe area
    - Lateral edge pec major
    - Post-axillary line
    - IC spaces 3-5
- Classically 5th IC space anterior-axilla ??
- ICC size
    - Air 10-20 Fr
    - Fluid 20-30 Fr
- Asepsis (GGMPD)
- LA to skin to rib bellow space
- Incise over rib
- Blunt dissect over rib and into pleural space
- Insert ICC (WITHOUT Trochar)
    - ↑ for air
    - ↓ for fluid
- Suture / Dressing
- Connect to under-water drain system

Bronchopleural Fistula

Definition = communication b/n bronchial tree and pleural space. Persistent air leak / failure to re-inflate the lung despite > 24hrs of chest drainage

Causes

- Trauma
- Complication of procedure (diagnostic / therapeutic)
- Chest drain

Main issues

- Difficulty ventilating patient
- Loss of Tv
- Unable to apply PEEP
- Persistent lung collapse
- Tension PTX if no ICC

Post-op Nerve Palsy

Causes

- Compression (pressure)
- Stretch (poor positioning)
- Ischaemia
    - Local (compression)
    - Global (hypotension)
- Metabolic derangement
- Direct trauma
- Laceration

Risk Factors

- Pre-existing disease
    - Acromegaly
    - Cancer
    - COAD
    - Diabetes
    - Hypoglycaemia

- Hypothyroid
- Liver disease
- Uraemia
- Porphyria

- Drugs (chemo agents / MTX / LA)
- Gender (M > F)

Most reliable / consistent RF

1. Male
2. Prolonged hospitalization
3. Extremes of body habitus

Post-op Cognitive Dysfunction

- More pronounced early
- Usually resolves in 3-6 months
- Persistent @ 3mth associated with ↑ mortality
- Risk Factors
  - Major > minor Surgery
  - Advanced age
  - Education level
  - Cardiac surgery
  - Anaesthetic agents
  - GA vs Regional → No difference

Massive Transfusion

• FFP	15ml/kg	If INR > 1.5
• Plt (Pooled~6U)	1 unit/10kg	if Plt < 50
• Cryo	1 bag/10kg	if Fibrinogen < 1.0

Management

- Temperature
- Acid/base
- Dilution (give clotting products)
- Citrate/Ca^{2+}
  - Each PRC contains ~ 3g citrate
  - Healthy liver can metabolise ~3g citrate per 5min

Definitions (multiple):

- One blood volume in 24hrs
- 150ml/min

Transfusion (trauma / obstetric) (New NHMRC guidelines) PRC:FFP:PLT

- < 2:1:1 (ideally 1:1:1)
- Bags at RMH: 4:2:1 (i.e. 4 PRC units to 2 FFP bags (2 units in each) to 1 pooled bag of platelets (4-5 units)

Cx Spine

- Airway
  - High flow O2 via mask
  - Ensure patent airway
  - Basic maneuvers (jaw thrust, chin lift +/- Guedel/NPA). NO neck extension!
- Assume Cx injury with significant blunt Trauma
- Position:
  - Maintain neck in neutral
  - Collar / sand bags / strapping / tape
  - MILS for intubation / log roll
- Priority:
  - <u>Immobilization</u>
  - NOT Clearance
- Clearance:
  - Clinical + Radiological

- Clinical Clearance
  - Alert / oriented / no head injury
  - Not intoxicated (ETOH / drugs / sedation)
  - No neck pain
  - No abnormal radiology
  - No distracting / significant injury
- Plain Films
  - 3 views
    - Lateral (Occiput → T1)
    - AP (C2 → T1)
    - Open mouth (C1 + PEG)
- CT
  - 2mm bone window

Consent - ? Impaired Patient

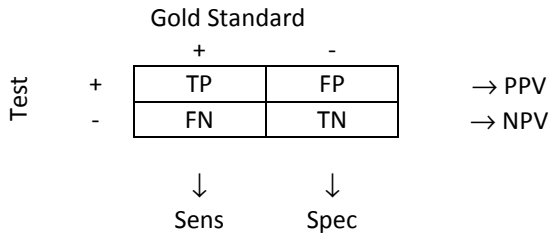
- Consent required by LAW and MEDICAL ETHICS
- Needs to be informed, competent and not coerced
- When lacking competence to make informed decision
  - SUBSTITUTE decision maker MUST be sought
- Balance of respecting autonomy of the patient AND protecting those with cognitive impairment
- Determine:
  - How surgeon obtained consent (? Is it valid)
  - NOK
  - Medical POA
  - Guardian (appointed by guardianship board)
  - Get legal advice from hospital counsel
  - Discuss with senior colleague

Alzheimer's

- Most common form of dementia
- Incurrable, progressive, terminal
- Memory loss
  - Confusion, irritable, aggressive, mood swings
  - Long-term memory loss
- Cause: Relative ↓ Ach neurotransmitter (loss / degen cholinergic neurons)
- Medical Treatment (slow but do not halt progression)
  - 3 are AchE⊗
    - Donepezil (Aricept)
    - Galantamine
    - Rivastigmine

- Anaesthetic Issues
  - Consent
  - GA:
    - Antagonism of NDMR (with above drugs)
    - Risk of CENTRAL CHOLINERGIC SYNDROME
    - Age-related co-morbidity
- DDx
  - Delirium (fluctuating rather than progressive course but hard to differentiate)
  - Depression
  - Drugs
  - Normal age-related memory changes
  - Organic brain issue (SDH, Trauma)
  - Infection (HIV, Syhpilis)
  - Metabolic / Endocrine (Hyper-calcaemia)
  - Other neurological condition (parkinsons / huntingtons)

Sensitivity and Specificity



Sensitivity

- Proportion of patients with the disease correctly identified by the test
- True positive rate
- High sensitivity = few cases are missed (Low FN)

Specificity

- Proportion of patients <u>without</u> the disease correctly identified by the test
- True negative rate
- High spec = few cases without the disease are labeled as having the disease (FP)

Screening Test (Highly Sensitive)

- Highly sensitive (i.e. won't miss those with the disease and have LOW FN)
- Trade-off is often lower specificity and will miss-label some as having the disease (i.e. FP)
- A NEGATIVE test result thus effectively RULES OUT having the disease (i.e. SN-OUT)

Diagnostic Test (Highly Specific)

- Highly specific (i.e. low FP)
- i.e. POSITIVE test result RULES the disease IN
- i.e. SP-IN

Predictive Values

- Depends on PREVALENCE of the condition within the population
  - (c.f. with sens/spec which is a property of the test and <u>independent</u> of the population)
  - A common condition will have a HIGH PPV/ NPV whereas the converse is true if the condition is uncommon
- PPV = likelihood of having the disease given a positive test result
- NPV = likelihood of NOT having the disease given a negative test result

Obstetric population

- Failed airway 1/250
- Spinal / Epidural
  - Failure epi: 1/20
  - PDPH 1/100 – 1/200
  - 1/1000 transient neuro
  - 1/10,000 nerve damage (persistent paraesthesia)
  - 1/150,000 paralysis (epi), 1/200,000 (spinal)

Difficult BMV

- RM BOOTS
  - Radiation
  - Male
  - Beard
  - Obesity
  - Old
  - Teeth (nil)
  - Snoring, stridor, stiff lungs

IBW administered drugs:

"Recommended retail price of Vec"

- Roc
- Remi (and other poor lipid sol opioids – morph, alf)
- Propofol (induction)& Paracetamol
- Vec

- ALL others are TBW including propofol maintenance

FLACC

Face
Legs
Activity
Crying
Consolability

Insulin management

Modern (Lantus + Novorapid)

- Lantus at night
- W/H novorapid

- Check sugars
- Glucose if low / novorapid sliding scale or GKI if high
- Check 1 hrly whilst in theatre complex
- Then 2-4 hourly on ward (novorapid scale with 2 hourly BSL / Actrapid 4hr/QID)

Older (Protaphane and actrapid)

- Nocte protophane
- AM list W/H actrapid
- PM list: add mane + middi actrapid and give 50% as protaphane

Older (mixes)

- 50% in the morning

Type II

- W/H metformin 48hrs
- Gliclazide day of surgery

After Mishap (RD 11)

- Contact senior colleague / friend / mentor
- Inform duty anaesthetist
- After event:
  - Isolate machine / drugs (allow careful examination)
  - Relief anaesthetist
  - Call family / NOK
  - Arrange structured interview
  - Call ward / admin / referring doctor
- Counseling of staff
- Contact medico legal representative (hospital counsel)
- Document
  - Account of facts not opinions
- Maintain contact with NOK
- Recognised potential ongoing stress (support services)

Mannitol

- Osmostic diuretic
- Plant-derived alcohol (Dhalia tuber)
- Draws H2O from ECF / ICF → vascular compartment
- Efficiency depends on intact BBB
- SE
  - Temporary ↑ CBF and ∴ ICP before it falls (particularly after rapid injection)
  - Fluid overload and APO (beware CCF)
  - Rebound ↑ ICP may occur
- Dose:
  - 0.5 – 1 g / kg
  - (presented as clear fluid 20% ∴ 2.5 – 5ml/kg)
- Effect within 30 min and lasts ~ 6 hrs

Dehydration (% of total body weight)

Fluid loss	5%	10%	15%
Fontanelle	NAD	Sunken	Deep sunken
Eyes	NAD	Sunken	Deep sunken
Skin	NAD	↓ turgor	↓↓ turgor
MM	NAD	Dry	Very dry
Pulse	NAD	↑	↑↑ feeble
Resps	NAD	↑	↑ / deep
Urine	< 2ml/kg/hr	< 1ml/kg/hr	< 0.5ml/kg/hr
Cap refill			

Pyloric Stenosis

- Hyponatraemic, hypochloraemic, hypokalaemic metabolic alkalosis
- Vomiting
  - Lose H+, H20, Cl-, Na+, K+
  - Net ↑ in HCO3-
  - Renal resorptive capacity overwhelmed by HCO3- → alkaline urine
- ↓ ECF volume
  - Renal conservation of Na+ by ↑ aldosterone secretion
  - Gain Na+ but ↑ loss of K+
  - Further loss of K+ to retain H+ in attempt to correct pH
- Management
  - NOT surgical emergency
  - Resuscitate and correct metabolic abnormalities
  - Restore ECF
- IV access, FBE, UEC, VBG
- NGT
- Severe dehydration
  - 20ml/kg 0.9% Saline or
  - 10ml/kg gelofusine / Albumin 5%
  - Mild/mod
    - 5% glucose + ½ saline + 10mmol KCl per 500ml @ 6-8ml/kg/hr
  - Maintenance: 4% Glucose + 1/5th saline @ 4ml/kg/hr (i.e. for 1st 10kg)
- Goals
  - **Chloride > 106**
  - Na+ > 135
  - **HCO3 <22-26**
  - Urine Cl > 20
  - U/O > 1ml/kg/hr

Aortic Stenosis

- Normal area: 2.5 – 3.5 cm^2

Severity	Area (cm^2)	Gradient mmHg
Mild	1.2 – 1.8	12 – 25
Mod	0.8 - 1.2	25 – 40
Severe	0.6 – 0.8	40 – 50
Critical	< 0.6	> 50

Haemodynamic aims:

- Low / normal HR
- Sinus rhythm

- Adequate preload
- High / normal SVR

Blood Volumes – Paeds

	EBV ml/kg	HCT	Acceptable HCT
Preterm	90-100	0.4 – 0.45	0.35
Term	80-90	0.45 – 65	0.3 – 0.35
Infant	75-80	0.3 – 0.42	0.25
1 year	70-80	0.34 – 0.42	0.2 – 0.25
6 yr Child		0.35 – 0.43	0.2 – 0.25

Acceptable blood loss

- ABL = Weight (kg) × EBV (ml) × $[(H_o - H_1) \div H_a]$
  - Ho = starting Hct
  - H1 = lowest acceptable Hct
  - Ha = average Hct (Ho + H1)/2

Fast Track Colorectal

- Effective analgesia allows early mobilization is a prerequisite for improved recovery
- Thoracic epidural followed by multi-modal non-opioid analgesia is most effective EBM approach (for open surgery)
- Lap-assisted
  - Opioid-sparing multi-modal analgesia
  - Paracetamol, NSAIDs, Gabapentin, Systemic LA, Continuous wound infusion
- Need for peri-op bowel prep? (probably not needed)
- Peri-op Fluids
  - Large RCT's: excess fluids ↑ mortality
  - Perio-op optimization of haemodynamic function (with goal directed approach)
  - Optimize SV by small colloid challenge ↓ morbidity and LOS (? Guided by FTc on Doppler)
  - Individual tailored fluid therapy is a main component of fast track colorectal Sx (Austin study in AIC highlighted excess fluid therapy)
- EBM
  - Pre-op patient info / optimize organ dysfunction
  - Epidural /or/ multimodal analgesia
  - Avoid excess fluids (goal-directed)
  - No pre-op bowel prep
  - No routine use of drains / NGT
  - Early feeding
  - Early mobilization
- Results
  - ↓ ileus
  - ↑muscle strength
  - ↓ CVS / RS morbidity
  - ↓ LOS

Laryngospasm

- Recognise
- CPAP / 100% O2 / Airway maneuvers
- Assess O2 entry (bag movement)
  - NONE (complete spasm) →
    - IV:
      - Sux 1-2 mg/kg
      - Atrop 20mcg/kg
    - No IV:
      - Sux 3-4 mg/kg IM
      - Atrop 20mcg/kg IM
    - CALL FOR HELP
    - If no improvement → CPR/ALS
  - SOME (partial spasm) →
    - Remove stimulus
    - Deepen anaesthesia
    - Re-assess

DKA

- Metabolic acidosis with high levels of Ketoacids
  - Acetoacetate
  - β-hydroxybutyrate
- 2° to absolute / relative insulin deficit
  - Mobilization and oxidization of Fatty acids results in Ketoacid production
- Prevention of DKA
  - Insulin Mx → prevents DKA rather than hyperglycaemia
- Management (Dx, A, B, C, Insulin)
  - Confirm diagnosis
    - ABG, UEC, BSL, Ketones (urine / serum)
  - A + B (O2 / intubate)
  - C – expand circulating volume (1-2L crystalloid)
  - I – Insulin therapy (i.e. 10U IV then 5-10U/hr)
    - Start at 0.1U/kg/hr (i.e 7U/hr for 70kg adult)
  - Sodium bicarb → only if profound acidosis (ph 7.1-7.2)
  - Repeat bloods 1-2 hourly
  - Start IV glucose and K+ once BSL < 12 (remember sugar isn't the issue, it the ketones)

Avoiding Massive Blood Transfusion

- Pre-op (optimize)
- Intra-op (Pharm vs Non-pharm)

Pre-op

- Check FBE and optimize
  - Fe supplement
  - B12 / Folate
  - EPO for 4-6 weeks
- Liaise with surgeon
  - Technique? Staged procedure?
- Autologous blood transfusion

Intra-op

- Non-pharm
  - Staged procedure
  - Meticulous haemostasis
  - Cell saver
  - Isovolaemic haemodilution
  - Careful positioning
    - Avoid ↑ venous pressure
    - Avoid PEEP
    - Avoid couhing / straining
  - Temperature control
  - LA with adrenaline infiltration
- Pharm
  - Permissive hypotension
    - GTN
    - Clonidine
    - Remifentanil
    - Esmolol

Management of bleeding

- Type of bleeding:
  - Capillary
  - Venous
  - Arterial
  - Medical

SAH – prevention & treatment of vasospasm

Re-bleeding

- On day 1: 15%
- By 1 month: 40%
- After 6 months: 3% per year

Cerebral ischaemia

- Immediate onset (increased ICP resulting in decreased CPP)
- Delayed onset (peaks 4–14 days after SAH)

Seizures Hydrocephalus (in 15–20% of cases)

Cardiac dysfunction (reflected by echocardiographic abnormalities and by increases in serum concentration of cardiac troponin)

Hyponatraemia, hypomagnesaemia or both (because of salt wasting)

- Vasospasm
  - Onset day 3-12
  - Lasts 2 weeks
  - Affects 60-70%
  - Angiographic / clinical diagnosis

Prevention and Management

- Nimodipine (CCB)
  - 60mg via NGT 4 hourly (max 360mg/d) and continue for 21 days
  - IV nimodipine no more effective than orally BUT ↑ hypotension
    - 1g/hr for 6hrs
    - 1.5g/hr for 6 hours if BP ok
    - 2g/hr max if BP ok
  - Must give via CVC (thrombophlebitis)

- Triple H therapy
  - Hypertension + Hypervolaemia + Haemodiltuion
  - Used when
    - ↑ TCD velocity (= spasm)
    - Neurological deficits
    - Both
  - Goals
    - ↑ CBF
    - ↑ CPP
    - Improve rheological factors
  - Hypertension (fluids + pressors) SBP:
    - 120-150mmHg unclipped
    - 160-200 mmHg clipped
  - Hypervolaemia
    - CVP 8-12
    - CWP 15-18
  - ↓ Haematocrit to 0.3 – 0.35

Complications:

- Worsening cerebral oedema
- ↑ ICP
- Bleeding into infarcted area
- CCF / APO

SAH – Clip vs Coil (ISAT trial)

- Clipping
  - Morbidity 4-11%
  - Mortality 1-3%
- Coiling
  - Morbidity ~ 3-5%
  - Mortality 1-1.5%
- Which one?
  - Coiling NOT indicated / possible in up to 15% of cases (morphology / location)
  - **ISAT (international subarachnoid aneurysm trial)** – neurological dependency / death
    - 23.7% - coil
    - 30.6% - clip
  - However…
    - < 10% of coil patients were high risk
    - Complete occlusion better with clip
    - Higher re-bleed rates (50% vs 40%)

Atrial Fibrilation

- Chaotic / unco-ordinated atrial depolarization with rapid ventricular response (usu 120 – 200 bpm)
- Stroke risk:
  - 4% / year
  - ↓ to 2% / hear with warfarin
- Common causes
  - Alcohol
  - Ischaemia
  - Valvular disease (mitral)
  - Sepsis
  - Electrolyte
  - Thyrotoxicosis
  - Thoracic surgery
- Atrial contraction contributes ~30% of LV filling
  - ∴ may lead to ↓ in CO

- Management (depends on onset and haemodynamic instability)
    - Acute (< 48hrs) – Correct Rhythm
        - Rx underlying cause
        - Correct electrolytes
        - DCR 200J (synched if unstable)
        - Rate control (β-blockers, verapamil 5-10mg IV, digoxin 500mcg over 20 min then 250mcg 6hr × 2)
        - Rhythm reversion (Amiodarone 300mg over 1 hour then 900mg over 24hr)
    - Chronic (>48hrs) – Rate control (< 100)
        - Rx / modify underlying cases
        - Digoxin, β-blocker, Verapamil, Amiodarone
        - If new, Warfain 4-6 weeks then DCR

SVT

- Non-pharm / pharm / electricity
    - Carotid sinus massage / valsalva
    - Adenosine 3, 6, 12mg
    - Verapamil 5-10mg
    - Metoprolol 1mg IV
    - Synch DC reversion 200J (if unstable)

Anorexia

- Chronic psychiatric condition resulting in multisystem dysfunction. Body dismorphic disorder with fear of being overweight.
- Associations
    - ~ 25% underweight
    - Depression / anxiety / OCD
    - IVDU
- Systems
    - CVS: hypotension, bradycardia, ECG changes (AV block, ST depression, TWI, **prolonged QT**). Rick of CCF if overfilled
    - RESP: ↓ lung elasticity
    - Renal: ↓ GFR
    - Metabolic: loss of Na, K, Cl, H (hypochloraemic metabolic acidosis)
    - GIT: delayed gastric emptying

Anaesthetic Mx

- Full lab work-up
- Re-hydrate and correct UEC's
- RSI
- Hypo Ca/K – may prolong NMB
- Temperature
- Positioning (pressure care)
- Hypoalbuminaemia (drug PK / PD)

Paediatric foreign body

- Senior anaesthetist and ENT surgeon <u>should</u> be present at induction
- Technique
    - SV inhalational induction
        - May ↓ risk of lung hyperinflation
        - ↓ risk of PTX
        - ↓ risk of forcing object distally
    - Induction time ↑ due to ↓ airflow (take your time)
    - Direct laryngoscopy (spray cords with local)
    - Maintenance
        - Volatile → via T-piece on side-arm of Stortz rigid bronchoscope
        - TIVA
            - Remi 0.05-0.1 mcg/kg/min
            - Props 15mg/kg→10→8

TIVA in children

- Existing models (Bristol / Marsh / Schnieder) not validated in children
- Paed-specifc algorithms developing
- Effectively they need much more and take longer to wake up
- Modifying the Bristol protocol of 10-8-6 almost double the figures to 20-16-12

Paediatric OSA

- Apnoea = cessation of airflow >10sec
- Hypopnea = reduction in flow > 50% for > 10 sec
- Obstructive = cessation despite respiratory effort
- Central = cessation without respiratory effort

Three questions (change recipe / HDU?)

1. Age
2. Comorbidities
3. Severity

Low Risk (DSU)

- Most children
- Early AM list

Moderate (ward)

- Age < 3
- Sx
    - Failure to thrive
    - Asthma
    - Recent URTI
    - Obesity
- Overnight stay with SpO2 monitoring

High (ICU/HDU)

- Age < 2
- Sleep study (severe OSA)
- Craniofacial
- Prem/ex-prem
- Pulm HTN

AHI (Tennis: love – 15 – 30 – >40)

- **Love**-5 normal
- 5-**15** mild
- **15**-**30** moderate
- > 30 severe

History

- snoring / apnoea
- how often / are you worried
- failure to thrive
- poor concentration / school
- hypo / hyper-active

Exam

- Syndromic with OSA
  - Down's
  - Piere Robin
  - Golden Har

Unrecognised OSA signs

- Pulm HTN
  - Low volume pulse
  - ↑ JVP
  - cyanosis
  - SOA
  - Ascites
- ECG – RVH / RH strain
  - Deep R in V1 / V2
  - P-pulmonale

Day case, Overnight or ICU?

Leong & Davis, J. Laryngol, 2007

Low Risk	Moderate Risk	High Risk
•Most children	•Age < 3 •Overnight oximetry nadir < 80% •FTT •Asthma •Recent RTI •Obesity	•Age < 2 •PSG: Severe OSA or >30% central •A: Craniofacial etc •B: Prem lung disease •C: Pulm HT •Neuromuscular d. •Morbid obesity
Day case (am list)	Overnight (SaO2,CPAP)	ICU

Safe Transport

- Critically unwell have ↓ physiological reserve
- Follow hospital protocol
- T/F must be justified (Benefit > risk)
- Consider
  - Equipment
  - Staff
  - Pt status
  - Pre-departure
  - Documentation
- Equipment
  - Dedicated / durable
  - Fit through doors / lifts
  - Must function at destination site (i.e. MRI)
  - MUST
    - NIBP / IBP
    - ECG
    - HR
    - SpO2
    - Ventilator + Manual circuit
    - Spare oxygen
  - Available
    - Airway, emergency drugs, sedation
- Staff
- Pre-departure
  - Dedicated team, CALL ahead
  - All equipment checked
  - Notes / imaging
  - Oxygen / drugs / ventilation / airways (Transport pack)
- Patient
  - Final prep just before move (NMB / sedation)
  - Reassess once new monitors / equipment attached
    - A – airway
    - B – ventilation
    - C – Stable / IV access
    - D – Drains / Drugs (inotropes / sedation)
    - E – Equipment
- In-Transit
  - Best route / communicate / check pt regularly
- Arrival
  - Check receiving monitoring prior to changing
  - Assess pt on new monitors
  - Handover

Machine Check

- Level 1 = detailed, by service technition
- Level 2 = at start of each session
  - Service label
  - High pressure sysem
  - Low pressure system
  - Other equipment (bag, scopes, pumps, monitors)
- Level 3 = immediately before each case
  - Vaporiser
  - Circuit
  - Pumps
  - Others (bag, scopes, etc)

Laser flex tube

- Stainless steel body
  - Airtight, flexible, laser resistant
- Double cuff
  - Assures tracheal seal should upper cuff be damage by laser

- Wall thicker than standard ETT

Brain Death

Definition

- Irreversible coma
- Irreversible loss of brainstem reflex response and respiratory center function
- Demonstrates cessation of intracranial blood flow

2 examinations by 2 medical practitioners

Before 1st examination

- Pre-conditions
  - Dx of severe brain injury / coma consistent with progression to brain death
  - Exclude
    - Drug causes (no sedation)
    - Metabolic
    - Hypothermia
    - NMJ dysfunction

Test

- Response to painful stimuli (CN distribution)
- Pupil reflex to light / corneal
- Gag / cough
- Vestibular ocular reflex
- Respiratory
  - Pre-oxy with 100% O2
  - Stop IPPV (O2 via ?)
  - Apnoea + pCO2 > 60 mmHg

Compatible with brain death

- Spontaneous spinal movements
- Resp-like movements without tidal volumes
- Sweaty, blushing, tachycardia
- Normal BP without support
- Absence of Diabetes Insipidus
- Deep tendon reflexes
- Babinski reflex

If unable to perform testing (i.e. severe facial trauma)

- MR angiography (MRA) demonstrating absent intracranial blood flow

Anaesthesia for organ retrieval

Brainstem Herniation

- Early / short-lived massive SNS activity
- Then paralytic autonomic collapse
- ↓ Lung function
- ↓T3/T4 → anaerobic metabolism
- ↑ glucose (↓ insulin)
- ↓ ADH → hypovolaemia → electrolyte disturbance
- SIRS
- Lose temperature regulation
- Coagulopathy

Principles

- Maintain organ perfusion + oxygenation
- IV resuscitation: blood / gelatin-based colloid
- Inotrope if ↓ BP despite filling

Goals

- CVP 4-10
- MAP 60-80
- PCWP 10-15
- Hb > 10
- SpO2 > 95%
- TV < 10ml/kg
- PIP < 30cmH2O

Need for GA?→ controversial

Anaesthetic management

- 1 MAC iso
- Fentanyl induction → ablate reflex pressor response
- Muscle relaxant → improves surgical access
- dDAVP → 0.5-2 units/hr (for DI)

Power Failure

- Prevention
  - Critical equipment plugged into:
    - Red → generator supplu
    - Blue → UPS
  - Ensure back-up batteries charged
- Management
  - Calm leadership
  - Clear communication
  - Formulate plan
- Find emergency flashlight (laryngoscope will work / iphones / ipads)

PATIENT MANAGEMNT

- Evaluate patient
  - ABCD
- Suspend surgery (obtain haemostasis)
- Ventilate and oxygenate
  - Manual ventilation (ventilators driven by O2 supply)
- Alternate anaesthetic (propofol TIVA with battery operated pump)
- IRREVERSIBLE SURGERY → lighting is PRIORITY

CHILD PUGH SCORE

"ABCDE"

3 biochemical and 2 clinical parameters

	1	2	3
Albumin	> 35		< 28
Bilirubin mmol/L	< 34		> 50
Clotting (INR)	< 1.7		> 2.3
Distension (Ascites)	Nil	Slight / controlled	Moderate (Despite diuretics)
Encephalopathy	Nil	1-2	3-4

Class	Score	Mortality (intra-abdo Sx)

A	5-6	10%
B	7-9	31%
C	10-15	76%

Miller Chapter 66

Points	Class	One year survival	Two year survival
5-6	A	100%	85%
7-9	B	81%	57%
10-15	C	45%	35%

MELD score

- Model for End-stage Liver Disease
- Mathematical score based on:
  - Creatinine
  - Bilirubin
  - INR

- On liver Tx list usu score between 11-20
- Originally devised to predict death from liver failure after TIPS
  - Score =/> 18 median survival of 3 month or less following TIPS

MELD = 3.78[$\log_e$ bilirubin (mg/dL)] + 11.2[$\log_e$ INR] + 9.57[$\log_e$ creatinine (mg/dL)] + 6.43

Encephalopathy

- From toxic buildup of ammonium
- Multifactorial

Grading:

0	**Alert** / Oriented
I	**Drowsy** / Oriented
II	Drowsy / **Disoriented**
III	**Rousable** / Stupor / Restless
IV	**Coma**

Chronic Liver Disease

Issues:

- CNS (encephalopathy)
- Resp (Hepato-renal syndrome)
- Renal (Hepato-renal syndrome)
- Metabolic
  - Hypoglycaemia (↓ BSL)
- Ascites
  - Hypoalbuminaemia
  - Na/water retention
- Infection (↓ immune function)
- Bleeding (↓ coag factors / thrombocytopenia)

Assess:

- Child-Turcote-Pugh score
- Routine pre-op assessment

Drugs

- Safe
  - Thio (reduce dose)
  - Propofol
  - Volatiles
  - Atrac/cis-atrac
  - Remi
- Caution
  - Midazolam
  - Sux
  - Fentanyl/morphine

Awake Fibreoptic

"PAD MOST"

- Prepare patient (explanation)
- Acid prophylaxis
- Dry secretions
- Monitors
- Oxygen
- Sedation
- Topicalisation

Execution:

- Glycopyrrolate
  - 200-400mcg IV / IM
  - 15-20min to work
  - Facilitates topicalisation
- Co-phenylcaine to nose (3 turbinates – inferior / middle / superior)
- Lignocaine gel on 7mm NPA → insert nostril
- Topicalisation
  - Nasl passage / nasopharynx
    - Anterior ethmoidal nerve / nasopalatine nerve
      - CoPhen spray
      - Lignocaine gel on NPA
  - Base of tonugue / post pharynx wall
    - Glossopharyngeal nerve

	Nerve supply	Technique	Test
Nose / Nasopharynx	Ant ethmoidal Nasopalatine (part of tonsils, palate, uvula)	Cophenylcaine + 4% lig gel NPA OR De Vibiss 4 sprays	
Base tongue Oropharynx	Glossopharyngeal	De Vilbiss 4 sprays	Loss of gag
Larynx	SLN of vagus (above cords) RLN (below)	De Vilbiss 4-8 sprays at **end** of exp just before start of insp OR Spray as you go OR Transtracheal injection SLN blocks (1-2ml lig)	Change in voice

Larynx Nerve Supply

Superior Laryngeal Nerve

- Branch of Vagus (X)
- SLN leaves the vagus in the carotid sheath
- Travels anterior to Cornu of hyoid bone
- Here it divides into:
  - Internal branch (sensory)
  - External branch (motor to cricoithyroid m.)

- Internal branch
  - Pierces thyroid mem. to enter piriform fossa
  - Sensory supply to:
    - Larynx down to vocal cords
    - Base of tongue
    - Vallecula
    - Aryepiglottic folds (false cords) and Arytenoids

Recurrent Laryngeal Nerve (RLN)

- Branch of Vagus
- Supplies sensation below vocal cords
- Motor to **all** muscles **except Cricothyroid**

PONV

Risk Factors

- Patient
  - Female
  - Non-smoker
  - PHx (PONV / motion sickness)
- Anaesthetic
  - Volatiles
  - Nitrous
  - Intra/postop opiods
- Surgical
  - Duration (Every 30min ↑ risk 60%)
  - Type
    - Laparosopic
    - Strabismus
    - Gynae
    - Breast

Simplified (Apfel) Score (each 1 point):

- Female
- Non-smoker
- Phx
- Opioids

Score	Risk
0	10% (baseline)
1	20%
2	40%
3	60%
4	80%

Reducing Baseline risk

- Avoid GA → Regional
- Propofol TIVA
- Avoid volatile / nitrous
- Minimal / avoid opioid / neostigmine
- IV fluid hydration

Prevention / Treatment

Risk Factors	Points
Female Gender	1
Non-Smoker	1
History of PONV	1
Postoperative Opioids	1
Sum =	0 ... 4

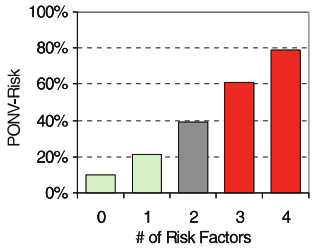


Figure 1. Simplified risk score for PONV in adults (3). Simplified risk score from Apfel et al. (3) to predict the patients risk for PONV. When 0, 1, 2, 3, or 4 of the depicted independent predictors are present, the corresponding risk for PONV is approximately 10%, 20%, 40%, 60%, or 80%.

Risk Factors	Points
Surgery ≥ 30 min.	1
Age ≥ 3 years	1
Strabismus surgery	1
History of POV or PONV in relatives	1
Sum =	0 . . . 4

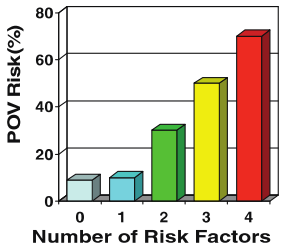


Figure 2. Simplified risk score for POV in children (39). Simplified risk score from Eberhart et al. (39) to predict the risk for POV in children. When 0, 1, 2, 3, or 4 of the depicted independent predictors are present, the corresponding risk for PONV is approximately 10%, 10%, 30%, 55%, or 70%.

Numbers Needed to Treat

	Prophylaxis	Treatment
Ondansetron	6	7
Droperidol	5 (3 with PCA)	5
Dexamethasone	? 4	

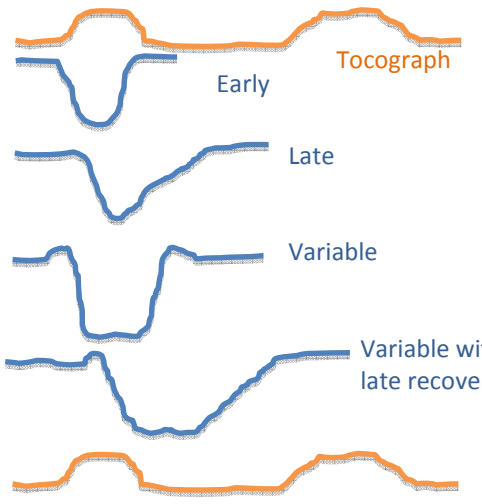
Gan et al. Society for Ambulatory Anesthesia guidelines for the management of postoperative nausea and vomiting. Anesthesia & Analgesia (2007) vol. 105 (6) pp. 1615

CTG (Cardiotocograph)

Features

- FHR (normal 110-160)
- Variability (5-25 bpm)
- Accelerations
- Decelerations
  - Early
  - Variable
  - Late

Decelerations



- **Early**
  - Symmetrical
  - In time with contractions
  - Head squeezed → vagal response
  - *BENIGN*
- **Late**
  - Onset after peak of contraction
  - Nadir at end of contraction
  - Exponential recovery
  - *HYPOXIA*
- **Variable**
  - With contraction
  - BOX-shaped
  - Often acceleration at start and finish
  - *CORD COMPRESSION*
- **Variable with late recovery**
  - Starts with contraction
  - Slower exponential recovery like Late deceleration
  - *CORD COMPRESSION + HYPOXIA*

Non-reassuring CTG
- ↓ FHR < 110 bpm
- ↓ variability (3-5 bpm)
- Variable decels

Foetal scalp pH
- Normal > 7.25
- Between 7.2-7.25 → repeat
- < 7.2 → medical / surgical intervention

Scalp Lactate

ITP
- Idiopathic Thrombocytopenia Purpura
- ↓ platelet count (< 50,000)
- ? Ab directed against PLT
- Usually asymptomatic
- Can get bruising, gum bleeding, blood nose, petichiae
- Treatment
  - IV or PO steroids
  - Immunoglobulin (intragam)
  - Splenectomy
- PLT Transfusion
  - Not normally required
  - Transfusion if bleeding
- Avoid aspirin / Regional blocks

RIFLE
- RIFLE classification of ACUTE renal dysfunction
- Uses GFR and Urine output criteria
- GFR criteria based on ↑ baseline serum creatinine or measured reduction in GFR

Grade (of risk / damage)	**GFR criteria**		**UO criteria**
	Serum Cr ↑	GFR ↓	
R isk	1.5-fold	> 25%	< 0.5 ml/kg.hr for **6 hrs**
I njury	2-fold	> 50%	< 0.5 ml/kg.hr for **12 hrs**
F ailure	3-fold	>75%	< 0.3 ml/kg.hr for **24 hrs** **OR** Anuria for **12 hrs**
L oss	Persistent ARF (complete loss of Fx) for **>4 weeks**		
E ndsatge	ESRD (complete loss of Fx) for **> 3 months**		

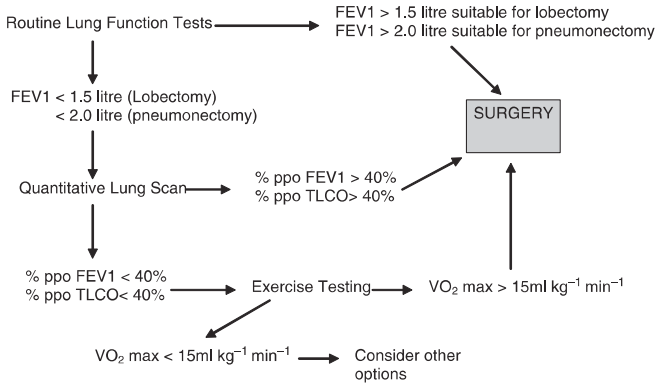
Thoracic Anaesthetsia

NUMBERS
ppoFEV1 > 40%
ppoFEV1 < 30% 10/10 needed post op vent support (without epidurals)
AWAC

DLT sizing

41 Fr > 180cm
39 Fr < 180cm (STD – 2 sizes up large male,2 down for a women)
Side – dependent side
Lips – 180cm = 30cm (change by 1cm for each 10cm)

Minimum Pre-op FEV1: (**not predicted!**)
- 55% pneumonectomy (2.0L)
- 40% lobectomy (1.5L)
- 35% wedge



Bronchopleural Fistula
- Aims
  - Not to soil good lung
  - Maintain SV ∴↓ fraction of Tv escaping via fistula
- Transport with full monitoring with bad side down

- Induction
  - SV – deep inhalational GA
  - Topicalise airway
  - Insert DLT under direct bronchoscopic guidance
  - Don't paralyse until surgeon into chest
- High Paw:
  - Patient:
    - Tension PTx dependent lung
    - Bronchospasm / DHI
    - Anaphylaxis
    - Secretions
  - Airway
    - Blocked tube
    - Tube malposition
  - Equipment issue (stuck exp valve / blockage, etc)
- Bilateral Tension PTx / BPF
  - Clamp during inspiration
  - Unclamp during expiration

Bronchial blocker:

Advantage:

- Down SLT
- Isolate lobes
- Post-op ventilation
- Easily added to ETT
- Easier in difficult airway
- Use in children
- CPAP to isolated lung

Disadvantage:

- Not perfect isolation

Thoracic epidural

PHAEO

- 10% familial
- 10% bilateral
- 10% malignant
- 10% extra adrenal

- SNP – low dose running from start via dedicated CVC port (50mg in 83ml (same as GTN): 2ml/hr = 20mcg/min)
- MgSO4 – 4g load and 1g/hr?
- Phentolamine boluses (1ml = 0.5mg)
- Remifentanil / high does Fentanyl
- Vec / roc
- Avoid: histamine releasing drugs / atropine / ephedrine
- IAL pre-induction
- CVC after asleep (less anxiety)
- Midaz soon as drip
- Norad needed once tumour out (lose norad infusion / blocked α receptors)
- Want positive balance post phaeo

AMPUTATION POST TRAUMA

- Issues regarding stump pain management acutely
- Pain issues
  - Stump pain (nociceptive)
  - Neuropathic pain
  - Phantom pain
  - Psychological
- Management
  - Biosphychosocial
  - Multimodal approach
  - Multi-disciplinary
  - Pharmacological / non-pharm
    - Stump nerve sheath catheter
    - Ketamine
    - Gabapentin
    - TCA
- Opioid-induced hyperalgesia
  - Opioid rotation
  - Methadone
  - ? hydromorphone
- Reducing risk of "severe" phantom pain
  - Periop epidural
  - Ketamine
- Pre-emptive = analgesic prior to surgery
- Preventative = intervention with effect beyond expected duration

CARCINOID

Pain history

Chronic Renal Impairment (CRI)

- Mulsti-system disease
- Complex medical Hx, multiple drugs
- Pre-op
  - "Routine pre-op evaluation + focused Hx, Ex, Ix"
  - Course, previous surgery. Drugs
  - Comorbidities: endo / CVS
  - Dialysis: type / last Rx / dry weight
  - Urine out put
  - Fluid overload
- Normochromic-normocytic anaemia
  - $\downarrow$EPO, $\downarrow$RBC survival, GIT loss
  - Aim Hb 8-10
- K+ $\geq$ 6 $\rightarrow$ dialysis
- Haematological
  - INR / APTT / PLT usually normal
  - Uraemia $\downarrow$ platelet function (improved by dialysis – when heparin worn off)
  - dDAVP - 30µg/kg in 30ml over 30min

Regional & anticoaglulation

Obstetric Limb Weakness

- Transient neurological dysfunction occurs in ~20% post-partum
- Requires carful assessment and documentation
- Lumbrosacral trunk (L4, 5, S1)
- Sciatic: (L4/5 – peroneal), (S1,2,3 – Tibial)
- Obturator: (L2-4)
- Femoral: (L2-4)
- Foot drop:
    - Usually injury to lumbrosacral trunk (L4/5) or less frequently common peroneal nerve (CPN)
    - LST:
        - Compression by head / forceps at sacral ala
        - Unilateral foot drop + paraesthesia lateral foot / calf (Weak plantar flexion)
    - CPN:
        - Paraesthesia dorsum of foot
- Prolonged block:
    - Trauma
        - Anaesthetic
        - Surgical
        - Delivery / lithotomy
    - Drug error
        - Wrong drug / mix
        - LA toxicity
    - Infection
        - Introduced
        - Haematogenous
    - Other
        - Chemical
        - Infarction?
        - Haematoma

Day Surgery

- Patient
    - ASA 1 / 2
    - Pre-op questionnaire
    - Paediatric (see elsewhere)
- Suitable procedure
    - Low post-op bleeding risk
    - Pain controllable as outpatient
    - Post-op care manageable by patient / responsible adult
    - Rapid return to oral intake
- Social requirement
    - Responsible person
        - Transport home
        - Stay overnight
        - Understands post-op care
    - Access to help
        - Telephone
        - With 1 hr of a medical facility
- Prior to discharge
    - Stable > 1hr
    - Alert / oriented
    - Adequate – pain control / PONV / hydration
    - Minimal bleeding
    - Passed urine (if retention risk)
    - Written instruction
    - Analgesia for 1st day

Venous Air Embolus (VAE)

- Key is prevention
    - Avoid sitting position
    - Elevate heart as little as possible ???
    - Adequate pre-load (+ve CVP)
    - ??
- Aware of possibility
- High index of suspicion
- Vigilance
- Presentation
    - Bronchospasm
    - Hypoxia
    - ↓ETCO2 (↑ PaCO2)
    - Hypotension, arrhythmia, CVS collapse
- Treatment
    - Supportive
    - Stop surgery → flood field
    - Call fo healp
    - Cease N2O
    - 100% oxygen
    - Operative site BELOW heart
    - If CVC – insert to RA and aspirate (specific multi-hole catheters specifically exist)
    - Fluid + Vasopressors
    - LEFT lateral + head down (move bubble to tip of right ventricle)
    - CPR
    - Post resus care, communication, documentation, M+M

DECRA study – look up

Paediatric Formula

Airway:

- Age/4 + 4
- Term 3.5
- Cuff @ 8yrs
- Lips: Age/2 + 12 (+ 3 more for nose)

Weights:

- (Age + 2) x 4????

Infusions:

- Adrenaline:

- 3 arrest doses in 50ml (i.e. 30µ/kg)
- Run 1-10ml/hr
- = 0.01 – 0.1 µ/kg/min

- GTN
  - Adult: 50mg in 83mls, 1ml/hr = 10 µ/min

Haemophilia

- Haemophilia A (in pregnancy)
  - F8 levels ↑ 200-500% late pregnancy
  - ↑APPT = ↓ F8 then do an activity level to confirm
  - < 1% activity = severe (Normal range 50-150%)
  - Maintained on recombinant factor 8 concentrate
  - KAbour: 50 U/kg F8 (raise levels to 100%) and able to site epidural (midline has less risk of vascular puncture)
  - Then infuse 3U/kg/hr F8 for maintenance
  - Many have Hep B/C as recombinant F8 is new
  - Prepare for manageming blood loss
  - < 5% bleed after trauma
- Anaesthetic issues
  - Hep B/C + HIV more common (recombinant F8 is new)
  - No IM injections
  - Difficult IV access
  - Care with tracheal intubations
  - Care with desmopressins (can cause hypo natraemia)
  - Inhibitors –
  - Dose F8 = % rise needed x (weight/2)
  - Test for F8 Ab
  - T1/2
- Minor surgery
  - Can give desmopressin (transiently ↑ F8)
  - TXA: 10mg/kg IV then orally post
- ENT: 1g then 500mg QID
- Factor 7
  - 90µg/kg (1-3 hours
- Obstertrics
  - Epidural if levels > 50%
  - Vaginal delivery preferred

Factor 9 (haemophilia B)

- F9 concentrate
- dDAVP doesn't work
- Factor 7 works

Murmur in Children

1. Emergency → proceed / consult

Elective:

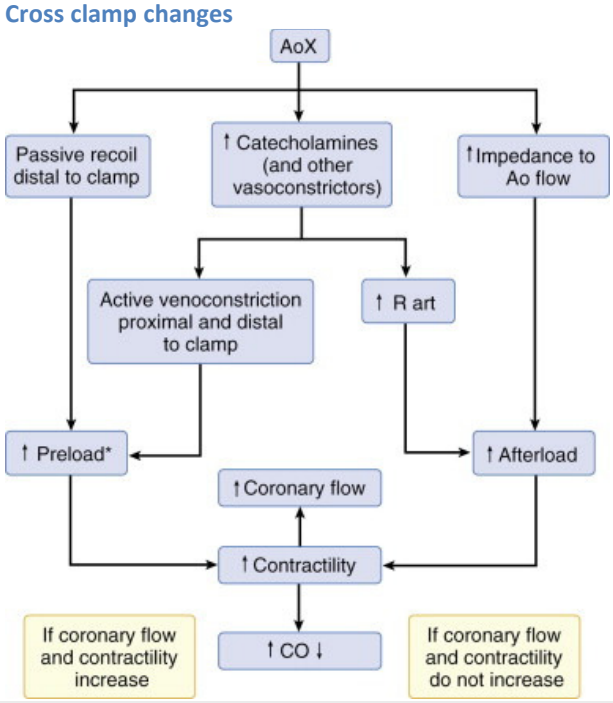
2. Activity – run / play / keep up with others
3. Diastolic = bad in ALL ages (if it doesn't go away)
   a. BUT → if it goes away with:
      i. Lying down
      ii. Shrugging shoulders
      iii. Compression of ipsilateral IJ
   b. Then it's a venous hum (NOT A PROBLEM)
4. If systolic, exclude the 3 B's
   a. Breathing fast
   b. Blue
   c. Bad signs
      i. Pulse (femoral): Bounding = (L→R shunt), weak (stenosis = LVOT Obx), delayed (= coarctation)
      ii. Praecordium (Thrill = 3/6 murmur = pathology)
      iii. Enlargement
         1. Heart – displaced apex = severe for all lesions
         2. Livers (CCF)
         3. Sacrum / Ankles
5. If systolic + no bad signs + normal activity = proceed

Remember the "S" rules:

- **Systolic** murmur
  - **Soft**, **short**, **small** area, NO added **sounds**
- NO **signs** of severity and NO **symptoms**
- **Syndrome** = defer and refer

AAA repair (Elective / Emergency)

Cross clamp changes



Cardiovascular Variable	Percent Change Occlusion (%)		
	Supraceliac	*Suprarenal-Infraceliac*	*Infrarenal*
Mean arterial blood	54	5*	2*

pressure			
Pulmonary capillary wedge pressure	38	10*	0*
End-diastolic area	28	2*	9*
End-systolic area	69	10*	11*
Ejection fraction	–38	–10*	–3*
Patients with wall motion abnormalities	92	33	0

Physiologic Changes with Aortic Cross-Clamping* and Therapeutic Interventions

Hemodynamic Changes

↑ Arterial blood pressure above the clamp

↓ Arterial blood pressure below the clamp

↑ Segmental wall motion abnormalities

↑ Left ventricular wall tension

↓ Ejection fraction

↓ Cardiac output[†]

↓ Renal blood flow

↑ Pulmonary occlusion pressure

↑ Central venous pressure

↑ Coronary blood flow

Metabolic Changes

↓ Total-body oxygen consumption

↓ Total-body carbon dioxide production

↑ Mixed venous oxygen saturation

↓ Total-body oxygen extraction

↑ Epinephrine and norepinephrine

Respiratory alkalosis[‡]

Metabolic acidosis

Therapeutic Interventions

Afterload reduction
- Sodium nitroprusside
- Inhaled anesthetics
- Amrinone
- Shunts and aorta-to-femoral bypass

Preload reduction
- Nitroglycerin
- Controlled phlebotomy
- Atrial-to-femoral bypass

Renal protection
- Fluid administration
- Distal aortic perfusion techniques
- Selective renal artery perfusion
- Mannitol
- Drugs to augment renal perfusion

Other
- Hypothermia
- ↓ Minute ventilation
- Sodium Bicarbonate

Preparation for emergency repair of abdominal aortic aneurysm

Patient
- Two wide-bore cannulae
- Baseline bloods (blood count, electrolytes, coagulation screen)
- arterial line (if time permits)

Equipment
- rapid fluid infusor (level 1 infusor)
- cell salvage equipment
- Forced-air warming device
- Invasive lines and cardiac output monitors
- urinary catheter, nasogastric tube and temperature probe

Drugs and fluids
- 6–10 units of cross-matched blood, fresh frozen plasma and platelets
- routine anaesthetic drugs, crystalloids and colloids
- Inotropes (epinephrine 1:100,000; ephedrine 3 mg/ml)
- Vasopressors (metaraminol 0.5 mg/ml; phenylephrine 100 µg/ml)

Theatre personnel
- Two anaesthetists and two operating department practitioners

Differential of MH

P	Phaeo	(No ↑ temp)
A	Anaesthetic depth	
I	ICP – bleed	
N	NMS	
T	Thyroid storm	(No mixed acidosis/↑CK)
E	Equipment failure	
R	Recreational drugs (ectasy, cocaine, amphet)	
S	Sepsis	

Thyroid storm

- Recognise / DDX (differ to MH – no mixed acidosis normal CK)
- Propranalol / esmolol
- Porpylthiouracil (PTU) / Carbimazole
- Lugol's iodine or K-iodide
- Cooling
- Hydrocortisone QID

Triggers – illness, trauma, surgery (including post-op 6-24hrs)
Hypertension, tachycardia (SVT/AF), hyperthermia, tremor, mania, N+V

Malignant hyperthermia

This is an emergency! Tell surgeon – stop surgery.
Call for help! MH trolley and assign tasks

Stop volatile + 100% FiO2 15L → change to Props TIVA

Give DANTROLENE (get more)
- 2.5mg/kg (20mg vial in 60ml sterile water)
  - Repeat up to 10mg/kg

- Endpoint: ↓ CO2, ↓ HR
- Get more supplies

Simultaneously treat other effects
- Potassium –
  - Calcium chloride 10% 10mls (7mmol) adult
    - (0.15ml.kg paeds)
  - Insulin + dextrose (10u + 50mls 50% - adult)
    - (0.15 u/kg + 0.5ml/kg – paeds)
- Temperature – Core temp, active cooling if > 38.5°
- Arrhythmia – Amiodarone 2-3mg/kg over 15 min
- Renal –IDC and aim 2ml/kg/hr
- Acidosis – hyperventilate +/- 0.5mmol/kg bicarb to maintain pH > 7.2

Post-resus care
- ICU
- Dantrolene
- Documentation
- Testing (relatives)
- M+M reporting

TURP Syndrome

Pulmonary oedema + cerebral oedema + hyponatraemia

Clinical Features:
- Hypertension / bradycardia / angina
- Headache / Aggitation / confusion
- Pulm oedema
- Visual disturbance / Blindness
- N + V

Treatment:
- 3% saline
  - TBW (L) x 2 = mls required to raise Na+ by 1mmol/L
- Limit correction to 12mmol/L in 24 hrs
- Delay in treatment ↑ death
- 70kg adult = 84mls 3%
- 1000ml of 3% in 24hrs raise by 12mmol/L
- Aim to correct:
  - 120mmol/L (asymptomatic)
  - Stop fitting

TURP syndrome risk factors
- Perforation
- Height of fluid above site
- Large prostate
- Resection time

BURNS
- Hx from Ambos / relatives
- Primary survey
  - **A** + Cx-spine
    - Compromise usually 2nd to ↓ GCS (trauma, drugs, ETOH, CO, smoke)
    - High flow O2
  - **B** + Sats
    - Usually compromised due to GCS
    - Constricting chest burn
    - High SaO2 with **COHb**
    - Tension PTx (blast / explosion)
  - **C** + IV Access + bloods + fluids
    - BP, ECG, HR
    - Burns resuscitation
  - **D** – GCS
  - **E –** exposure / explain

Burns Resucitation

- If
  - Adult > 15%
  - Child > 10%

- Burns resucitaiton
  - Treat <u>shock</u> first: 20ml/kg
  - Calculate fluid <u>replacement</u> for fisrt 24hrs
    - Lund Browder chart paeds
    - Adult
      - Head 9%
      - Arms 9%
      - Front torso 18%
      - Back torso 18%
      - Legs 18%
- Parkland:**4ml/kg/BSA%**
  - ½ in 8hrs other ½ over 16hrs
    - ½ crystalloid + ½ albumin
    - Adults: CSL
- Maintenance: 4/2/1 ml/kg
- UO: > 1-2 ml/kg/hr

Burns Transfer

- FT > 5% in any age group
- PT / FT burn
  - > 10% BSA in <10yrs or > 50yrs
  - Any age > 20% area
- Special areas
  - Eyes, face, ears
  - Genitalia / perineum
  - Major joints
- Electrical burns / lightening strike
  - Renal failure / compartment syndrome / myoglobinuria
- Chemical burns
- Inhalation injury
- Pre-existing illness

Haemorrhage assessment - adults

EMST 8th ed

Adult: (note 10% = 500ml in 70kg with 70ml/kg BV)

	Class 1	Class 2	Class 3	Class 4
% BV (70kg)	15% (750ml)	30% (1500ml)	40% (2000ml)	> 40% (>2000ml)
HR*	< 100	**> 100**	↑	↑> 140
BP	N	N	↓	↓
Pulse P	N / ↑	↓	↓	↓
RR	N 14-20	↑ 20-30	↑	↑> 35
UO	>0.5ml/kg/hr	↓	↓	Nil / min
CNS			Anxious / confused	Confused / lethargic

*beware β-blockers, CCB, PPM

Thus:

- Normal HR, BP, UO, CNS < 15%
- HR > 100 at least class 2 30%
- Hypotension at least class 3 40%
- Lethargy at least class 4

Fluid response:

- Rapid: EBL < 20% (minimal)
- Transient: EBL 20-40% (moderate / ongoing)
- Non: EBL > 40% (severe)

Haemorrhage assessment – Paediatrics

Vitals

Blood pressure (> 1yo)

- Average SBP = 90 + (2 × Age)
- Lower limit of normal SBP = 70 + (2 × Age)
- DBP = 2/3rd SBP

Heart rate (> 1yo)

- Max HR = 160 – (4 × Age)

	Weight	HR	SBP_{min}	RR	UO
Infant 0-12mth	3-10	< 160	> 60	< 60	2.0
Toddler 1-2yr	10-14	< 150	> 70	< 40	1.5
Preschool 3-5yr	14-18	< 140	> 75	< 35	1.0
School 6-12yr	18-36	< 120	> 80	< 30	1.0
Adolescent > 13yr	36-70	< 100	> 90	< 30	0.5

Blood loss

System	Moderate < 30%	Severe 30-45%	Uncompensated > 45%
CVS#	↑ HR Thready **periph**pulses Normal SBP Normal P pressure	Marked ↑ HR Thready **central** pulse Low normal SBP Narrow P pressure	Tachy →**brady** Weak / **absent** central **Low SBP** Wide P pressure
	BP = 80-90 + (2×Age)	70-80 + (2×Age)	(undetectable DBP) < 70 + (2×Age)
CNS	Anxious, irritable, confused	Lethargic ↓ response to pain*	Comatose
Skin	Cool Mottled Cap refill > 2sec	Cyanotic Cap refill ↓↓↓	Cold Pale
UO	Low-very low	Minimal	None

* ↓ response to IV insertion

Tachycardia is 1° response to hypovolaemia but is affected by anxiety, fear and pain.

- Hypotension in children represents decompensated shock and indicates blood loss of > 45%. Bradycardia is a pre-terminal sign

- Blood volumes
  - Infant 90ml/kg
  - Child 80ml/kg
  - Adult 70ml/kg

Summary of assessment:

- Skin = temperature, colour, capillary refill
- CVS = peripheral / central pulses, HR, BP
- CNS = irritable → lethargic → comatose
- UO = reduced → minimal → none

Bier's Block

- Duration 30min
- IV in each limb
- Exasunguation with Eschmark bandage
- Double cuff
  - Leave top on
  - Then bottom on
  - Then top off
  - Now bottom cuff is not painful
- Prilocaine
  - 0.5%
  - up to 6mg/kg (double lignocaine)
  - Volume 60mls
  - Wait 15 min
- Lignocaine
  - 0.5%
  - 3mg/kg
- Torniquet
  - Paralysis – nerve injury 6-9months to recover (excessive pressure on nerve)
  - Syndrome –microvascular weeks-months, swollen painful limb
- Deflate
  - Wait > 15 min for prilocaine
  - Then let down slowly
- Failure rate only 2-4%
- Pros / cons
  - Pros – avoid sharp needle, low failure rate
  - Cons – tourniquet damage, cuff failure and LA toxicity, surgery outlasting block
- CI
  - Pre-existing nerve damage, PVD, lymphedema, sickle cell, raynauds,

scleroderma, pagedts disease – enters via bone

Paediatric day case

- Patient:
  - Patient: age / PCA, co-morbidities
  - PCA
    - Term 46 weeks
    - Preterm (<37 weeks)
      - ANZCA 52
      - Cote up to 60
- Surgical
  - Short < 1hr
  - Minimal blood loss
  - Pain control / outpatient
  - Surface / laparoscopic
- Social
  - Responsible adult
  - Within 1 hour medical care
  - Telephone
  - Understand instructions

Circumcision

- Caudal (longest duration)
  - 0.5mk/kg (up to1ml/kg)
  - Clonidine 1mcg/kg
  - +/- adrenaline 5mcg/ml
  - NOT ketamine (potential apoptosis)
- Penile block
  - 21G needle
  - Hit Symphysis pubis aspirate and inject
  - Midline and angle 10°
  - Levobupiv 0.5% 1ml + 0.1ml/kg
  - Then subcut 2mls across base of penis
- Topical LA
  - Not as good

Bilateral inguinal hernia repair – options

6 monther in tertiary centre

- GA + caudal
- GA + ilioinguinal nerve block
  - Landmarks – ASIS superior and medial
  - Two pop (External oblique + internal oblique)
    - Ilioinguinal (bn IO + TAP) supra pubic
    - iliohypogastric (bn EO + IO) – scrotum + groin
    - Subcostal – fan wise block above ligament
    - Genitofemoral –s/c superficial inguinal ring
    - Contralateral fibres – midline above pubic symphisis
- Spinal

Paediatric Spinal

- 0.5% bupivacaine 0.5ml/kg
  - Lower than adults (TerminateL3/4 – thus lower than this)
  - 25G pencil point (0.1cm/kg to space)
  - Last 30-40 min
  - Lose bowel control

Ubilical hernia - regional

- Rectus sheath block
- Short bevel needle
- 2 pop
  - 1st ant rectus sheath
  - 2nd rectus itself
  - inject in the posterior sheath

Pre-Eclampsia

Definition

- Multi-system disorder characterized by (Obstetric SIG evidence – ANZ definition):
- Hypertension (after 20 weeks)
  - > 140 sys +/-
  - > 90 dia
- Plus one of:
  - Proteinuria: 0.3g/24hr (2+ dipstick)
  - Renal impairment
  - Liver disease
  - Neurological problems
  - Haematological disturbance
  - FGR

RWH definition:

- BP + proteinuria /or/
- prot:creat ratios > 30mg/mmol

Severe PE (CEACCP) (any one of):

- BP: Sys > 160 or Dia > 110
- Protein: > 5g / 24 hr (> 0.3g / 24hr RWH)
- Oliguria: < 400ml / 24hr
- Cerebral irritability
- RUQ / epigastric pain (liver distension)
- Pulmonary oedema

HELLP

- Haemolytic anaemia (measure haptoglobin)
- Elevate Liver ensymes
- Low Platelets

Principles of management

1. Control hypertension
   a. Labetolol (supplants hydralazine, less SE)
      i. RHW: 20mg IV every 10 min to maximum 300mg (CEACCP: 50mg IV every 5 min max 200mg)
      ii. Infusion 20-160mg/hr
   b. Hydralazine
      i. 5-10 mg, repeat 10min to maximum 20

ii. Infusion if no response: start 1mg/hr, titrate 1-10mg/hr

c. Nifedipine
   i. 10-20mg oral BD or TDS (not Sublingual)

2. Seizure prophylaxis
3. Fluidbalance / renal output
4. Early epidural during labour
   a. PLT > 100 for epi
   b. PLT > 80 for spinal

Seizure prophylaxis

- MgSO4 4g load (8mls 50%) + 2g/hr
- MAGPIE trial
  - Effective ↓ risk of seizures
- Therapeutic level 2-3.5 mmol/L
- Continue 24 hrs / 24hr after last seizure
- 1g = 4mmol
- Toxicity
  - Loss tendon reflex >5mmol/L
  - Resp depression > 6 mmol/L
  - Cardiac arrest > 12 mmol/L

Table 2 Drugs used to control the blood pressure in pregnancy

Drug	Dose	Mechanism of action	Comments
Hydralazine	5 mg increments IV every 20 min IV infusion 5–20 mg h^{-1}	Directly acting vasodilator, mainly arterioles	Widely used Side-effects (headache, tremor, vomiting) may mimic impending eclampsia
Labetalol	50 mg increments IV every 20 min 100 mg increments PO every 30 min IV infusion 20–160 mg h^{-1}	α- and β-blocker	Few maternal side-effects Contraindicated in asthma May impair capacity of fetus to cope with stress Safety of long-term use not known
Methyldopa	1–3 g PO per day in 3–4 divided doses	Centrally acting, reduces sympathetic outflow	Side-effects include drowsiness, depression, postural hypotension Safe for long-term use
Nifedipine	20 mg, slow release preparation, PO	Calcium channel blocker	Short acting Can get profound hypotension in combination with magnesium Safety of long-term use not known
Sodium nitroprusside	IV infusion starting at 0.25 μg kg^{-1} min^{-1}	Directly acting vasodilator, mainly arterial	Rapid onset and offset Good for hypertensive emergencies May cause excessive hypotension Risk of cyanide toxicity to fetus
Glyceryl trinitrate	IV infusion starting at 10 μg min^{-1}	Directly acting vasodilator, mainly venous	May cause excessive hypotension Risk of methaemoglobinaemia

GA for severe PE:
M – Standard + IAL, BIS
A – Assistant fro RSI + large bore IV
D – Acid prophylaxis, Induction (Props + sux + including alfentanil), Maintenance (sevo / des), BP control

MAGPIE Trial

- Large randomized control trial > 10,000 women, 33 countries
- Rx: 4g load and inf 1g/hr for 24hr
- Criteria: b4 birth or 24hr postpartum, BP 140/90, urine protein 1+ (30mg/ml)
- Endpoint eclampsia & death of baby
- Outcome:
  - PE: NNT 91
  - Severe PE: NNT 63
  - Mild PE: NNT 109
  - mortality lower RR 0.55 (benefit probably from 3rd world countries mainly)

Neuraxial in obstetrics (RWH)

- Consent / CI / time out / Venous accesswith MADE
- Check clotting in severe PE and FDIU > 10 days

- Spinal
  - Plt > 80
  - 2.2ml 0.5% heavy bupivacaine + 15mcg fentanyl
- Epidural
  - Plt > 100
  - (risk benefit below 100 but > 80 and clotting normal)
  - Each dose is a test dose
  - Loading incremental 0.2% ropicavaine 5ml up to 15-20ml total
  - Fentanyl ~ 1mcg/kg (usu 100 mcg)
  - PCEA
    - 0.2% ropiv + 2mcg/ml fentanyl
    - 5ml bolus
    - 15min lock out
    - 60ml 4 hour limit
  - Monitoring
    - Midwife 20 min after each test dose
    - 5 minutely obs (HR, BP, sats) and FHR
    - CTG continously

Hypercalcaemia

Level > 3.5 mmol / L
Rx

- Fluids + diuresis
- Pamidronate IV

SAFE trial

- Albumin in ICU patients
- Albumin vs saline
- Improved outcomes in sepsis
- Worse in TBI (traumatic brains)
  - Issue was SECONDARY analysis

Pyloric Stenosis

- Medical emergency (NOT surgical)
- Ready?
  - Fluid resuscitated
  - Cl > 100
  - Bicarb < 26
- Check have NGT. If not?
  - When did it come out?
  - Have losses been replaced with saline?
  - Are they adequately rescuitated now?
  - Replace NGT and 4 quadrant suction
    - Replace was is suctioned PRIOR to induction!

Return of bleeding tonsil

- Need IV and RSI
- IV fell out
  - MUST replace IV
- Gas induction? Left lateral with head down. Not very safe and difficult. NEED IV FIRST

Prothrombinex

- 2, 9, 10
- Heparin
- Low 7 (FFP thus better)
- Dose: 50 units / kg

Recombinant factor 7

- Dose: 90 units / kg

Cryopercipitate

- 8 + 13
- Fibronectin
- Dose: 1 unit / 10kg
- 70kg adult – 10 units

Hb substitutes

- Per-fluorocarbons
  - Linear OHDC
- Hb-containing solutions
  - Sigmoid OHDC
- Problems
  - Allergy
  - Renal impairment (free Hb)
  - Iron build up

Acid prophylaxis

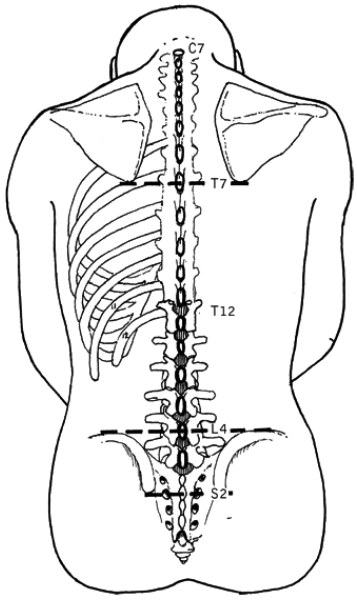
- Aims:
  - pH > 2.5
  - Volume < 25ml
- Citrate:
  - Onset immediate
  - Duration 30 min
  - 0.3M 30ml
- Ranitidine
  - 150mg orally night before and morning of
  - Onset: > 60 min
- Ranitidine + citrate
  - Works for 30 min (citrate)
  - Low pH between 30-60 min
  - ↑ pH as ranitidine works
- IV ranitidine
  - Onset 30-45 min
- Omeprazole
  - Onset 45 min
  - Not as effective as ranitidine (ranitidine ↓ volume)
- Use from 18-20 weeks (Obstetric SIG)

Obstetric epidural

TRICC

- > 800 ICU patients in Canada (1999)
- Euvolaemic + Hb< 90 within 72 hrs in ICU
- Treatment arms
  - Restrictive: trigger < 70 (aim 70 – 90)
  - Liberal: trigger < 100 (aim 100 – 120)
- Outcomes
  - Overall 30-day mortality = same
  - Restrictive 30-day lower in (subgroup analysis)
    - Less sick (APACHE </= 20)
    - Age < 55
    - But NOT if clinically sig cardiac
  - In-hospital mortality significantly lower in restrictive group (22% vs 28%, P 0.03)

Paravertebral



18 G Touhey
T7 = angle of scapulae
LA to skin 2.5 cm lateral spinous process
Insert 18 G Touhey
Needle should hit transverse process of vertebra below
Angle needle caudad and walk off TP
Advance 1 – 1.5cm beyond this and inject (other: LORTS / hanging drop technique)
Inject:

- 5ml per level (multiple level technique)
- 15ml will block 3-5 segments (Median = 3 somatic levels and 8 sympathetic levels)
- I inject 20-30mls

Block segments 1 up 3-4 down with 20ml

If sitting up expect spread ? 1/3rd up and 2/3rd down

Pregnancy and cardiac disease

Table 31. Valvular Heart Lesions Associated With High Maternal and/or Fetal Risk During Pregnancy

1. Severe AS with or without symptoms
2. AR with NYHA functional class III–IV symptoms
3. MS with NYHA functional class II–IV symptoms
4. MR with NYHA functional class III–IV symptoms
5. Aortic and/or mitral valve disease resulting in severe pulmonary hypertension (pulmonary pressure greater than 75% of systemic pressures)
6. Aortic and/or mitral valve disease with severe LV dysfunction (EF less than 0.40)
7. Mechanical prosthetic valve requiring anticoagulation
8. Marfan syndrome with or without AR

AR indicates aortic regurgitation; AS, aortic stenosis; EF, ejection fraction; LV, left ventricular; MR, mitral regurgitation; MS, mitral stenosis; and NYHA, New York Heart Association.

Eisenmengers in pregnancy

- Issues:
  - Very high-risk pregnancy
    - Delivery via LUSCS maternal mortality reported up to 80%
    - Perinatal mortality quoted at 60%
    - Most deaths between days 2-9 postpartum
  - Prenancy-related issues (Airway, reflux, PE)
  - Esingmenger's management
  - **When, where, how to deliver her**
- Multidisciplinary meeting (experienced obstetric anaesthetist, obstetrician, cardiologist, cardiothoracic surgeons, paediatricians)
- Where: quanternary hospital with cardiology and cardiothoracic capability (may be best at cardiac centre with paediatricians, obstetricians travelling there and a cardiac and obstetric anaesthetist)
- Eisenmengers
  - Cardiac shunt (most commonly VSD) untreated leading to irreversible pumlmonary hypertension and bi-directions shunt presenting with cyanosis and polycythaemia
  - Management
    - Anticoagulation for embolic risk (therapeutic LMWH)
- Treatment
  - Anticoagulation (LMWH)
  - Pulm vasodilators (oral nifedipine) or (IV: prostacyclin) or (inhaled: nitric)
  - Prem spont labour common $\rightarrow \therefore$ planned delivery between 32-34 weeks
- Management principles during peri-partum period
  - Avoid ↑ PVR
  - Maintain RV pre-load (stiff RV)
  - Maintain LV afterload (maintain coronary perfusion particularly the RCA and prevent shunt reversal)
  - Maintain RV contractility (fixed CO)
- Best results attained by avoiding ↑ PVR due to:
  - Hypothermia (actively warm)
  - Acidosis
  - Hypercarbia
  - Hypoxia (O2 is best dilator)
  - High ventilation pressures (small volumes and fast rate / avoid PEEP)
  - Sympathetic agents (avaoid norad / ad)?
- Anaesthetic management:
  - Goal to avoid changes in PVR and SVR
  - **NVD** probably least changes BUT balance against uncontrolled timing and lack of afterhours support
  - **Induction and NVD** – issues with whether induction is favorable and risk of this failing requiring urgent LUSCS out of hours. Need clear progression criteria – if not met will need intervention
  - **Elective LUSCS** – probably the most controlled option. Cardiac + obstetric anaesthetist with obstetric, cardiology and paediatrics available.
- GA LUSCS
  - Acid prophylaxis (ranitidine / citrate)
  - Left lateral tilt (30°)
  - IAL + CVC + inotropes (adrenaline ready)
  - Opioid based induction cause least change to PVR
  - No nitrous (↑ PVR)
  - TIVA – least change to uterine tone / PVR
  - Oxytocics dilute and given in small increments
  - Treat blood loss aggressively
  - Destination: ICU

A-a gradient & P:F ratio

- FiO2 x5 ~ = expected pO2
- A-a gradient ↑ with:
  - Age: (Age/4)+4
  - ↑ FiO2: ~ 5mmHg for 10% increase

Causes of hypoxemia WITH increased A-a gradient:
1. Diffusion defect
2. V/Q mismatch
3. Shunting

Causes of hypoxemia WITHOUT increased A-a gradient:
1. Alveolar hypoventilation
2. Low FiO2 (FiO2 <21%)

- P:F ratio (pO2:FiO2)
  - < 300 ALI
  - < 200 ARDS
    - PCWP < 18
    - Bilateral pulm infiltrates

Hyperthyroidism

- Aim euthyroid and HR < 100

- Options:
  - Propranolol
  - Carbimazole
  - Propothyrouracil (PTU)
  - Lugol's iodine (↓ vascularity and thyroid storm)

Gillian barre

- If on ward serial VC measurements by physio
- VC < 1.0L (15ml/kg) indicates need to intubate as can't cough
- To cough one needs double tidal volume (TV i.e. 2 x 500ml in an adult)
- Treatment
  - Supportive
  - Ventilate as required
  - Plasmapheresis
  - Nutrition (early enteral)
  - Analgesia – difficult to manage
  - Stress ulcer
  - DVT prophylaxis

Intra-op Heat Loss

- Radiation 60%
- Evaporation 25%
- Convection 12%
- Conduction 3%

Steroids

Equivalence

- 4mg Dexamethasone*
- 25mg Prednisolone
- 100mg Hydrocortisone
- 20mg Methylprednisolone
- 0.25mg Fludrocortisone*

*Dexa has no mineralocorticoid activity and fludrocortisone has minimal glucocorticoid activity

- Pred < 10mg/day → little risk

- Pred > 10mg/day → HPA suppression likely

	Minor	Intermediate	Major
Preop	Take normal dose preop		
Induction	25mg	25mg	25mg
Post-op	Resume normal therapy	25mg QID for **24 hrs**	25mg QID for **72 hrs**

- For high dose therapy
  - Convert to IV equivalent of hydrocortisone
  - i.e. 50mg pred = 50mg hydrocort IV QID
- If ceased steroids
  - Replace if < 3 months
  - No cover if > 3 months

Torsades / Long Qt

- Most are short-lived and self-limiting
- Revert if causing severe haemodynamic compromise / VT
- MgSO4:
  - 2g IV over 2-3min (4mls of 50%)

Cocaine

- As with amphetamines → symp hyperstimulation
- MOA
  - ⊗ Na+ channels (LA effect)
  - ⊗ pre-synaptic re-uptake of NA / DA
- Acute SE
  - Coronary artery spams (MI) ↓ O2 delivery
  - Arrhythmia
  - HTN ↑ O2 demand
  - Tachycardia ↑ O2 demand
- Dose max: 3mg/kg
- Intranasal peak: 30-60 min

Co-phenylcaine Spray

- 100µL/spray ∴ 10 sprays = 1ml
- Lignocaine 5% 50mg/ml
- Phenylephrine 0.5% 5mg/ml

Pain Management – Paediatrics

- Naloxone
  - 0.4mg in 20mls (20mcg/ml)
  - Sedation 2mcg/kg (1ml per 10kg)
  - Resus 10mcg/kg (1ml per 2kg)
- Morphine Infusion (< 50kg)
  - 0.5mg/kg in 50mls
  - 1 – 4 ml/hr (10 – 40mcg/kg/hr)
  - PCA: 1 – 2 ml > 10min intervals
- Morphine PCA (< 50kg)
  - As above
  - 2ml bolus (5min) (20mcg/kg bolus)
- Fentanyl infusion
  - 15mcg/kg in 50mls
  - 1 – 4ml/hr (0.3 – 1.2mcg/kg/hr)
- Ketamine
  - 5mg/kg in 50mls
  - 1 – 4ml/hr (0.1 – 0.4 mg/kg/hr)
- Epidural
  - Levobupivacaine 0.125%
  - 0.1 – 0.3 ml/kg/hr
    - Fentanyl 1-2 mcg/ml
    - Clonidine 1mcg/ml
  - Space: ~ 1mm/kg (over 10kg)

Cleft Palate

- Lip 3 months
- Palate 6-9 months (pierre robin at 18months)
  - Repair before talking

- Redo 8-9 years (prior to eruption of canines)
- Incidence
    - 1:750 overall for any lip / palate defect
    - 1:2000 (isolated palate)
    - Risk ↑ to 1:25 if +FHx
- Pre-op Ax:
    - Airway
    - Associated with:
        - Treacher Collins
        - Goldenhar
        - Pierre Robin Sequence (micrognathia + glosoptosis + airway Obx)
    - ↑ incidence of congenital abnormalities
        - Esp ↑ CVS (will have had an echo)
    - Chronic URTI / mucous / saliva
        - +/- glycopyrolate premed
- Anaesthetic issues:
    - Difficult airway
    - Shared airway
        - ↓ access
        - ETT kinked by gag (watch CO2 and Paw)
        - *Throat pack*
    - Potential blood loss (relative to small circulating volume)
- Technique
    - Atropine / glyco for secretions if difficult airway
    - ETT: RAE / re-enforced ETT
    - Throat pack
    - Protect eyes
    - Analgesia
        - Fentanyl 2-4 µg/kg + paracetamol 20mg/kg (+ NSAID if > 1yr old)
        - LA + adrenaline by surgeon (analgesia and ↓ blood loss)
        - Clonidine / Ketamine for opioid spairing technique
        - Dexamathasone 0.1mg/kg may ↓ swelling
- Emergence
    - Extubate awake +/- NPA
    - Suction pharynx ++

Physiological anaemia of infancy

- Newborn Hb 17 – 18 g/dL
- May rise 1-2 g/dL → excretion of fluid
- After 1 week will return to 18 g/dL then will ↓ to 11-12 g/dL @ 4-8 weeks due to ↓ RBC mass
- HbF ~ 70% @ birth
- Falls rapidly and is negligible by 6 months

Cerebral palsy

- 1:500 live births
- Classification (no more comprehensive)
    - Motor
    - Physical activity
    - Psycho-social ability
- ***CNS***
    - **2/3rd intellectual / cognitive dysfunction**
    - Difficult / unable to communicate (consider premed for anxiety)
    - **50% focal / general epilepsy**
    - Other: altered pain sensation
    - Anxiety 2° multiple admission
- ***Respiratory / Airway***
    - Many born prem → Chronic lung disease 2° to Neonatal Respiratory Distress Syndrome (RDS)
    - ↑ risk of GORD and chronic aspiration
        - Risk of aspiration
    - Chronic chest infections
    - **Scoliosis over time with truncal spasticity → restrictive lung defects and pulm HTN**
    - TMJ dysfunction / hypersalivation → airway difficulties
- ***GIT***
    - Small for age
    - Pseudo-bulbar palsies / oro-motor dysfunction
    - Hypersalivation
    - Leading to poor nutrition:
        - **Anaemia**
        - Malnutrition
        - Dehydration
        - Electrolyte abnormalities
    - NGT / PEG feeds
    - Poor dentition (dental extractions)
- ***Musculoskeletal / Skin***
    - Flexion deformities
    - Decubitus ulcers
    - Positioning issues / ulcer risk
    - **Poor IV access**
    - Poor SC fat reserves →**Risk of Hypothermia** (often present to theatre ~ 35°C)
- ***Urological***
    - Many are incontinent (multifactorial)
    - **Multiple urological procedures ↑ latex exposure and development of Latex Allery**

Treatment of CP

- Goals
    - ↓ spasticity and ↑ mobility
    - Mx medical problems (GORD, epilepsy, chest infections)
- Multimodal / multidisciplinary Mx
    - Antispastic → Baclofen
    - NMJ denervation → i.e. botulinum
    - Surgery → tenotomies, arthrodesis, osteotomy, tendon transfers, multi-segment spinal fusions

    - Physotherapy / OT / Speech / behavioural
- Drugs
    - Antispasmodics (baclofen / BZD)
    - Antiepileptics
    - Antisilagogues
    - Antidepressents
    - Analgesics
    - Antibiotics
    - Laxatives
- Drug interactions
    - Anticonvulsants
        - ↓MAC 30%
        - ⊗/induce enzymes
        - Blood dyscrasias (CMZ)
    - Baclofen
        - $GABA_B$® agonist
        - ↓ spasticity by ⊗release of excitatory glutamate / aspartate in dorsal horn @ Rex lamina II and III
        - Oral or Intrathecal via subcut implanted pump via catheter T12-L1
        - IT baclofen: smaller doses and less systemic SE (i.e. sedation, muscle weakness, resp depression, incontinence)
        - Pumps are often overlooked

Cerebral Palsy: Peri-op Management

Prosser, D., & Sharma, N. (2010). Cerebral palsy and anaesthesia. Continuing Education in Anaesthesia, Critical Care & Pain, 10(3), 72.

Pre-op

- Hx,Ex,Ix focus on
    - Previous anaesthetics / experience
    - Hydration status + renal function
    - Drug history (anticonvulsants and antispasmodics need to be continued)
    - Cardiorespiratory reserve
- Allergies
- FBE, UEC within 6 months
- CXM for major surgery
- ECG / CXR not routine

Intra-op

- Propofol induction is ideal (less airway issues)
- Sux is not contraindicated
- NDMR – more resistance and shorter lived (offset by ↓ ECF 2° to dehydration)
- ETT for GORD
    - Many use RSI with sux
    - Not shown to be superior to gas induction with 20-30° head up (little other option given difficult IV access and unco-operative)

Post-op

- HDU best option given ↑ risk of
    - Hypoxia
    - Hypovolaemia
    - Hypothermia
- Analgesia (depends on surgery)
    - Opioid infusion (PCA may be difficult)
    - Epidural infusion +/- clonidine (i.e. SEMLS)
    - ***Diazepam 0.1-0.2mg/kg po / IV Q4H***
    - ***Daily APS review – FLACC scoring***

Note:

- Baclofen withdrawl can be fatal

SEMLS

- Single-Event Multi Level Surgery
- Blood loss
    - Warm theatre, large IV access, CXM, IAL
- Analgesia
    - Epidural + clonidine (asleep)
    - **Levobupiv 0.125% 0.1-0.3ml/kg/hr + clonidine 1 µg/ml** (less spasm, less PONV, better analgesia cf levo+fent)
    - **Daily APS review – FLACC scoring**
- CP
    - Hypothermia prone
    - Anaemia
    - Difficult access
    - Blood issues (NSAIDS , anticonvulsants blood dyscrasias)
    - Scoliosis
- PICU post-op

Mastectomy pain

- Gabapentin
- Mexilitine
- Pre-inscsion paravertebral
- Diclofenac = more blood loss than COX II
- Antidepressants not thought to improve chronic pain
- Phantom breast 1% @ 2 years, sensation ~20% @ 5 years
- Chronic pain: young age, radiotherapy, reconstruction, pain post-op

Amputation phantom pain

- Risk factors
    - Pre-op pain
    - Chemotherapy
    - Post-op stump pain
- Treatment phantom pain (acute)
    - Calcitonin (acute)
    - MS contin ↓ pain
    - Gabapentin effective
    - IV lig good for stump
    - Ketamine
    - Amitriptyline
    - Tramadol

LMA and ETT

- iLMA: Size 3,4,5 will all accommodate size 8.0 ETT
- classic LMA
    - 3+4: size 6 tightly, 5.5 freely
    - 5: size 7

Fibrescope

- Use 4mm as bigger harder to pass through ETT
- Aintree needs 4mm

Intra-arterial Thiopentone

- Declare emergency – stop surgery
- Flush with hep-saline
- Inject 1% lignocaine (analgesia + vasodilatation)
- 40mg papaverine
- Call vascular surgeons
- Stellate ganglion / axillary block

AHA guidelines

- Recent AMI: 7 – 30 days

Opioid Conversion

Patch	IV	PO	IV:PO
Morphine	10	**30**	1:3
Oxycodone	10	**20**	1:2
Fentanyl	100 µg (100:1)	-	-
Tramadol	100	100	1:1
Buprenorphine	0.4mg	0.8mg (SL)	

IV morphine 10mg:

	Ratio	**Morph 10mg ≡**
Fentanyl	100 : 1	**100 mcg**
Hydromorph	5 : 1	**2 mg**
Tramadol	1 : 10	**100 mg**
Oxycodone	1 : 1	**10 mg**

Morphine 10mg oral:

	Ratio	Morph 10mg ≡	30mg PO≡ (≡ 10mg IV)
Tramadol	1:5	50mg	150mg
Codeine	1:8	(7.5mg) ≡ 60mg	240mg
Methadone			
Oxycodone	1.5:1	15mg ≡ 10mg	20mg
Hydormorph	5:1	2mg	6 mg

Same opioid Oral → Parenteral (IV,SC,IM)

	Ratio	Oral	IV
Morphine	3 : 1	30mg	10mg
Oxycodone	2 : 1	20mg	10mg
Hydormorph	3 : 1	30mg	10mg
Methadone	2 : 1	20mg	10mg
Tramadol	1.5 : 1	150mg	100mg

Parenteral Fentanyl → Transdermal Fentanyl (1:1)

IV (mcg/24hr)	Patch µg/hr	Morph IV →↓by 50%
300	12	30mg → 15mg / day
600	**25**	**60mg → 30mg/day**
1200	50	
1800	75	
2400	100	

Conversion from patch → oral morphine: (2 ratios suggested)

- 1:100 ratio (i.e. 600µg/day ≡ 60mg/day morph)
- 1:150 ratio (i.e. 600µg/day ≡ 90mg/day morph)

Working from IV fent → IV morph → oral morph

- 600µg/day → 60mg IV morph
- 60mg morph @ 50% for incomplete tolerance = 30mg IV
- 30mg IV × 3 → 90mg orally (i.e. 1:150 direct conversion)

Tansdermal Fentanyl

- Peak serum concentration between 24-72 hours
- When stopping, will still get benefit for ~ 24 hrs

Transdermal Buprenorphine to Oral Morphine

- Ratio: 1:100
- Convert oral morphine → TD bup
    - 30mg/day ÷ 100 = 0.3mg bup
    - 0.3 mg bup = 300µg/day
    - Round down to 10mg weekly patch3

Patch	Delivery (µg/hr)	PO morph	IV morph
5mg/week **120**µ/24hr	5	**12mg** / day	4 mg / day
10mg/week **240**µ/24hr	10	**24mg** / day	8 mg / day
20mg/week **480**µ/24hr	320	**48mg** / day	16 mg / day

Max dose is 40µg/hr (two 20mg patches)
After stopping patch: short acting opioid for 1st 24 hours → then commence long-acting opioid

Methadone conversion

- Complex and best done by experienced APS, D+A or palliative physician
- Long elimination half-life with large inter-patient variability
- Conversion ratio varies with morphine dose
- Suggested change method:
    - Day 1-2: give calculated dose + 25-50% extra for loading in 4 divided doses
    - Day 3-4: give calculated dose NO loading in 3 divided doses
    - Day 5 onwards: give calculated dose in 2 divided doses (BD)

Daily PO morphine (mg)	Conversion ratio	Daily PO methadone
< 100	3 : 1	10 – 30mg
100 – 300	5 : 1	20 – 60mg
300 – 600	10 : 1	30 – 60mg
600 – 800	12 : 1	50 – 65mg
800 – 1000	15 : 1	50 – 65mg
> 1000	20 : 1	50mg

Buprenorphine – High Dose

Roberts, D. (2005). High-dose buprenorphine: perioperative precautions and management strategies. Anaesthesia and intensive care.

- Saboxone
  - Buprenorphine 4, 8, 16, 32mg
  - Naloxone
  - BA sublingual – naloxone metabolized
  - IV – Naloxone active ∴↓ illicit use

- **ELECTIVE SURGERY**
  - Multidisciplinary (D&A + APS)
  - Minor surgery:
    - Continue bup + ↑25% for added analgesia
    - Maximize non-opioid analgesia
  - Major surgery (option 1)
    - Continue bup + 25%
    - Admit HDU for titration high dose opiod (don't stop bup)
  - *Major surgery (option 2) – D&A:*
    - *Stop bup > 72 hours*
    - *Start full agonist after 24hrs / later (methadone / SR morphine)*
    - *Rough guide (D&A not available):*

	Methadone	*SR Morph*
Bup < 4mg	*20mg / day*	*60mg / day*
Bup > 4mg	*40mg / day*	*80mg / day*

Charles Kim: Bup 8-16mg S/L = 60mg methadone

- **EMERGENCY SURGERY**
  - Liaise with D&A + APS
  - Maximise non-opioid (regional + simple + adjuncts)
  - Admit HDU:
    - If short convalescence titrate high dose opioid in HDU
    - If long: change to methadone / morphine (may be prudent to remain intubated for 24 hours and add in morphine)
- **DISCHARGE**
  - Pre-op bup + simple analgesics
  - Restart when analgesic use is low
  - Start >**8hrs** post last opioid dose (too soon may precipitate withdrwal)
  - Liaise with out of hospital bup ***prescriber and pharmacy***

NFR in the peri-op period (Ethics)

- Ethical considerations
  - Non-maleficence do no harm
  - Beneficence do good
  - Autonomy own choice
  - Justice
- Peri-op management
  - Recognise that many Cx under anaesthesia are readily reversible with limited morbidity
  - Recognise that general anaesthesia contravenes many limitations in an NFR (no intubation / inotropic / ventilator support, etc)
  - Discussion with:
    - Patient
    - MPOA / Guardian / NOK
    - Surgeon
    - ICU
  - Clarify resus status during anaesthesia
- Options:
  - Easiest = suspend NFR status for 24 hours in agreement with patient / MPOA
  - "Limited resus" = if event occurs, outline the limit to resus efforts (ETT, CPR, DCR, ICU, etc)
  - If procedure carries very high risk – the anesthetist / surgeon may counsel against having the procedure
- Advanced directives should be followed
- Hospital ma have guidelines on this issue

Office of Public Advocate – Victoria

NFR:

Next of kin

The next of kin cannot make a NFR directive for a patient unless they have some status as either

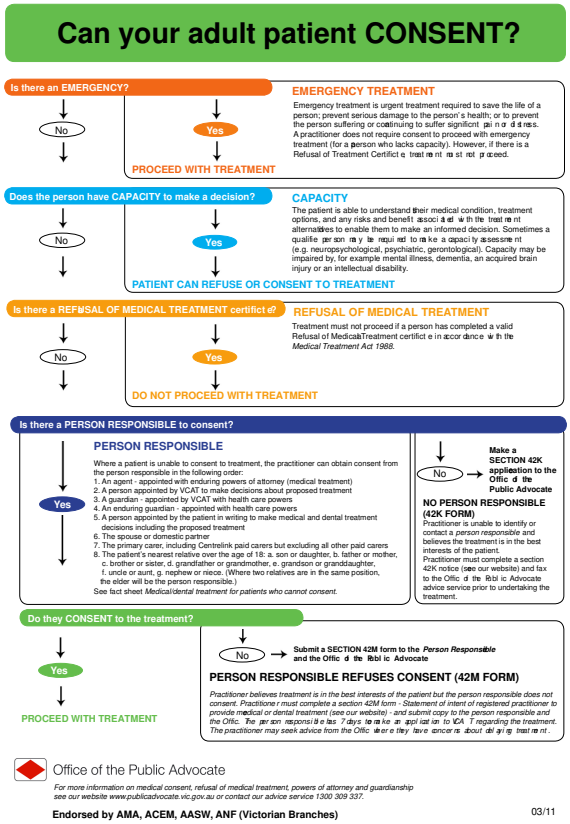
- a plenary guardian;
- or a guardian with appropriate health care powers;

- or an agent under the Medical Treatment Act 1988.

Consent – Hierachy

Who can make these decisions?

- The '<u>person responsible</u>' is the person who is available and willing to make medical and dental decisions on behalf of the patient.
- This can be, in <u>order of priority</u>:
    - An agent appointed by the patient under an enduring power of attorney (medical treatment)
    - A person appointed by the Victorian Civil and Administrative Tribunal (VCAT) to make decisions about the proposed treatment
    - A guardian appointed by VCAT to make medical treatment decisions
    - An enduring guardian with appropriate powers appointed by the patient
    - A person appointed by the patient in writing to make decisions about medical and dental treatment including the proposed treatment
    - The patient's spouse or domestic partner
    - The patient's primary carer, including carers in receipt of a Centrelink Carer's payment but excluding paid carers or service providers
    - The patient's nearest relative over the age of 18 in order listed:
        a. son or daughter (the eldest)
        b. father or mother (the eldest)
        c. brother or sister (including adopted persons and 'step' relationships) (the eldest)
        d. grandfather or grandmother
        e. grandson or granddaughter
        f. uncle or aunt (the eldest)



SIRS – systemic inflammatory response syndrome

- 2 of 4:
    - temp > 38° or < 36°
    - HR > 90
    - RR > 20 /or/ PaCO2 < 32
    - WCC > 12 /or/ < 4
- Sepsis
    - = SIRS 2° to infection
- Infection = inflammatory response to microorganism in the host
- Severe sepsis = sepsis + organ dysfunction
- Septic shock = sepsis + hypotension

Delayed Recovery

Initial Mx

- Urgent / potentially life-threatening
- High flow O2 (100%), adequate IV access, check vitals, Assess ABCD, apply BIS, consider wide DDx
- MEND
    - <u>*Metabolic*</u> – Na+, Ca++, Acidosis, ammonium, uraemia, ↓T°
    - <u>*Endocrine*</u> – BSL
    - <u>*Neurological*</u> – ICH, ICP, NMS, serrotenergic syndrome, POC, delirium
    - <u>*Drugs*</u> – error, prolonged effect, sux apnoea
- Other
    - Physiological
    - Pharmacological
    - Psychiatric

- Pathological

Placenta

- Previa
  - Abnormal implantation between presenting part and cervical Os
    - I – lower segment but not os
    - II – adjacent but not covering os
    - III – partially obstructing os
    - IV – complete
- Accreta
  - Abnormal attachment through endometrium and into myometrium
  - High risk of bleeding and hysterectomy
  - Placenta previa + Phx LUSCS = high risk for accreta
- Increta
  - Extension further into myometrium but not through it
- Percreta
  - Penetrate through myometrium and often onto adjacent structures (bowel + bladder)
- Risk of accreta ↑ with previa + # of previous LUSCS
  - 25% risk if one previous LUSCS
  - 50% if 2 previous LUSCS

Hypoxia

- Urgent emergency needing rapid treatment + simultaneous diagnosis
- Hypoxia:
  - ↓ sats by 4%
  - ↓ PaO2 < 60 (92% sats) = dangerous
- DDX
  - Delivery / Ventilator / Circuit (equipment)
    - Hypoxic gas mixture (wall / machine)
    - Ventilator failure
    - Disconection
    - Circuit issue (block / leak)
  - Airway + Filter
    - ETT / LMA: blocked, secretions, kinked, FB, blocked filter, endobronchial
  - Patient
    - Circulation (↓ delivery)
      - Hypotension
      - Embolus (gas / air / PE / fat)
    - ↑ O2 demand
      - MH / sepsis / thyroid
    - Shunt / V/Q
      - CCF
      - Atelectasis
      - ↓HPV
      - Aspiration
      - CHD
    - Failure to ventilate
      - Bronchoconstriction
      - Anaphylaxis
      - Tension Ptx

ARDS NET

ARDS Definition:

- Acute onset severe respiratory distress with one or more risk factors or known causes:
- Impaired arterial oxygenation
  - ALI PaO_2/FiO_2 ratio < 300mmHg
  - **ARDS PaO_2/FiO_2 ratio < 200mmHg**
- Bilateral pulmonary infiltrates on CXR
- No clinical evidence of raised LAP (or PCWP < 18mmHg)

Aeitiology:

Pulmonary	Extra-Pulmonary
Pneumonia	Sepsis
Aspiration	Severe trauma
Inhalational	Shock
Contusion	Acute pancreatitis
Near drowning	Bypass
Fat embolus	DIC
Reperfusion injury	Burns
	TRALI

- Avoid ventilator associated lung injury (VALI)
- Cause of VALI described as:
  - *Volutrauma*– end-inspiratory alveolar overdistention
  - *Barotrauma*– high inflation pressures
  - *Atelectrauma*– alveolar de-recruitment at end of expiration (alveoli opening and collapsing)
  - *Biotrauma*– biochemical injury and inflammation
  - Above mechanisms result in cytokine release leading to systemic effects including SIRS and MOF

Ventilation:

TV:	6ml/kg
Plateau P:	< 30 cmH2O
Permissive hypercapnoea	Aim pH 7.3 – 7.45
Ideal PEEP	↑ until maximal ↑ in PO2 then reduce to last level resulting in increase
FiO2	Aim sats 88 – 95%
Prone if needed	↑ PaO2 but inherent risks

- **ARDS Network trial**
  - n=861 in 10 centres
- 9% absolute reduction in 28 day mortality
- Criticised for high volume in controls (12ml/kg) vs treatment arm (6ml/kg)
- Isolated benefit of low tidal volume demonstrated (independent of PEEP)

Active Cardiac Conditions

1. UNSTABLE Coronary Syndromes
   a. Unstable angina
   b. NYHA angina 3 / 4
   c. Recent MI (>7 but < 30days)
2. DECOMPENSATED heart Failure
   a. NYHA 3 / 4
   b. New onset
3. SIGNIFICANT Arrhythmia
   a. High grade AV block
   b. 3rd° HB
   c. SVT (incl AF) rate > 100
   d. Symptomatic bradycardia
   e. New VT
4. SEVERE Valvular disease
   a. Severe AS
      i. Symptomatic – angina / syncope / exertional dyspnoea
      ii. area < 1.0cm^2 / mean gradient > 40mmHg
   b. Severe MS (symptomatic – dyspnea, syncope, CCF)

Clinical Risk Factors

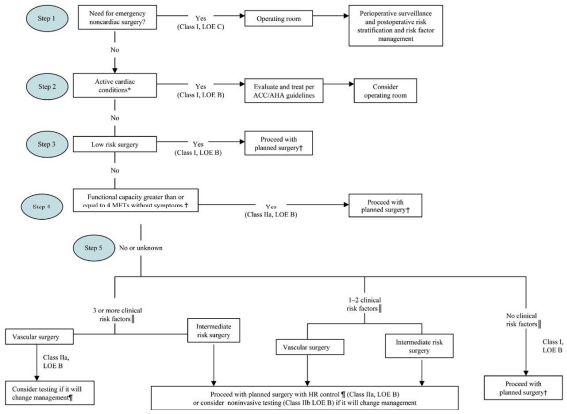
- history of **ischemicheartdisease**
- history of compensated or prior **HF**
- history of **cerebrovascular** disease
- **diabetes mellitus**
- **renal insufficiency**

Lee Revised Clinical Risk Index

1. **High risk surgery**
   a. Intraperitoneal
   b. Intrathoracic
   c. Vascular - suprainguinal
2. Hx of **IHD**
   a. +ve stress test
   b. Previous MI
   c. Q waves on ECG
   d. On nitrates
3. Hx of **CCH**
   a. PHx CCF
   b. Bilateral creps / S3
   c. APO / PND
   d. CXR suggesting oedema
4. Hx of **CVA / TIA**
5. Pre-op **INSULIN**
6. Pre-op **Renal impairment** (Cr > 175 µmol/L)

RISK OF MAJOR CARDIAC EVENT

Points	Class	Risk
0	I	0.4%
1	II	0.9%
2	III	6.6%
3 or more	IV	11%



Treatment of CHB

- Correct electrolytes
- Beware drug interactions / overdose
  - βb + CCB + amiodarone
  - CCB overdose – give Ca++
  - βb overdose – give glucagon
- Pacing:
  - Chemical:
    - Adrenaline
    - Isoprenaline
  - Eelctrical
    - Percutaneous
      - Pads: antero-posterior left sternal / scapula edge) Can be normal positioning also.
      - Starting Amps ~ PNS i.e. 60mA-80mA
      - Painful – may need sedation / GA
    - Transvenous
      - Via Swan sheath under I.I.
    - PPM
  - Check capture: spike → QRS complex

Pace Makers & AICD

PPM code

Position	1	2	3	4	5
Meaning	Paced	Sensed	Response	Program / rate modulation	Anti-tachy function
Letters	O = None A = Atrium V = Vent D = Dual	O A V D	O = None T = Trig I = Inhibit D = dual	O = None P = simple M = multi C = communicating R = rate mod	O = None P = Pacing S = shock D = dual (P+S)

Defibrillator code

Position	1	2	3	4
Meaning	Shock chamber	Anti-tachy chamber	Tachy detection	Anti-Brady pacing
Letters	O = None A = Atrium V = Vent D = Dual	O A V D	E = ECG H = haemodynamic	O A V D

Peri-op management

- Pre-op
  - Hx / records
    - Indication
    - Date insertion
    - Date checked
    - Mode
    - Magnet effect
  - Ix
    - ECG – underlying rhythm, capture
    - CXR – box position, lead fracture, type
    - UEC – correct abnormalities pre-op as may ⊗ capture
    - Check – ideally within 3 months
  - Ex
    - Box position
- Preop day of surgery
  - Consider (depending on device and surgery):
    - PM tech
    - Asynchronous mode
    - Defib function off
- Intra-op
  - 5-lead ECG
  - Sats
  - IAB – low threashold
  - External pacing pads
  - Bipolar diathermy
  - Magnet available if effect is KNOWN
- Post-op
  - PM tech (check device / return to normal function)
  - CCU / HDU depending on surgery +/- reason for device

Ventricular Hypertrophy on ECG

- Unusually large QRS
  - **LVH**: sum S in V1 and R in V5/6 > 35mm (6.5 large squares)
  - **RVH**: Dominant R in V1
- **Strain patterns**
  - *ST depression + TWI*
    - RV strain: V1-3
    - LV strain: V4-6

Dominant "R" in V1

WPW
Brugada
Posterior MI
RVH
Duchennes MD

Acute Herpes Zoster

- VZV reactivation
- Important Mx
  - **Antiviral** therapy
    - Must start within 72hrs (acyclovir 7-10days)
    - ↓ duration of acute pain (**L1**)
    - Does not ↓ PHN (**Reversed** – cochrane)
  - **TCA** (nor/amitryp for 90 days)
    - ↓ prevalence of PHN by 50% @ 6 months (Level 2)
- Other
  - Gabapentin (level 2 – single dose)
  - Topical aspirin / topical LA / SR oxycodone provide effective analgesia (Level 2)
- PHN occurs in 15%

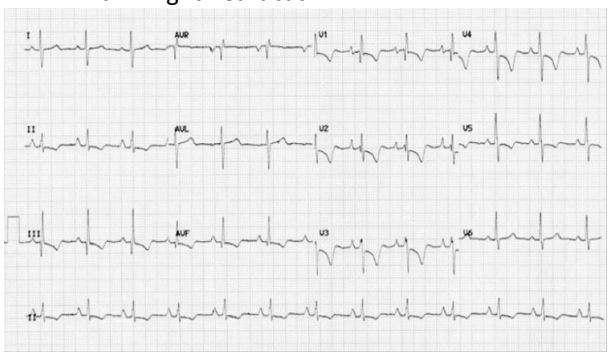
Trigeminal Neuralgia

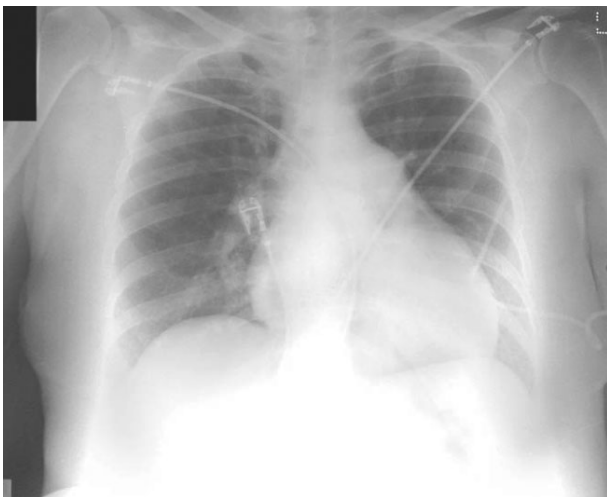
- Incidence ~ 1/20,000
- Age: 50-60
- Hallmark
  - Agonizing, paroxysmal lancing pain in one/more distributions of the trigeminal nerve (V1-3)
- Non-noxious stimuli trigger pain (commonly peri-oral region)
- 80% associated with microvascular compression at cerebropontine angle (seen on high res MRI / MRA)
- 70% can be controlled non-surgically
  - Carbamazepine NNT 1.8
  - Others used
    - Gabapentin
    - Baclofen
- Surgical decompression if medical Mx fails
- Percutaenous neuroablative techniques
- Associated with MS

Pulmonary Hypertension

- Avoid
  - Hypothermia
  - Hypoxia / hypercarbia

- Acidosis
- Rare condition with few Rx options
- Causes
  - Idiopathic
  - Lung disease
  - Heart disease (Eisenmengers)
  - Recurrent PE
- Definition
  - Mean PAP > 25mmHg @ rest
  - Mean PAP > 30mmHg with exercise
- Clinical features
  - Dyspnoea
  - Chest pain (similar to angina)
  - Syncope = ↓ C.O. and indicates severe disease (note normal RV can only generate up to 50mmHg pressure)
- Examination
  - RVH / RVF
  - Tachycardia, ↑ JVP, RV heave, TR, Loud P2, ascites, SOA
- Investigations
  - ECG: Deep "R" in V1, RAD, RBBB
  - CXR: prominent pulm vasculature
  - RFT: often NAD
  - TTE
    - PAP estimated by TR jet ($P = 4v^2$)
  - Right heart cath





- Treatment
  - Underlying cause
  - Warfarin, diuretics, digoxin, O2
  - Prostacyclin (↑ life expectancy)
  - PDEi – Bosenten, sildenafil
  - CCB (no large scale trials)
  - Transplantation

Sanders Jet Ventilator (venturi)

- Contraindications
  - Sig lung disease (bullous emphysema)
  - Inability to exhale (i.e. asthma)
- Must be paralyzed (cac't use in spont vent cases)

Airway Fire

- 3 components
  - Oxidizer (O2 / N2O)
  - Fuel (ETT, drapes, sponges, prep)
  - Ignition source (diathermy, LASER)
- Management
  - Disconnect circuit (removes O2)
  - Pull out ETT
  - Extinguish (douse with saline)
  - Evaluate airway (Bronch + new ETT)
- Have a plan and be prepared
- Minimising risk:
  - ↓ FiO2: 21% (< 30%)
  - Metal ETT

Difficult Airway

• Difficult BMV	0.1-0.5%
• Difficult laryngoscopy	1-10%
• Difficult intubation	1-4%

LA toxicity

- Emergency, High flow O2 (100% if ventilated) Hyperventilate. Call for help and LA toxicity trolley
- Midazolam / thiopentone increments for seizures
- Intubate if unconscious / requires CPR
- ALS management (adrenaline, amiodarone). Consider bypass early
- Intralipd if no immediate response
- **Intralipid 20% =**
  - **1.5ml/kg bolus**
  - **then 15ml/kg/hr infusion.**
  - **Can give 3 boluses in total and up rate to 30ml/kg/hr.**
  - **Bypass**

Regional risks – AURORA Study

• NEuropraxia	< 1 in 1000
• LA toxicity	1 in 1000