Contents

Physiology

CVS Physiology

- CO:
  - pregnancy: ↑50% :
    - initially: ↑SV - via dilation of LV
    - later: ↑HR with
    - (no diff in contractility)
    - max CO @ 26weeks then slight drop until delivery
  - in labour: ↑further with max immediately following delivery
    ↳ not affected by epidural
    ↳ thus greatest risk around labour if impaired myocardial function

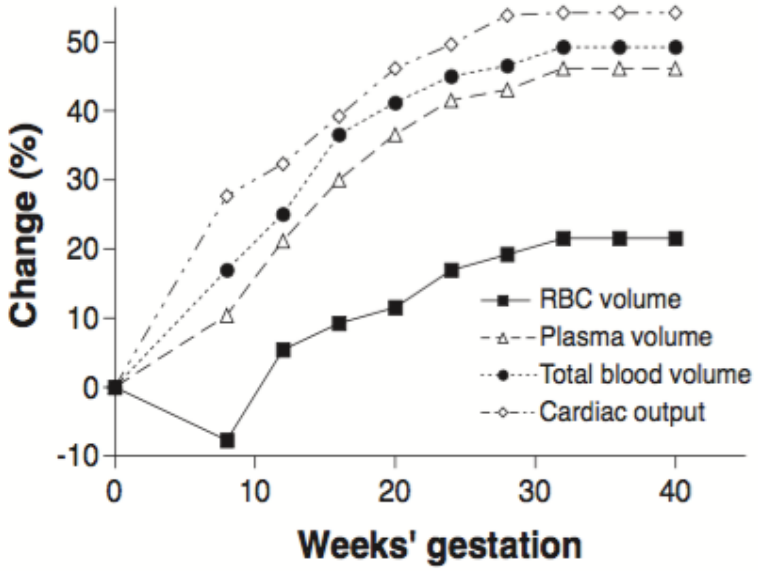


Fig. 1 Haematological changes.

- bp:
  - slight ↓MAP before returning to norm at term
  - wide pulse pressure:
    - DBP falls through pregnancy but returns to norm at term
    - (SBP less affected)
- CVP & PAPs not affected
- normal ECG:
  - L axis deviation - 15-20 deg
  - lat T inversion
  - III mimicks LVH
- Uteroplacental blood flow dependent on uterine blood flow (not autoregulated)
  ↳ needs MAP >70
- @term see physiological anaemia:
  - plasma volume ↑50% = ↑of ~ 2000mls
  - red cell mass ↑30%

  ↳ return to normal 2/52 post partum
- hypercoagulable:
  - start in 1st trimester - most common PE at this time
  - platelets:
    - ↑total number

    - ↓count due to haemodilution & destruction -in 3rd trimester
    - (platelet function normal throughout)
  - ↑I, VII, IX, X, XII with less but still ↑in antithrombin III ⟹ normal coag screen
- Aortocaval compression:
  - @term complete occlusion in supine near universal
  - Only 10% will have hypotensive syndrome due to sufficient collateral circulation
  - >20weeks must ensure L lat tilt
  - if symptomatic must increase tilt to near 90deg
- contraction in labour ⟹ 500ml blood expelled from uterus into maternal circulation ⟹ swelling of epidural veins ⟹ ↑risk of epidural vein puncture

Resp

- airway:
  - gum disease ⟹ contact bleeding
  - oedematous airway
- upward diaphragm by uterus with ↓20% FRC
- max ↑ in MV of 45% by 2nd trimester:
  - ↑VT
  - mild ↑RR

  ↳ driven by progesterone
- PaCO2 ↓to 30mmHg
- high/normal pH - ↑HCO3 excretion in kidneys
- FRC ↓20% ⟹ airway closure in 50% supine women at term
- ↑O2 consumptions by 60%:
  - physiological breathless of pregnancy -
    - experienced by most
    - signs of pathology = sudden SOB, CP, orthopnoea/PND
- see ↓ed EtCO2: pCO2 gradient - ↓alveolar dead space due to ↑ed maternal CO

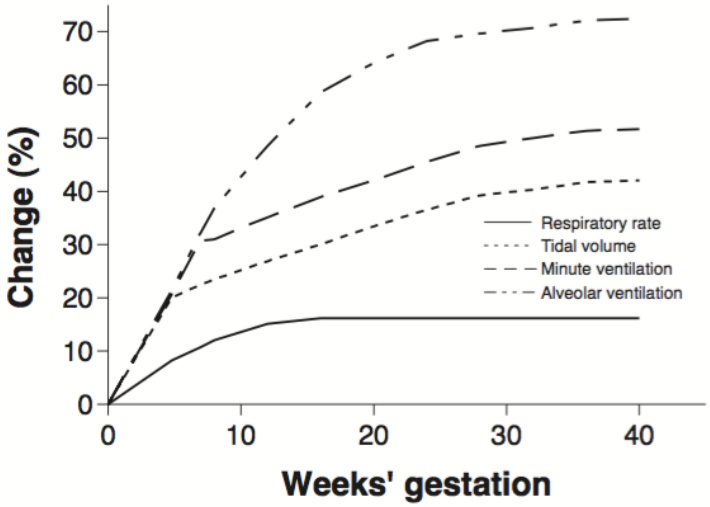


Table 2 Changes in cardiorespiratory variables with pregnancy

Cardiorespiratory variable	Alteration in pregnancy
Functional residual capacity: FRC	↓ 30%
Forced expiratory volume in 1 s: FEV1	→ unchanged
FEV1/FVC	→ unchanged
Tidal volume	↑ 45%
Minute volume	↑ 20–50%
Respiratory rate	→ ↑small increase
Cardiac output	↑
Stroke volume	↑
Heart rate	→↑ small increase

Other

- GI:
  - pregnancy does not alter emptying or acidity
  - gastric emptying only slowed in labour; halted with opioids
  - ↑intragastric pressures from gravid uterus
  - LOS barrier pressure ↓ed all stages
  - chance of regurgitation into upper oesophagus in asymptomatic individuals not sig different until 3rd trimester
  - 24-48hrs post partum: intra-abdo pressure, emptying, volume & acidity = normal
  - ↑chance of gallstones
- renal:
  - @ term:
    - ↑RBF 50%
    - ↑GFR 50%
    - ↓urea & creatinine by 50% ∴ upper normal = diseased
    - ↓reabsorption of glucose
    - ↑risk of UTI
- acid base:
  - pain in labour
    - ⟹ hypervent ⟹ acute L shift OHDC ⟹ ↑affinity for maternal Hb for O2⟹↓fetal O2 delivery
    - ⟹ ↑maternal O2 consumption ⟹ lactic acidosis ⟹ R shift OHDC ⟹ ↓maternal O2 uptake
- Neuro:
  - ↑potency of LAs
  - ↓MAC 30%
- Spinal:
  - ↓CSF volume in spine:
    - ↑venous pressure - blood diverted through epidural venous plexus
    - gravid uterus
    - enhanced neural sensitivity to LAs
    - higher apical level of throacic kyphosis
  - ∴ ↓25% dose requirement for spinals/epidurals
- Endocrine:
  - ↑insulin production but also ↑insulin resistance ⟹ any carbohydrate causes ↑ed BSL compared to norm ⟹ ↑ed foetal glucose delivery
  - thyroid gland ↑25%:
    - ↑HCG stimulate TSH receptors in ant pit (similar molecules) ⟹
      - hyperthyroidism
      - hyperemesis gravidarum
    - Graves disease 1:500 pregnancies:
      - must hydrate, monitor CVS, ECG, electolytes & glucose

Pharmacology

- ↑VD by 5L ⟹ affects water soluble agents
- ↓PPBs ⟹ affects lipid soluble drugs
- Sux dosing unaffected: ↓25% plasma cholinesterase but ↑VD
    ↳ if HELLP syndrome: 60% of these pts have pseudocholinesterase activity below normal

Labour

Informed Consent

- = the process by which a patient gives permission or declines a procedure or service to be performed on themselves after having considered the benefits, side effects, risks and consequences of not carrying out treatment.

Important Elements for Informed Consent

(VIC BRAN)
- voluntary
- informed
- competent (capacity) -> comprehend and remember
- benefits
- risks
- alternatives
- consequences of doing nothing

- capacity to process information:
  - patient must be able to comprehend & remember the information provided
  - often difficult when a woman is distressed and tired from labour contractions,
  - studies have shown that women do not remember conversations in labour
- informed = process of insertion of epidural not interested in a detailed description of process due to pain
- benefits = superior analgesic technique when comparing other modalities in labour
- Risks =
  - side effects (prolongation of labour, increased risk of instrumental delivery, increased use of drugs to augment labour, potential need for catherisation, weakness of legs, pruritis, possible hypotension and nausea/vomiting)
  - complications (post-dural puncture headache, neuraxial infection, nerve damage, failure, total spinal)

- ideal time for consent is well before labour.
- Ideally all women in labour would have been able to read the document on labour analgesia produced by ANZCA.

Analgesia for Labour

Physiology

- uterine pain transmitted via sensory fibers which accompany sympathetic nerves in the dorsal horns (T10-L1)
- vaginal pain transmitted via pudendal nerves (S2-S4)

Options

1. TENS & other psych approaches
2. Entonox
3. Opioids
4. Regional analgesia (epidural, spinal, CSE)

TENS

- only weak evidence for TENS
- massage/warm water baths/prepared childbirth

Opioids

- act as sedatives and amnesics
- pain scores minimally changed
- pethidine most common worldwide but:
  - long fetal half life 18-23hrs - max time to conc is 2-3hrs post IM injection
  - ↓s fetal HR variability in labour
  - changes neonatal neurobehaviour
  - ↓ed breastfeeding success
  - norpethidine: ↓ed seizure threshold, ↑s bp,

- morphine:
  - IM or IV
  - may provide more sedation than analgesia
- fentanyl:
  - lacks active metabolite
  - rapid onset & short duration if used sparingly & intermittently
  - can use as PCA but compared to regional:
    - not as effective
    - dosing unknown
    - parturient & neonate need close monitoring
- remi PCA an option if regional contraindicated
  ↳ see below

Entonox
- more efficacious than pethidine but complete analgesia never achieved
- ~10 breaths or 50s required to achieve max effect
- SEs: drowsiness, disorientation, nausea
- should not use constantly as can ⟹ hypocapnia, alkalosis, vasoC ⟹ ↓UBF & fetal desaturation
- if used with pethidine see ↑ed risk of maternal hypoventilation & hypoxia

Regional Analgesia
- most effective (85% successful)
- adv:
  - pain relief
  - if hypotension avoided -> improved fetal condition in first stage c/o reduced maternal sympathetic tone and hyperventilation
  - improved fetal umbilical pH at delivery
- disadvs:
  - hypotension
  - ↑ed oxytocin usage
  - 40% ↑rate of instrumental delivery
  - ↑ed incidence of maternal pyrexia
  - prolongation of labour: 1st stage 42mins; 2nd stage 14mins

  ↳ lot of confounders & can be mitigated by using ↓ed concentrations of LA
- important negative findings:
  - no ↑ LSCS
  - no ↑in back pain (50% women with no epidural will report back pain at 6/12 (28% for first time))
  - no diff in neonatal pH or APGAR
- low dose LA + opioid -> reduce motor block + greater maternal satisfaction
- PCEA results in
  - greater maternal satisfaction
  - delivers smallest dose possible
  - ↓motor block & ↑ed mobility
- no real difference between CSE and epidural with regard to maternal satisfaction, hypotension, neonatal outcome, mode of birth, mobilization in labour, incidence of PDPH (more pruritis, more paraesthesia)
- should be allowed to mobilise with close support at all times

Indications
- maternal request
- expectation of operative delivery (malpresentation, multiple pregnancy)
- maternal disease where sympathectomy is beneficial
- specific cardiovascular disease (regurgitant murmurs, cerebral AVMs, spinal cord injury)
- severe respiratory disease (CF)
- obstetric disease (PET)
- conditions where GA may be life threatening eg morbid obesity

Absolute contraindications

- maternal refusal after adequate explanation of process, benefits and risks
- true LA allergy
- local infection
- uncorrected hypovolaemia
- coagulopathy (platelets >75-100 and not falling and INR >1.4)
    - ↳ may accept lower platelets in idiopathic thrombocytopaenia
    - ↳ tests should be within 6hrs & include serial measurements esp in PET
- ↑ed ICP (but not including idiopathic intracranial hypertension)

Relative contraindications
- untreated systemic infection - established Abx makes seeding very unlikely
- specific cardiac diseases (stenotic murmurs, Eisenmengers syndrome, peripartum cardiomyopathy)
    - ↳ dont want sudden changes in CVS. Can consider intrathecal opiates with no LA
- previous back surgery -
    - epidural scaring may limit effectiveness
    - spinal should work normally
- expected massive haemorrhage eg placenta praevia, accreta, percreta

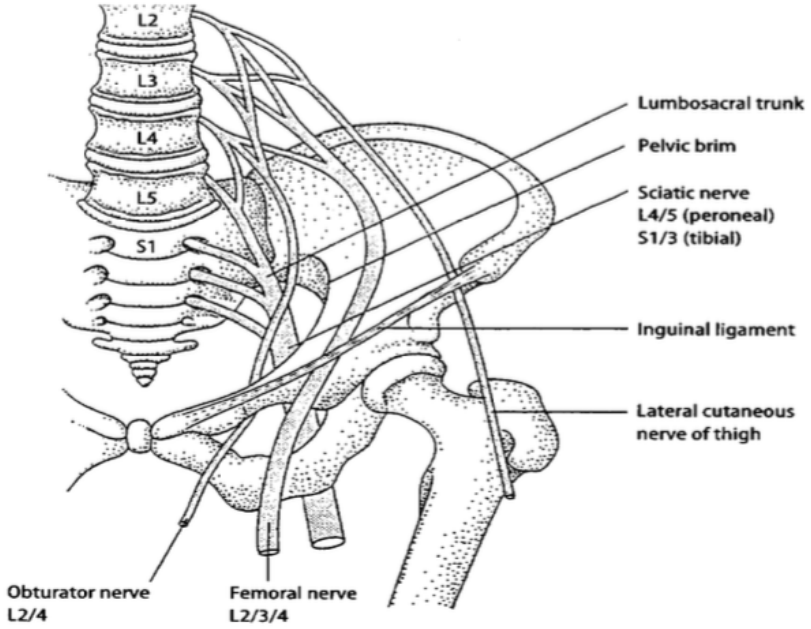
Options for dealing with a poorly functioning epidural
- check full bladder isn't cause
- top up with bad side down
- withdraw catheter
- if OP & severe back pain ⟹ ↑LA & opioid
- use more opioid
- resite epidural

Complications
- hypotension ->
    - acceptable range is SBP >100mmHg or 20% fall
    - left lateral tilt (check NIBP on dependant arm), IVF, vasopressor
- subdural block (slow onset, extensive block, patchy and assymetrical, total spinal) -> resite
- total spinal
    - unexpected 1:1500 to 1:4500
    - S&S: difficulty coughing, arm weakness, difficult talking, respiratory distress, cardiovascular depression, unconsciousness
    - Rx with intubate, cardiovascular support, check for foetal distress, ventilate for 1-2 hours
- Puncture of epidural vessel:
    - identification is key ∴ signs:
        - difficulty inserting catheter
        - passive flow if blood back into epidural catheter (highly sensitive) – if doesn't clear with flushing then withdraw catheter by a few millimetre and flush and observe again (if ongoing blood flowing remove and resite)
        - aspiration of blood when aspirating on filter prior to bolus dose
        - no development of block once catheter has been topped up
        - development of local anaesthetic toxicity symptoms on injection of LA (perioral numbness, dizziness, tinnitus, SOB, feeling twitchy, metallic taste in mouth, seizure, cardiovascular collapse)
        - test dose with adrenaline (5-20mcg) and monitoring to see whether patient gets palpitations or there is an objective increase in heart rate - very poor predictor of catheter place
- IV injection of LA -> divide doses, always aspirate, run through symptoms as injecting, use lignocaine
- fever ?cause
- neurological damage:
    - occurs after childbirth
    - establishing cause & affect is difficult
    - neuro sequelae following delivery under GA is as common as delivery under regional anaesthesia
        - ↳ ∴ suggests obstetric causes are more likely than regional techniques
        - ↳ ~20% of women - only significant 1:500
    - Exam:
        - Sensory +/- motor palsy without pain ≈ obstetric cause
        - Periph symptoms with back pain ≈ central causes incl Anaesthetic causes
        - can see bilateral periph symptoms without central cause (but unusual)

- MRI vs EMG studies to differentiate causes
- If reversible central cause - surgical decompression 6-12hours needed
- include:
  - Peripheral:
    - nerve injury:
      - reversible -
        - most common problem
        - direct trauma from needle or intraneural injection of LA
        - 1:1000
      - prolonged neuro deficit ~1:10,000; major neuro damage in 1:100,000
  - Central:
    - CN palsy - CSF leakage
    - spinal cord compression - abscess/haematoma
    - meningitis - infective
    - cord ischaemia - Ant spinal artery syndrome
    - Cauda equina syndrom - compression/ischaemia
    - arachnoiditis - chemical - rare

Neurological Complications

- Nerve is affected in order of fibre type & size (first to last):
  - Motor = Aα
  - Proprioception = Aß
  - Golgi afferent = Aγ
  - Sensation fast /pain = Aδ
  - Sensation slow-mechanical = C

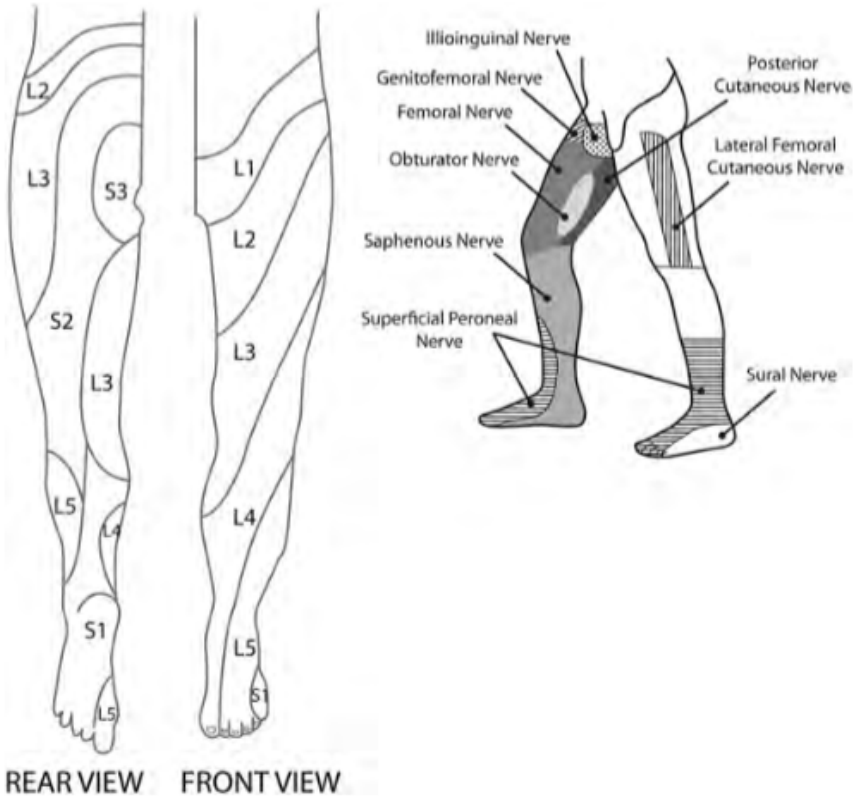


- Periph nerve lesions:
  - Lat cutaneous nerve - (most common)
    - 2nd stage ⟹ ↑IAP ⟹ compression ⟹ numbness lat thigh
    - usually resolve within 3 months
  - Postpartum foot drop:
    - damage to
      - lumbosacral trunk:
        - caused by :
          - compressed by descending baby head against sacrum
          - forceps delivery
        - ↑risk of large baby
        - unilat foot drop with parasthesia alone lat calf & foot
      - pernoeal nerve:

        - poor lithotomy positioning or prolonged
        - loss of sensation to dorsum foot only
    - nerve conduction studies required to localise cause
- femoral neuropathy:
    - L2-L4 fem nerve damage
    - caused by:
        - fetal head in pelvis ⟹
        - forceps delivery
        - retractors during LSCS
    - loss of hip flex & knee extension power - problems climbing stairs
    - sens loss over ant thigh & ant/medial lower leg
    - test: absent/↓ed patellar reflex
- Obturator palsy:
    - L2-L4
    - caused by forceps delivery
    - sens loss = medial thigh & ↓adduction of hip joint
    - commonly co-injured with fem nerve

- Hip Flexion – L2 (femoral)
- Hip Extension – L5 (inferior gluteal)
- Knee Extension – L34 (femoral)
- Knee Flexion – S1 (sciatic)
- Ankle Dorsiflexion – L4 (deep peroneal)
- Ankle Plantarflexion – S1 (tibial)
- Great toe flexor – L5 (deep peroneal)

- Shoulder Abduction – C5 (axillary)
- Shoulder Adduction – C678
- Elbow Flexion – C5 (musculocutaneous)
- Elbow Extension – C7 (radial)
- Wrist Flexion & Extension – C67 (radial)
- Finger Flexion – C8 (median)
- Finger Extension – C7 (radial – posterior interosseous)
- Finger Abduction – T1 (ulnar)
- Abductor pollis brevis – T1 (median)



- Nerve root damage:
    - by direct needle trauma/intraneural injection
    - may or may not see painful paresthesia during technique

    - usually present with skin hypoaesthesia in dermatome +/- occasional mm weakness
    - major symptoms resolve within weeks ⟹ complete recovery months
    - remove epidural catheter if paresthesia persists
        ↳ (periph nerve damage almost certainly caused by obstetric causes - not anaesthesia)
- Disc prolapse:
    - L4/5 or L5/S1
    - backache & pain down lat aspect of thigh
- Spinal cord damage:
    - 2-20% cord ends lower border of L2
    - Tuffiers line unreliable - L3/4 to L4/5
    - chose low space
- CN nerve palsy:
    - CN 6:
        - most common
        - CSF leak post dural puncture
        - see diplopia
        - resolution spontaneous within weeks
    - Cn 7:
        - oedema in facial canal
        - most common 3rd trimester
        - recovery within 6weeks
    - any palsy:
        - epidural blood patch
        - via ↑CSF pressure ⟹ compromise already oedematous nerve
- Epidural haematoma:
    - spontaneous haematoma can occur with no risk factors
    - no regional within 12hrs of clexane or any oral anticoagulation
    - suspect if effect of
        - epidural last >8hr post last dose **AND** backache + local tenderness
        - bilateral motor and sensory abnormality
        - bladder or bowel dysfunction
    - urgent MRI
- epidural abscess:
    - <4/100,000
    - can occur spontaneously
    - ↑risk with ↑duration of epidural in situ
    - present similar to haematoma:
        - backache with local tenderness
        - fever & signs of sepsis
        - 3 days back pain ⟹ nerve root pain ⟹ rapid LL weakness ⟹ paraplegia
- Meningitis:
    - 1.5/10,000 spinals
    - prognosis better than epidural abscess
- Ant spinal artery syndrome:
    - ASA supplies ⅔ spinal cord at all levels
    - supplemented with radicular arteries from aorta
    - syndrome:
        - severe hypotension
        - arteriosclerosis
        - disturbance aortic blood flow
    - rare in obstetrics - severe hypotension & LA with adrenaline suggested cause
- Cauda equina syndrome:
    - pressure, ischaemia or toxic chemicals
    - signs:
        - bladder atony & loss voluntary micturition control (S2-4 lesions)
        - saddle distribution sensory loss
    - caused by
        - compression by too large epidural LA doses
        - spinal microcatheters with toxic 5% lignocaine
- arachnoiditis:

    - days/weeks/months after regional
    - back pain worse on exertion +/- leg symptoms
    - progressive weakness & sensory loss in LLs ⟹ paraplegia
    - inflam process with poor prognosis
    - causes:
        - meningitis
        - spinal trauma
        - injection neurotoxics - must avoid preservatives
        - idiopathic

Practical Aspects

- skin sterilsation with 0.5% chlorhexidine:
    - is neurotoxic ∴ must be dry before performing
- fever & epidural:
    - cause:
        - infective cause eg chorioamniionitis, UTI, LRTI, epi abscess
        - non-infective eg operation, trauma, new drug
    - duration - are Abx established and systemic ie absorbed
    - well being of fetus
    - local infection
    - evidence of severe sepsis - then CI'ed

  ↳ ∴ if no CI to RA AND on IV Abx, normal vitals, constitutionally well ⟹ ok for epidural

  ↳ alt remi PCA
- LOR to saline vs air:
    - ↓ed incidence of dural puncture
    - ↓ed incidence of missed segments
- epidural blood vessel catheterisation (occurs in 5%)
    - ↓ed by injecting 10mls of saline prior to passing catheter
    - remove catheter to 3cm and retry
- place 4-5cm of catheter into space. anymore = ↑chance of unilateral block
- walking epidurals:
    - possible with low concentration, low dose epidurals or spinals
    - disadv:
        - leg strength & proprioception compromised with ↑ed risk of fall
        - assessing fetal condition difficult when walking

Remifentanyl PCA

- opioid analgesic (Mu receptor agonist)
- unique ester linkage
- organ independent metabolism (non-specific esterases)
- rapid onset (peak effect @ 1min)
- rapid offset (CSHT 3min independent of duration)
- attenuation of hypertensive response to intubation

Comparisons

- more effective than IM pethidine
- as effective than fentanyl PCA but less fetal resuscitation required (but ↑ed maternal resp depression)

Indications

- epidural contra-indicated
- failed epidural
- unilateral block
- maternal, obstetric or anaesthetic choice

Dose

- bolus: 1mcg/kg
- infusion: 0.1-1mcg/kg/min

PCA in Labour (CCDHB) Dosing
- 0.25mcg/kg bolus LBW (pre-pregnancy)
- 0.025mcg/kg/min infusion (can increase after 30min, max = 0.1mcg/kg/min)
- 2 minute lock-out
- continuous SpO2 monitoring & O2 if SpO2 <94%

Pharmacodynamics
- decreased BP, HR, RR and LOC
- towards 2nd stage remi not good enough analgesic
- decreases requirement for epidurals
- less instrumental deliveries and C/S -> more likely to have NVD
- similar APGAR and requirement for neonatal resuscitation
- no increase in non-reassuring CTG traces

Complications
- respiratory depression (40%) -> O2
- bradycardia (4%) -> ephedrine, atropine, glycopyrulate
- hypotension (4%) -> IVF, ephedrine
- skeletal muscle rigidity (3%) -> reduce dose, benzodiazepine
- nausea +/- vomiting (44%)
- pruritis (20%) -> anti-histamine, naloxone
- headache (20%) -> simple analgesia, decrease rate, breath!

- requires monitoring (SpO2, NIBP, RR, SS and one to one care with midwife in room), O2, paediatric notification

Pharmacokinetics
- AV ratio in baby = 30% -> thus fetal metabolism takes place

Pharmaceutics
- set up
- potential for drug errors

Dural Punture Headache
- techniques to ↓chance of PDPH:
  - LOR to saline = less dural punctures than LOR to air
  - consistent needle size
  - smaller needle - size 18
- pathophys:
  - CSF loss > CSF creation ⟹ ↓CSF pressure ⟹ brain sinks ⟹ stretching of meninges ⟹ headache
  - assoc compensatory vasoD of intracranial vessels ⟹ further worsening
- incidence should be <1%
- 52% will go on to have headache
- Complications:
  - functionally impairing headaches
  - CN palsy
  - ICH/subdural
  - seizures
  - brainstem herniation
- headache characteristics:
  - positional nature - worse in upright position (CSF pressure lying =10cmH20; sitting=40cmH2O)
  - onset 24-48hrs
  - headache relieved by tight abdominal compression
  - assoc symptoms: nausea, photophobia, diff accomodation, hearing loss, tinnitus, VI palsy with diplopia
  - untreated headache last 7-10days

- 16G tuohy needle = 90% PDPH
- recognition:
  - only 40% are recognised by CSF flowing through needle during insertion
  - >30% of dural punctures were not recognised at insertion

Immediate Management

- achieve effective analgesia without causing further complications:
- 2 options:
  - pass epidural catheter into subarach space
    - label as such and only doctors top up
    - intermittent top ups 1-2ml 0.125% bupiv
    - leave in 24hrs
    - if then LSCS careful incremental top upIadv:
      - excellent analgesia
      - no possibility of 2nd dural puncture
      - eliminate unpredictable spread of epidural solution with tear in situ
      - need for blood patch may be ↓ed
    - disadv:
      - theoretical risk of infection
      - mistake catheter for epidural
  - place epidural at 1 interspace higher:
    - run epidural as normal but beware of intrathecal spread of LA
    - special care during epi top ups for LSCS
- daily post natal follow ups

Late Management

- prophylatic Rx -
  - patching not routinely commonly done:
    - high incidence of bacteraemia post delivery
    - poor efficacy of blood patching early
    - risk of blood patching when dont know PDPH will develop
  - mobilising -
    - no difference to those which then develop headache.
    - ↑VTE risk with immobilisation
- symptomatic Rx:
  - simple analgesia - unlikely to completely relieve headache
  - laxatives
  - hydration - no evidence
  - 5HT-agonists - RCTs show no benefit
  - caffeine/theophylline -
    - theory to ↓cerebral vasoD ⟹ ↓ headache
    - IV aminophylline has been shown to ↓incidence of headache
    - BUT may see ↑seizures
  - epidural infusion of saline:
    - does ↓symptoms but at 24hrs no change to incidence of headache AND radicular pain in LLs
  - small inconclusive studies: ACTH analogues & gabapentin may help
  - Sphenopalantine blocks - emerging technique
  - blood patch:

Autologous Blood Patch

- definitive Rx
- performed around 48hrs
  ↳ 24-48hrs has lower success rate, and <24 even lower success rate
- success rates:
  - 1st attempt - 60-90%
  - 2nd patch success >90%
  - if no success after 2nd patch should consider further imaging prior to further patches
- proposed mechanism:
  - blood in epidural space ⟹ physical compression of dural sac ⟹ ↑ICP ⟹ instant improvement in pain
  - blood forms clot over site of dural tear sealing leak
- patch should be performed at level or 1 lower - blood spreads cepehelad

- practical:
  - apryrexial with normal WCC (prevent bacterial seeding)
  - period of bed rest prior to ensure ↓ed CSF volume in epidural space
  - strict asepsis
  - perform in lateral to minimise CSF pressure in dural sac
  - obtain 20mls blood ⟹ inject slowly into back until max given or pain in back/legs
  - if pain, pause, then if pain resolves continue at a slower rate. if recurrence abandon
  - bed rest for 2hrs
  - avoid straining for 48hrs
- complications:
  - backache -
    - 35% will have discomfort 48hr post patch
    - 16% prolonged backache - mean duration 1 month
  - fever
  - dural puncture
  - neuro deficits
  - seizures
  - CN damage
  - arachnoiditis

PostPartum Headache

- = complaint of headache & neck/shld pain first 6/52 post delivery
- 39% experience it in 1st week

Table 1 Differential diagnosis and incidence of postpartum headaches

Headache aetiology
Non-specific/tension headache
Migraine
Pre-eclampsia/eclampsia
Post-dural puncture headache
Cortical vein thrombosis
Subarachnoid haemorrhage
Posterior reversible leucoencephalopathy syndrome
Space-occupying lesion—brain tumour, subdural haematoma
Cerebral infarction/ischaemia
Sinusitis
Meningitis

- Tension headache:
  - = band like headache lasts 30min-7days
  - not changed by physical activity
  - self remitting
  - assoc neck & shld pain
- Migraine:
  - = recurring unilateral headache lasts 4-72hrs
  - pulsating with assoc nausea & photophobia
  - +/- focal neuro signs:
    - preceding aura
    - visual disturbances - flashing/flickering/temp blindness
    - periph paresthesia
    - dysarthria
  - PMH of migraines may notice ↓occurrence in pregnancy ⟹ return of frequency post partum (34% in 1st week)
- HTN/PET:
  - see other section
  - headache = bilateral, pulsating, worse on exercise
  - assoc: visual disturbance, N&V, seizures ⟹ coma
  - eclampsia first manifests postpartum 11-44% affected women
- cortical vein thrombosis:

    - non specific headache
    - assoc focal neuro & seizures
    - may have a postural component - diff to distinguish from PDPH
    - MRI only way to diagnose
- SAH:
    - acute onset severe unilateral headache
    - assoc nausea, neck stiffness, ↓consciousness
- posterior reversible leucoenecephalopathy syndrome:
    - = severe diffuse headache of gradual or sudden onset
    - assoc focal neuro deficit eg loss of vision/seizures/LOC
    - assoc with PET
    - pathophys = loss of cerebrovascular autoregulation ⟹ compromise bbb ⟹ oedema
    - Rx:
        - aggressive control of HTN
        - seizure prophylaxis
- SOL
- stroke
- sinusitis:
    - frontal headache over sinuses
    - worse in morning & on leaning forward/palpation
- meningitis:
    - neck stiffness, photophobia, fever
    - Kernig & Brudzinski signs +ve +/- petechial rash

CTG Interpretation

DR C BRAVADO

- **D**efine **R**isk – low or high
- **C**ontractions
- **B**ase Line **RA**te - normal 110-160
- **V**ariability
    - (normal 10-25 beats/min; <5 = bad, 5-10 = reduced
    - opposing sympathetic and parasympathetic effect on sinoatrial pacemaker -> loss can be a sign of foetal stress
- **A**ccelerations - >15bpm at least 15sec
- **D**ecelerations – always pathological if not in labour
    - Early =
        - compression of head ⟹ vagal sim
        - must start prior to endow contraction
    - Variable =
        - compression of cord
        - depends on stage of labour
        - Ok if 2nd stage + progressing
    - Severe/atypical variable decelerations = compression of cord + an element of foetal hypoxia,
    - Late =
        - foetal hypoxia
        - peak after peak of contractions
    - Prolonged = very bad
- **O**verall impression

Very Concerning CTG Patterns

- late decelerations - cancern if other non-reassuring trace eg foetal tachy, ↓variability
- prolonged bradycardia with no recovery
- late decelerations with loss of variability
- sinusoidal pattern
- unprovoked loss of variability

Other Monitors

- Scalp pH
- Foetal ECG
- Foetal heart pattern analysis
- Vibroacoustic stimulation
- Foetal oximetry
- Doppler U/S of umbilical flow during contractions

Intrauterine Resuscitation

- oxytocin off
- left lateral position (if doesn't work -> right lateral with elbow-knee position ?cord prolapse)
- FiO2 1.0
- rapid IV fluid
- low BP -> vasopressor
- tocolysis (terbutaline 250mcg SC or GTN 0.8mg SL Q 5min (maximum 3 doses))
- amnioinfusion (1L of N/S)
- cord prolapse -> knee-elbow position, displacement of presenting part OR put 500mL into bladder, keep cord wet and warm

Feeding in Labour

Goals

1. decreased aspiration risk
2. avoidance of ketosis and hypoglycaemia
3. maintenance of hydration
4. safety of mother and baby

Risk factors

- eating solids
- obesity
- opioids
- prolonged fasting may increase risk!

Management

- only 'low risk' woman should eat
- stop all oral intake if any of:
    - opioid,
    - epidural
    - oxytocic administered
- 'low residue foods' -> cereal, toast, low fat cheese, semi-sweet biscuits
- ice chips, H2O and clear fluids
- isotonic energy drinks good too
- RSI

By Surgery

Awareness & Risks

- Awareness:
  - GA Caesar = 1:670
  - Gen Population with NMB = 1:8,000
  - GA with no NMB = 1:136,000
- Failed intubation risk = x10 in obs:
  - Failed intubation 1:250
  - General population 1:2,500

Caesarean Section

Table 33.4 Categories of urgency of Caesarean section

Category 1	Maternal or fetal compromise with immediate threat to the life of mother or fetus
Category 2	Maternal or fetal compromise that is not immediately life-threatening
Category 3	No maternal or fetal compromise, but requires early delivery
Category 4	No maternal or fetal compromise. Delivery timed to suit mother and maternity services

Category 1

- Cat 1 = must be done asap, at least quicker than 30mins
- intra-uterine resuscitation should be commenced immediately (position IVF, stop oxytocin, tocolytics)
- GA vs RA decision based on time:
  - if well established epidural top up: ETU may be just as quick as GA
  - rapid sequence spinal:
    - sterile gloves only
    - other staff do IV cannulation
    - 1 attempt at spinal only
    - pre-oxygenation while attempting spinal

    ↳ concern around asepsis

Preoperative Management

- important that obstetric team communications degree of urgency (immediate, urgent, early, elective)
- immediate = GA
- urgent = RA.
- Anaesthestist's responsibility to chose method of anaesthesia appropriate for mother
- standard clinical assessment
- G+H
- U/S report for position of placenta - low lying, ant placenta ⟹ ↑risk of haemorrhage
- explanation of technique and risks
- Antacids:
  - types:
    - gastric fluid ⟹ chemical pneumonitis
    - particulates, blood or bile = worse outcome
  - Na+ citrate 30ml 0.3M:
    - pH >2.5 only maintained for ~30mins post dose
  - [metoclopramide 10mg IV (prokinetic) 2 hr before surgery]
  - ranitidine 50mg IV (H2 antagonist) or 150mg 12 and 2 hours prior

Intraoperative Management

- left lateral tilt

REGIONAL ANAESTHESIA (spinal, CSE and epidural)

- IVF preloading not required
- aim for T4-S4 block
- if epi: check sacral dermatomes in case of poor caudad spread
- opioid improves quality of analgesia & may accept slightly lower block eg T6

Advantages
- ??>16 x safer than GA - may be more marginal given good GA care
- lower risk of anaphylaxis
- lower risk of aspiration
- improved safety for mother
- neonate more alert
- earlier bonding
- earlier breastfeeding
- less maternal 'hangover' effect
- better post operative analgesia
- earlier mobilisation
- both mother and partner can be present @ birth
- if CSE or epidural used can slowly top up block and provides options if block inadequate intraoperatively
- spinal gives a denser, quicker block

Disadvantages
- risk of neuraxial blockade
- degree of BP drop -> may decrease neonatal pH (significance still questionable)
- inadequate block -> communicate with patient and surgeon -> N2O, IV opioids, top up epidural, resite spinal, surgical administration of LA or GA

Nausea

- causes differential:
  - ↓bp
  - vagal stim
  - opioid induced nausea
  - pain
  - iatrogenic eg tramadol
  - Amniotic fluid embolism
- Rx:
  - check surgeons activity - ask to stop
  - Ax blood pressure & Rx
  - Ax block height
  - if nil found ⟹ antiemetic
  - if pain ⟹ epi top up, 70% N2O, GA
  - ready for vomit with bowl and suction

Type of Regional Comparisons

Table 33.5 Epidural anaesthesia for Caesarean section

Advantages	Disadvantages
A functioning labour epidural is easy to top up	Slow onset
Stable BP	Large doses of LA
Intraoperative top-up possible	Poorer quality of block than spinal anaesthesia
Epidural can be used for post-operative analgesia	

Table 33.6 Spinal anaesthesia for Caesarean section

Advantages	Disadvantages
Quick onset	Single shot
Good-quality analgesia	Limited duration
Easy to perform	Inadequate analgesia is difficult to correct
	Rapid changes in BP and cardiac output

Table 33.7 Combined spinal/epidural anaesthesia for Caesarean section

Advantages	Disadvantages
Quick onset	Rapid change in BP and cardiac output
Good-quality analgesia	Technically more difficult, with higher failure rate of spinal injection
Intraoperative top-up possible	Untested epidural catheter
Epidural can be used for post-operative analgesia	

GENERAL ANAESTHESIA

- failed intubation x10 more common (1:250 compare to 1:2500):
  - obesity
  - pharnygeal/laryngeal oedema
  - large tongue & breasts
  - poor positioning in emergency
- failed intubation but success with LMA:
  - use DAS chart to consider waking patient
  - most experienced surgeon to perform LSCS
  - must minimise fundal pressure - use forceps
- preO2 - 3-5min or 4-8 VC breaths. Use nasal cannula
- RSI (5-7mg/kg thio or propofol 2-3mg/kg, sux 1-2mg/kg, size # 7.0 ETT)
- alfentanil or Remi if HTN of pregnancy
- ventilate to PaCO2 of 30mmHg
- Use co-anaesthetic technique to minimise uterine atony:
  - N2O:O2 (50:40) - if severe fetal distress use min 70% O2
  - 0.75 MAC sevo or des. overpressure inhalational agents so get MAC up quickly to
- syntocinon 5IU -> infusion
- morphine 10-20mg post delivery
- NSAIDS and paracetamol
- LA infiltration or ilioingunial blocks or TAP blocks
- extubate awake - high sitting is fine
- effect on fetus:
  - 1min & 5min APGAR are lower post GA
  - thio & fentanyl penetrates to fetus (naloxone 10mcg/kg IV or 200mcg IM)

Post operative Management

- paracetamol
- NSAIDS - avoid in PET
- opioids

→ Fentanyl – IV or intrathecal, gone by end of case
→ Morphine – 100mcg intrathecal 12-18 hours of analgesia, 3mg epidurally 6-24 hours
- tramadol

Complications
- failed intubation (as above)
- aspiration - 1:400-600
- ↑ed risk of awareness
- ↑ed blood loss - 100-200mls more than with regional LSCS
- (↓ed shivering)

Drug Errors
- high risk group
- NAP3 (complications of neuraxial blocks):
  - limited major morbidity in obstetrics
  - multiple drug errors surrounding neuraxial procedures

Breast Feeding & Analgesics
- method of T/f = secreted in milk, absorbed in neonatal GI tract, avoid 1st pass metabolism
- neonatal serum conc of drug <2% of maternal serum concentration
- risk drugs =
  - low maternal protein binding
  - lipophilic drugs or MW <200Da
  - weak bases ⟹ ↑proportion of ionised drug in weakly acidic breast milk ⟹ trapping
- timing:
  - breastfeed just prior to maternal drug dosing
  - breastfeed just before neonates sleep period

Table 33.8 Some important drugs and breastfeeding

Drug	Comment
Opioids	Minimal amount delivered to neonatal serum. Minor concern about the long duration of action of pethidine metabolite—norpethidine. Care with codeine and other oral opioids if mother or neonate excessively drowsy
NSAIDs	Most NSAIDs are considered safe in breastfeeding. Some would advise caution with aspirin because of unsubstantiated concerns about causing Reye's syndrome in the neonate
Antibiotics	Penicillins and cephalosporins are safe, although trace amounts may be passed to the neonate
	Tetracycline should be avoided (although absorption is probably minimal because of chelation with Ca^{2+} in milk)
	Chloramphenicol may cause bone marrow suppression in the neonate and should be avoided
	Ciprofloxacin is present in high concentrations in breast milk and should be avoided
Antipsychotics	Generally suggested that these should be avoided, although the amount excreted in milk is probably too small to be harmful. Chlorpromazine and clozapine cause neonate drowsiness
Cardiac drugs	Amiodarone is present in milk in significant amounts, and breastfeeding should be discontinued
	Most β-blockers are secreted in minimal amounts. Sotalol is present in larger amounts. Avoid celiprolol
	While enalapril and captopril have no known adverse effects, other ACE inhibitors, ARBs, and amlodipine should be avoided
Anticonvulsants	While carbamazepine does not accumulate in the neonate, phenobarbital and diazepam may. Neonates should be observed for evidence of sedation

- dont discharge mother with opioids

Fetal Death In Utero
- deaths assoc with:
  - concealed abruption
  - sepsis
  - DIC

Surgery On The Parturient

Preoperative Management

- most common ops = appendicitis, cholecystitis, trauma, maternal malignancies
- increased risk of fetal loss and preterm labour (up to 8% risk)
    ↳ may reflect underlying surgical problem not anaesthetic
- teratogenic risk low
- if possible delay surgery to ≥second trimester (decreased teratogenic risk)
- inform obstetric team
- aspiration prophylaxis (ranitidine safe) - from 14-18 weeks
- DVT prophylaxis
- consider regional (although evidence that this is better is lacking)
- benzodiazepines safe
- CTG OK to use if after 24 weeks ie viable fetus
- U/S to assess fetal well being (liquor, size, cord dopplers)
- laproscopic surgery is more safe than open abdo surgery!
- Elective surgery:
    - During pregnancy - avoid
    - Post-partum - delay until at least 6weeks

Intraoperative Management

Goals

1. decrease risk of preterm labour
2. optimise uterine blood flow
3. ensure maternal normoxyaemia (hyperoxaemia is not harmful to fetus)
4. ensure maternal slightly low CO2 (~30mmHg)
    - ↑CO2 ⟹ fetal resp acidosis, uterine vasoC & ↓UBF
    - ↓CO2 under 30 ⟹ uterine vasoC & L shift OHDC ⟹ ↓release of O2 to fetus

- assess need for RSI -
    - ≥18weeks ↑ed risk pregnancy induced aspiration
    - <18hours post partum
- pre-oxygenate for ~3minutes
- aggressive haemodynamic management
- after 20 weeks use left lateral tilt - normal maternal bp does not = normal uterine blood flow
- could consider tocolytic prophylaxis in 3rd trimester: volatiles, MgSo4, terbutaline, nifedipine, GTN
- if >24weeks fetal heart rate should be monitored intra-op

Postoperative Management

- biggest risk to fetus is preterm labour post op ∴ monitor closely & institute tocolysis if required
- analgesia
- if epidural used -> should have CTG to monitor uterine activity

Drugs & Teratogenicity

- premed - ranitidine & benzo's fine short term
- induction:
    - propofol (?safe in early pregnancy) and thiopentone safe (avoid etomidate)
    - ketamine - avoid 1st & 2nd trimester - ↑s intrauterine pressure (not apparent in 3rd trimester)
- maintenance:
    - sustained diazepam linked with cleft palates - single midaz fine
    - inhalational agents are good as they are tocolytics
    - avoid N2O (def in 1st trimester)- although well studied & fine in short term human studies
    - muscle relaxants safe - dont cross placenta
    - anti-cholinesterases safe
    - LAs:

    - cocaine - avoid as ↑fetal demise & GI abnormalities
    - bupiv fine
    - lignocaine - may have mild neurobehavioural effects
  - Reversal: use atropine with neo (not glyco) - neostigmine can cross bbb ⟹ fetal ↓HR (glyco does not cross bbb, whereas atropine does)
- post op:
  - opioids - cross placenta but short periods fine. Avoid chronic use
  - NSAIDs -
    - avoid in 1st - impaired organogenesis
    - avoid in 3rd - may close ductus
    - fine in 2nd - used to prevent preterm labour
- drugs to avoid:
  - antibiotics (tetracyclines, quinolones, aminoglycosides),
  - warfarin,
  - thalidomide
- cardiac drugs:
  - ACEI - avoid
  - amiodarone - foetal hypothyroidism
  - ßblockers - may cause IUGR, neonatal hypoglycaemia & bradycardia
  - sildenafil - likely ok in humans
  - diuretics - thiazides in 3rd trimester ⟹ neonatal thrombocytopaenia
  - digoxin - may need dose adjustment
  - hydralazine - avoid in 1st & 2nd trimester
  - Heparin - fine
  - CCBs:
    - nifedpine - known tocolytic ∴ may inhibit labour
    - diltiazem - avoid
    - verapamil may ↓UBF

Cervical Cerclage

= insertion of a cervical suture to prevent miscarriage
- normally in 2nd trimester

Preoperative Management

- normally performed between 14th and 26th week
- emergency cerclage may be required if cervix dialating and membranes bulging
- risks = membrane rupture, infection, haemorrhage, preterm labour
- aspiration cares
- can be transvaginal or transabdominal approach

Intraoperative Management

- spinal or GA (RSI)
- lithotomy
- RA -> get block above T10
- relax uterus with 50mcg boluses of GTN
  ↳ allows bulging membranes to be reduced

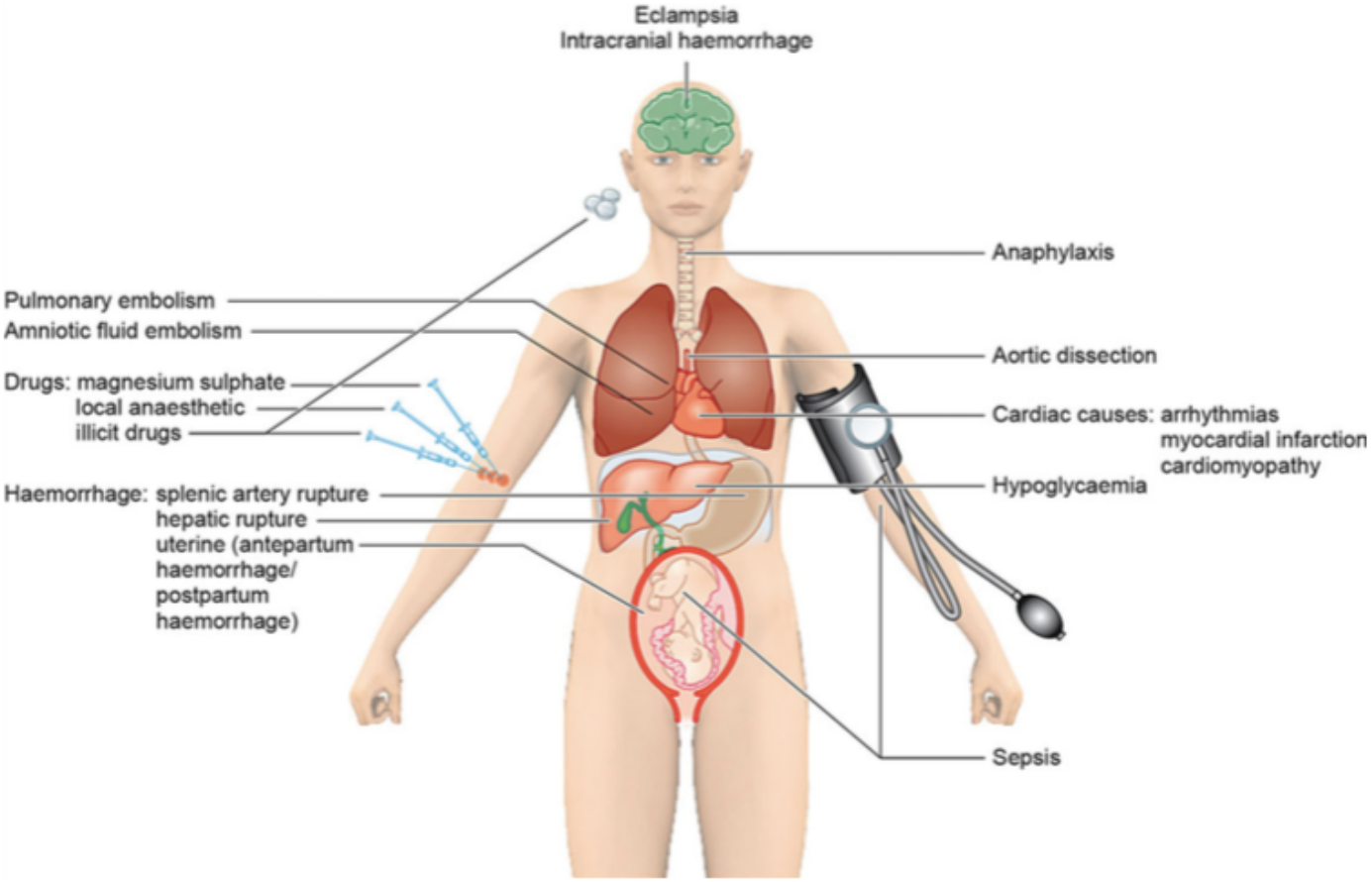
Postoperative Management

- observe for preterm labour
- usually removed @ 38 weeks
- can be removed without anaesthesia

Medical Problems

Maternal Resuscitation

- >20weeks - MUD vital
- fetal delivery >4mins
- secure airway asap - risk of aspiration
- consider causes of maternal collapse:
  - **Hypoxia**: aspiration, high spinal
  - **Hypovolaemia/hypotension**: bleeding, high spinal
  - **Metabolic disorders**: AKI from severe pre-eclampsia, ↓BSL
  - **Hypertension**: intracranial haemorrhage, eclamptic seizure
  - **Toxicity**: Anaphylaxis, ↑Mg^{2+}, LA toxicity, eclampsia/seizures
  - **Thromboembolism**: VTE, amniotic fluid or air embolism
  - **Tamponade**: cardiac 2nd to aortic dissection, trauma
  - **Tension PTX**: trauma



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High Spinal

= block extended above thoracic dermatomes
- no deaths reported but adverse outcomes for fetus have been
- supportive care
- intubate ensuring amnesics & analgesia if signs of resp distress

Table I Clinical features of a high spinal

Cardiac	Respiratory	Neurological	Other
Hypotension	Low oxygen saturations	High sensory block	Nausea and vomiting
Bradycardia	Apnoea	Paralysis or weakness of upper limbs	
Cardiac arrest	Difficulty coughing or speaking	Loss of consciousness	
		Cranial nerve block	

Obstetric Emergencies

Prolapsed Cord

- cord detected in vagina
- need urgent delivery but immediate if cord compressed

Fetal Distress

- indications for immediate delivery:
  - FHR <70
  - fetal scalp pH <7
- while awaiting delivery should perform intra-uterine resus:
  - apply O2
  - stop oxytocic drugs - consider tocolytic
  - MUD
  - IVF +/- vasopressors

Massive Obstetric Haemorrhage

- no definition but consider definitely >1500mls
- gravid uterus receives 10-20% of Q -> bleeding can be rapid!
- principle causes; abruption, praevia, PPH
- baby more @ risk than mum

Antenatal

- ABRUPTION = ⅓:
  - bleeding with pain.
  - bleeding may be concealed
  - >small bleeds have high fetal mortality
- PRAEVIA = ⅓:
  - small bleeds and painless

    - may be catastrophic
- Other = ⅓: including
    - UTERINE RUPTURE –
        - painful or painless usually assoc with prev CS scar,
        - universal fetal distress

Postnatal

- normal blood loss =
    - VD = <400mL
    - LSCS = <1000ml
- **Tone**:
    - UTERINE ATONY – associated with chorioamnionitis, prolonged labour, polyhydraminios, macrosomia, multiple gestations
    - uterine inversion - rare & assoc with atony. need further relxation to enable reduction then uterotonics
- **Tissue**:
    - RETAINED PLACENTA or PRODUCTS
- **Trauma**:
    - GENITAL TRACT TRAUMA – vaginal/vault haematoma, retroperitoneal bleeding
- **Thrombin**:
    - lack of clotting factors & massive bleeding itself ⟹ further bleeding
- **Other:** hepatic rupture & splenic artery rupture (v rare)

- NB disease of placental invasion:
    - accreta – invasion into first 1/3 of myometrium
    - increta – invasion further into myometrium
    - percreta – invasion through myometrium into surrounding structures (bladder and bowel)

Summary of Causes

TONE – rub down
TRAUMA – uterus, vaginal or cervical laceration
TISSUE – retained placenta, accreta
THROMBIN – coagulopathy from multiple causes (AFE, retained products, intrauterine death, sepsis, PET, abruption)

PreAssessment

History

- pain
- bleeding
- labour
- delivery; instrumental or not, explosive

Examination

- haemodynamics
- perfusion (be aware of the women with cold peripheries)
- abdominal examination

Investigations

- U/S
- Hb
- cross-match

Management

- MDT management (important issues = massive blood loss management, surgical technique, possible remote anaesthesia - radiology, anaesthetic technique)
- call for help
- O2
- left lateral tilt (if antepartum)
- large bore IV access x 2
- fluids -> O negative if required
- invasive monitoring
- catheter
- induce: ketamine 2mg/kg, thiopentone 4mg/kg
- paralysis: suxamethonium 2mg/kg
- CTG
- GA
- agggressive warming (patient and fluids)
- level one
- cell salvage to complement level one
    - ↳ best practise to use separate suction to ↓amniotic fluid uptake into cell salvage
- correct coagulopathy with products/drugs
    - (transexamic acid, RBC's, FFP, Cryo, Platelets, rFVIIa)
    - 10mls Ca chloride/4 units of rbc
    - fibrinogen <2 after 1 litre blood loss is assoc with major haemorrhage
        - ↳ ∴ give cryo over & above MTP protocols at least to keep fibrinogen >1.5 or better >2
- 6U of blood (on floor)
- FBC + Coag's

- Blood loss control:
    - rub down or bimanual compression
    - B lynch suture
    - manual Aortal compression
    - intrauterine balloons - generally leave for 24hrs
    - surgical ligation of blood vessels
    - packing of uterine vault
    - interventional radiology - can place balloon catheters in int iliacs prior to delivery - only inflated post delivery
    - sub total hysterectomy - dont delay until pt is in extremis
- drugs - uterotonics:
    - synto bolus -> infusion
    - ergometrine 0.5mg IM (not in HTN or PET - duration of action = 3hrs post IM)
    - carboprost (prostaglandin F2 alpha) 0.25mg intra-myometrially Q15min to max of 2mg (not in asthma)
    - misoprostol (PGE1α) up to 1g PO or intravaginal

Placenta Praevia & Accreta

Praevia

- = placental implant between fetus & os
- 1:200 but higher if prev scars/multips
- 3 steps to management:
    - placenta within 2cm of os ⟹ Vaginal delivery unlikely possible
    - lower anterior segment uterus ⟹ ↑ed blood loss as need to divide placenta to deliver fetus
    - risk of accreta - ↑ed if prev LSCS scar as placenta likely to invade through scar
- US diagnosis
- Usual Rx is to delivery around 37th week

Accreta, Increta, Percreta

- definitions:
    - Accreta = growth through endometrium to the 1st third myometrium
    - Increta = growth into myometrium
    - Percreta = through myometrium into uterine serosa & into surrounding structures

- absence of normal cleavage plane ⟹ life threatening haemorrhage
- risk factors for accreta:
  - prev uterine scars
  - uterine fibroids
  - prev uterine compression sutures
- often missed antenatal diagnosis & first recognised at surgery

Management

- ↑risk of bleeding:
  - failure of separation
  - blocking of contraction
- Regionals fine for praevia as long as pt normovolaemic

Embolism in Parturients

- 25% maternal deaths caused by emboli

Thromboemoli

- pregancy = hypercoaguable state
- other RFs = immobility, smoking, surgery, hypovolaemia, hypotension, hypothermia, malignancy, inherited disorders
- x10 ↑VTE risk during pregnancy
- x25 ↑VTE risk post partum

Air

- possible during removal of retained placenta
- signs: SOB with CP, haemopytis

Amniotic Fluid Embolism

- = 4th commonest cause of direct maternal death 1:12:000
- 70% within labour, 11% post partum
- 50% mortality; only 15% survive without neuro impairment
- thought entry via small tears in lower uterine segment & endocervix
- likely due to anaphylactic response to fetal tissue
- sequelae:
  - phase 1: within 30mins: intense ↑pulmon vasoC ⟹ R heart failure, ↓O2, ↑CO2, ↓pH
  - phase 2: L heart failure ⟹ pulmon oedema
  - coagulopathy
  - 50% mortality in 1st hour
- RFs:
  - >35yr multip
  - obstructed labour esp with uterine stimulants
  - multiple pregnancy
  - short labours
- signs (often a diagnosis of exclusion):
  - sudden pHTN ⟹ heart failure ⟹ sudden collapse with ↓bp & fetal distress
  - APO (>90% of cases) & cyanosis (80%)
  - hypoxaemia
  - coagulopathy (80%)
  - seizures (50%)
  - cardiac arrest (>90%)

Diagnosis

- still no diagnostic marker for AFE - diagnosis of exclusion

Management

- purely supportive:
  - senior staff
  - early delivery of fetus vital for both parties survival
  - oxygenation - may require NIV (CPAP/PEEP)/intubation
  - aggressively support
    - coagulopathy - high risk of DIC. Involve haematologist

    - R heart strain,
    - uterine tone - use routine meds
  - deliver baby as quickly as possible
  - possible but not evidence evidence based:
    - steroids
    - plasma exchange/haemofiltration
    - bypass

Hypertension in Pregnancy

Definitions

- **Hypertension** = sustained SBP >140 or DBP >90
- **Chronic HTN** = HTN which existed before the 20/40
- **Gestational Hypertension** – occurs during pregnancy but not associated with other signs of PET
- **Pre-existing Hypertension** – HTN that existed before pregnancy

Pre-Eclampsia

- **Pre-eclampsia** – hypertension occurring after 20 weeks gestation and resolving within 3 months of delivery with the following specific features:
  - SBP > 140mmHg or DBP > 90mmHg **with** proteinuria (>300mg/24hrs) or ≥2 on dipstick (2 samples 4hrs apart)

  ↳ incidence = 6-8%
- **severe pre-eclampsia** if (0.25-5%):
  - SBP >160 or DBP >100 or severe organ dysfunction **AND** any of ….
    - renal impairment – proteinuria>5g/24hr, high Cr, ↓UO <400ml/24hr
    - Resp: compromise or pulmon oedema
    - liver disease – epigastric pain, liver tenderness, elevated transaminases
    - neurological problems – seizures, visual disturbance, papilloedema, clonus
    - haematological disturbance – thrombocytopaenia (<100), haemolysis, DIC
    - fetal growth restriction – non reassuring CTG, reverse flow on Doppler, IUGR
- **eclampsia:** convulsions in pregnancy or puerperium in absence of other causes

  ↳ there may be no signs of pre-eclampsia until 1st seziure

- = multisystem disorder of pregnancy characterised by hypertension and organ system derangement
- aetiology is incompletely understood: immunological, genetic, endothelial, abnormal placental implantation, fatty acid metabolism, coagulation & platelet factors
- more severe disease manifests earlier in pregnancy

Diagnosis

- as above criteria:
  - HTN
  - proteinuria
  - plasma uric acid -
    - helpful if pre-exisiting HTN
    - >360mmol/l (6 mg/dl) assoc with pre-eclampsia

Pathophysiology

- CVS:
  - ↑sensitivity to endogenous & exogenous catecholamines/vasopressors
  - ↓circulating volume but ↑TBW
  - ↑cap permability ⟹ pulmon oedema & laryngal oedema
- hem:
  - platelet consumption & hypercoagulable & ↑fibrin turnover ⟹ DIC
  - ↑HCT 2nd to fluid leak
- renal:
  - ↓GFR but ↑permeability to large molecules ⟹ proteinuria
  - ↑uric acid levels 2nd to ↓urate clearance

- oliguria in severe disease
- cerebral function:
  - headache, visual disturbance & generalised hyperreflexic
  - stroke
  - eclampsia - from cerebral oedema & vasoC
- fetus:
  - IUGR & oligohydraminos
  - ↓placental function with ↑ed sensitivity to maternal bp changes

Management

- 1st prevention - no effective prophylactic measure
- 2nd prevention - detect disease early & monitor. Nothing to stop progress
- 3rd prevention = symptom control until placenta delivery (symptom improvement 24-48hr post delivery)

Aims

1. management of HT
   - Consider Arterial line
   - keep SBP <160/110 (>180 = medical emergency):
     - labetalol oral
     - methyldopa PO 0.5-3g/day
     - nifedipine PO 10-20mg
     - beta-blockers (metoprolol, propanolol, esmolol)

     ↳ must avoid ACEIs
   - rapid bp control: (decrease by 10-20mmHg every 20min)
     - IV labetalol IV 5-10mg injected slowly
     - hydrallazine IV 5mg aliquots up to 20mg - onset 30min ∴ must titrate v slowly
     - nifedpine sublingual 5-10mg
     - GTN IV 0.1-0.8mcg/kg/min
     - SNP IV 1-4mcg/kg/min
   - NBs:
     - modern epidurals not primary Rx:
       - high volume, low conc regimes have limited effect on bp
       - will affect pain around contractions ∴ indirectly ⟹↓bp
     - Mg is not a primary Rx for bp - instead prevents seizures
     -
2. Fluid therapy:
   - balance of rehydration vs ↑propensity to develop APO
   - severe pre-eclampsia see 30-40% ↓plasma volume
   - volume expansion shown to ↓SVR & ↓SBP
   - targets:
     - CVP 3-5
     - UO >0.5ml/kg/hr
3. delivery of baby and placenta:

   <32 weeks should take efforts to prolong pregnancy
   - regional:
     - platelets <50 = absolute CI to regional
     - within 6hrs with proven trend
     - better = TEG, bleeding time, platelet function studies
   - GA:
     - ↑Risk of Diff intubation, CVS instability
     - seizures may be easier to manage under GA
     - upper body oedema is worrying!
     - options:
       - AFOI
       - asleep FO
     - must obtund HTN to laryngoscopy & extubation: Mg, alfent, esmolol, lignocaine
   - NB:
     - pre-eclampsia often worsens after delivery
     - 30% diagnosed post partum
4. prevention of eclampsia:

- Mg ↓s risk of eclampsia (NNT = 200 to prevent one fit)
- indication = any signs of severe pre-eclampsia incl >3beats clonus, HELLP syndrome, ALT/AST >70, platelets <100
- dosing:
  - load with MgSO4 (5g over 5min)
  - maintenance 1g/hr
- monitor for toxicity – drowsiness, loss of patella reflexes, respiratory depression, loss of consciousness -
- treatment of toxicity = 10mL calcium gluconate 10%

5. Prevention of complications:
   - fluid management balance
     - cautious IV fluids (high risk of APO)
     - must correct intravascular hypovolaemia
   - follow local policy but generally ensure **hourly intake <80ml**
   - aim for fluid neutral anaesthetic

Surgery

Preoperative/delivery Management

- position patient in left lateral tilt
- intermittent -> continuous monitoring of baby
- MDT input (obstetrician, neonatologist, midwife)
- platelets & clotting within 6hrs or sooner if rapid changes:
  - <100 ⟹ clotting screen
  - >75 & normal clotting = neuraxial likely fine
  - <75 then careful assessment by senior of pros/cons
- epidurals good if no contraindications
- if decision to move to C/S standard care
- Assess oedema esp facial oedema, stridor

Intraoperative/labour Management

- single shot spinal, CSE and epidural have all been employed:
- hypotension less common
- GA;
  - if severe pre-eclampsia ⟹ awake A line
  - abate hypertensive response to intubation
    - 1mg alfentanil
    - +/- labetalol 10-20mg before induction
    - +/- remi 2mcg/ml bolus (&glycopyrrolate)/infusion
  - if Mg used -
    - NDNMBDs will be prolonged
    - likely need oxytocin infusion to support uterine tone
  - extubation:
    - labetalol to cover emrgence SNS drive
    - monitor for APO
- avoid syntometrine and ergometrine -> acute hypertension

Postoperative/delivery Management

- continue antihypertensives
- continue MgSO4
- avoid NSAIDS until proteinuria resolved (likely >48hrs)
- Maintenance fluid only ie 1ml/kg/hr total max or 80mls/hr
- thromboprophylaxis
- manage APO in standard manner (LMNOP)

Eclampsia

- incidence 1:3500
  - 40% antepartum

    - 20% intrapartum
    - 40% post partum
- impending eclampsia signs:
    - headache & visual disturbances (incl cortical blindness)
    - hyper-reflexia
    - abdo pain - liver capsule distension
- most seizures in pregnancy not due to eclampsia:
    ↳ eg epilepsy, uncontrolled DM, LAST, meningitis, tumours, ICH, central venous sinus thrombosis, stroke
- most common in 3rd trimester or within 12hrs of delivery
- = life threatening but eclamptic seizure is normally short & self terminating
        ↳ majority of death due to ICH 2nd to HTN
- Rx aimed at immediate control & prevention of further fits:
    - MgSo4 - all must get!
        - dosing:
            - 1st seizure: Load 4g over 5min; Maintenance 1g/hr for 24hrs
            - recurrent seizure: 2-4g over 5min
        - monitor levels:
            - therapeutic levels = 2-4mmol/L
            - >5mmol/L = loss of deep reflexs
            - >6-7 = ↓RR
            - >12 = cardiac arrest
        - if on CCBs = ↑ed risk of toxicity
        - Rx toxicity with 10mls Calcium
    - if antenatal then
        - consider urgency of delivery: if foetus well eclampsia is NOT an indication for LSCS
        - establish Mg treatment
        - vaginal or LSCS is fine

HELLP Syndrome

- severe HELLP ⟹ 5% mortality
- usually assoc with PET ~50%
- rarely presents before 20wks
- may present post partum
- symptoms
    - initially may be mild flu like illness
    - Hypertension & proteinuria - found in 80% of HELLP
    - N&V

Definition

- may see partial HELLP if ⅔:
1. Haemolysis (falling Hb with no evidence of bleeding, haemoglobinuria, elevated bilirubin, elevated LDH)
2. Elevated LFT's (RUQ pain from liver bleed)
3. Low platelets (<100) (<50 = severe)

Management

- see management of PET
- delivery of baby and placenta
- if not severe symptoms: NVD may be acceptable
- severe HELLP ⟹ urgent C/S
- prepare for major haemorrhage, ARDS, renal failure, DIC
- invasive monitoring
- HDU
- recovery 24-48hrs post delivery

PreTerm Labour

- threatened or actual

Tocolytics

- prem labour:
  - CCBs - nifedipine 10-20mg tds
  - Steroids - fetal lung maturation in case inevitable delivery
- foetal distress:
  - ß agonists - salbutamol 15mcg/kg
  - GTN - 100mcg IV, 0.8mg s/l
  - volatiles MAC >0.5

Obesity in Pregnancy

- Generally = risks of complications is higher!
- threshold for pre-op clinic BMI >30->40
- 18.5-25 = normal; 25-30 = overweight, >30 = obese

Preoperatively

HISTORY
- co-morbid conditions: IHD, DM, vasculopathy, HT, cholesterol, OSA
- PPH
- Abnormal presentation
- PET
- Fetal abnormalities
- GORD

EXAMINATION
- AIRWAY:
  - Mallampatti sensitive and specific of difficult airway in Pregnancy, nasal hyperaemia, increased incidence of difficult intubation
  - difficult airway in obese & pregnant = 1:3
- RESP: increased WOB, decreased FRC, hypoxia, OSA, pHTN
- CVS: increased Q, normal SVR, increased myocardial O2 consumption, ↑aorto-caval syndrome, ↑peri-partum cardiomyopathy
- ABDO: HH, ↑GORD

INVESTIGATIONS
- routine and as clinically directed

MANAGEMENT
- preparation
- diff IV access
- starvation times
- GORD cares
- difficult airway management - pt should be told if emergency airway required may be a delay waiting for senior staff
- OSA - bring CPAP machine
- managed in a tertiary centre
- early regional technique
- pre-labour referral to anaesthesia and obstetric team
- DVT prophylaxis

Intraoperatively

- EmC/S rate = 30-50%

- increased risks of:
    - Infection
    - Shoulder dystocia
    - Fetal distress
    - Instrumental delivery
    - FTP
    - Intra-operative blood loss
    - DVT/PE
    - Fetal death
    - Childhood obesity

Epidurals

- very high failure rate (up to 25%) -> multiple attempts
- easier if sitting - easier to see midline
- less haemodynamic change
- higher risk of dural puncture as epidural space is narrower = 4% risk
- do pre-procedure US scan to identify midline, skin puncture site
- in most obese women its around 8cm to space (>6cm = ↑ed risk of dural puncture)
- use less drug -> at risk of high blocks
- dosing in sitting position -> reduces cephalad spread of LA
- improve post-operative spirometry compared to opioids

Post-operatively

- DVT prophylaxis
- early mobilisation
- multimodal analgesia with opioid minimisation
- attention to possible complications

Maternal Sepsis

- leading cause of maternal death
- lack of fever is not predictive
- modified immune response in pregnancy - not reduced
- pathogens:
    - Gp A strep (GAS)- ß-haemolytic (most common)
    - E coli
    - staph a.
- use vitals charts & review if ≥2 SIRS criteria:
    - >38 or <36
    - HR >90
    - RR >20 or pCO2 <32
    - WCC <4 or >12 or >10% immature bands

Modified for Obstetrics:
- temp =same
- HR >100
- RR>20 on 2 occasions 4hrs apart
- WCC >17 or <4 or >10% immature bands

Signs of infection

- SIRS criteria
- standard constitutional features, eg cough, D&V, sore throat, meningism
- PROM +/- offensive vag discharge
- spreading rash

Definitions

- SIRS = as above
- sepsis = SIRS + presumed or proven infective process
- severe sepsis = sepsis with organ dysfunction
- septic shock = sepsis with hypotension despite IVF resuscitation
- puerperal sepsis = infection of genital tract any time between ROM or labour & 42nd day post partum assoc with 2 or more of: pelvic pain, fever, vag d/c, smelly discharge, delayed ↓size of uterus

Severe Sepsis

- = sepsis with organ dysfunction:
    - ↑lactate

- oliguria & AKI
- deranged LFTs ⟹ ↑↓BSL ⟹ coagulopathy
- altered mental status
- ↓↓bp & ↓↓pO2

Management

- as ICU sepsis:
  - avoid steroids unless refractory
  - maintain Hb 70-90
- early empirical Abx
  - not critically ill = cefuroxime
  - septic = tazocin
  - GAS = clindamycin more effective than penicillin
  - MRSA = teicoplanin
- routine support & monitoring
- decision for surgery should involve MDT incl neonatologist:

Table 5 Surgical procedures in sepsis management

(i)	Evacuation of retained products of conception
(ii)	Debridement of wound infection or fasciitis
(iii)	Percutaneous drainage of abscesses
(iv)	Stent or percutaneous nephrostomy for obstructive pyelonephritis
(v)	Delivery of fetus if chorioamnionitis is suspected
(vi)	Hysterectomy for myometrial necrosis

- regionals generally contraindicated:
  - not tolerate SNS loss ⟹ vasoD
  - assoc coagulopathy & ↓platelets
  - risk of seeding epidural abscess or meningitis
    ↳ although risk is v small if fully Abx Rx'ed
- GA:
  - avoid oxytocin bolus - give infusion
  - consider ketamine induction

Cardiac Disease & Pregnancy

- pregnancy is a physiological stress to woman
- if woman symptomatic with minimal activity (NHYA III, IV) -> pregnancy going to be rough with mortality of 30%
- risk factors for morbidity:
  - NYHA III or IV or cyanosis
  - myocardial dysfunction
  - L heart obstruction ie AS/MS
  - prior arrhythmia
  - prior cardiac event
- most stress = immediately post partum
- see Surgery on Parturient for cardiac drug summary & effect on fetus
- pre-existing prosthetic valve will need to be switched to LMWH from warf
- CPB risk:
  - normothermia & good pressures = 10% risk
  - hypothermic CPB = 30% risk of mortality to fetus

Pathology

- **Pulmonary Hypertension and Eisenmengers Syndrome** =
  - high mortality (>70%)
  - R heart failure due to lungs & RV unable to cope with changes in cardiac output
  - most deaths 2-9d post partum
  - delivery often done under elective GA LSCS with full invasive monitoring eg ?PAC
    ↳ but regional still an option
  - Rx: nifedipine, NO, prostacyclin, sildenafil
  - Goals of Rx:
    - avoid ↑pHTN - standard cares, caution with oxytocin, avoid carboprost
    - optimise RV function via preload & afterload
- cyanotic heart disease; avoid ↓SVR ⟹ epidural slowly topped + phenylephrine to maintain afterload
- AS; avoid tachycardia and decreased afterload, aggressively maintain SR ⟹ GA or epidural top up
- Mitral stenosis:
  - highest risk of valvular problems
  - manage in tertiary centre
  - greatest risk is APO at delivery due to ↑↑cardiac output
    ↳ further ↑in risk if PET
  - if large LA - start on ß blockers & heparin to prevent AF
  - invasive A line early in labour
  - slow institution of epidural
  - minimal IVF - bolus max 200ml at time
  - vag delivery is fine or Epi top up or low dose CSE if LSCS
- regurgitant murmurs well tolerated in pregnancy due to ↓SVR ⟹ ↓regurgitant lesion
- Marfans with aortic root dilation & risk of dissection
  - pre-pregnancy root dilation >4-4.5cm offer replacement prior to pregnancy
  - regular screening ECHO through pregnancy 1-2monthly
  - highest risk near full term or immediate post partum
  - establish ß blockers early
- heart failure - safe to Rx with diuretics, dig, hydralazine, nitrates
- MI
  - usually happens in 3rd trimester
  - often no RFs
  - early angio - dissection of LAD most common cause ⟹ stenting
  - otherwise Rx with standard care of ACS
  - attempt to delay delivery by 3 weeks post MI, provide appropriate analgesia
  - clopidogrel use would preclude regional techniques
- peripartum cardiomyopathy:
  - dilated cardiomyopathy final 1month & 5 months post partum
  - unsure of cause
  - often see severe LV dysfunction & if biopsy myocarditis

- Initial Rx:
  - ↓preload: fluid restrict & diuretics
  - ↓afterload: hydralazine, nitrates & amlodipine
  - antiarrhythmics - dig
- Other Rx:
  - ß blocker low dose - ↑survival in dilated cardiomyopathy
  - VTE prophylaxis if Ef <35% - heparin
  - (avoid ACEIs)
- may resolve otherwise subsequent pregnancies high mortality

Preoperative Management

- high index of suspicion (particularly with patients with risk factors)
- early ECHO or imaging
- tertiary level referrals
- early cardiological assessment and MDT discussions
- severe disease = elective Caesarian Section
- may need to deliver in cardiac theatre

Intraoperative Management

- cardio-prophylactic antibiotics if indicated
- use oxytocin with extreme caution
  ↳ recommended to omit bolus & use infusion only
- avoid ergometrine - risk of vasoC, HTN, ↑ACS & ↑APO risk
- avoid carboprost - may ↑APO
- may require IABP or LVAD as bridging to recovery/transplant
- early invasive monitoring
- if RA:
  - careful incremental epidural is safe in most instances
  - avoid spinal
- If GA:
  - obtund HTN response to intubation
  - NO/volatile

Postoperative Management

- first 1-2 hours post delivery most important c/o autotransfusion
- HDU/ICU care

Respiratory Disease & Pregnancy

- classification:
  - restrictive:
    - sarcoid
    - fibrotic
    - post radiation fibrosis
    - fibrosing alveolitis
  - obstructive
    - asthma
    - bronchiectasis
    - CF
- Asthma most common -
  - need reassurance in early preg due to ↑MW
  - reactivity of airways may ↓ - although some may worsen
- Loss of FRC & closing capacity within VT ⟹ severe compromise of some women
- baseline PFTs useful at booking

Endocrine Disease In Pregnancy

- most common problems:
  - DM
  - thyrotoxicosis
- DM:
  - types:
    - preexisting: I, II, MODI
    - gestational DM
  - ↑ed risk of pregnancy induced HTN, polyhydraminos, LSCS & preterm labour
  - gestational DM have x2 LSCS rate vs non-DM

Neurological Conditions

General Principles

- avoid spinal if concerns about maternal tethered spinal cord
- Avoid sux for majority of neuro conditions due to ↑sensitivity of nAch receptors
  ↳ RSI suggestions = high dose roc or remi 3cg/kg
- avoid esmolol due to risk of fetal bradycardia
- up to 40% pts complain of headache postpartum

Conditions

Epilepsy

- epilepsy = most common cause of seizure in pregnancy
- eclampsia = most common cause of seizure peri-partum
- seizure frequency ↑ during pregnancy:
  - non compliance with meds
  - altered pharmacokinetics
  - hormonal changes

Multiple Sclerosis

- 10% of cases present in pregnancy
- no evidence of harm with neuraxials even though theory of exposed demyelinated cord to LA's
  ↳ if concerned can use epidural or CSE
  ↳ many consent pt for chance of relapse with neuraxial
- intraop ↓bp should be aggressively Rx'ed to ensure spinal perfusion
- relapses may be slightly ↓ed in pregnancy but ↑ed in 3 months post partum

Spina Bifida

- MRI is mandatory to exclude tethered spinal cord ⟹ then can perform block at unaffected level
- 70% of pts with cord abnormalities will have dimpling or hairy patch base of back
- epidural:
  - ↑ed risk of dural puncture due to abnormal ligaments
  - ↑ed cephelad spread - ↑dural permeability, ↓size epidural space
  - ↓caudal spread - insert above lesion, but doesnt migrate south
    ↳ can do second epidural below lesion or spinal injection/catheter
- assoc with difficult intubation

Intracerebral Vascular Events

- cerebral venous thrombosis -
  - ↑chance postpartum
  - supportive Rx to manage ICP & anticoaglation
- SAH:
  - ↑chance of aneurysmal rupture: ↑circulating blood volume
  - post clipping no ↑risk during vag delivery
  - unclipped - safer to perform LSCS

Infection

- meningitis
- spinal TB - in immigrants with low back pain

- Guillain Barre -
  - = demyelinating polyneuropathy often post viral illness
  - Regionals:
    - cause ↓autonomic instability by removing pain
    - ↑sensitivity to LAs ∴ slow titratio
  - GA - if resp/bulbar affects

Myasthenia Gravis

- = autoimmune commonly affecting young women
- variable course during pregnancy: 40% deteriorate (mostly post partum)
- ↑incidence of preterm labour
- sensitive to CCBs
- avoid Mg ⟹ myasthenic crisis
- should optimise anticholinestarase meds antenatally - convert to IV for labour
- aim for short 2nd stage to cope with muscle fatigue
- LSCS:
  - Regionals -
    - preferable
    - caution in case resp impairment
  - GA:
    - sux resistance ⟹ phase II block
    - NDNMBs - use sparingly as ↑ed sensitivity

Neurofibromatosis

- type 1 =
  - freckling & cafe au lait lesions
  - periph NS affected by tumour growth
  - CNS involvement <10%
- type II =
  - CNS tumours in 90% ⟹ acoustic neuromas
- Regionals -
  - contraindicated unless MRI has excluded local spinal cord lesion
  - ↑ed chance of patchy epidural block
- other risks include:
  - neurofibroma in airway
  - cardiomyopathy

Space Occupying Lesions

- Regionals contraindicated: sudden ↓CSF pressure ⟹ cerebellar herniation ⟹ disaster!
- ICP in labour up to 40; 2nd stage up to 70
  ↳ ∴ GA LSCS!!

Spinal Cord Injury

- ↑ed risk of aortocaval compression:
  - ↓circulating blood volume
  - ↓LL SNS tone
- avoid sux for 9months post injury
- contractions not felt if lesion above T5
- lesions above T5 ⟹ ↑risk of autonomic dysreflexia:
  - physiology = severe vasoC below lesion & vasoD above
  - signs = HTN, headache, pallor, ↓HR ⟹ cardiac arrest
  - labour = powerful trigger & syndrome may be an indication of labour
  - epidural inserted prophylactically may be protective
  - antiHTNs may be needed
  - risk continues 48hrs postpartum ∴ leave epidurals in until then
  - spinal LSCS is fine

Benign Intracranial Hypertension

- = ↑ed ICP in absence of intracranial lesion, hydrocephalus or infection & normal CSF composition
  ↳ ie a diagnosis of exclusion
- signs: morning headache, visual disturbance, nausea
- more common in obese

- symptoms worsen in pregnancy ⟹ improve post partum
- severe may require lumbar peritoneal shunt
- labour plan:
  - symptomatic patients ⟹ elective LSCS (avoid ↑CSF pressures of labour)
  - asymptomatic pts ⟹ effective epidural & short instrumental 2nd stage
- spinal may be unpredictable due to altered CSF flow - CSE may be better
- if shunt in situ - neuraxial is contraindicated

Epidural Abscess

Differential Diagnoses

- Epidural abscess
- Nerve injury from epidural + associated infection (urinary tract infection, chest infection, retained products of conception, wound infection)
- Nerve injury associated with labour + associated infection

Acute Management

- Most important to rule out = epidural abscess
  ↳ decompression within 8 hours of neurological signs otherwise irreversible nerve injury

Focused history

- labour and delivery
- epidural insertion
- back pain
- neurological symptoms
- fevers
- chills
- shakes
- other symptoms for focus of infection

Examination

- observations
- general examination
- neurological examination of limbs including PR to check for cauda equina signs
- back examination

Investigations

- the most important investigation = MRI (while organising an urgent MRI I would do other less important investigations)
- blood cultures
- MSU
- CXR
- bloods for inflammatory markers and signs of other organ dysfunction

Management

- start broad spectrum antibiotics - > flucloxacillin (>60% are Staph aureus), cefuroxime (broader gram +ve cover), gentamycin (gram -ve cover)
- early neurosurgical consultation
- liaison with obstetric and neonatal staff regarding plan and drug therapy started on (may need to formula feed or express milk before antibiotic therapy
- analgesia
- urinary catheterisation
- HDU or ICU involvement if other organ dysfunction developing
- discuss with theatre regarding need for urgent surgery if indicated

VTE Prophylaxis

Preoperatively

- not confined to bed
- ambulation prior to OT
- TEDS stocking from time she is immobile
- consider SC LMWH prior to theatre (will have to administered 12 hours prior to establishment of spinal anaesthesia - @ 1800 the night before if patient is on morning list)
- IV fluid hydration while fasting
- preoperative referral to haematology to discuss and assess underlying thrombophilia

Intraoperatively

- TEDs stocking (small benefit in reducing risk of VTE, non-invasive)
- intermittent, pneumatic calve compressors (also has been shown to produce small benefit in reducing risk of VTE, non-invasive)
- adequate hydration with IVF

Postoperatively

- LWMH:
  - 40mg s/c 6hrs post neuraxial/surgery - surgeon must be happy with haemostasis
  - delay 24 hrs if :bloody insertion of spinal/epidural
- continued use of TEDS and pneumatic calve compressors
- monitoring for signs and symptoms of DVT with low threshold for organising an ultrasound
- early mobilisation (adequate analgesia important for this to take place)
- encouragement to perform leg exercises in bed

Older Parturient

Antenatal

- most are professionals
- increased infertility rates
- increased weight gain
- increased obesity
- increased pregnancy induced hypertension
- increased pre-existing hypertension
- increased antepartum haemorrhage
- increased multiple gestation
- increased DM
- increased risk of congenital malformations

Intrapartum

- increased malpresentation
- increased PROM
- increased pre-term labor
- increased use of oxytocin
- increased C/S rate
- increased fetal distress
- increased risk of still birth

Post-natal

- babies have worse APGARS
- low birth weight
- increased preterm delivery
- small for gestational age

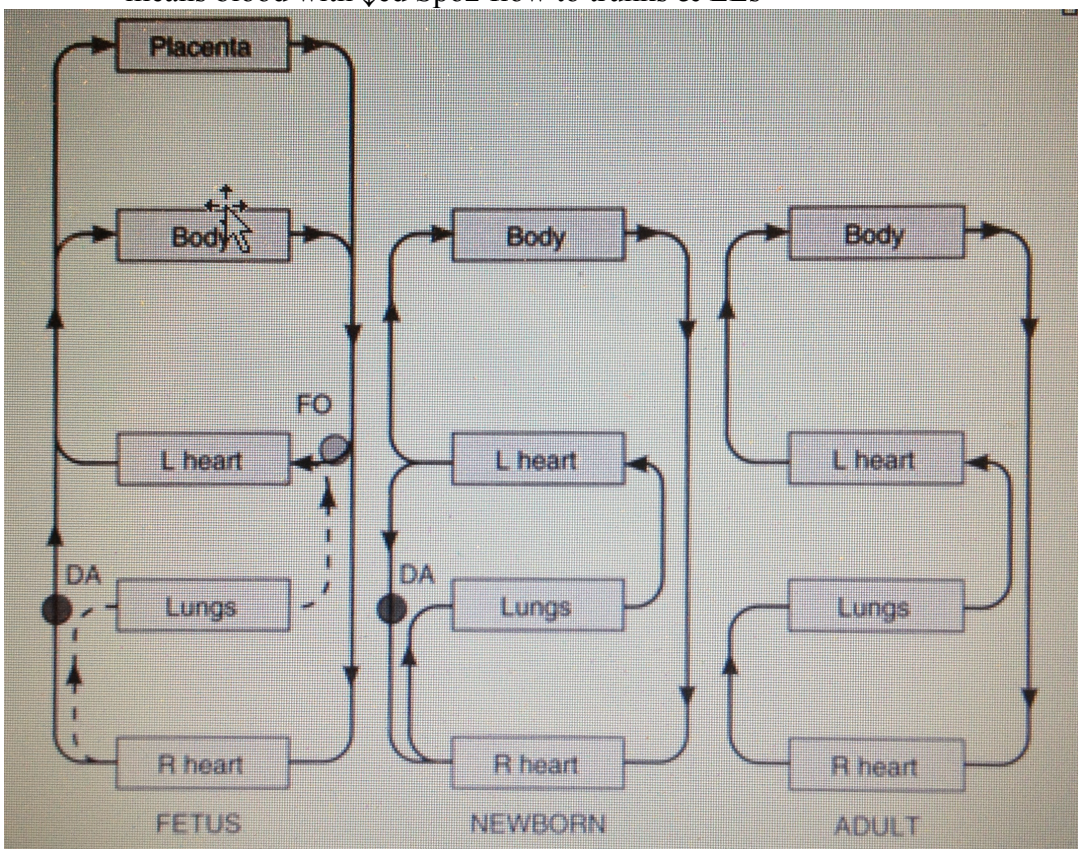
- increased neonatal intensive care unit admissions

HOWEVER,
- generally overall the babies and mothers do well c/o the high standard of peripartum care they have access too
- there aren't any more babies or mothers dying in this age bracket

Neonatal Physiology

Foetal Circulation

- 55% fetal CO ⇒ placenta
- blood in umbilical vein Spo2 80%
- placenta ⇒ liver
- ductus venosus allows ~50% blood to bypass liver ⇒ IVC
- Eustachian valve at IVC & RA junction directs blood flows thorugh heart:
  - Returning IVC blood ⇒ heart ⇒ through PFO ⇒ L atrium
    ↳ allows blood with ↑ed SPo2 to go to brain
  - SVC blood ⇒ R vent ⇒ pulmon artery ⇒ ductus arteriosus ⇒ aortic arch post to L subclavian
    ↳as pressure in aorta < fetal pulmon circulation
    ↳means blood with ↓ed Spo2 flow to trunks & LLs



Adult vs Fetal Circulation

- adult = circulation in series:
  - no shunts
  - RV output = LV (averaged over 1min)
- fetus = parallel circulation:
  - shunt

- RV gets 65% of VR
- LV gets 35% of VR
- 8% of circulation ⟹ pulmonary circulation
- 45% circulation ⟹ placenta

Saturations in Different Foetal Vessels

- Ductus venosum = 80%
- IVC 67%
- Hepatic Portal blood = 26%
- SVC 30%
- systemic circulation = 60%

Control of Fetal Circulation

- poorly understood
- factors:
  - circulating catecholamines -
    - via α & ß receptors
    - predominant vasoC seen
  - autonomic system - only completed in neonatal period
  - other hormones
  - locally released vasoactives
- high PVR is multifactorial:
  - high mm mass in PAs with high resting tone
  - lungs collapsed
  - low resting O2 tension
- ductus arteriosus:
  - mms sensitive to O2 & vasocatives
  - patency maintained by low O2, PGE2

O2 delivery in Fetus

- DO2 = CO x O2 content
- O2 content = Hb x SpO2
- fetus Hb conc of ~16 at term with high HbF
- HbF has low 2-3DPG ⟹ L shift curve ⟹ favour O2 uptake in placenta ⟹ see higher O2 saturation in umbilical veins vs uterine veins
- ∴ in fetus even with low pO2 see high DO2
- post birth must ↓HbF as limits O2 extraction at tissue level

Changes At Birth

Respiratory

- changes:
  - loss of placental gas exchange
  - initiation of ventilation of newborns lung
  - start of pulmon gas exchange
  - establishment of FRC
- physiology of first few breaths:
  - pre delivery lung contains ~20ml/kg fluid
  - some expelled with thoracic compression during movement through vaginal birth canal
  - rest rapidly absorbed & replaced with air
  - 1st breath: v large -ve ITP ie -60 to -70cmH20
  - next breaths: progressively less -ve ITP as establishment of air-liquid interface with surfactant
  - ∴ FRC ↑s rapidly after 1st breath:
    - 10mins FRC ~17ml/kg
    - 30-60min ~30ml/kg (=adult value)

CVS Changes

- changes:
  - loss of umbilical circulation to placenta
  - closure of ductus venousus
  - functional closure of foramen ovale
  - closure of ductus arteriosus (reversible)
    (↳ NB is less responsive to O2 in prems)
  - large ↑pulmon circulation (reversible)

Physiology of Changes

- in fetus R & L heart pump in parallel rather than series
  ↳ possible due to PFO & PDA
- umbilical vessels have thick muscular walls which v reactive to:
  - trauma
  - tension
  - catechoaines/bradykinin/angiotensin
  - changes in PO2
- @birth:
  - placental circulation cut off ie flow through umbilical vein ceases
  - ductus venosum closes - unknown mechanism :
    - peripheral resistance sudden ↑
    - aorta pressure rises until > than pulmon artery
  - infant ↑ing hypoxia ⟹ activation of resp centre of newborn
  - infant gasp initiates circulatory changes:
    - expansion of lung ⟹ ↓pulmon vascular resistance to ~10% of intrauterine value
      (↳ not O2 mediated as occurs with N2 inflation breaths)
    - ⟹ ↑LA pressure > RA & IVC due to:
    - ↓pulmon resistance ⟹ ↑LA filling
    - ↓RA filling due to occlusion of umbilical vein
    - ↑ed LV afterload due to closure of umbilical arteries
      ↳ ⟹ functional closure of PFO (with fusion in days)
    - reversal of flow through ductus arteriosis - due to:
      - pulmonary artery pressure falls to 50% of intrauterine value (35mmHg
      - ↑aortic pressure

      ↳ within minutes ductus starts to close ⟹ turbulent flow = murmur of newborn
    - placental transfusion – sucks blood from umbilical vein (upto 100mls blood)
- Ductus arteriosus:
  - Initial functional closure
  - 24-48hr anatomical closure by intimal thickening
  - Ductus Arteriosus closure not totally understood:
    - Incr in O2 arterial tension
    - ↓ing conc of prostaglandins, bradykinin, adenosine
      ↳ prostaglandin synthesis blocked by inhibition of cyclooxygenase at birth
    - Permanent closure at 4-8weeks
  - DA post birth can be:
    - closed with drugs that inhibit COX
    - kept open with VDs eg NO/prostaglandins
- morphology changes of heart & vasculature - over weeks:
  - @ birth:
    - 2 ventricles = same weight - due to parallel foetal circuit
    - arterioles of pulmon circuit = thick & muscular
  - after birth:
    - RV fails to grow like LV
    - muscular layer of pulmon circulation is lost

Persistent Fetal Circulation

- Transition of circulation at birth may be reversible ⟹
  - vicious cycle of hypoxia & acidosis
- ↑tone of pulmonary arterioles can be triggered by ↓O2, ↑CO2, ↓pH & cold ⟹
  - ↑PVR ⟹ ↑R to L shunt via FO & DA
  - return to fetal circulation pattern
  - but no placenta
  - ↳ ∴ deterioration

Abnormal Circulations

- PDA:
  - DA normally closes <24hrs
  - failure closure ⟹ L to R shunt
    - due to ↑SVR & ↓PVR
  - see ↑volume & workload of LA & LV ⟹ L heart failure
- VSDs:
  - depends on size & balance between PVR & SVR
- TOF:
  - depending on severity aorta will carry large amount of CO
  - if obstruction to pulmon blood flow large may see flow to lung via DA from descending aorta
    ↳ ie reverse of normal
  - ∴ if duct closure may see rapid decline & cyanosis
  - re-open duct with prostaglandin infusion
- transposition of great arteries:
  - aorta from RV
  - pulmon artery from LV
  - FO & DA normal ∴ no problems in utero
  - post birth survival depends on 1+ ASD, VSD, PDA
  - must maintain PDA with PGE1 infusion