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General principles

Anaesthetic Concerns

Preoperative Management

- severe arthritis limits CVS and RESP assessment
- RA -> think atlanto-axial instability
- anticoagulation and regionals need to be organized properly ie timing of LMWH
- high risk of VTE (prophylaxis with TEDS, pneumatic calve compressors and LWMH)

Intraoperative Management

- IV A/B
- careful positioning to avoid nerve and soft tissue damage
- blood loss can be significant (cell salvage effective)
- consider invasive monitoring
- catheter for long procedure or neuraxial technique
- maintain normothermia

Regional Anaesthesia

- regional can be used for all joint replacements
- Regional +/- sedation
- advs:
 - ▶ ↓postop analgesia requirement
 - ▶ ↓PONV
 - ▶ improved outcomes in hip & knees surgery
 - ▶ ↓bleeding - allowing improved fixation of cement & prosthesis
 - ▶ surgeons prefer operating conditions under regional

Post operative Management

- good analgesia important
- NSAIDS -> effective but ask surgeons

Spinal vs Peripheral Nerve Blocks

Epidural

- disadv:
 - ▶ standard risks of insertion
 - ▶ analgesic benefits compared to PCA limited at 4-6hrs post op
 - ▶ hypotension
 - ▶ urinary retention
 - ▶ bilat motor block preventing mobilisation

Spinal

- advs:
 - ▶ quick
 - ▶ reliable onset & offset
 - ▶ simple to perform
 - ▶ co-administration of multiple drugs
- disadv:
 - ▶ standard risks
 - ▶ require specific coagulation & platelets targets
 - ▶ not recommended if on clopidogrel/other anticoagulants
- intrathecal opioids:
 - ▶ fentanyl - rapid onset, short duration of action

- ▶ morphine -
 - slow onset & offset with cephalad spread
 - THJR ~100mcg - pain relief for 21 hrs
 - TKJR - less efficacious. 200mcg = single shot femoral
 - SE's: PONV, pruritis, urinary retention, hypotension, ↓RR

Peripheral Nerve Blocks

- advs:
 - ▶ low risks during insertion with US
 - ▶ excellent analgesia with minimal motor block
 - ▶ limits reflex mm spasm
 - ▶ avoids intrathecal opioid SEs

Fat Embolism Syndrome

- causative theories:
 - ▶ mechanical theory = emboli into lungs
 - ▶ biochemical theory =
 - can get without trauma
 - chylomicrons obstruct pulmonary vasculature
 - ARDS like picture

Major Features	Minor Features	Lab Findings
- Resp symptoms = ↑RR, SOB, bilat creps, haemoptysis, diffuse shadowing on CXR	- ↑HR	- ↓platelets
- Neuro - confusion, drowsy	- Retinal change - fat or petechiae	- Sudden ↓Hb 20%
- Petechial Rash	- Jaundice	- ↑ESR
(ie no CVS collapse - as cement syndrome)	- Renal: oliguria or anuria	- Fat macroglubulaemia
	temp >38.5	

- extremely variable presentation
- often diagnosed by exclusion
- assoc with major trauma or surgery (esp of long bone #s)
- embolism of fat is common but syndrome is rare (1%)
- early surgery & avoidance of intramedullary fixation ⇒ ↓incidence
- treatment is supportive
- early mortality 1-20% but serious long term complications are rare

Signs & Symptoms

- typical onset 24-72 hrs post injury
- classical triad seen in long bone #'s=
 - ▶ sudden onset hypoxia (with ↑HR)
 - ▶ confusion
 - ▶ +/- petechial rash (check conjunctiva)
- CXR: - diffuse infiltrates/ARDS like picture
- CT head - petechial bleeds
- ECHO - RV dysfunction with ↑PVR

Treatment

- Early resus
- early O2
- IPPV (10-40% patients require)
- good ICU care
- controversial options:
 - ▶ Steroids
 - ▶ IVC filter

Prevention

- early mobilisation + ORIF
- ventilation hole in long bones when reaming \Rightarrow \downarrow intra-osseus pressure
- cementless fixation

Course

- Usually resolves within 7days

Cement Implantation Syndrome

- cement = methylmethacrylate acrylic polymer
 - used for >30yra
 - essential a problem of sudden \uparrow PVR with assoc:
 - ▶ hypoxia
 - ▶ \downarrow MAP
 - ▶ CVS collapse
 - suggested aetiologies:
 - ▶ embolic:
 - fat \Rightarrow mediator release & mechanical problems
 - Air \Rightarrow doppler evidence in 30%
 - fibrin/bone/platelets
 - ▶ direct cement effects \Rightarrow systemic vasoD
 - ▶ hypersensitivity/histamine release model
 - ▶ complement model
 - syndrome now graded 1-3:
 - ▶ grade 1 = \downarrow SBP >20% & SpO2 <94%
 - ▶ Grade 2 = \downarrow SBP >40% & SpO2 <88%
 - ▶ grade 3 = CVS collapse
 - RFs:
 - ▶ Patient:
 - ASA 3-4
 - pre-existing pHTN
 - osteoporosis
 - ▶ Surgical:
 - pathological #s
 - intertrochanteric #s
 - long stem arthroplasty
- \hookrightarrow femoral cementing = 85% of embolic events

Presentation

- shortly after cement insertion:
 - ▶ CVS: \downarrow MAP (10-30%)
 - ▶ Resp: hypoxia
 - ▶ metabolic: \uparrow met acidosis, \uparrow BSL
- pHTN resolves within 24hrs
- non diseased hearts can compensate in mins to hours

Prevention

- bone vacuum cementing technique to cavity to evac air & fat during cement insertion \Rightarrow $\downarrow\downarrow$ complications
- \uparrow bp measurement frequency peri-cementing
- adequate blood volume prior to cementing
- avoid deep volatile anaesthesia
- \uparrow FiO2 - hypoxia is common
- stop N2O

Treatment

- Rx as R heart failure:
 - ▶ IVF
 - ▶ pulmonary vasodilators
 - ▶ inotropes eg milrinone, dobutamine
- Flood field with saline
- place invasive CO monitoring/PAWP

- check tryptases - differential diagnosis
- ICU post op

Tourniquets

- used to produce a bloodless field - venous & arterial
- only use pneumatic tourniquets as pressure can be titrated predictably

Contra-indications to Tourniquet use

- PVD
- severe crush injuries
- sickle cell disease (controversial)
- open wound/compound #s
- Underlying thrombosis

Contra-indications to use of an Esmarch Bandage for Exsanguination

- severe infection -> dissemination
- tumour -> dissemination
- suspected DVT
- ventricular impairment -> fluid overload (adds 7%/leg to circulating volume)
↳ 5min elevation at 90deg just as good

Cuff width

- > 20% diameter of upper arm
- > 40% circumference of the thigh (max 20cm)
- this ensures the pressure in the underlying central artery will be equal to that in the cuff.
- arm cuffs = 90mm
- leg cuffs = 105mm
- cuff length should exceed the circumference of the extremity by 7-15cm

Site of application

- area must have sufficient muscle bulk to distribute the cuff pressure evenly
- suggested areas = upper arm and thigh
- for fit patients who under go short operations -> calf preferred by some surgeon
- position at the point of maximal circumference
- protect with cotton wool

Pressure

- upper limb = systolic BP + 50mmHg
- lower limb = twice systolic BP
- in the normotensive patient 200mmHg for UL and 250mmHG for LL

Tourniquet Time

- goal = minimal time
- notify surgeon @ 1 hour and remove as soon as possible
- 2 hours = maximum
- if required for longer -> deflate for 15min then reinflate

Tourniquet Pain

- mechanism of pain theorised:
 - ▶ may be from unmyelinated C fibres - less affected by compression ∴ carrying pain from ischaemic arm
 - ▶ cutaneous C fibres sensing compression under tourniquet
- physiological parameters of pain seen 30-60min post inflation ie ↑HR, ↑bp
- preventative strategies:
 - ▶ adequate regional: LL: neuraxial; UL: interscalene or supraclavicular/infraclavicular
 - ▶ ketamine 0.25mg/kg prior to cuff inflation

- treatment:
 - ▶ labetalol
 - ▶ ↑ depth anaesthesia
 - ▶ short acting opioids

Systemic Effects

CVS

- ↑ circulating volume
- ↑ SVR
- after 30-60min -> ↑HR and ↑BP
 - ↳ mechanism: ??SNS activation in response to tourniquet pain
- after deflation -> ↓CVP and ↓BP for 15min from shift of blood into limb and hyperaemia + ↓ SVR

RESP

- ↑PvCO₂
- ↑MV

CNS

- ↑CO₂ content -> ↑CBF -> ↑ in ICP

HAEM

- release of catecholamines
- ↑platelet aggregation
- hypercoagulability
- ↑tPA in ischaemic limb -> when release causes systemic thrombolysis ?possible reason for post-tourniquet bleeding
- ↑DVT **not** seen
- small and moderate PE's have been noted during tourniquet release

METABOLISM

- isolated limb become hypothermic -> transferred to body once cuff deflated
- ↑ plasma K
- ↑ lactate
- ↑CO₂
- ↑O₂ consumption

Local Effects

Nerve injury

- paraesthesiae -> complete paralysis
 - ↳ physiological block 15-45mins due to ischaemia (not compression)
- radial > ulnar > median in UL
- sciatic in LL
- ↑risk with ↑ed duration of inflation
- intraneural compression -> oedema formation -> compromise to local tissue -> axonal degeneration
- mostly heal within 6 months

Muscle injury

- ischaemia & mechanical deformation ⇒ rhabdo
- products of anaerobic metabolism -> intracellular acidosis -> necrotic damage and inflammation + oedema
- stiffness, pallor, weakness, numbness of limb

Vascular injury

- risk factor = PVD
- pressure causes fracturing and rupture of atherosclerotic plaque
- post tourniquet syndrome ⇒ reperfusion + prolonged swelling

Skin injury

- pressure necrosis
- friction induced burns

Compartment Syndrome

= circulation and tissues within a closed space are compromised from an increase in pressure

- ischaemia, necrosis, tissue damage, oedema -> all ↑pressure within a compartment
- damage can be irreversible within 4 hours
- can produce MODS

Risk factors:

- significant injury to a limb (with or without a #)
- tibial or forearm #'s
- crush injury
- tourniquets
- malposition in OT
- hypotension
- haemorrhage
- oedema
- direct injection of drugs

Clinically:

- pain over affected compartment
- drum tight fascia/skin
- extreme pain on passive extension of muscles
- paresthesia in distribution of nerves traversing compartment
- weakness or paralysis of limb (late sign)
- pulses usually present (once absent = late sign)
- can occur even in open fractures

Management:

- Surgical emergency
- Keep limb @ level of heart (elevation may ⇒ ↓perfusion below critical pressure)
- Release all constricting dressings
- Measure compartment pressures:
 - ▶ arterial line transducer + needle into compartment
 - ▶ diagnosis = **compartment pressure within 30mmHg of diastolic pressure**
 - ▶ NB limbs have multiple compartments so false negative possible
- Fasciotomy
- Stabilise #
- Splint limb to prevent contractures
- IVF +++
- Monitor for organ dysfunction

Regional Blocks

- controversial
- generally should avoid as may mask early signs ie pain
- risk especially high in tibial & forearm #'s ∴ be extra cautious

Tranexamic Acid

- Benefits in THJR & TKJR:
 - ▶ ↓blood loss intro
 - ▶ ↓blood transfusion peri-op
- single intra-op injection 10-20mg/kg
- can also be given topically or intra-articular
- no ↑VTE rate
- no ↑ in AKI but use with caution in renal failure due to renal excretion

By Surgery

THJR

Preoperative Management

- discuss whether cement could be avoided in patients with severe cardiac disease
- VTE prophylaxis should be started on admission

Intraoperative Management

- lateral or supine
- prophylactic antibiotics
- spinal + sedation or GA (LMA) +/- nerve block (lumbar plexus or 3:1 femoral block)
- some evidence that regional anaesthesia decreases VTE (also good analgesia and reduced PONV)
- use midazolam or propofol TCI
- can use CSE technique for longer cases
- catheter for long operations or neuroaxial technique (with morphine)
- neuraxial techniques reduce blood loss
- intrathecal morphine good adjunct (may be over kill for hip)
- large access (in upper arm if lateral)
- blood loss:
 - ▶ active warming
 - ▶ TXA markedly ↓ed blood loss
 - ▶ load with IVF pre-spinal and pre-cement insertion
 - ▶ cell salvage considered for complex surgery

Postoperative Management

- supine in bed with legs abducted by pillow (prevents dislocation)
- VTE prophylaxis (1% develop DVT)
- O₂
- Hb day 1 - transfusion or Fe supplement
- simple analgesia + a few doses of morphine
- mobilise @ 24-48 hours

Special points

- epidural analgesia benefits only last 1st 6hrs
- bone cement \approx x3↑PE
- UFH compared to LMWH \approx 1x6 DVT
- Bilateral Hip Replacements -
 - ▶ should only be done on young & fit
 - ▶ GA with epidural
 - ▶ A line & CVP monitoring

Revision THJR

Preoperative Management

- as primary replacement but:
 - ▶ ↑length of surgery
 - ▶ ↑blood loss
 - ▶ ↑post op pain
- often more elderly and have more co-morbidities
- can't be done under single shot spinal (surgery too long)

Intraoperative Management

- 2-6 hours depending on complexity

- invasive monitoring
- rapid transfusion access (large bore IV, trauma line, RICC)
- GA with IPPV +/- epidural or LL regionals
- cell salvage useful
- call for blood early - 2 units in theatre suite

Post operative Management

- more post operative pain compared to native hip replacement
- epidural or PCA
- O2
- prevention of VTE

#NoF

- operations:
 - ▶ cannulated screws - quick, non invasive & little blood loss
 - ▶ DHS - intermediate
 - ▶ hemiarthroplasty - similar to THJR

Preoperative Management

- mortality @3 months 15%, 12 months – 30%

Priorities

1. Assess injury
2. Fluid resuscitation
3. Diagnose reason for fall
4. Assess and manage co-morbid conditions: polypharmacy, falls, IHD, CCF

MANAGEMENT

- MDT approach
- analgesia (3:1 femoral block – femoral, obturator and lateral cutaneous)
- DVT cares
- operate at next available daytime session:
 - ▶ only delay surgery if there is real benefit in being able to optimise patient
 - ▶ delay >48hrs \approx \uparrow mortality, morbidity, LOS

Table 1 AAGBI recommendations concerning acceptable and unacceptable reasons for delaying surgery. Note that the 'acceptable' reasons for delay are not absolute

May be acceptable	Unacceptable
Severe anaemia $<8 \text{ g dl}^{-1}$	Lack of facilities or theatre space
Severe electrolyte imbalance, plasma [Sodium] <120 or $>150 \text{ mmol litre}^{-1}$ [Potassium] <2.8 or $>6.0 \text{ mmol litre}^{-1}$	Awaiting echocardiography Unavailable surgical expertise Minor electrolyte abnormalities
Uncontrolled diabetes	
Uncontrolled/acute left ventricular failure	
Correctable cardiac arrhythmia, ventricular rate $>120 \text{ bpm}$	
Chest infection with sepsis	
Reversible coagulopathy	

- audible systolic murmurs:
 - ▶ incidence of AS in this group 20-40% (compared to 3% in >75yr olds)
 - ▶ should not wait for ECHO
 - ▶ Rx all pts as if have at least moderate AS: A line, slow HR, preserve SR or rate control AF, avoid significant \downarrow SVR
- traction doesn't work and increases risk of pressure sores
- rate control AF
- Anaemia:

- ▶ expect peri-op Hb drop ~25mmHg
- ▶ 90% will have post op anaemia
- ▶ restrictive transfusion likely comparable to liberal (80 (FOCUS trial used 80 not 70) vs 100)
- clopidogrel - stop preop. Consider benefits/risks of neuraxial
- discuss risks with patient and loved ones (document resuscitation status)
- increased risk with: MI, CCF, CVA, renal failure, angina and AS

Intraoperative Management

- position = supine or lateral
- choices:
 - ▶ GA (LMA or ETT)
 - ▶ RA:
 - choices: spinal with sedation; femoral 3 in 1; lumbosacral plexus
 - possible advs (although not conclusive): ↓ed POCD, blood loss & VTE
 - ↳ but ↑hypotension with spinal
- ↳ either is fine given local skills & setup
- blood loss 250-750mL (proportional to surgery)
- invasive monitoring
- antibiotic prophylaxis
- hip table used
- position with small dose of alfentanil or ketamine (avoid if possible)
- warm
- fluid load if cement used
- pressure cares

Post operative Management

- patients will require some analgesia post op (opioids)
- avoid NSAIDS
- monitor for: MI, CCF, PE, pneumonia, delirium (50%)
- ideally HDU

TKJR

- shorter op with less blood loss & less chance of cement hypotension

Preoperative Management

- warn of severe pain
- as for hip surgery

Intraoperative Management

- supine position
- tourniquet issues
- move away from regionals to spinals ⇒ allow faster mobilisation
- tourniquet pain (deepen, opioids, ketamine)
- fluid load before release of tourniquet

Post operative Management

- combine femoral and sciatic nerve blocks can produce effective analgesia and allow mobilisation (12-24 hours)
- epidural anaesthesia may delay mobilisation
- simple analgesia + PCA
- post deflation of tourniquet:
 - ▶ reperfusion event = ↓MAP, ↓SpO₂, ↑EtCO₂
 - usually shortlived
 - best prevented with fluid loading prior to tourniquet release
 - ▶ expect 500mL of blood loss into drains in 1st hr
- expected to exercise in bed @ 24 hours and mobilise @ 48 hours

Post Operative Management

- post op pain can be severe:
 - ▶ PCA
 - ▶ spinal with morphine
 - ↳ single shot femoral = 250mcg intrathecal morphine
 - ▶ high volume LA into joint
 - ▶ regional blocks

Special points

- Bilateral TKJR:
 - ▶ only in young, fit & motivated pts
 - ▶ elderly & CVS disease = high risk
 - ▶ adv: avoid 2 admissions
 - ▶ disadv: major CVS stress, unpredictable blood loss, unknown fluid needs
 - ▶ CSE + GA/sedation
 - ▶ A line
- Revision TKJR ->
 - ▶ as primary but additional length ~2hrs
 - ▶ CSE +/- sedation/GA

Arthroscopy of LL

Preoperative Management

- generally young patients with limited co-morbidity
- day case
- operations; EUA, meniscal surgery, removal of FB, synovectomy, ligament reconstruction
- premed = paracetamol + NSAIDS

Intraoperative Management

- GA (LMA)
 - ↳ regionals limited by length & lack of tourniquet cover
 - ↳ spinals by length
- IV fentanyl (avoid morphine due to high incidence of PONV)
- tourniquet issues
- surgeons often administer LA and morphine to joint
- can use IV ketamine 0.15mg/kg

Post operative management

- paracetamol, NSAIDS + tramadol to take home

Cruciate Ligament Repair

Preoperative Management

- arthroscopic reconstruction of anterior cruciate ligament using patella tendon +/- hamstring ligaments
- moderate pain

Intraoperative Management

- 2 hours
- spinal/CSE ideal or GA (LMA)
 - ↳ regionals useful but hinder post op mobilisation
- if hamstrings used ⇒ ↑ post op pain & longer op

Postoperative Management

- require 12 hours of analgesia -> mobilisation

- may require PCA

Ankle Surgery

- 4 main operations:
 1. tendon transfers ≤ 1 hr
 2. ORIF - may be an emergency
 3. joint arthrodesis 1-2hrs
 4. prosthetic joint replacement ≤ 2 hrs

Intraoperative Management

- can use GA/neuraxial or RA (beware of masking compartment syndrome)
- nerve blocks required =
 - popliteal (posterior tibial, deep and superficial peroneal, sural)
 - femoral (saphenous)
- spinal ideal for ORIF
- tourniquet issues
- position; supine, prone or lateral

Post-operative Management

- pain can vary
- intrathecal morphine can be effective
- blood loss is minimal as tourniquet often used

Foot Surgery

Preoperative Management

- operations 30min - 1hr:
 1. first metatarsal osteotomies
 2. Keller's
 3. excision of ingrown toenails
 4. terminalisation of toes
 5. tendon transfers
 6. mid foot osteotomies
- often elderly
- comorbid conditions – PVD, DM, peripheral neuropathy
- osteotomies are painful
- often done as day cases

Intraoperative Management

- supine
- nerve blocks can produce good post operative analgesia (need placed 40min prior to surgery)
- quick GA (LMA) or spinal
- tourniquet issues

Postoperative Management

- lots of LA (femoral, sciatic, ankle blocks and ring blocks)

Spinal Surgery

Preoperative Management

- 5 reasons for requiring operations:
 1. trauma (spine unstable)

2. infection
3. malignancy
4. congenital/idiopathic (scoliosis)
5. degenerative disease

- co-morbid conditions to look out for: severe respiratory disease, pulmonary hypertension, Duchennes, CP, muscular dystrophy
- spinal trauma: note level:
 - ▶ hypotension if lesion above T6,
 - ▶ bradycardia if lesion above T2-T6
 - ▶ autonomic dysreflexia seen after 3-6 weeks
- thorough assessment of CVS, RESP and NEURO systems
- AIRWAY; previous difficult intubation, restricted neck movements, stability of cervical spine, restricted mouth opening -> may require AFOI
- BREATHING; PFTs = restrictive lung disease, hypoxia or hypercapnia (ABG useful), preoperative antibiotics, physio, nebuliser may be indicated, use of NIV @ night is a sign of severity
- CIRCULATION; pulmonary hypertension -> cor pulmonale, DVT prophylaxis with calf compressors and TEDS (most surgeons like to avoid LMWH)
- DISABILITY; thorough neurological examination should be documented preoperatively, risk of bulbar dysfunction may mean post operative ventilation required
- major risks of spinal surgery:
 - ▶ blood loss
 - ▶ infection
 - ▶ port op resp complications
 - ▶ spinal cord damage & paralysis = 1%

Intra-operative Management

- premedications; glycopyrrulate, nebulisers, H2 antagonist, PPI
- may need AFOI (nebulised lignocaine for topicalisation)

Induction

- muscle relaxation;
 - ▶ sux contra-indicated if paraplegia or large areas of mm denervation (48hrs - 8months)
 - ▶ NDNMBs - use small dose of short acting
- intubation; inline immobilisation and direct laryngoscopy acceptable, ILMA, asleep FOI, may require double lumen tube for anterior approaches (ask surgeon), secure ETT well, use a reinforced tube (non-kinking)

Maintenance

- may require SSEP's or MEP's -> IV propofol & remi is ideal
- induced hypotension; improves surgical field and minimise blood loss, can use a number of agents (no one is currently better)
- monitoring; art line mandatory, ETCO2, ABG, +/-CVL (although poor reliability prone)
- positioning; prone issues, patients may have to change position intraoperatively, protect pressure points and eyes (Montreal mattress)
- blood conservation;
 - ▶ blood loss can be large, be aware with multilevel procedures, careful technique,
 - ▶ controlled hypotension
 - ▶ active warming
 - ▶ careful abdo positioning
 - ▶ anti-fibrinolytics - TXA's
 - ▶ reduce intra-abdominal pressure,
 - ▶ intraoperative cell salvage.
- spinal cord monitoring (opioids>propofol>volatiles ∴ generally TIVA. No nerve blockade)
 - ▶ the ankle clonus test,
 - ▶ [wake up test - now replaced by neurophysiology monitoring]
 - ▶ Electromyography:
 - electrical stimulation of individual nerve roots
 - energy down laminar screw - if breach cortex then see mm contraction
 - ▶ SSEP:

- compromise if <50% baseline values
- method:
 - site of stimuli = posterior tibial, peroneal or sural nerve
 - site of recording = small amplitude potentials measured in sensory cortex or epidural electrodes
 - ↳ ∴ basal mm tremor & noise can affect quality ∴ deep anaesthesia better (volatiles ok)
- ▶ MEP:
 - considered better than SSEPs as responds quicker to adverse event
 - Transcranial elec energy applied & sensed at contralat corticospinal tract
 - binary outcome: present or absent
 - method:
 - site of stimulation = motor cortex or spinal cord,
 - method of stimulation = electrical potential or magnetic field,
 - site of recording = spinal cord or mixed peripheral nerve or muscle (tib ant, vastus medialis)
 - ↳ (reference needle electrodes place in small mm of hands)
 - rely on corticospinal tract ∴ ASA territory
 - large amplitude measurements ∴ incompatible with profound mm relaxation
 - ↳ use remi - or low dose infusion NDNMBs in d/w neurophysiologist
 - pre-requisites:
 - volatile >0.5 MAC = unreliable MEP ∴ TIVA & remi
 - MAP >60mmHg
 - effects on amplitudes:
 - ↓amplitude = benzo's, N2O, ↓temp, PNS excessive traction
 - ↑amplitude = ketamine
 - no effect on amplitude = α2 agonist
 - Opioid

Pain

- depends on procedure
- options:
 - ▶ epidural LA +/- morphine by surgeon under direct vision
 - ▶ PVBs
- concern about NSAIDs - spinal haematoma
- gabapentin pre-op & continued for 14days
- multimodal: lignocaine infusion, ketamine, simple analgesia, PCA

Post-operative Management

- goal = an awake patient who can be neurologically assessed quickly
- may need post-operative ventilation c/o significant lung disease
- often have chest drains
- may need blood, warming or resuscitation
- avoid HTN SBP < 160 (depending on pre-op levels)
- need good multi-modal analgesia (simple, opioids, regional, intrapleural catheters post-thoracotomy)
- complications include; ARDS, pneumonitis, atelectasis, infection, PE, CVA, MI
- use incentive spirometry and physio

Paediatric Scoliosis Surgery

- curvature of spine measured by Cobb angle

Causes

- idiopathic = 70%
- neuromuscular eg CP, myopathies, syringomyelia = 15%
- others = congenital, traumatic, syndromes (Marfans, RA, NF), neoplastic, infection

Natural History

- adolescent idiopathic scoliosis most common form
- may self resolve or progress
- concern with progression:
 - ▶ cosmetic deformity
 - ▶ back pain
 - ▶ chest cavity narrowing & resp deficit
- degree of curve:
 - ▶ >40 = surgery indicated
 - ▶ >65deg = restrictive lung deficit seen
 - ▶ >100deg = resp failure, pHTN, R heart failure

Surgical Technique

- post, ant or combined approach
- post preferred as less invasive:
 - ▶ facets destroyed, spinous processes removed
 - ▶ bone packed over raw surfaces
 - ▶ stainless steel rods with pedicle screws used to correct deformity & allow bony fusion
- ant approach - may require OLV

Anaesthetic Management

Preoperative

- idiopathic scoliosis:
 - ▶ all should have PFTs:
 - surgery well tolerated even to FVC <32% predicted
 - ▶ ECHO if:
 - >100deg
 - ECG signs RVH
 - evidence of R heart failure
- non-idiopathic:
 - ▶ neuromuscular disease pts hard to assess
 - ▶ mm dystrophies:
 - diff to quantify ex tolerance or perform PFTs
 - ECHO required - many have dilated cardiomyopathy with ↓EF
 - Duchenne - may be on steroids - need peri-op cover

Perioperative

Induction

- as adult spinal:
 - ▶ avoid sux (risk of muscular dystrophy ⇒ rhabdomyolysis, ↑K arrest)
 - ▶ IV propofol & remi

Maintenance

- TIVA with remi
- prone cares
- preparation for large blood loss incl cell saver, controlled hypotension (MAP 50-60) with continuous neuro monitoring
- wake up test no longer performed in presence of continuous neuro monitoring

Pain

- multimodal as spinal surgery in adults:

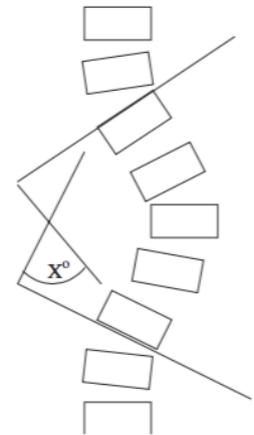


Fig. 1 The Cobb Angle. Perpendicular lines are drawn from the outer surfaces of the upper and lower, maximally tilted, vertebrae. The angle formed by these intersecting perpendiculars determines the Cobb angle (X°).

- ▶ epidural/PVBs
- ▶ NSAIDs after 24hrs

Post Op

- ICU

Shoulder Surgery

Preoperative Management

- often extremely painful (first 48hrs worst)
- discuss interscalene block (warn of numbness + breathlessness from phrenic nerve blockade)
- RA:
 - ▶ ~25% have atlantoaxial instability
 - ▶ establish if any resp compromise with PFTs
 - ↳ interscalene ⇒ ↓25% PFTs
 - ▶ skin & nerve compression injuries

Intraoperative Management

- GA ETT (LMA) +/- shld regional
- don't have access to airway intraoperatively (secure well, use a south facing RAE or reinforced ETT)
- place IV access in opposite arm or feet/ankle
- position; supine with head up, lateral, deck-chair position (change posture slowly as patient with impaired cardiovascular function need time to accommodate)
- potential for air embolism in upright positions
- consider art line - with transducer at correct height
- 3 regional options:
 - ▶ interscalene:
 - C1'ed: contralat phrenic nerve palsy
 - single shot:
 - advs: ↓surg time, ↓blood loss, shorter PACU stay, ↓post op opioids, shorter length of stay
 - bupiv = analgesia for 15hrs
 - catheter:
 - prolonged anaesthesia
 - allow mobilisation
 - eg ropiv 0.2% at 5ml/hr with PCA bolus 2.5ml/30mins
 - ▶ suprascapular nerve block:
 - not as good as interscalene - partial coverage only of joint & no cutaneous cover
 - LM method
 - ~1cm above mid point of scapular spine
 - needle perpendicular to skin
 - use PNS
 - 10ml LA
 - ▶ LA infiltration by surgeon or wound catheter into subacromial bursa/wound
 - efficacy not brilliant

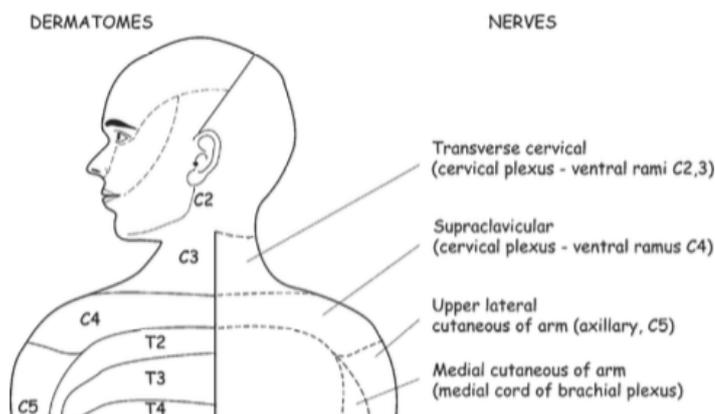


Fig 1 Innervation of the shoulder.

Postoperative Management

- PCA, NSAIDS, Paracetamol required for 1-2 days
- intermittent LA into catheters (better than infusion)
- support arm

Total Shoulder Replacement

Preoperative Management

- co-morbid conditions; elderly, RA, OA
- ask about CVS and RESP status if planning interscalene block

Intraoperative Management

- interscalene block prior to surgery:
 - ▶ covers pain excellently
 - ▶ may see some pain during glenoid phase (can receive fibres from T2)
- art line may be beneficial
- intubated with south facing RAE
- beware of hypotension when changing position
- A/B
- LA infiltration or ICB

Post operative Management

- severe pain post op
- PCA
- NSAIDS

Special points

- air/fat embolism is rare
- high risk pts ⇒ A line

Elbow Replacement Surgery

Preoperative Management

- co-morbid conditions; trauma, severe RA -> atlanto-axial instability
- may be revision

Intraoperative Management

- supine
- minimal blood loss
- moderate pain
- GA (LMA)
- IV opioids
- tourniquet issues
- careful positioning to prevent damage and post pain from other parts of body
- vertical infraclavicular block ideal

Postoperative Management

- ulnar nerve dysfunction common

Hand Surgery

Preoperative Management

- good cases for local or regional (day case) +/- sedation
- IVRA for procedures below arm (<30min)

- make full assessment for GA
- needs to be able to lie down flat for duration of surgery if awake
- empty bladder

Intraoperative Management

- tourniquet issues
- full monitoring
- axillary block ideal +/- augmentation lower in forearm if needed
 - ↳ of infra/supraclavicular blocks
- be ready to convert to GA

Post-operative Management

- if just soft tissue -> usually mild pain
- if involving bone -> increased pain

Major Trauma Surgery

Preoperative Management

- ATLS guidelines
- make own assessment of injuries
- review all investigations (including CXR)
- be aware of developing life threatening injuries -> tamponade, TP, haemorrhage, spinal cord injury, fat embolism
- damage control surgery important - negotiate with surgeons what can be delayed
- warm
- don't delay life saving surgery
- severe TBI (GCS <8) = 50% have C spine injury
- complete transection of C spine very unlikely: generally anterior or central cord syndrome

Intraoperative Management

- Airway – RSI, N/G
- Breathing - ventilator strategy based on injuries
- Circulation –
 - ▶ large access,
 - ▶ permissive hypotension until surgical control of bleeding obtained,
 - ▶ level 1, fluid warmer,
 - ▶ art line when appropriate, CVL not a priority (fem line may be better than IJ)
 - ▶ aggressive treatment of blood loss to prevent 4Hs (hypothermia, hypoxaemia, hypovolaemia hypocoagulability)
- Disability – remember BSL and TBI care
- Exposure - warm

- > if things deteriorating go back to A, B, C, D and E -> diagnose and treat
 - ▶ ↓bp & ↑HR ≈ ↓volume, PTX, tamponade, fat/air embolism
 - ▶ ↓SpO₂/↓PaO₂ ≈ PTX, embolism
 - ▶ ↑bp ≈ pain ↑ICP, traumatic disruption of thoracic aorta

Post-operative Management

- thorough hand over to team taking over care

Cervical Spine # Fixation

- operations;
 1. stabilisation (halo, skull tongs, plaster jacket) -> pain control and prevention of malposition
 2. definitive fixation of bony column
- d/w surgeon approach which can vary: anterior, prone, through mouth

Preoperative Management

HISTORY

- ATLS work up
- comorbidities; RA, neurogenic shock (bradycardia and hypotension)
- quantify degree of respiratory failure

EXAMINATION

- neurological examination

INVESTIGATION

- review x-rays, CT's and MRI

MANAGEMENT

- perform full neurological examination to assess level of spinal cord injury
- assess need for post operative ventilation

Intraoperative Management

- airway;
 - ▶ AFOI (nasal/oral) - coughing can be very uncomfortable
 - ▶ asleep FOI
 - ▶ direct laryngoscopy with inline stabilisation - may still see neck movement
 - ↳ chin lift/jaw thrust likely to cause as much Cx movement as DL
 - ▶ video laryngoscopy
- can't use sux 48 hours – 9 months after injury
- positioning cares
- long operation
- invasive monitoring
- IDC
- hypothermia cares
- anterior approach (supine with head up, sometime transoral approach)
- posterior approach (prone -> get surgeon to control neck, log roll, I should hold ETT, some complete AFOI and then get patient to position self!)
- prevent neuro deterioration during anaesthesia:
 - ▶ neutral head position
 - ▶ optimise spinal cord perfusion (protect recruitable zone of injury):
 - SCPP = MAP - (CSF + CVP)
 - keep MAP >80 (similar to CPP or ICP goals)
 - ▶ monitor cord function eg MEP, SSEPs
- blood loss minimal
- judicious use of fluids and pressors

Post-operative Management

- neurological examination early
- ICU if high spine injury requiring ongoing ventilation
- minimal pain
- NSAIDS
- PCA

Special Points

- acute spinal cord lesions
 - ▶ assoc with neurogenic shock (↓HR, ↓MAP)
 - ▶ use fluid & vasopressors guided by CVP
- later see spinal hyper-relexia
- tracheostomy not advised if pt for ant fusion due to required approach

Other Cervical Spine Surgery

- operations generally done to
 - ▶ relieve compression of cord or roots from:
 - spinal stenosis - congenital, tumours, infection, disc protrusion, RA
 - cervical spondylosis - osteophytic projections in intervertebral joints
 - ▶ improve stability which can lead to stenosis:
 - trauma
 - infection
 - tumours
 - RA

Cervical Instability

Table 1 Definitions of instability

Some definitions of instability

1. Symptomatic
 'Loss of the ability under normal physiologic loads to maintain relationships between vertebrae in such a way that there is neither initial nor subsequent damage to the spinal cord or nerve roots, and there is neither development of incapacitating deformity or severe pain'¹⁹
 2. Radiological measurements
 - (a) Translation
 - C1-C2: anterior atlanto-dental interval >5 mm, posterior ADI <13 mm
 - C2-T1: >3.5 mm between points on adjacent vertebrae
 - (b) Angulation
 - >11° between vertebrae
 - These values have been widely used, but there is a poor correlation between radiographic abnormality and neurological symptoms and signs
 3. Integrity of anterior and posterior spinal columns
 The spine can be thought of as two columns (anterior and posterior), anterior column disruption tending to make the spine unstable in extension and posterior column damage favouring instability in flexion
-

- RA:
 - ▶ asymptomatic instability - 50% of pts with atlanto-axial subluxation (AAS) will be unaware of it
 - ▶ AAS symptoms = pain (neck, occipital, facial), subtle neurology, sudden death
 - ▶ flexion - extension views controversial
- Instability below C2:
 - ▶ = 2 column approach (ant & post)
 - ▶ 1 column intact = functionally stable (not evidence based)
- Occipito-atlanto-axial (OAA) instability:
 - ▶ column approach not appropriate
 - ▶ commonest pattern is anterior AAS instability
 - >3mm abnormal gap between C1 & peg C2
 - due to lax transverse & apical dental ligaments
 - seen in Down's, RA, infections head & neck
- Immobilisation is standard but:
 - ▶ no grade 1 evidence to support its practice

Complications

- Post op airway obstruction:
 - ▶ not uncommon post ant Cx spine surgery:
 - haematoma
 - generalised oedema
 - ▶ usually >6hrs later
 - ▶ presentation:
 - stridor is unusual - swelling is supraglottic
 - subjective SOB with need to sit upright
 - normal SpO₂ until very late

- drain in neck does not help
- ▶ Rx:
 - medical: heliox, dex, adrenaline neb
 - definitive: reintubation in sitting. AFOI or inhalational SV technique with bougie
- Eye damage:
 - ▶ corneal abrasion - poor taping
 - ▶ ischaemic optic neuropathy (ION) - prone
 - ▶ central retinal artery thrombosis (CRAT) - inappropriate ext pressure

Limb #'s

- Long bone # complications:
 - ▶ haemorrhage
 - ▶ arterial injury ⇒ ischaemia
 - ▶ nerve injury
 - ▶ DVT
 - ▶ compartment syndrome
 - ▶ fat embolism syndrome

Preoperative Management

- MUA -> ORIF
- quantify other injuries
- if has mod-severe TBI (<24hrs) then non-life saving surgery should be delayed
- is c-spine cleared?
- ALTS review

Intraoperative Management

- operation duration can be minutes to hours
- may need RSI
- blood loss can be variable
- A/B prophylaxis
- be aware of fat embolism
- if TBI: may need ICP monitoring +/- post operative ventilation

Post operative Management

- analgesia
- RA can mask compartment syndrome or can miss radial nerve damage post humeral # reduction and repair.

Procedures/Issues

IV Regional Anaesthesia (Biers Block)

- Agent = prilocaine 0.5% (preservative free)
- Dose = dependent on arm size - normal dose for average arm size = 50mL of 0.5% = 250mg (= 3mg/kg)
- Maximum safe dose = 6mg/kg
- Other options
 - ▶ lignocaine however this has a lower therapeutic range with max dose of 3mg/kg
 - ▶ procaine
 - ▶ chlorprocaine

Reasons for using Prilocaine:

PC

- cheap
- preservative free (decreased thrombophlebitis, increased block efficacy)
- readily available
- registered for IV block use
- no pain on injection (unlike chlorprocaine)

PD

- proven efficacy with technique
- fast onset
- offset determined by tourniquet time so duration of action irrelevant
- low CNS:CVS toxicity compared to other agents

PK

- increased Vd and PB -> decreased plasma concentration so decreased toxic risk
- is the most rapidly metabolised amide A
- significant pulmonary extraction -> decreased plasma concentration when cuff deflated
- THUS is safer in the event of accidental arm tourniquet deflation
- minimum tourniquet time (prilocaine 15min, lignocaine 20min)
- risk of methHb (problem with dose >600mg or G6P deficiency) -> but can be readily treated with methylene blue (1-2mg/kg)

Benefits of Biers Block

- safe
- quick to establish and set up
- cost effective
- doesn't require theatre (can be performed in ED with full resuscitation equipment available)
- good analgesia
- no pain on injection of prilocaine
- accepted technique
- patient not exposed to side effects of GA (POCD, MI, CVA, PONV, nerve injury, aspiration, failed airway)
- minimal post operative complications (can be discharged)
- patient is awake and can report any adverse symptoms

Disadvantages of Biers Block

- risk of accidental tourniquet release/failure with subsequent LA toxicity
- methaemaglobinaemia with prilocaine
- tourniquet risks (nerve, muscle, vascular damage, tourniquet pain, hypotension from products of anaerobic metabolism @ cuff deflation)
- patients aware of manipulation (may have vasovagal)
- requires special equipment (IV x 2, full resuscitation equipment, monitoring, tourniquet)
- requires fasted patient

- not 100% reliable -> some patients get breakthrough pain on manipulation
- no postoperative analgesia

Beach Chair Position

Problems

- Access to Airway limited
 - ▶ intubate patient (LMA may become dislodged intraoperatively)
 - ▶ patient not in optimal position for emergent re-intubation
 - ▶ securing ETT with tape and ties
 - ▶ ensuring there is no tension on ETT from circuit
- Eye compression - appropriate padding and protective lenses
- Vascular compression - appropriate padding
- Nerve Injury:
 - ▶ brachial plexus - risk of stretching if head laterally tilted away from surgical site
 - ▶ ulnar nerve - risk of compression neuropraxia if elbow flexed and ulnar groove against hard surface (use pillows and padding to protect)
 - ▶ occipital nerve compression
 - ▶ auricular nerve compression
 - ▶ sciatic nerve compression at knee - provide some knee flexion
- MSK - patient palling off
- IV access difficulty
- Eye - blindness 2nd to hypotension/compression of eye
- DVT prophylaxis
 - ▶ TEDS
 - ▶ intermittent, pneumatic calve compressors
 - ▶ preoperative LMWH
- Hypotension:
 - ▶ can be multi-factorial ->
 - bleeding,
 - ↓VR from legs (below level of RA),
 - preoperative dehydration,
 - side effect of anaesthetic drugs
 - ▶ cerebral hypotension possible despite normal NIBP @ arm - head above BP measurement
 - this may lead to watershed infarcts
 - use IVF & vasopressors, gentle induction, compression stockings to increase VR
- Venous Air Embolism (VAE)
 - ▶ operative site is above the RA in the beach chair position
 - ▶ large vein accessed ⇒ air ingress ⇒ embolism into pulmonary capillary bed ⇒ ↓Q with acute right heart failure ⇒ hypoxaemia and cardiovascular collapse.
 - ▶ communication with surgeon
 - ▶ preoperative assessment of PFO
 - ▶ saline to flood surgical field
 - ▶ intraoperative TOE to detect bubbles
 - ▶ if occurs; declare emergency, call for help, FiO2 1.0, lay patient down in left lateral position, place gentle pressure over jugular veins, flood surgical site with saline, if CVL insitu and is placed in RA -> aspirate, turn N2O off if using, supportive care.
- Massive Bleeding
 - ▶ large vessels surrounding the shoulder joint (axillary and subclavian vessels)
 - ▶ ensure coagulation normal and anti-platelet medication minimised
 - ▶ careful surgical technique important
 - ▶ if bleeding is intrapleural -> emergency chest drain placement may be indicated
- Pneumothorax:
 - ▶ careful surgical technique required
 - ▶ if pleural or lung parenchyma breeched:
 - declare an emergency, call for help,
 - assess and manage A, B, C.
 - On table CXR or PTX,

- chest drain insertion should be carried out urgently as patient at risk of developing tension pneumothorax

Prone Position

Problems

- Limited access to the Airway
 - ▶ must be secured properly
 - ▶ check position after turning patient
 - ▶ use an non-kinking ETT (reinforced)
 - ▶ ensure there is no bulky attachments pressing into face
 - ▶ a throat pack can be used to decrease the amount of secretions draining onto pillow
- Post-operative blindness:
 - ▶ 2 forms:
 - posterior ischaemic optic neuropathy:
 - from a decrease in perfusion pressure to the pial blood vessels supplying optic nerve
 - RFs = male, obese, >6hr surgery, anaemia, ↑blood loss
 - No clear preventable factors
 - central retinal artery occlusion: from direct pressure on globe ⇒ ↑IOP ⇒ ↓perfusion
 - ▶ 1:60,000 to 1:120,000
 - ▶ risk factors include; spinal surgery (70% of cases), anaemia, congenital absence of central retinal artery, infection, venous obstruction, internal carotid dissection, blunt trauma of eye, cardiac arrest
 - ▶ should document eye checks 30min-hourly
 - ▶ minimise IOP by avoiding head down position (10 degrees of reverse trendelenburg ideal)
 - ↳ Wilson frame associated due to dependant position of head
- Ventilation difficulties:
 - ▶ excessive pressure on the thorax and abdomen can causing high airway pressures
 - ▶ increased pressure on the diaphragm -> basal atelectasis and need for higher lung inflation pressures (particularly in obese patient)
- Potential nerve damage:
 - ▶ arms are usually placed above head
 - ▶ be aware of brachial plexus stretching or it being pressed against mattress
 - ▶ ulnar nerve = most common ink in closed claim
 - ▶ ensure axilla is not under tension after positioning
- Abdominal organ ischaemia:
 - ▶ hepatic & pancreatic dysfunction due to ↑ed pressures
- Decreased access to monitoring & vascular access:
 - ▶ check lines after positioning
 - ▶ ensure all are adequately working before draping patient
- Hypotension:
 - ▶ increased blood loss
 - ▶ increased abdominal pressure -> compresses veins and decreases venous return -> hypotension or increase bleeding from surgical site
- Peripheral pressure areas:
 - ▶ breasts, genitalia, nose, eyes, chin, elbows, knees and ankles
 - ▶ pillows and pads should be used judiciously
 - ▶ monitor and move limbs every hour to prevent pressure necrosis
- Risk to staff when positioning patient:
 - ▶ when turning patient from supine -> prone and back again
 - ▶ may require log rolling
 - ▶ risk to patient if axial twisting take place (particularly if spine unstable)
 - ▶ there are mechanical hoists that can help with this procedure
- Difficulty interpreting CVP:
 - ▶ because of difficulty estimating level of RA
 - ▶ rarely required
 - ▶ trend can be followed

ERAS After LL Arthroplasty

- key concepts of ERAS:
 - ▶ improving preop care
 - ▶ ↓ physical stress of operation
 - ▶ ↓ post op discomfort
 - ▶ earlier mobilisation & early supported d/c
- Key points:
 - ▶ preop
 - optimisation of anaemia - by GP
 - meds: gabapentin, simple analgesia incl NSAIDs, steroids
 - ▶ intraop:
 - non opioid spinal with propofol sedation
 - ↳ ↓s catheterisation rate to ~7%
 - ketamine 0.25mg/kg
 - TXA 10-15mg/kg (1-1.5g)
 - ↳ ↓transfusion need in TKJR to 1%
 - restrictive fluid regime
 - high volume ropiv 0.2% (with adrenaline 0.5mg) by surgeon
 - 150mls into joint capsule (or 100mls in <50kg, >80yrs, ASA III, IV)
 - ▶ postop:
 - cryocuff
 - gabapentin for 5/7
 - long actin opioid & PRN breakthrough
 - mobilisation day 0 to toilet
 - rescue pain plan:
 - femoral nerve block
 - epidural
 - PCA
- (no evidence that pt education ↓s LOS or pain but may ↓ anxiety)

Necrotising Fasciitis

= progressive fulminant bacterial infection of subcut tissue which spreads rapidly though the fascial planes ⇒ extension destruction

- can spread through any part of body
- most serious is necrotising soft tissue (NSTI)

Classification

- by microorganism
 - ▶ type I:
 - most common
 - 4 diff organisms present: gram +ve cocci, gram -ve rods & anaerobes
 - most frequent in perianal & trunk in immunocompromised
 - Fourniers gangrene = NF in perineal, perianal & genital region
 - RFs: obesity, CRF, HIV, alcohol abuse, IVDA, trauma etc
 - ▶ type II:
 - grp A strep (pyogenes) alone or with staph aureus
 - generally body extremities
 - assoc with toxic shock syndrome & MRSA
 - ▶ type III:
 - gram -ve non microbial NF
 - uncommon
 - 30-40% mortality
 - ▶ type IV:
 - fungal Candida
- by location
- by depth of infection:
 - ▶ stage 1 = erythema, tenderness, swelling, hot skin

- ▶ stage 2 = formation skin bullae, blister, skin fluctuation
- ▶ stage 3: haemorrhagic bullae, crepitus, skin necrosis

Pathophysiology

- microbial invasion of tissues from perforated skin or internal organ
- bacterial growth in superficial fascia ⇒ release enzymes, toxins ⇒ spread through this fascia
- result is:
 - ▶ thrombosis small vessels ⇒ poor microcirculation ⇒ profound ischaemia ⇒ cell death
- early stages see:
 - ▶ normal skin
 - ▶ chemical markers inconsistent with significance of infection

Diagnosis

- NF vs cellulitis similar but:
 - ▶ ↑pain compared with clinical findings
 - ▶ dermatological features:
 - skin may not look affected early
 - stage 1 = erythema, swelling, hot but pain beyond erythema
 - stage 2 = skin bullae, blistering (v rare in cellulitis)
 - stage 3: haemorrhagic bullae, crepitus, skin necrosis
 - ▶ lymphangitis rare

Investigations

- clinical diagnosis
- gold standard = surgical exploration:
 - ▶ fascial necrosis along planes
 - ▶ myonecrosis
 - ▶ lack of resistance to blunt dissection
 - ▶ lack of bleeding
 - ▶ foul smelling dishwater pus
- Bloods:
 - ▶ FBC - like standard sepsis
 - ▶ Biochem:
 - ↑CK = myositis
 - ↓Ca = fat necrosis
 - other sepsis findings
 - ▶ Blood cultures - +ve in ~50% if group A strep
 - ↳ scoring systems do exist
- Tissue biopsy an option but slow
- Imaging:
 - ▶ can be useful but should not delay surgery if though indicated
 - ▶ CT = fascial thickening & enhancement with fluid & gas in soft tissue planes
 - ▶ MRI =
 - mode of choice given time
 - can differentiate necrotic & inflamed tissue

Treatment

- early diagnosis
- aggressive resuscitation
- surg debridement -
 - ▶ most imp't Rx
 - ▶ do early
 - ▶ often multiple debridements
 - ▶ vacuum dressings
- Abx:
 - ▶ cannot penetrate necrotic tissue
 - ▶ empiric: tazocin + clindamycin
 - ▶ Group A strep = penicillin & clindamycin
- ICU support
- (hyperbaric O₂ - can enhance neutrophil action & switch off toxin production)

Anaesthetic Implications

- Preop:
 - ▶ severity of sepsis
 - ▶ resuscitation
- Intra-Op:
 - ▶ invasive monitoring
 - ▶ CVL & NA
- Post Op:
 - ▶ ICU
 - ▶ adequate analgesia