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# Practical Anaesthesia

## Creatinine Clearance

- pre-op renal dysfunction = indep RF for morbidity & mortality
- creatinine =
  - ▶ product of skeletal mm metabolism
  - ▶ undergoes limited renal tubular secretion
  - ▶ ∴ clearance = GFR
- normal GFR = 125ml/min
- GFR ↓s by 1%/yr after 30yrs old
- plasma creatinine = rectangular hyperbolic relationship with creatinine clearance:
  - ▶ GFR must be ↓50% before ↑plasma creatinine
  - ▶ small changes in serum creatinine = large change in GFR
    - ↳ ∴ is v sensitive test
- low mm mass ⇒ little creatinine to clear ∴ normal plasma creatinine might mean abnormal GFR
- Creatinine clearance estimated using Cockcroft-Gault formula

$$\text{Creatinine clearance (mL/min)} = \frac{(140 - \text{age}) \times \text{weight (kg)}}{0.814 \times \text{serum creatinine (micromoles/L)}} \quad (\times 0.85 \text{ for women}).$$

# By Disease

## Chronic Renal Failure

### Preoperative

- CRF classification
  - ▶ stage 1 = normal GFR but other evidence of renal damage
  - ▶ stage 2 = GFR 60-90 and other evidence of renal damage
  - ▶ stage 3 = 30-60
  - ▶ stage 4 = 15-30
  - ▶ stage 5 = <15ml/min
- Dialysis <15mL/min
- ESRF <5mL/min
- multi-system disease
- causes:
  1. DM - 30%
  2. HT - 24%
  3. GN - 17%
  4. chronic pyelonephritis - 5%
  5. polycystic renal disease - 4%
  6. unknown - 20%

### HISTORY

- when diagnosed
- type of dialysis (frequency, line or fistula)
- residual urine output
- last dialysis
- target weight
- thorough review of symptoms
- diagnosis
- chart review
- medications
- co-morbidities: DM, IHD, CVA, LVF, valve disease, pericardial disease
- complications:
  - CVS: IHD, HT, cardiac failure, fistulae, pericardial effusions, access problems
  - RESP: fluid overload
  - CNS: uraemia, encephalopathy
  - HAEM: anaemia, platelet dysfunction
  - ABDO: peritonitis
  - MUSCULO: gout, osteodystrophy
  - METABOLIC: uraemia, hypocalcaemia, hyperphosphataemia,
- transplant problems: rejection, infection, complications of immunosuppression
- functional limitation

### EXAMINATION

- CVS: fluid overload/hypovolaemia, BP, weight (+ ideal body weight), fistulae or access line integrity, oedema
- RESP: fluid overload

CNS: peripheral neuropathy, GCS  
 GU: abdominal examination (kidneys and transplant)

## INVESTIGATIONS

- FBC – normochromic, normochromic, normocytic anaemia (aim for Hb 80-100), platelets
  - ↳ ↓EPO, ↓rbc survival & GI losses
- Bloods:
  - ▶ K<sup>+</sup> - if >6 need preop dialysis
    - ↳ drugs ⇒ ↑K = sux, NSAID, βblockers, ACEI, spironlactone, tacrolimus/ciclosporin
  - ▶ low or high Na<sup>+</sup> (low salt diet)
  - ▶ urea -> platelet dysfunction
  - ▶ hypocalcaemia 2nd to ↓vit D
  - ▶ hyperphosphataemia
  - ▶ metabolic acidosis - esp pre dialysis 2nd to ↓HCO<sub>3</sub>
  - ▶ ↑Mg as don't excrete
  - ▶ ↑aluminium - from phosphate binders
- Acoag's
  - ▶ usually normal
  - ▶ note uraemia ⇒ impaired platelets ⇒ ↑ed bleeding time
- ABG: metabolic acidosis
- CXR: pericarditis, catheter position
- ECG:

## MANAGEMENT

- allow 4 to 6 hours between haemodialysis and surgery (equilibration time and elimination of heparin)
- urgent dialysis indications = uraemia, hyperkalaemia, acidosis, fluid overload
- platelet dysfunction -
  - ▶ not improved by platelet transfusion
  - ▶ give DDAVP 0.3mcg/kg IV in 30mls NSL over 30min
- may need ICU
- liaise closely with renal team

## Intraoperative

- don't muck around with fistula or forearm (no IV's or NIBP)
  - ↳ wrap in softban
- cannulate other arm in dorsum of hand (in case future fistula on that side)
- use dialysis catheters as IV access as last resort
- maintain normovolaemia
- invasive monitoring can be useful (avoid femoral if possible future transplant)
- K management:
  - ▶ balanced crystalloid better than NSL even though has K (less acid load)
  - ▶ avoid ↑CO<sub>2</sub>, ↓temp
  - ▶ sux increases K<sup>+</sup> by 0.5mmol/L
- reflux care (autonomic dysfunction) - high dose roc & suggamadex (if GFR >30)
- asepsis - humoral & cell mediated immunity is inhibited
- staff protection (Hep B and C common)
- careful use of analgesics (fentanyl, morphine, LA, paracetamol – cautious dosing)
- decision to place epidural done with caution

## Postoperative

- careful fluid balance
- good analgesia
- avoid nephrotoxic agents

## Drugs

- general principles:

- ▶ loading doses unchanged -> reduce maintenance doses or frequency
- ▶ ↓albumin & acidosis ⇒ ↑free drug in highly protein bound drugs
- to avoid:
  - ▶ analgesics -> tramadol, pethidine, NSAIDS
  - ▶ volatiles -> enflurane (prolonged used of sevo c/o inorganic fluoride ion production)
  - ▶ NDNMBD -> vecuronium, rocuronium, pancuronium
- analgesics:
  - ▶ codeine half live x6 longer
  - ▶ oxycodone
    - has active metabolites but ↓ed activity compared to M6G
    - ↓dose & prolonged intervals
  - ▶ tramadol - active metabolites - ↓dose & avoid in ESRF
- inductions agents:
  - ▶ ↓30%
  - ▶ ↑dose of propofol required
- volatiles:
  - ▶ sevo ok for induction
  - ▶ will produce inorganic fluoride ions if >4MAC hours - avoid prolonged use
- relaxants:
  - ▶ roc & vec will have prolonged action for same dose
  - ▶ suggamadex
    - excreted unchanged in urine
    - not recommended if GFR <30ml/min
    - unpredictably removed by dialysis
  - ▶ excretion of neostigmine & glyco prolonged in CRF
- LAs:
  - ▶ duration of action is ↓ed
  - ▶ ↓max dose by 25% due to ↓PPB & ↓seizure threshold
- Antibiotics:
  - ▶ normal loading dose, with ↓ed dosing/maintenance dose

	Drugs safe in CRF	Drugs safe in limited or reduced doses	Drugs contraindicated in CRF
Premedication	Lometazepam, midazolam, temazepam		
Induction	Propofol	Ketamine, etomidate, thiopental	
Maintenance	Isoflurane, desflurane, halothane, propofol	Sevoflurane	Enflurane
Muscle relaxants	Suxamethonium, atracurium, cisatracurium	Vecuronium, rocuronium	Pancuronium
Opioids	Alfentanil, remifentanil	Fentanyl, morphine, oxycodone	Pethidine, codeine, tramadol
Local anaesthetics	Bupivacaine, lidocaine (reduce dose by 25%)		
Analgesics	Paracetamol		NSAIDs

# Acute Renal Failure

## Preoperative

- risk factors:
  1. pre-existing problems (renal compromise, DM, advanced age)
  2. perioperative (sepsis, hypovolaemia)
  3. drugs (NSAIDS, ACE I, diuretics, lithium, chemo, contrast)
  4. trauma (rhabo)
  5. surgery (hepatorenal syndrome, vascular, renal)
  6. abdominal compartment syndrome
  7. urinary obstruction

## HISTORY

- think causes:
  - ▶ pre renal
  - ▶ intra renal
  - ▶ post renal
- ask about RF's as above
- symptoms of overload
- symptoms of hypovolaemia

## EXAMINATION

- fluid review
- hourly urine output

## INVESTIGATIONS

- urinary electrolytes can help differentiate:
  - ▶ hypoperfusion =  $\text{Na}^+ < 20\text{mmol/L}$ , urine osmolality  $> 500\text{mosmol/kg}$
  - ▶ ATN =  $\text{Na}^+ > 20\text{mmol/L}$ , urine osmolality  $< 500\text{mosmol/kg}$
  - ↳ meaningless if diuretics been given
- creatinine & urea (less specific)
  - ↳ also ↑ in dehydration, GI bleed, sepsis, excessive diuretics
- $\text{K}^+$
- CrCl (24 hour urine required)
- renal U/S (r/o obstruction)

## MANAGEMENT

- maintain U/O  $> 0.5\text{ml/kg/hr}$
- rehydrate
- invasive monitoring
- MAP  $> 70$  ( $> 85$  in hypertensive)
- inotropes as required
- if full & normotensive -> diuretics can be tried
  - ↳ furosemide 250mg over 1hr
- mannitol 0.5g/kg IV
- renal consult

## Intraoperative

- same as above

## Postoperative

- avoid nephrotoxics
- avoid dehydration
- close monitoring of U/O

- IAP measurement (may need laparosotomy if intra-abdo HTN)

# By Surgery

## Renal Transplantation

### Renal Transplant Criteria (NZ)

- > 80% survival @ two years from all causes
- age < 65
- BMI < 35
- solid organ cancer (> 2 year disease free or longer)
- no hepatitis B or C
- rigorous IHD assessment and optimization

### Preoperative

#### HISTORY

- when
- indication
- immunosuppression drugs
- chart review

- co-morbidities:

#### EXAMINATION

- fluid status
- site of donor kidney

#### INVESTIGATIONS

- U+E: Cr may be normal but renal function isn't (only 50% of nephrons work)

#### MANAGEMENT

- close liaison with renal team about perioperative plan
- optimise prior to surgery

### Intraoperative

- strict asepsis
- avoid hypovolaemia and hypotension
- avoid nephrotoxic agents
- careful positioning during operation c/o damage to transplant
- steroid (methylprednisone) prior to reperfusion
- Aim CVP 10-12 - may need 60-100ml/kg of fluid
- evidence for dopamine, mannitol & frusemide is sparse

### Postoperative

- aggressive monitoring
- fluid = 30ml + losses +UO/hr
- UO >0.5ml/kg/hr
  - ↳ early onset urine output = directly correlated with graft survival
- MDT input

### COMPLICATIONS

#### Early

- infection



- bleeding
- pain
- renal failure and graft maintenance

### **Late**

- rejection (hypertension, proteinuria and worsening renal function)
- immunosuppression
- lymphoma

## **Anaesthesia in Patient with Renal Transplant**

- serum creatinine may be normal but renal function & creatinine clearance is not normal
- transplanted kidney is never normal cos:
  - ▶ half functioning nephrons
  - ▶ ciclosporin (immunosuppression) ↓function
- strict asepsis
- d/w nephrologist ⇒re continuing immunosuppression throughout
- maintain CVS to ensure kidney perfusion
- avoid nephrotoxic drugs ie NSAIDs
- careful prone positioning to avoid transplant problems

## **Living Donor Transplant Nephrectomy**

- best results for transplant
- donor mortality = 0.02%
- laparoscopic in L lateral
- post op pain an issue ⇒ PCA, wound catheter, PVB
- post op renal function improves to ~75% of normal in time

## **Fistula Formation**

- Anaesthesia based on location:
  - ▶ brachio basilic fistula = local
  - ▶ brachiocephalic fistula = supraclavicular/axillary
- avoid hypotension ⇒ thrombosis
- fistula used 3-4weeks post dialysis

## **Peritoneal Dialysis**

- requires placement of catheter into peritoneum:
  - ▶ temporary (hard)
  - ▶ permanent (soft) = Tenckhoff
- insertions requires mini-laparotomy