Identification & Treatment of Acute Renal Failure

Lecture 12: Snake Bite Management Course

Introduction

- There are multiple potential causes of acute renal failure in snake bite in Cambodia
- The most important species, perhaps the only one, causing direct (primary) nephrotoxicity is Russell's viper
- Most causes are secondary
- Be alert for pre-existing causes renal function impairment
- The presentations of acute renal failure are discussed
- Treatments for acute renal failure, its causes & its complications are presented

Acute Renal Failure - Definition

- Reduction on glomerular filtration rate or other significant renal function measure
- Some causes are irreversible - eg cortical necrosis
- Most are reversible (eg. acute tubular necrosis), with good supportive care
- This may result in renal failure which is:
  - Non-oliguric
  - Oliguric
  - Anuric
- Recovery from acute renal failure (ATN) is often accompanied by polyuria

Estimating Glomerular Filtration Rate (1)

- Calculating GFR can be effectively based on creatinine, height, age, sex
- Estimated & provided routinely be some labs, using other methods, including urea
- Most accurately measured by measuring the creatinine level in a 24-hour urine sample & comparing this to the serum creatinine level

Estimating Glomerular Filtration Rate (2)

- Adults:
  - Males: $186.3 \times (Cr/88.4)^{1.154} \times AGE^{0.203}$
  - Females: $186.3 \times (Cr/88.4)^{1.154} \times AGE^{0.203} \times 0.742$
  - Example: F/38 with creatinine of 716 umol/L
  - $186.3 \times (716/88.4)^{1.154} \times 38^{0.203} \times 0.742$ = eGFR of 5.9
- Children (0-18 yrs):
  - 41.3 x (Height/Cr)
  - Example: M/12, 146 cm with creatinine of 235 umol/L
  - 41.3 x (146/235) = eGFR of 25.6

Estimating Glomerular Filtration Rate (3)

- Critical values, ml/min:
  - 90+ normal
  - 60-89 mildly reduced
  - 30-59 moderate impairment
  - 15-29 severely reduced
  - <15 end stage renal failure

Causes of Acute Renal Failure after Cambodian Snake Bite

- Primary:
  - Russell's viper: acute glomerulonephritis
- Secondary:
  - Shock due to oedema & blood loss
  - Severe hypoxia
  - Some forms of coagulopathy
  - Prolonged dehydration
  - Bladder outlet obstruction
  - Use of NSAIDs for analgesia
  - Haemoglobinuria & myoglobinuria
  - Intraparenchymal renal haemorrhage

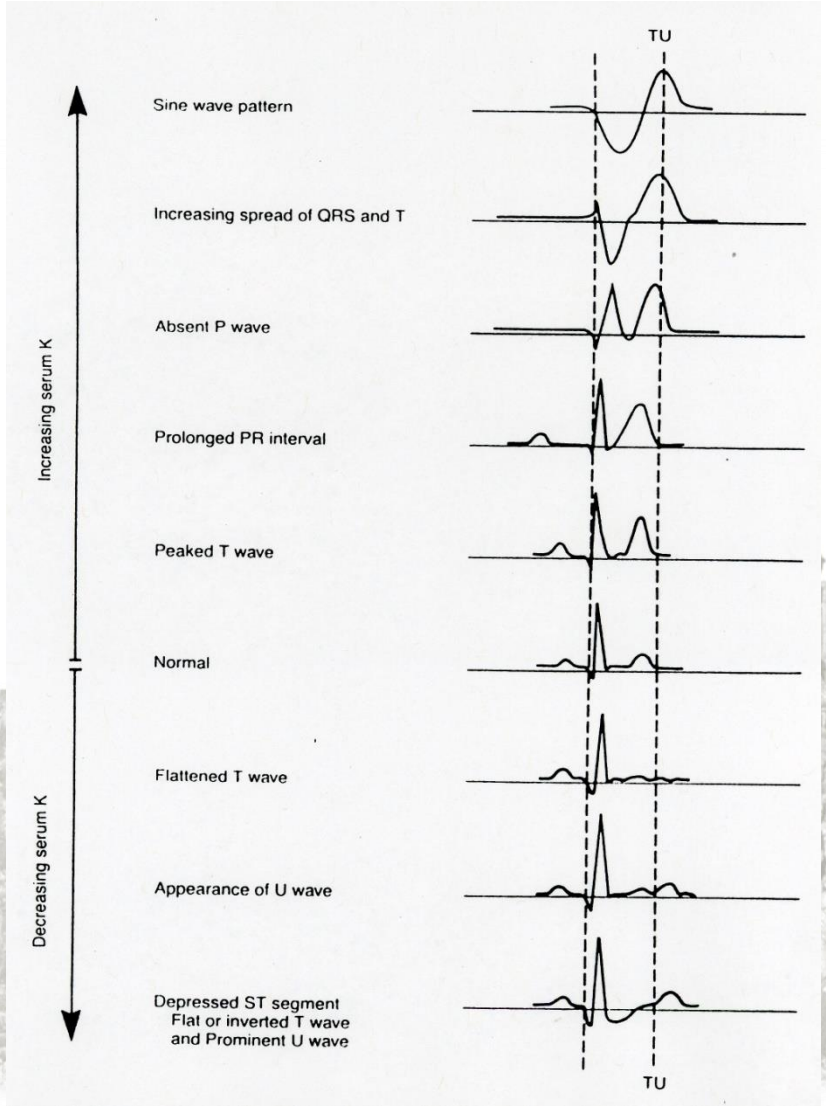
Causes of Chronic Renal Failure

- Diabetes
- Hypertension
- Post-streptococcal
- Tb

Effects of Acute Renal Failure

- Reduced urine output (oliguria or anuria)
- Raised creatinine & urea
- Fluid retention +/- pulmonary oedema (widespread fine crackles)
- Renal/metabolic acidemia/acidosis, due to reduced excretion of acids, causing organ dysfunction at pH<7.2
- Both are associated with Kussmaull's breathing, "air hunger", a specific clinical presentation
- Hyperkalemia, possibly causing peaked T waves, wide QRS complexes, bradycardia/asystole or tachycardia/VT/VF

ECG Changes of Hyperkalemia



Treatment of Acute Renal Failure

- Effective treatment must consider:
  - Treating the complications/effects of ARF
  - Treating the causes of the ARF
- All patients MUST have close monitoring & a urinary catheter, good oxygenation & maintenance of a good perfusion pressure
- ALL will benefit from early appropriate antivenom

Treatment of Effects of ARF (1)

- Hyperkalaemia:
  - ECG:
    - Peaked T waves
    - wide QRS complexes on ECG
    - bradycardia or tachycardia
    - may suddenly deteriorate to VF or VT, asystole
  - as per standard treatment manuals:
    - Ca gluconate 10-20ml IV
    - 100-200ml 8.4% $NaHCO_3$ IV
    - 20mg nebulised salbutamol
    - glucose/insulin infusion (50ml 50%, 10u Actrapid) IV
    - +/- IV saline
    - frusemide 40-80mg IV
    - K^+-exchange resin (Resonium A, B)
    - peritioneal dialysis or haemodialysis (PO, OGT, PR)
    - low-K diet if eating - no bananas or citrus fruit

Treatment of Effects of ARF (2)

- Pulmonary oedema:
  - frusemide IV 20-40mg (large does may be required)
  - Continuous Positive Airway Pressure may help
  - IV mannitol (0.25m/kg over 30mins) +/- repeat
  - consider haemodialysis (PD less effective, though used widely used in Burma)

Treatment of Effects of ARF (1)

- Indications for dialysis:
  - Resistant hyperkalaemia or pulmonary oedema
  - Severe acidaemia pH<7.0
  - Anuria & severe fluid retention, not responsive to good supportive care (good oxygenation & perfusion pressure)

Treatment of Causes of Acute Renal Failure

- **Prevent** renal failure if possible by:
  - Avoid hypoxia & hypotension
  - Give appropriate antivenom as early as indicated, to reduce the risk of ARF
  - Maintain hydration, or treat dehydration - give adequate maintenance fluids
- Treat any of the above things, if present

Other Issues

- Monitor hourly urine output, ideally 1-2ml/kg/hr in children, 0.5-1.0ml/kg in adults
- Avoid massive positive fluid balances
- Prevent & treat urinary tract infection
- Renal tract ultrasound if persistent renal dysfunction (more than a week, of earlier if possible)
- Measure daily urea, creatinine & electrolytes, VBG/ABG
- In the presence of rhabdomyolysis (direct or due to prolonged tourniquet use):
  - alkalinise the urine with IV 8.4% $NaHCO_3$ (30ml/litre of IV fluid)(urine pH > 7.5)
  - monitor for compartment syndrome - pain, pallor, parasthesiae, & pulselessness (late!); elevate
  - **avoid** surgical intervention (cf. necrosis due to tourniquet use, which may require amputation)
  - analgesia!
  - muscle rehabilitation, physiotherapy

Anuric Renal Failure - 28l Positive Fluid Balance

Summary - Key Points

- Avoidance of renal failure, using good supportive care, is vital
- If it still occurs, suspect Russell's viper
- Look for & treat complications
- Know the indications for dialysis (PD & HD) and where to refer patients for this

Treatment of Myotoxicity

- **ANTIVENOM**
- Maintain good urine output 1-2ml/kg/hr
- Alkalinise IV fluids to reduce precipitation of myoglobin:
  - 30ml of 8.4% $NaHCO_3$ per litre of crystalloid
  - probably useful until anuric renal failure is established
  - then is potentially useful for hyperkalemia/acidemia
- Monitor closely for signs of renal failure
- Physiotherapy upon recovery of motor nerve function & after antivenom therapy