

GUIDELINES ON INVESTIGATION AND MANAGEMENT OF ACUTE RENAL FAILURE

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Definition

- Sudden, and often reversible, decline in glomerular filtration rate, with or without oliguria.
- Oliguria = urine output < 0.5 ml/kg/hr (or < 1ml/kg/hr in neonates)
- Anuria = urine output < 1 ml/kg/day

Aetiology

Pre-renal failure

- Hypovolaemia (dehydration, GI losses, third space losses- sepsis, nephrotic syndrome)
- Impaired cardiac output (congestive heart failure, pericarditis, tamponade)
- Renal vessel occlusion
- Hepato-renal syndrome

Intrinsic renal disease

- Acute tubular necrosis (ischaemic-hypoxic injury, drug or toxin mediated)
- Interstitial nephritis
- Glomerulonephritis
- Tumour lysis syndrome/ tumour infiltrate
- Myoglobinuria as a result of rhabdomyolysis
- Haemolysis causing renal tubular damage (HUS)

Post-renal or obstructive uropathy

- Posterior urethral valves
- Bilateral ureteric obstruction (trauma, calculi)
- Urethral obstruction (trauma, calculus)

Key features in history

- Current urine output
- Fever, diarrhoea or vomiting, reduced fluid intake
- Recent drugs (prescribed or otherwise)
- Previous UTIs
- Urinary symptoms
- Family history of renal disease

Clinical assessment

- ABC
- Hydration status- peripheral circulation, oedema
- Signs of cardiac failure

- Blood pressure (changes are late and measurements in isolation not usually helpful)
 - ↓ BP with cool peripheries → intravascular depletion and shock
 - ↑ BP with warm peripheries → fluid overload
- Neurological examination
- **ALWAYS** plot height and weight on a growth chart and weigh **atleast** daily. Ideally this should be at the same time each day, particularly in small children, so as to avoid inaccuracies relating to fluid intake.

Investigations

Ensure no life-threatening features present

- Pulmonary oedema (blood gas, CXR)
- Hyperkalaemia (urgent U+Es on blood gas)

These investigations should be carried out on all patients

- Biochemistry- U+E, creatinine, LFT, Ca, PO₄, Mg, urate (tumour lysis syndrome)
- Haematology- FBC and blood film, coagulation
- Blood culture and CRP
- Urinalysis and microscopy for casts
- Urine sodium
- Plasma and urine osmolality
- Urgent renal ultrasound (ideally within 24 hours, earlier if obstruction suspected)

The most common cause of ARF in children is pre-renal (hypovolaemia). Other investigations should be considered based on clinical presentation

Haemolytic uraemic syndrome

- Blood film if not done already
- Group and save/ crossmatch
- Stool culture
- Serology for E.Coli 0157

Glomerulonephritis

- C3 and C4
- ASOT and throat swab
- ANA, dsDNA, ANCA, anti-GBM antibodies

Acute on chronic

- PTH
- XR of left wrist and hand (renal osteodystrophy)

Ongoing investigations

- U+E, creatinine, bicarbonate (upto 6 hrly)

- Bone profile, albumin (daily)
- FBC (daily)
- Urinalysis (daily)
- Urine electrolytes (daily)
- Weight (daily)

If cause uncertain and renal function deteriorating, a renal biopsy is indicated and the patient should be referred to the nearest tertiary unit.

Value of urinary electrolytes in determining cause

	Pre-renal	Intrinsic	Post-renal
Osmolality (mosm)	> 500	< 300	< 350
Sodium (mmol/L)	< 10	> 40	> 40
Fractional excretion sodium FE Na (%)	< 1	> 2	< 2

$$\text{FE Na (\%)} = 100 \times \frac{\text{Na}_{(\text{urinary})} \times \text{Creatinine}_{(\text{plasma})}}{\text{Na}_{(\text{plasma})} \times \text{Creatinine}_{(\text{urinary})}}$$

Management

Early discussion with the tertiary renal unit is advisable. This should be the on-call registrar (or consultant) at Evelina Children's Hospital if the patient is not already known to another unit.

Fluid balance

Initial

- **Hypovolaemic-** Initial fluid resuscitation 10-20 ml/kg normal saline then reassess
- **Euvolaemic-** Fluid challenge with 10-20 ml/kg normal saline. Consider 2-5 mg/kg furosemide if no urine response
- **Overloaded-** Furosemide 0.5-2 mg/kg (upto 4 mg/kg if severe) with fluid restriction

Ongoing management

- Accurate input/output
- Atleast daily weigh
- BP and toe-core temperature gradient monitoring
- Initially fluid replacement should equal **insensible losses** (400 ml/m²/day) plus **urinary output** (UO)
- Increase insensibles if pyrexial, sweating, hyperventilating, vomiting or profuse diarrhoea
- Restrict to 50-75% of UO if overloaded
- Beware of polyuric recovery phase- initially replace UO and insensibles for 24-48 hrs, but possibly longer. If renal function continuing to improve, set fluid target

Electrolyte abnormalities

Hyponatraemia

- If mild, often dilutional secondary to fluid overload
- If Na > 120 mmol/L will normally correct with fluid restriction and replacement with 0.9% NaCl
- If < 120 mmol/L risk of seizures, therefore correct according to formula:
Dose (mmol) = [Desired Na (mmol/L) - actual Na (mmol/L)] x 0.6 x bodyweight (kg)

Hypernatraemia

- Much less common
- Careful assessment of fluid status- may be due to sodium retention or water depletion which will correct with volume resuscitation
- Replace insensibles with 0.9% NaCl

Hyperkalaemia

- Monitor for signs of toxicity on ECG
- $K^+ > 6.5$ mmol/L is an indication for treatment until dialysis or UO established
- Temporary measures:
 - Calcium gluconate 10% (stabilises membrane)
 - Salbutamol nebuliser (shifts K^+ into cells)
 - Calcium resonium (colonic exchange of Ca^{2+}/Na^+ for K^+)
 - Sodium bicarbonate 8.4% (if acidotic, shifts K^+ into cells)
 - Insulin dextrose only if other methods ineffective

Hypocalcaemia

- If severe (< 1.9 mmol/L)- calcium gluconate 10%
- Non-emergency- oral calcium salts and calcium carbonate
- Acute on chronic- 1 alpha-calcidol

Hyperphosphataemia

- Start treatment if > 1.7 mmol/L
- Dietary restriction
- Phosphate binders with meals (eg: calcium carbonate)

Acidosis

- Treat only if severe
- ½ correction with sodium bicarbonate, initially, then reassess
- Dose (mmol) = (0.3 x weight x base deficit) / 2
- Avoid rapid correction as may cause hypocalcaemia and therefore tetany or seizures

Hypertension

- May be solely due to salt and water overload and therefore a trial of diuretics is initially recommended
- Treatment (IV or oral) depends on clinical condition and severity

- Pulmonary oedema with oliguria is an absolute indication for ventilation and dialysis
- First line IV treatment is labetalol (1-5 mg/kg/hr)
- First line oral treatment is usually nifedipine as required (0.25-0.5 mg/kg, maximal 4 mg/kg/day)

Nutrition

- Hypercatabolic state and therefore aggressive nutritional support needed
- Low phosphate and potassium diet
- Majority of calories should be as carbohydrates
- Start nutritional feeds orally or via NG tube as early as possible

Dialysis

Indications for dialysis include:

- Hyperkalaemia > 6.5 mmol/L
- Severe fluid overload with pulmonary oedema resistant to diuretic therapy
- Uraemia > 40 mmol/L
- Multi-system failure
- Anticipation of prolonged period of anuria/ oliguria (eg HUS)

Ensure tertiary referral centre updated on regular basis

References

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