Prevention and Management of Acute Kidney Injury Guideline

1 Introduction

- Acute Kidney Injury (AKI), previously known as acute renal failure, is characterised by a sudden decline in kidney function.
- AKI can occur without symptoms and is detected through a routine blood test (serum creatinine) and/or a decrease in urine output (KDIGO, 2012).
- AKI is associated with an increased risk of death, length of hospital stay, risk of chronic kidney disease (CKD) and cost to the NHS.
- It is likely that early AKI currently goes unrecognised and a number of AKI cases in at risk groups / high-risk scenarios are preventable.
- Early detection and appropriate management of AKI can minimise further injury.

1.1 Recognise AKI

AKI is defined according to the KDIGO criteria (KDIGO, 2012) and relies primarily on assessing the change in serum creatinine measurement from a previous baseline.

Depending on the availability of previous creatinine measurements, in order of preference, 'Baseline creatinine' is defined as:

a) The lowest serum creatinine measurement in the preceding 7 days
b) The average (mean) of all serum creatinine measurements over the preceding year
c) The upper limit of the age specific reference interval for serum creatinine.

In addition, urine output <0.5 ml/kg/h for ≥8h may indicate AKI and should prompt further investigation.

AKI severity	Serum creatinine
Stage 1	1.5–1.9× baseline OR ≥26 µmol/l increase
Stage 2	2.0–2.9× baseline

Stage 3	3.0× baseline OR Increase in serum creatinine to ≥354 µmol/l) OR Initiation of renal replacement therapy OR Decrease in estimated glomerular filtration rate (eGFR – see Appendix A for calculation) to <35 ml/min per 1.73 m^2

2 Prevention of AKI

2.1 Identify patients at risk for AKI

An audit at Alder Hey identified that our leading causes of AKI are cardiac bypass surgery and nephrotoxic medications.

The BAPN recommends that children meeting any of the following criteria should be considered at risk of AKI:

Children at high risk of AKI include those with:
- Nephro-urological, cardiac or liver disease
- Malignancy and/or a bone marrow transplant
- Dependence on others for access to fluids (e.g. gastrostomy fed)
- History of taking medication that may adversely affect renal function (ACEI / ARB, NSAIDs, aminoglycosides, calcineurin inhibitors)

Scenarios in which children can be at high risk of AKI include:
- History of reduced urine output
- Sepsis
- Hypoperfusion or dehydration
- History of exposure to drugs or toxin that may adversely affect renal function
- Renal disease or urinary tract obstruction
- Major surgery

2.2 Prevention: 3Ms

Monitor the following daily in children at high risk of AKI:
- Serum creatinine and electrolytes
- Urinalysis
- Weight
- Fluid balance (including urine output)
- PEWS including blood pressure

Maintain circulation
- adequate treatment of hypoperfusion

Minimise kidney insults
- Review, monitor and adjust potentially nephrotoxic medications
  - Calculate eGFR (see Appendix A)
  - Review medication list in liaison with pharmacist
  - Consider risk of radiocontrast for CT scans (if essential, ensure adequate hydration)

3 Management of confirmed AKI

3.1 Aims
- Recognise AKI early
- Minimise further kidney injury
- Identify and treat the underlying cause

3.2 Management: 4Ms

Monitor the following daily in children at high risk of AKI:
- Serum creatinine and electrolytes
- Urinalysis
- Weight
- Fluid balance (including urine output)
- PEWS including blood pressure

Maintain circulation
- adequate treatment of hypoperfusion

Minimise kidney insults
- Review, monitor and adjust potentially nephrotoxic medications
  - Calculate eGFR (see Appendix A)
  - Review medication list in liaison with pharmacist
  - Consider risk of radiocontrast for CT scans (if essential, ensure adequate hydration)

Management
- Initial investigations:
  - Repeat creatinine & electrolytes (including bicarbonate)
  - Bone profile
  - FBC
  - Urine dipstick
  - Urine microscopy
- Urgent review by a senior member of the patient's primary clinical team.
- Urinary tract ultrasound scan, usually within 24 hours (primarily to exclude urinary tract obstruction)
- Further investigations if clinically relevant:
  - C3 / C4
  - ASOT
  - ANA
  - ANCA
  - Anti-GBM antibodies

- Immunoglobulins
- Blood film
- LDH
- CK

3.3 Paediatric Nephrology Referral (excluding patients on Intensive Care)

AKI Stage 1 **Consider discussion** with nephrology team
AKI Stage 2 **Discuss** with nephrology team
AKI Stage 3 **Refer** to nephrology team:

- Notify patient's lead consultant
- Telephone referral to Nephrology team (Registrar bleep 184, Out-of-hours contact on-call consultant via switchboard)
- Also complete Meditech Nephrology referral

Criteria for immediate discussion with nephrology team in any stage of AKI:

- Pre-existing renal condition (e.g. existing CKD 4 or 5 or renal transplant)
- AKI associated with multisystem disease or suspected intrinsic renal disease (e.g. haemolytic uraemic syndrome)
- Potassium >5.5mmol/l (free-flowing, non-haemolysed sample)
- Oligoanuria and/or plasma sodium <125mmol/l
- Pulmonary oedema or hypertension
- Rising plasma urea >20mmol/l unresponsive to fluid challenge

3.4 Referral of patients on Intensive Care to Paediatric Nephrology Team

We recognise that AKI often occurs as part of multisystem illness in critically ill patients, and will usually be managed independently by the intensive care team.

The Nephrology team should be routinely informed of any patient with AKI stage 2 or more for 2 days or more.

Some patients may benefit from additional Paediatric Nephrology input, including:

- Where there is diagnostic uncertainty
- Where intrinsic renal disease is suspected
- Where the patient is likely to require ongoing renal input following stepdown from intensive care.

4 Discharge after AKI

AKI stage 2 or more
For 2 days or more

= Refer for Nephrology AKI follow-up

4.1 Discharge summary

- Document AKI episode (including stage and dates) on discharge summary
- Document the likely cause of AKI (e.g. nephrotoxic (state causative agent), dehydration, sepsis, cardiac surgery, etc.)
- Request AKI follow-up with nephrology team for all patients with AKI stage 2 or 3 for 2 days or more:
  - State 'Nephrology AKI follow-up clinic in 3 months' in discharge summary plan
  - Inform Nephrology team of discharge (bleep 184)

4.2 Follow-up

All patients with AKI stage 2 or 3 for 2 days or more will be followed-up by the paediatric nephrology team 3 months after the episode.

5 Contributors

Caroline Jones, Consultant Paediatric Nephrologist
Richard Holt, Consultant Paediatric Nephrologist
Henry Morgan, Consultant Paediatric Nephrologist
Louise Oni, Consultant Paediatric Nephrologist
Tolu Awogbemi, Consultant General Paediatrician

6 References

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Appendix A – Calculation of estimated glomerular filtration rate (eGFR)

$$eGFR(ml/min/1.73m^2) = \frac{40 * [Height\ (cm)]}{serum\ creatinine}$$

Appendix B – BAPN AKI Management Recommendations

alderhey.nhs.uk/AKI

Document Control Sheet

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