Acute kidney injury is a common but serious disorder. Knowing how it can develop enables prevention and early detection, leading to better outcomes for patients.

**Acute kidney injury: prevention and recognition**

**In this article...**
- The function of the kidneys
- How acute kidney injury arises
- How to prevent, detect and treat acute kidney injury

**Keywords:** Kidney injury/Renal nursing/Education/Prevention

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**Authors** Coral Hulse is nurse consultant, Mid Cheshire Hospitals Foundation Trust; Annette Davies is teaching fellow, School of Health Sciences, University of Surrey; both are advisers to Think Kidneys.


Acute kidney injury (AKI) is common and often preventable. Nurses should be able to recognise it and respond when it occurs. Through prevention or early detection, nurses can help to reduce morbidity and mortality associated with AKI, improving patients’ quality of life and reducing the financial impact of AKI on the NHS.

Acute kidney injury (AKI) is an acute and sudden deterioration in kidney function that presents over a period of hours or days. Previously known as acute renal failure, AKI is a syndrome with many causes, the most common of which are sepsis and low blood pressure.

There are three stages to AKI, which define a spectrum of injury or insult to the kidneys, ranging from less severe to significant life-threatening episodes.

AKI can be detected by a low urine output or a rise in serum creatinine, in accordance with Kidney Disease Improving Global Outcomes (2012) AKI classifications (Table 1). To detect AKI, patients’ serum creatinine is compared with a previous value – the baseline value. It is important to monitor the fluid balance of hospital patients who are at risk of AKI.

**Epidemiology**

The National Confidential Enquiry into Patient Outcomes and Death (2009) found AKI to be a common and harmful complication affecting one in five emergency adult hospital admissions. Around 100,000 deaths in hospital each year are associated with AKI. According to the National Institute for Health and Care Excellence (2013), mortality rates are around 25–30%; NCEPOD (2009) identified that potentially 30% of AKI in hospitals could be avoided if early signs were detected and managed. It is estimated that AKI costs between £434m and £620m a year, but up to £186m (Kerr, 2011) could be saved if patients with avoidable AKI were identified and managed.

However, AKI is not just a hospital-based problem. Selby et al (2012) found that two-thirds of diagnoses were community-acquired AKI (c-AKI). They also showed that c-AKI has poorer outcomes than hospital-acquired AKI (h-AKI), highlighting the need for community-based nurses to be able to detect early signs of AKI.

**Pathophysiology**

The kidneys are vital for the maintenance of homoeostasis, contributing via:

**Box 1. Risk factors for developing AKI**

- Age ≥65 years
- Heart failure
- Liver disease
- Chronic kidney disease (particularly if eGFR<60)
- Past history of AKI
- Diabetes
- Neurological impairment or disability, particularly where reliance on a carer may mean reduced access to fluids
- Hypovolaemia
- Oliguria (urine output <0.5 ml/kg/hour)
- Haematological malignancy
- Symptoms or history of or risk factors for urological obstruction
- Sepsis
- Use of iodinated contrast agents within the previous week
- Current or recent medication with nephrotoxic potential, such as, NSAIDs, ACE inhibitors, ARBs, aminoglycosides, diuretics
- Deteriorating EWS

**5 key points**

1. Acute kidney injury (AKI) is a common, serious and harmful occurrence
2. 100,000 deaths a year are associated with AKI in the UK and up to 30% could be avoided
3. One in five people admitted to hospital as an emergency has AKI
4. The annual cost to the NHS of AKI is estimated to be around £500m
5. Nurses have a vital role in preventing and detecting AKI

**Source:** NICE (2013)
Regulating fluid balance and acid-base status;
Excreting waste products via urine;
Excreting drugs (for example digoxin, lithium, antibiotics);
Secreting hormones, including erythropoietin, activated vitamin D₃ and renin.

The primary function of the kidneys is to filter the blood and produce urine. To function normally, they need:
- An adequate blood flow and blood pressure through the kidneys;
- An unobstructed urinary tract beyond the kidneys, to excrete the urine from the body.

Based on the above, the causes of AKI fall into themes of:
- Pre-renal;
- Renal;
- Post-renal.

Table 2 gives examples of conditions associated with these three themes.

If pre-renal causes of AKI have been ruled out and the cause of AKI is unknown, an ultrasound scan of the renal tract is required to identify whether there is a blockage, for example from stones or strictures. Ultrasound scans can also identify some types of pathology within the kidneys, including hydro-nephrosis.

Detection and diagnosis

Early detection of AKI means that patients receive care sooner, which is vital in stopping its progression.

Serum creatinine and urine output are the best markers available to detect AKI, and are the two measurements defined by KDIGO (2012) to determine that a patient has AKI and to stage its severity (Table 1).

Creatinine is a waste product produced by muscles, which is freely filtered and removed from the body via the kidneys. If a patient’s kidney function is reduced for any reason, the level of creatinine measured in the blood will be elevated.

According to the Edinburgh Royal infirmary Renal unit, normal creatinine is 60–120 micromol/L (Bit.ly/EDRENKidneyTests); the normal range is wide because “normal” levels depend on muscle bulk, so a patient with a larger muscle bulk will inevitably produce more creatinine. NICE (2013) recommends that serum creatinine should be monitored regularly in all people with AKI or at risk of developing it (see Box 1 for risk factors).

The most significant recent initiative to aid in the early detection of AKI is an automated computer software algorithm for AKI produced by NHS England (2014). This was developed to standardise the definition of AKI and ensure a timely and consistent approach to its detection and diagnosis across the NHS. It provides a two-step approach, the first of which is detection. The patient’s serum creatinine level is compared with previous measurements, or to a population-referenced normal if no previous measurement is available.

If a rise in creatinine is detected, step two is the creation of an alert, which also indicates the level of injury, based on the KDIGO AKI stages (KDIGO, 2012).

How the alert is managed is the responsibility of the individual organisation. A number of hospitals have instigated methods of alerting clinical staff, including dedicated messaging platforms and through integration in early warning scoring (EWS) observation systems. Nurses should be aware of alerting systems used in their clinical area and observe and respond promptly to them, instigating management. Some alerting systems also provide guidance on patient management.

The other marker that nurses should be vigilant about is urine output. Nurses and healthcare assistants are central to detecting reduced output or increased concentration of urine, which indicate that a patient may be becoming dehydrated. KDIGO (2012) defines patients as having AKI if their urine output is less than 0.5ml/kg/hr for six hours or more. Other symptoms include thirst, poor fluid intake, diarrhoea and vomiting, or a raised temperature, all of which puts the patient at risk of dehydration and consequently AKI.

Management of AKI: the three ‘Rs’

For patients to have a good outcome from AKI, there must be:
- Recognition – early detection;
- Response – early identification and swift treatment of the underlying cause;
- Referral – timely escalation using the principles of the “right patient, right professional, right time”. All patients presenting with AKI should be discussed with a doctor and management plans put into place.

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Complications of AKI caused by the obstruction – for example, the AKI is advanced and has led to severe fluid overload, a metabolic acidosis or severe hypertkalaemia;
- When stenting or nephrostomy is required to overcome obstruction (this should take place as soon as possible and within 12 hours). Loop diuretics such as furosemide should not be used routinely to promote urine output in patients with AKI, as they have been linked to worse outcomes. The only exception is when the patient has pulmonary oedema secondary to AKI.

Any patient who may require RRT should be discussed with a critical care specialist or nephrologist as soon as possible.
TABLE 2. CONDITIONS ASSOCIATED WITH AKI

<table>
<thead>
<tr>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-renal</td>
<td>Blood flow through the kidney is reduced, resulting in hypoperfusion of the kidney. The most common cause is prolonged hypotension.</td>
</tr>
<tr>
<td>Renal</td>
<td>Pathology within the kidney itself—these patients may be well-hydrated with a normal blood pressure.</td>
</tr>
<tr>
<td>Post-renal</td>
<td>Obstruction to urinary flow beyond the kidney. The kidneys produce urine but the obstruction leads to back-pressure and swelling within the kidney (hydronephrosis), which leads to AKI.</td>
</tr>
</tbody>
</table>

The administration of iodinated contrast media during clinical diagnostic radiology can lead to contrast-induced AKI (c-AKI) in patients with known risk factors for AKI. The contrast can cause vasoconstriction in the renal artery and altered glomerular haemodynamics due to an elevation in plasma oncotic pressure, a form of osmotic pressure exerted by proteins in the blood. NICE (2013) recommends that patients with identified risk factors for AKI who need a radiographic procedure requiring contrast should receive volume expansion before the procedure, with isotonic sodium bicarbonate or 0.9% sodium chloride.

NICE (2013) recommends that all patients in hospital should have their clinical observations scored regularly using an EWS system. This will aid the identification of those who are at risk of AKI because their clinical condition is deteriorating or is at risk of deteriorating. Nursing staff need to be particularly alert to patients’ urine output, which is highly likely to be reduced to below 0.5ml/kg/h if their blood pressure is reduced.

The nurse’s role

Patients present with AKI or risk factors for AKI in all sectors of healthcare. The extent to which nurses can influence the management of AKI will depend on their role and place of work. However, all nurses can make a major contribution by assessing risk factors for AKI and actively looking for serum creatinine rises or oliguria when assessing patients. In all settings, suspicion or confirmation of AKI must be immediately escalated to a doctor.

An AKI core competency document promotes the acquisition of competence in multidisciplinary teams to improve care for patients with or at risk of AKI, recognising that only by good integrated teamwork can the best results be achieved (Academy of Medical Royal Colleges et al, 2011).

Primary care

Increasingly, nurses are the first point of contact for many patients in the community. This may be a practice nurse, community nurse or advanced nurse practitioner. Patients may be seen in their own home, at a GP surgery or at a walk-in centre, and nurses working in these settings should suspect AKI in patients who are unwell, particularly if:

- There are signs of sepsis;
- The patient is dehydrated (vomiting or diarrhoea is a common cause of AKI—children this would include bloody diarrhoea);

The key elements in preventing AKI occurring are avoidance of hypovolaemia, nephrotoxic drugs and contrast media. Advancing age increases susceptibility to AKI; approximately 70% of patients with AKI are aged 70 years or older (Feest et al, 1993). This is because older people are commonly subjected to polypharmacy; often have a number of comorbidities; experience dehydration and are likely to have a degree of chronic kidney disease.

The most common cause of c-AKI is dehydration (Schissler et al, 2013), so it is vital that older patients in the community with identified risk factors are closely monitored for changes in urine output, or a deterioration in health status (for example, developing diarrhoea and vomiting or feeling generally unwell or confused). Many older people find it difficult to maintain a satisfactory hydration status, due to immobility, frailty, fear of incontinence and somnolence which, coupled with a reduced sense of thirst, can often result in dehydration (Scales, 2011).

NICE (2013) recommends that patients who are at risk of AKI should not be prescribed nephrotoxic drugs such as aminoglycosides, common examples of which are gentamicin and vancomycin. These accumulate in the renal cortex and can become highly concentrated, resulting in vasoconstriction, which can lead to acute tubular necrosis.

Angiotensin-converting enzyme (ACE) inhibitors and angiotensin-receptor II blockers (ARBs) can cause AKI to decline more rapidly. If a patient taking this type of medication experiences an acute kidney insult, the reduction in perfusion pressure that occurs with this medication will be detrimental to the already injured kidney. The presence of sepsis and/or hypovolaemia can substantially increase the risk of AKI, so it is recommended that these drugs are temporarily withheld until the AKI has resolved (NICE, 2013).
There is history of taking ACE inhibitors ARBs/non-steroidal anti-inflammatory drugs (NSAIDs) or the patient has had iodinated contrast within the previous seven days; Hypotension; The patient is unwell with fatigue, particularly if there is reduced urine output, breathlessness and signs of pulmonary oedema, peripheral and or periorbital oedema; A dipstick urine test is positive to blood and protein in the absence of infection or trauma; The patient has any risk factors for AKI. If AKI is suspected, it should be escalated immediately to a doctor and serum creatinine levels checked. Decisions on referral to secondary care or a nephrologist should be made between the patient and health professionals.

Intermediate care

Nurses working in care homes need to assess hydration regularly, especially when patients are unable to drink independently. Particular care is needed during heatwaves, which increase older people’s risk of dehydration.

Nurses should look out for the signs and symptoms of AKI, and consider the risks of AKI when administering medicines that can affect the kidney when patients are unwell, especially if there is diarrhoea, vomiting or sepsis. Patients with a long-term catheter should be closely monitored and nurses should act promptly on blocked catheters, as obstruction to urinary flow is a cause of AKI. If AKI is suspected or detected, nurses must escalate their findings as soon as possible to medical staff.

Hospital

Nurses’ role in the management of AKI in hospital should include:

- Using EWS and a graded response system to identify and respond to deteriorating patients, in line with NICE guidance on recognising and responding to acutely ill patients in hospital (NICE, 2007);
- Undertaking regular and accurate fluid balance monitoring, recognising when urine output falls below 0.5 ml/kg/hour;
- Escalating the case to a doctor if there is rising serum creatinine and/or oliguria;
- Exercising caution with drugs that can harm the kidney, especially when patients are unwell and have risk factors for AKI. Discuss and take advice from doctors and pharmacists; Providing adequate hydration, in particular for patients who rely on others to provide drinks – asking “do you feel thirsty?” is more meaningful than asking if a patient would like a drink, as patients may refuse a drink if they feel nauseous, are in pain or simply do not like the drinks on offer;
- Performing a urine dipstick test soon as AKI is confirmed and documenting the result – the presence of haematuria and/or proteinuria in the absence of trauma or infection is significant, indicating possible kidney disease.

Mental health

Patients with mental health conditions may be at increased risk of AKI for a number of reasons:
- Depressed patients may be withdrawn and be at risk of dehydration;
- Those with mental illness may not seek medical advice during episodes of intercurrent illness;
- Lithium can cause AKI if levels become too high, so patients on lithium must have regular checks of both their lithium and serum creatinine levels.

Conclusion

Acute kidney injury can occur in all patient groups, in all healthcare settings. Nurses play a pivotal role in improving outcomes, especially by identifying risk factors and helping to prevent AKI. The introduction of the AKI national algorithm will facilitate earlier, definitive detection of AKI. Nurses have a duty to escalate the detection of AKI to medical colleagues, whether this is based on AKI laboratory alerts, or if they suspect AKI based on oliguria.

The Think Kidneys national programme (Box 2) provides information and toolkits that nurses and other health and social care professionals can access to extend their knowledge and understanding of AKI. It also provides information and best-practice guidance for commissioners, and acts as a signpost for patients and carers who would like to learn more about AKI prevention and management.

References

Bit.ly/KDIGOGuideline

For more on this topic go online...

- Recognising and preventing dehydration among patients
  Bit.ly/NTPreventDehydration