
ACUTE RENAL INSUFFICIENCY

Acute renal insufficiency is a relatively common problem postoperatively¹. It can be caused or exacerbated by problems with volume status (typically hypovolemia), exposure to renally-toxic agents (contrast, myoglobin, anti-inflammatories, aminoglycosides), surgical trauma (e.g., cross clamping of the aorta), surgical complications (ligation of a ureter), and all of the usual causes of renal insufficiency seen in medical patients. Acute worsening of renal function is particularly common in patients who have pre-existing renal disease or those who have undergone extensive procedures.

In a recent retrospective study including data on more than 15,000 patients, seven independent preoperative predictors were identified ($P < 0.05$) that predicted postoperative renal dysfunction (defined as a Cr Cl < 50 ml/min).² They were: age, emergent surgery, liver disease, body mass index, high-risk surgery, peripheral vascular occlusive disease, and chronic obstructive pulmonary disease necessitating chronic bronchodilator therapy. Several intraoperative management variables were independent predictors of acute renal failure: total vasopressor dose administered, use of a vasopressor infusion, and diuretic administration. Acute renal failure was associated with increased 30-day, 60-day, and 1-yr all-cause mortality.

PRE-RENAL CAUSES

- Most patients having procedures third space considerable quantities of fluid at their surgical site. As a result they are typically intravascularly volume depleted. Significant output from NG tubes or diarrhea may also exacerbate the situation. When a patient appears to be acutely volume deficient a check of the hematocrit is reasonable as bleeding is also a common cause of acute hypovolemia and one that deserves acute attention.
- Acute reno-vascular compromise or atherosclerotic emboli can occur, particularly with aortic surgery and some nephrectomies, but this should be obvious by the history, discussion with the team and/or operative note. Pre-renal azotemia can occur with severe congestive heart failure, but these patients are usually obvious by history, exam or laboratory findings. In the appropriate patient population one should also consider pancreatitis, sepsis, abdominal compartment syndrome, and cirrhosis as pre-renal causes of acute renal insufficiency.

RENAL CAUSES

- The most common renal cause for acute postoperative renal insufficiency is acute tubular necrosis (ATN). Patients with intra or postoperative hypotension are at highest risk and a review of the anesthesia record and postoperative vital signs can be very helpful in these circumstances.
- As with other forms of trauma, creatinine kinase levels will rise after surgery, and obese patients and those with long procedures are at risk for rhabdomyolysis. A check of serum CK or urine myoglobin is always reasonable. Allergic interstitial nephritis can occur, particularly with common administration of antibiotic therapy, urine eosinophils will generally be elevated in these cases. Intravenous contrast administered during radiology procedures may exacerbate renal insufficiency.

POST-RENAL CAUSES

- When patients with acute renal insufficiency are postop from abdominal procedures it is reasonable to check an ultrasound to assess that they do not have unilateral or bilateral hydronephrosis due to some unexpected consequence of their surgery.
- Kidney stones may also form acutely, and these can also be identified (or at least the obstruction noted) by ultrasound.
- If bladder outlet obstruction suspected, a bladder scan (or single I/O cath) can help eliminate this concern immediately. For patients with indwelling catheters, the catheter should be flushed at least once to assure that it is not obstructed.

POSTOP EVALUATION OF ACUTE RENAL INSUFFICIENCY

Renal

- Patients need a thorough review of their records with attention to vital signs, input/output, weights, medications and recent studies. Findings on physical exam of tachycardia, a low JVP, poor skin turgor, dry mucous membranes and minimal amounts of concentrated urine suggest volume depletion. In difficult cases when patients are not responding as expected to fluid challenges measurement of central venous pressure with a central line can be helpful.
- A marked increase in clear output from pelvic or abdominal drains should raise concerns for urinary leaks or fistula formations. A spot fluid creatinine performed on the drain output will settle the question quickly. Drain output usually has a creatinine value that is near serum levels. When a drain is contaminated by urine the creatinine in the fluid is usually markedly elevated (10-100 fold).
- Placement of a Foley catheter may be appropriate in some circumstances to monitor urine output closely and to assess for distal obstruction. Renal ultrasound may be used when indicated to assess for proximal urinary tract obstruction and extra-vesicular fluid collections.
- Laboratory studies should include a basic metabolic panel, complete blood count, and full urinalysis with examination of sediment, along with a urinary Na, creatinine and osmolality. High urinary specific gravity/osmolality, a low urinary sodium, and (<1%) fractional excretion of sodium (FENa) support the diagnosis of prerenal azotemia (see below). The changes of ATN are typified by muddy brown granular and epithelial cell casts. The presence of significant numbers of red cells may indicate a stone or ureteral trauma. Excessive numbers of eosinophils can indicate interstitial nephritis.

Urine Findings	Pre-Renal	Renal
Urinary sediment	None or hyaline casts	Muddy brown casts, eosinophils
Specific gravity	> 1.020	< 1.010
Osmolarity	>500	<350
Sodium	<20	>40
Fractional excretion of sodium	<1	>1

$$\text{Fractional excretion of sodium: FENa, percent} = \frac{\text{UNa} \times \text{PCr}}{\text{PNa} \times \text{UCr}} \times 100$$

Where U = urine, P = plasma, Na = sodium, Cr = creatinine

MANAGEMENT

- Because hypovolemia is the most common cause of postoperative renal insufficiency, treatment should generally start with a vigorous fluid resuscitation. Classically lactated ringers or normal saline are used for resuscitation. However, caution should be used with massive infusions of normal saline as it can precipitate hyperchloremic metabolic acidosis. Routine use of diuretics in the immediate postoperative is generally contraindicated. If there is any doubt about the patient's intravascular volume status, measurement of the central venous pressure may be helpful.
- If the patient's renal function does not improve once it is determined that the patient is volume replete, then a search for alternate diagnosis should be started. If the patient maintains reasonable urine output, then fluids can be continued at a maintenance rate. If urine output falls off, some attempt at maintaining urine output with IV furosemide may be worth considering. If there is any concern for an obstructive process (e.g., recent abdominal or pelvic surgery) an ultrasound should be performed immediately. Any medications which could be adversely affecting renal function should be discontinued if possible and all other medications should be adjusted for the patient's current level of renal function (See the chapter on "CHRONIC KIDNEY DISEASE" for management details). Nephrology consultation is usually advisable.

References

¹ Lameire N, Van Biesen W, Vanholder R. Acute renal failure. Lancet. 2005;365:417-30.

² Kheterpal S, Tremper KK, Englesbe MJ, et al. Predictors of Postoperative Acute Renal Failure after Noncardiac Surgery in Patients with Previously Normal Renal Function. Anesthesiology. 2007;107:892-902.