Stratification and Risk Reduction of Perioperative Acute Kidney Injury

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KEYWORDS

• Acute kidney injury • Chronic kidney disease • Preoperative evaluation
• Renal protection strategies

KEY POINTS

- Acute kidney injury (AKI) is a frequently encountered complication in surgical patients and can lead to significant morbidity in the immediate and distant postoperative periods.
- Preoperative risk stratification is critical for informed consent and perioperative planning. Potential preoperative interventions, such as hematocrit and blood glucose optimization, and continuation of angiotensin-receptor blockers and statins may have a protective role.
- Perioperative renal protection strategies, including goal-directed fluid therapy, avoidance of hyperchloremic crystalloid solutions, and maintenance of hemodynamics within the renal autoregulation curve, are potentially invaluable in the prevention of AKI. Current advances in the development of biomarkers may offer the opportunity for early diagnosis and the implementation of therapeutic strategies.
- Increased awareness and concerted efforts by all perioperative physicians are needed to provide an improved outcome for surgical patients.

DEFINITION

Acute kidney injury (AKI) is a frequently encountered complication in surgical patients and can lead to significant morbidity in the immediate and distant postoperative periods. The most recent consensus for its diagnosis and staging by the Kidney Disease: Improving Global Outcomes (KDIGO) Work Group[1] defines AKI as a decrease in kidney function resulting in either an absolute increase in serum creatinine (sCr) of 0.3 mg/dL or more within 48 hours, an increase in sCr of 1.5 times from baseline that has occurred

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within the prior 7 days, or a urine volume of 0.5 mL/kg/h or less for more than 6 hours.[1] Three stages of AKI have been classified according to these criteria (**Table 1**).

EPIDEMIOLOGY

The incidence of AKI varies within the range of 5.0% to 7.5% in all acute care hospitalizations and is approximately 20% in intensive care unit (ICU) admissions. Nearly 40% of AKI in hospitalized patients occurs in the perioperative period.[2] The incidence of AKI varies depending on the surgical setting (**Fig. 1**). Most of the authors' knowledge regarding AKI is from the cardiovascular surgery literature. This information is reviewed as well as emerging data from other surgical settings.

RISK STRATIFICATION BASED ON SURGICAL SETTING

Kheterpal and colleagues[3] developed a preoperative renal-risk index in *major noncardiovascular surgical procedures* that identified the following as independent risk factors for postoperative AKI: age greater than 59 years, body mass index (BMI) greater than 32, high-risk surgery (anticipated hospital stay of 2 or more days, emergency surgery, peripheral vascular disease, liver disease, and chronic obstructive pulmonary disease [COPD]). Based on the number of risk factors in patients with a normal baseline glomerular filtration rate (GFR), the incidence of postoperative renal failure, as defined by an absolute GFR of less than 50 mL/min, ranged between 0.3% and 4.3% (**Table 2**).

In bariatric patients undergoing *gastric bypass surgery*, the incidence of postoperative AKI as defined by an increase in sCr of 50% or dialysis requirement was 8.5%.[4] The higher BMI of gastric bypass patients is combined with other risk factors, namely, hyperlipidemia and preoperative use of angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs).

A study by Kim and colleagues[5] used a less sensitive definition for AKI of an increase in sCr of greater than 2 mg/dL above the baseline and/or dialysis in *intra-abdominal surgical procedures* and found an overall incidence of AKI of 1.1%, ranging from 0.2% in appendectomies and 0.3% for gastric bypass surgery to 3.5% in exploratory laparotomy patients.

In patients undergoing *orthopedic surgery*, a recent study by Kimmel and colleagues[6] describes an AKI incidence of 15% following elective total joint arthroplasty (TJA) in a population that was older and more obese and included patients with

Table 1
Stages of severity of AKI according to AKIN criteria

Stage	Change in sCr	Urine Output
I	Increased Cr 0.3 mg/dL or 1.5–2.0 fold of baseline	UOP <0.5 mL/kg/h for >6 h
II	Cr increase of >2–3 fold of baseline	UOP <0.5 mL/kg/h for >12 h
III	Cr increase >3 fold of baseline (or Cr >4 mg/dL with 0.5 mg/dL acute increase); AKI requiring dialysis	UOP <0.3 mL/kg/h for 24 h or anuria for 12 h

Abbreviations: AKIN, Acute Kidney Injury Network; Cr, creatinine; UOP, urine output.

Adapted from Kellum JA, Lameire N, Aspelin P, et al. Kidney Disease: Improving Global Outcomes (KDIGO) acute kidney injury work group. KDIGO clinical practice guideline for acute kidney injury. Kidney Int Suppl 2012;2:1–138; with permission.