Q: Who is at risk for developing acute renal failure after surgery?

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A: Patients who are at risk of developing acute renal failure (ARF) after cardiac surgery are usually older than 65 years of age; have diabetes, underlying renal disease, or cardiovascular disease; and have undergone recent coronary angiography or other procedures requiring intravenous contrast.

Perioperative ARF has clinical consequences

In most clinical studies, ARF has been defined as a greater than 25% to 50% increase in serum creatinine from baseline within 1 week after surgery. Monitoring serum creatinine is the most commonly used method to observe changes in renal function perioperatively. Unfortunately, an elevated creatinine level is a late indicator of renal injury, and even a minor increase should be regarded as clinically important and followed closely.[1]

ARF requiring dialysis develops in 1% to 5% of patients after cardiac surgery, and is strongly associated with perioperative morbidity and mortality.[2] A prospective multicenter trial of patients who had myocardial revascularization found that mortality in patients with renal dysfunction not requiring dialysis was 19%, compared with 63% in those who needed dialysis.[3] In patients without renal dysfunction after cardiac surgery, mortality was 0.9%.[3] Postoperative ARF also confers an increased risk of mortality in follow-up more than 5 years after cardiac surgery.[4] Only about 15% of patients who develop ARF at the time of cardiac surgery fully recover.[1]

ARF risk score developed for open-heart surgery

A recent retrospective study of more than 33,000 patients who underwent open-heart surgery at the Cleveland Clinic offers the first solid evidence of risk factors for ARF.[5] About 70% of the study population was male, and 89% was Caucasian. The primary outcome was ARF that required dialysis during the postoperative period. A risk score was derived to calculate the risk for developing ARF (Table).

TABLE
Risk factors and risk score for acute renal failure after cardiac surgery

Risk factor	Points
Female gender	1
Congestive heart failure	1
Left ventricular ejection fraction < 35%	1
Preoperative use of IABP	2
Chronic obstructive pulmonary disease	1
Insulin-requiring diabetes	1
Previous cardiac surgery	1
Emergency surgery	2
Valve surgery only (reference to CABG)	1
CABG + valve (reference to CABG)	2
Other cardiac surgeries	2
Preoperative creatinine 1.2 to < 2.1 mg/dL	2
Preoperative creatinine ≥ 2.1 mg/dL	5

Calculated risk score	Risk of acute renal failure requiring dialysis
0–2 points	0.4%
3–5 points	1.8%
6–8 points	7.8%
9–13 points	21.5%

IABP = intra-aortic balloon pump; CABG = coronary artery bypass graft surgery
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Patient-specific risk factors for ARF after cardiac surgery included higher serum creatinine level (> 1.2 mg/dL), diabetes, chronic obstructive pulmonary disease, previous cardiac surgery, markers of severe cardiovascular disease, and female gender. The major intraoperative factor was longer cardiopulmonary bypass time. Age, weight, race, peripheral vascular disease, and cerebrovascular disease were excluded from the scoring model on the basis of the statistical analysis done by the authors.

Each risk factor was assigned a number of points, and the points were then computed to calculate a total score (Table). The risk for developing ARF was directly related to the number of risk factors. The risk

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score ranged from 0 to 17 points. Four risk categories of increasing severity (scores 0 to 2, 3 to 5, 6 to 8, and 9 to 13) were determined arbitrarily by the authors. The frequency of ARF among these categories varied between 0.4% for the lowest risk score to 21.5% for the highest score.

This study involved a large cohort of patients, sufficient to generate and validate a postoperative ARF score that incorporated multiple independent risk factors. Limitations included the single-center data source and the retrospective observational design. Nevertheless, the study provided a valuable tool for both determining the risk of ARF for individual patients and planning future clinical trials.

Clinical score needed for noncardiac surgery

Currently, a risk score for ARF has only been developed for patients who have had cardiac surgery; no sufficiently powered study has yet been done for those undergoing noncardiac surgery. The Section of Hospital Medicine and the Department of Nephrology and Hypertension at the Cleveland Clinic are currently conducting a large retrospective cohort study in patients undergoing elective noncardiac surgery.

Importance of identifying patients at risk

Identification of patients likely to develop ARF after surgery is important, as it enables physicians to improve care and to inform patients about their individual risk. Future intervention-based trials can be conceived to target high-risk populations to decrease length of stay, morbidity, and mortality.

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