

Preoperative Care of Patients with Kidney Disease

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Patients with chronic kidney disease often require surgical interventions for vascular access and for medical problems related to comorbid conditions. Perioperative morbidity and mortality rates are increased in these patients. Preoperative attention to common medical problems that occur in patients with impaired renal function can lower some surgical risks. Hyperkalemia can be temporarily improved by the intravenous administration of an insulin-dextrose combination or bicarbonate, and polystyrene binding resins or dialysis can remove excess stores of potassium. Increased bleeding related to uremic platelet dysfunction can be managed by the administration of desmopressin, cryoprecipitate, or estrogens, and by avoiding the use of medications with antiplatelet effects close to the time of surgery. Transfusions of red blood cells should be reserved for use in patients with clinically significant anemia, because antibody formation may decrease the likelihood of successful renal transplantation in the future. Cardiovascular disease is the most common cause of death in patients with renal disease. Patients with chronic kidney disease may have hypertension and hypoglycemia in the perioperative period. Preoperative testing may be necessary in patients with cardiac risk factors. If future vascular access grafting is contemplated, intravenous line placement and blood draws should be avoided in a patient's nondominant arm. (*Am Fam Physician* 2002;66:1471-6. Copyright© 2002 American Academy of Family Physicians.)



Surgical procedures are frequently necessary in patients with chronic kidney disease who are not yet undergoing dialysis and in patients with end-stage renal disease who are undergoing dialysis. Access for dialysis accounts for the vast majority of these procedures. In one retrospective study,¹ access-related procedures were performed in 86 percent of 2,187 patients with end-stage renal disease. The next most common procedures were related to peripheral vascular disease, coronary artery disease, and kidney transplantation.

Responsibility for the perioperative care of patients with chronic kidney disease is shared by the family physician, nephrologist, anesthesiologist, and surgeon. Given the projected shortage of

nephrologists and the increasing number of patients with kidney disease, portions of this care may be shifted to the family physician in the future.

Preoperative management of patients with chronic kidney disease can be challenging. A number of factors, including preoperative assessment, fluid and electrolyte issues, bleeding, and dialysis issues, must be considered simultaneously to decrease morbidity and mortality related to surgery.

Preoperative Assessment

Patients with kidney disease include the following²:

1. Patients with chronic renal failure in whom dialysis has not yet been initiated.
2. Patients with acute renal failure who are or are not undergoing dialysis.
3. Stable patients with renal failure who are undergoing hemodialysis or peritoneal dialysis.
4. Patients who have undergone kidney transplantation but have impaired renal function.

See page 1379 for definitions of strength-of-evidence levels contained in this article.

Whenever possible, an acceptable potassium level (less than 5.5 mEq per L [5.5 mmol per L]) should be obtained before surgery is performed in a patient with chronic kidney disease.

SURGICAL RISK

Surgical risk in patients with chronic kidney disease, as in all other patients, depends on the type of surgery and whether the procedure is routine or performed on an emergency basis. The extent of renal impairment and the use of dialysis also affect outcome and subsequent morbidity.

Data from the literature (1963 to 1990) indicate that overall surgical mortality rates in patients with end-stage renal disease range from 1 to 4 percent.³⁻⁵ Emergency surgery is associated with an even five times greater risk of death.⁶ In patients with end-stage renal disease who undergo cardiac surgery, estimated mortality rates range from 10 to 20 percent,^{3,7} and concomitant diabetes mellitus and patient age greater than 60 years further increase the risk of death.⁸ In these patients, cardiac arrhythmias and sepsis are the most common causes of perioperative mortality.³

Perioperative morbidity is also increased in patients with end-stage kidney disease. When these patients undergo cardiac surgery, they receive vasopressor agents for a longer period, spend more time on a ventilator, remain in the intensive care unit for a longer time, and are

hospitalized for more days than patients who do not have kidney disease.⁹

Estimated morbidity rates for both cardiac and general surgery in patients with end-stage renal disease range from 14 to 64 percent.^{3,5,10} Causes include decreased abilities to concentrate urine, regulate fluid volume and sodium concentrations, handle acid loads, and excrete potassium and medications. Hyperkalemia is the most frequent complication, followed by infection, hemodynamic instability, bleeding, and arrhythmias. Additional causes of morbidity include anemia, pericarditis, neuropathy, clotted vascular access ports, and infection.³

Strategies to Reduce Surgical Risk

POTASSIUM LEVELS

Although no recommendations exist for safe preoperative potassium values, one study¹¹ suggested avoiding general anesthesia in patients with chronic kidney disease who have a serum potassium level above 5.5 mEq per L (5.5 mmol per L). However, an unpublished review of 214 dialysis-related vascular access procedures showed no increase in arrhythmias among patients who had preoperative potassium levels above 5.5 mEq per L, compared with those who had lower potassium values (M. Krishnan, P. Scheel, B. Sullivan, unpublished data, 2001). In part, this finding may be due to tolerance of chronically elevated potassium levels in this patient group. Nonetheless, whenever possible, it is prudent to obtain an acceptable potassium level before surgery.

The incidence of preoperative hyperkalemia is estimated to be as high as 19 to 38 percent in patients with chronic or end-stage renal disease.^{5,12,13} Treatment options include polystyrene binding resins, insulin in combination with intravenously administered dextrose, intravenously administered bicarbonate, and, if all else fails, dialysis.

If polystyrene binding resins cannot be given orally before surgery (i.e., non per os [NPO] status), these agents can be administered as retention enemas (30 to 60 g rectally every six hours). Intravenously administered

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bicarbonate or insulin-dextrose causes a transient decrease in the serum potassium level, but the level may rebound with time. Hence, these two measures represent only temporary solutions for hyperkalemia through mechanisms of intracellular shifting of potassium. In contrast, polystyrene binding resins and dialysis remove excess stores of potassium.

ACID-BASE DISORDERS

Chronic metabolic acidosis in patients with end-stage renal disease has not been associated with increased perioperative risk. However, acidosis in patients with chronic kidney disease or end-stage renal disease may decrease the effectiveness of some local anesthetics.¹⁴

BLEEDING

Uremia can cause platelet dysfunction, which can result in increased perioperative bleeding. To minimize uremic complications, patients with end-stage renal disease should undergo dialysis on the day before surgery.

Bleeding time is the most sensitive indicator of the extent of platelet dysfunction, although test results are subject to some operator variation. While bleeding times of greater than 10 to 15 minutes have been associated with a high risk of hemorrhage,¹⁵ the exact correlation of elevated bleeding times and surgical risk has not been clearly established. Standard options for correcting an elevated bleeding time are described in *Table 1*.¹⁶⁻²¹

Antiplatelet agents, including aspirin and dipyridamole (Persantine), should not be given within 72 hours before surgery in patients with end-stage renal disease or uremic chronic kidney disease. In addition, some agents that have only minor platelet effects in patients without uremia can have exaggerated effects in patients with end-stage renal disease and may theoretically increase the risk of intraoperative bleeding. These drugs include diphenhydramine (Benadryl), nonsteroidal anti-inflammatory drugs (NSAIDs), chlor-diazepoxide (Librium), and cimetidine (Tagamet).²¹

A small amount of heparin is used during hemodialysis, with a residual anticoagulant effect lasting as long as two and one-half hours. The effect of this heparin on intraoperative bleeding is not clear. Therefore, unless heparin-free dialysis is used, it is prudent to wait at least 12 hours after the last hemodialysis with heparin before an invasive surgical procedure is performed.²²

ANEMIA

As renal function declines, patients are likely to develop anemia because of decreased renal production of erythropoietin. While there is no published standard for safe preoperative hematocrit levels in patients with impaired renal function, one study⁵ demonstrated increased intraoperative complications in patients with end-stage renal disease and preoperative hematocrit levels ranging from 20 to 26 percent.

Correcting severe or hemodynamically significant anemia may help to avoid complications from perioperative blood loss, as well as hemodilutional effects that may occur if a heart-lung bypass machine must be used.²³ Given these concerns, transfusion is necessary in some circumstances.

A possible downside to blood product transfusion is antibody formation, which may

TABLE 1
Options for Correcting Elevated Bleeding Times in Patients with Renal Failure

Intensive dialysis

Desmopressin (DDAVP), 0.3 mcg per kg IV 1 hour before surgery¹⁶

Cryoprecipitate, 10 units over 30 minutes IV; effects should be apparent in 1 hour.¹⁷

Conjugated estrogens, 0.6 mg per kg per day IV or orally for 5 days; some effect should be apparent in 6 hours, but peak effect occurs in 5 to 7 days.¹⁸⁻²⁰

Transfusion of packed red blood cells to raise the hematocrit to at least 30 percent, which increases platelet interaction with vessel walls.²¹

IV = intravenous.

Information from references 16 through 21.

Blood product transfusion should be avoided when not absolutely indicated, because antibody formation may decrease future chances of successful renal transplantation.

decrease a patient's future chances of successful renal transplantation.²⁴ In addition, intraoperative infusion of blood may cause hyperkalemia as a result of cellular lysis. A study⁵ of 49 surgical patients with end-stage renal disease found that hyperkalemia occurred in as many as 44 percent of patients who received blood intraoperatively, compared with 25 percent of patients who did not receive a transfusion during surgery.

If the surgery is elective, erythropoietin may be administered to raise the hematocrit to the upper acceptable value (36 percent). Treatment should be initiated several weeks before surgery, so that the hormone has adequate time to raise the hematocrit to the desired level. Erythropoietin therapy is a particularly important option in patients with chronic kidney disease who object to transfusions on religious grounds.

Iron stores should be checked in all patients receiving erythropoietin. For maximum effectiveness of erythropoietin, iron deficiency should be remedied with oral supplements.

ANTIBIOTIC PROPHYLAXIS

Many patients with chronic renal failure receive prophylactic antibiotics for surgical procedures, particularly dialysis graft procedures.²⁵ Although vancomycin (Vancocin) has been routinely used for this purpose, bacteria are becoming resistant to this drug. Hence, a first-generation cephalosporin in a dosage appropriate for renal function would be a better choice for empiric therapy.

Even with minor procedures (e.g., dental care²⁶), antibiotic prophylaxis using standard endocarditis regimens is recommended for the first several months after the placement of synthetic vascular access grafts. The purpose is

to avoid bacterial seeding of the grafts before epithelialization occurs.

EVALUATION OF CARDIAC RISK

Cardiovascular disease is the greatest cause of mortality in patients with renal disease of any stage. One half of all deaths before and after kidney transplantation are due to cardiac causes, with diabetes increasing the chance of atherosclerotic disease.²⁷ Because of the high prevalence and rapid progression of coronary artery disease in patients with kidney disease, cardiac evaluation must be current to be useful.

Targeting cardiac testing to patients with risk factors increases the positive predictive value of an abnormal test that suggests the presence of underlying heart disease.²⁸ Cardiac risk factors include age greater than 50 years; history of angina, diabetes mellitus, or congestive heart failure; and an abnormal electrocardiogram (ECG).

Stress testing (using exercise or pharmacologic agents), radionuclide scanning, and stress echocardiography have all been used to screen for coronary artery disease in patients with end-stage renal disease. If exercise testing is used, patients who are receiving peritoneal dialysis should drain their abdomen completely before the test to increase their exercise capacity.²⁹

In the many patients with chronic kidney disease who cannot exercise adequately because of comorbid conditions, dipyridamole is often used to achieve a maximal heart rate; however, this drug may cause transient hypertension.³⁰ Some authorities prefer to use dobutamine (Dobutrex) stress echocardiography. Several studies^{31,32} have demonstrated a positive predictive value of about 90 percent for this modality.

Minor procedures, such as access manipulation, do not require an extensive cardiac evaluation unless the preoperative ECG is abnormal. Cardiac revascularization may decrease intraoperative cardiac risk and enhance survival in patients with kidney disease, as in

TABLE 2

Typical Preoperative Diagnostic Testing in Patients with Chronic Kidney Disease

Renal panel: sodium, potassium, chloride, blood urea nitrogen, creatinine, calcium, and bicarbonate levels
Complete blood count to evaluate for anemia
Arterial blood gas measurements if the bicarbonate level is below 18 mEq per L (18 mmol per L) ³⁵
Bleeding time if uremic bleeding is a concern ³
Physical examination, with emphasis on volume status
Repeat of electrolyte levels 2 to 3 hours before surgery ³⁵
Chest radiograph to evaluate fluid status

other patients.² However, cardiac revascularization is typically reserved for use in patients whose cardiac risk is high enough to merit intervention independent of preoperative management considerations. Several guidelines^{33,34} on preoperative cardiac risk assessment are available. [Reference 34: Evidence level B, systemic review of non-randomized controlled trials].

HYPERTENSION

Preoperative and intraoperative hypertension is common in patients with chronic kidney disease. Contributing factors include anxiety, a catecholamine response related to the stress of surgery, and baseline hypertension caused by kidney failure.

With few exceptions, patients who have kidney disease and hypertension should continue antihypertensive drug therapy throughout the surgical period. Oral agents that cannot be given intravenously, such as methyldopa (Aldomet), clonidine (Catapres), and propranolol (Inderal), may be replaced with transdermally administered clonidine two to three days before surgery or with an intravenously administered agent.

Unless diuretics are being used for volume management (e.g., congestive heart failure or nephrotic syndrome) in patients with chronic kidney disease, they should be discontinued two to three days before surgery. Discontinuation is necessary to avoid possible volume depletion and intraoperative hypotension, which may worsen renal function.¹⁴

Abrupt withdrawal of NSAIDs, antihistamines, and decongestants may cause rebound

Even with minor procedures (e.g., dental care), antibiotic prophylaxis using standard endocarditis regimens is recommended for the first several months after the placement of synthetic vascular access grafts.

hypertension. Hence, sudden discontinuation of these agents should be avoided immediately before surgery.³⁵

Hypoglycemia may also cause hypertension as a result of catecholamine release for mobilization of glycogen stores. This most commonly occurs in patients with diabetes mellitus who are kept on NPO status for a prolonged period before surgery. Inadvertent hypoglycemia can be avoided with the continuous administration of a low-dose dextrose infusion.

Routine Testing

Preoperative diagnostic tests that are typically performed in patients with chronic kidney disease are listed in *Table 2*.^{3,35} Excess blood-draw procedures should be avoided preoperatively and during hospitalization in this generally anemic patient population. It is also important to avoid intravenous line placements and blood-draw procedures in the nondominant arm of a patient who will be starting dialysis in the near future. In this situation, the vasculature needs to be protected for the creation of an arteriovenous fistula or graft.

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