Perioperative Care of Patients with Kidney Diseases

By

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Why it is important ??

- High incidence of coronary artery disease and myocardial dysfunction.
- Difficulty adjusting fluid, acid base and electrolytes in the perioperative period in patients.
- Failure to normally excrete and/or metabolize anesthetics and analgesics, leading to toxic levels of these agents.
- Increased bleeding complications.
- Poor blood pressure control.

Why ?

- Great challenge for the medical team participating in the preparation (anesthesiologists, surgeons, nephrologists...)

- CKD can be associated with excess surgical morbidity, the most important of which include acute renal failure, hyperkalemia, volume overload, and infections

Patients with kidney disease include the following

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.

Preparation of the patient

- *Aim:*
  - *Identification of coexisting cardiovascular, circulatory, hematologic, and metabolic derangements secondary to renal dysfunction are the goals of preoperative evaluation in these patients*

Preparation of the patient:
initial evaluation:

- History taking:

- Diagnosis (type of kidney disease)
- Etiology of kidney disease
- Comorbid conditions(e.g., diabetes, hypertension, ischemic heart or peripheral artery disease, chronic heart failure, jaundice) or known infections
- Symptoms of uremia or symptoms of complications
- previous MI and symptoms consistent with ischemic heart disease. To assess the cardiovascular risk

History taking: (cont.)

- Systemic diseases.
- Recent treatment, previous anesthesia as well as current therapy

- **If the patient is on dialysis :**
- AVF.
- Method of dialysis, number of dialysis sessions per week, their duration in hours, tolerance.
- Side effects.

initial evaluation:

- Physical examination:

- Volume status examination
- The patient's functional status and exercise tolerance
- Manifestations of anemia
- Bleeding (bruises, petechiae)
- Manifestations of complications :
  - Acidosis
  - Confusion (uraemic encephalopathy)
  - Pulmonary oedema
  - Pericarditis (pericardial friction rub)

initial evaluation:

- Laboratory evaluation:

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

Concept of Preoperative Diagnostic Tests

- **Avoid excess blood-draw procedures** preoperatively and during hospitalization in this generally **anemic patient population.**
- **Avoid IV 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 AVF or graft**.

- The doctor should ask **whether the result of the test** is going to alter the patient's management. Ordering unnecessary tests is neither helpful nor cost-effective.

Surgical risk assessment

- Clinical predictors of preoperative cardiovascular risk
- Major predictors include the following

  - Unstable coronary syndromes - Recent MI with evidence of important ischemic risk based on clinical symptoms or the results of noninvasive testing or unstable or severe angina
  - Decompensated CHF
  - Significant arrhythmias - High-grade atrioventricular block, symptomatic ventricular arrhythmias in the presence of underlying heart disease, supraventricular arrhythmias with uncontrolled ventricular rate
  - Severe valvular disease

Clinical predictors of preoperative cardiovascular risk

- Intermediate predictors include the following:
  - Mild stable angina pectoris
  - Prior MI based on history findings or the presence of pathological Q waves
  - Compensated or prior CHF
  - Diabetes mellitus
- Minor predictors include the following:
  - Advanced age
  - Abnormal ECG findings (eg, left ventricular hypertrophy, left bundle-branch block, ST-T abnormalities)
  - Rhythm other than sinus (eg, atrial fibrillation)
  - Low functional capacity
  - History of stroke
  - Uncontrolled systemic hypertension

Surgical risk according to the procedures :

- **High risk (reported cardiac risk often >5%) :**
  - Emergency operations, particularly in elderly persons
  - Aortic and other major vascular procedures
  - Peripheral vascular procedures
  - Prolonged surgical procedures with large fluid shifts, blood loss, or both

- **Intermediate risk (reported cardiac risk generally < 5%) :**
  - Carotid endarterectomy
  - Head and neck procedures
  - Intraperitoneal and intrathoracic procedures
  - Prostate surgery
  - Orthopedic procedures

- **Low risk (reported cardiac risk generally < 1%) :**
  - Endoscopic procedures
  - Superficial procedures
  - Cataract surgery
  - Breast surgery

Strategies to Reduce Surgical Risk

1. ***POTASSIUM LEVELS***
   - Whenever possible, an acceptable potassium level (less than 5.5 mEq per L) should be obtained before surgery is performed in a patient with Chronic kidney disease
   - Hyperkalemia may be precipitated by tissue breakdown, transfusions, acidosis, ACE inhibitors, rhabdomyolysis, and the use of Ringer lactate solution as a replacement fluid.
   - Treatment options include polystyrene binding resins, insulin in combination with intravenously administered dextrose, intravenously administered bicarbonate, and, if all else fails, dialysis.

POTASSIUM LEVELS (cont.)

- 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 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

2. ***ACID-BASE DISORDERS***

- Most patients with CKD have chronic acidosis; surgical operation can further complicate the acidemia. Such patients are at a higher risk for hyperkalemia, myocardial depression, and cardiac arrhythmia
- Also, acidosis in patients with chronic kidney disease or end-stage renal disease may decrease the effectiveness of some local anesthetics.
- Sodium bicarbonate is used in the setting of metabolic acidosis not caused by hypoperfusion when serum bicarbonate levels are below 15 mEq/L. It can be administered in intravenous (IV) fluid as 1 to 2 ampules in a 5% dextrose solution

3. BLEEDING

- Uremia can cause platelet dysfunction, which can result in increased perioperative bleeding.
- Bleeding time is the most sensitive indicator of the extent of platelet dysfunction While bleeding times of greater than 10 to 15 minutes have been associated with a high risk of hemorrhage
- Measures to reduce the preoperative bleeding are :
  - 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.

3. BLEEDING (cont.)

- Measures to reduce the preoperative bleeding are :
  - Antiplatelet agents, including aspirin and dipyridamole , should not be given within 72 hours before surgery in patients with end-stage renal disease or uremic chronic kidney disease.
  - To minimize uremic complications, patients with end-stage renal disease should undergo dialysis on the day before surgery.
  - A small amount of heparin is used during hemodialysis. And , unless heparin-free dialysis is used, it is important to wait at least 12 hours after the last hemodialysis with heparin before an invasive surgical procedure is performed

4. ***ANEMIA***

- Correcting severe or hemodynamically significant anemia may help to avoid complications from perioperative blood loss.

- Blood product transfusion should be avoided when not absolutely indicated, because antibody formation may decrease future chances of successful renal transplantation. In addition, intraoperative infusion of blood may cause hyperkalemia as a result of cellular lysis.

4. ANEMIA (cont.)

- 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.

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

5. ***ANTIBIOTIC PROPHYLAXIS***

- 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. The purpose is to avoid bacterial seeding of the grafts before epithelialization occurs.

6. Hypertension

- Should be optimized before surgery
  - Controlled by multiple drugs & dialysis
  - Emergency operation:

    IV antihypertensive should be used
  - Discontinuation of current antihypertensive drug is not recommended
  - But ACEIs withdrawal may be attempted:

  As it may cause development of hypotension and large volume distribution is expected

7. ***Fluid and metabolic balance***

- Should be optimized before surgery
  - Assess Residual kidney function.
  - Anuric patients replace with 800 cc to 1 L/day □ normal saline and 5% glucose
  - 3rd space loss differs according to surgery.
  - Optimal Weight: as
  - Hypervolemic → pulmonary edema
  - Hypovolemic → hypotension “anesthesia induced VD

7. ***Fluid and metabolic balance: (cont.)***

- **Maintenance of euvolemia and renal perfusion** seem like obvious goals for patients with CKD or AKI. However, assessing their adequacy in the perioperative period is not a simple task.
- Features of hypovolemia can be masked by anesthesia and surgery.
- Invasive monitoring may improve assessment but disease states, such as sepsis, can cause maldistribution of intravascular volume due to VD and altered capillary permeability.
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7. ***Fluid and metabolic balance: (cont.)***

- Intraoperative blood loss and fluid shifts during surgery can compound these problems.
- Typically the anesthesia team will aim for a mean arterial pressure > 65 to 70 mmHg, or higher for the uncontrolled HTN patient, UO >0.5 ml/kg/h as applicable, CVP 10 to 15 mmHg, and pulmonary artery wedge pressure of 10 to 15 mmHg.
- Intraoperative transesophageal ECHO and newer monitors of stroke volume may also be used to assess adequacy of cardiac preload.

7. ***Fluid and metabolic balance: (cont.)***

- **Fluid resuscitation** is typically with either crystalloids or colloids or blood products as indicated. The ideal crystalloid is debatable and many texts continue to recommend normal saline as the choice of IV fluid for patients with kidney dysfunction.
- Normal saline is hypertonic and hyperchloremic compared with plasma and volumes of > 30 ml/kg can lead to hyperchloremic metabolic acidosis and exacerbation of hyperkalemia.

8. *Contrast media*

Surgical techniques include the use of nonionic contrast agents or the use of intraabdominal laparoscopy and they may need to be modified for patients with CKD or AKI. Earlier studies on patients with CKD suggested that nonionic contrast agents might increase the risk of death in patients with CKD. However, others show clinically insignificant changes, when preoperative prevention strategies are employed.

- **The ideal strategy to prevent contrast-induced nephropathy (CIN)** is unknown but current recommendations include hydration, avoidance of other nephrotoxic medications, prevention of hypotension, and possibly use of adjuvants such as sodium bicarbonate or N-acetylcysteine.

Renal Risk Assessment and Interventions

1. Patients with CKD treated conservatively

- **Euvolemic patients, responsive to diuretic therapy, and have no significant electrolyte abnormalities or bleeding tendencies have uncomplicated cases and do not require dialysis before surgery.**

- **Patients with edema, CHF, or pulmonary congestion or those who are responsive to diuretic therapy require further cardiovascular evaluation. If the results of the cardiovascular evaluation are optimal, then fluid overload can be attributed to CKD. Combination diuretic therapy can help treat these patients to achieve euvolemia prior to surgery.**

1. Patients with CKD treated conservatively

- **Patients with diabetes have a greater tendency of having volume overload or cardiovascular disease. CKD may be so advanced that the patient develops diuretic resistance, with progressive edema. Preoperative dialysis may be considered in these patients.**

- **If postoperative dialysis is imminent, the surgeons should be advised to place a temporary catheter intraoperatively. This avoids the use of femoral cannulation, which carries a higher risk of infection. Permanent vascular access placement can then be arranged when the patient is more stable.**

1. Patients with CKD treated conservatively

- Further deterioration in renal function can be avoided by identifying and eliminating potential nephrotoxic agents by dosage adjustment for antibiotics (eg, aminoglycosides, acyclovir, amphotericin), sedatives, and muscle relaxants. Nonsteroidal anti-inflammatory drugs (NSAIDs) should be avoided, as should radiocontrast material.

- Iodinated radiocontrast material can induce acute renal failure and gadolinium should be avoided as much as possible. If iodinated radiocontrast material must be used, good hydration (0.45% saline), may reduce the risk of acute renal failure.

1. Patients with CKD treated conservatively

- Use of demerol (meperidine) for postoperative pain control should be avoided because accumulation of its metabolite normeperidine can cause seizures in patients with CKD, especially those on dialysis.

- Drug interactions and potential nephrotoxicity must be identified and either the drug must be stopped or its dose adjusted for the level of renal function. Electrolyte abnormalities must be identified and corrected perioperatively.

Renal Risk Assessment and Interventions

2. Patients with Aki treated conservatively

- *In the acute setting, patients who have stable volume status can undergo surgery without preoperative dialysis, provided that no other indication exists for emergency dialysis.*

3. Dialysis and Renal Transplant Patients

For patients already on dialysis, the following need to be determined:

1- Dialysis adequacy

2- Preoperative dialysis needs

3- Postoperative dialysis timing

4- Dosage requirements for all medications

- **Patients on hemodialysis usually require preoperative dialysis within 24 hours before surgery to reduce the risk of volume overload, hyperkalemia, and excessive bleeding. Such patients are often dialyzed on the day after surgery as well.**

- **Patients with peritoneal dialysis who are undergoing abdominal surgery should be switched to hemodialysis until wound healing is complete. Peritoneal dialysis should be continued for those undergoing nonabdominal surgery.**

3. Dialysis and Renal Transplant Patients

- Because of complicated interactions and immunosuppressive dosing, monitoring, and adjustment, a nephrologist with specialized knowledge of renal transplantation should be involved in the preoperative evaluation of patients with CKD who have received kidney transplantation.

- Cyclosporine or tacrolimus taken by renal transplant recipients for immunosuppression are metabolized by the cytochrome P-450 system in the liver and, thus, interact with a wide variety of agents.

3. Dialysis and Renal Transplant Patients

- Diltiazem, Statins, macrolides, and antifungal drugs can precipitate nephrotoxicity.

- Others, such as carbamazepine (Tegretol), barbiturates, and theophylline can precipitate rejection.

- Drug levels must be monitored in this setting.

- Intravenous cyclosporine or tacrolimus should be given at one third the oral dose until the patient is able to tolerate oral medications.

Post-Procedure

- **Adequate hydration :** by good oral intake of fluids once the oral feeding is permitted . Also isotonic saline infusion (better to be monitored by central venous line)

- **Prophylactic antibiotics** with prober dose to guard against infection

- **Avoid nephrotoxix drugs**

- The routine use of **mannitol** post operative is not advisable anymore

Post-Procedure

- Careful follow up of the cardiac condition or occurrence of any acute cardiovascular events (as angina, MI, or arrysmia) of the patient at high risk of cardiovascular risk

- Frequent monitoring of the renal function and electrolytes postoperative

Post-operative

Pain management in the dialysis patient
Peripheral nerve block whenever possible
Mild pain: Acetaminophen±tramadol*
Moderate to severe pain: Acetaminophen+opioids** (fentanyl or hydromorphone)±tramadol*±ketamine
Antiepileptics* in neuropathic pain only
Avoid NSAIDs

**Adjusted dose, **1 = Adjusted dose, 2 = Avoid morphine and codeine, 3 = Avoid long acting forms, NSAIDs = Nonsteroidal antiinflammatory drugs*

Tawfic, QA et al, J Anaesthesiol Clin Pharmacol. 2015 Jan-Mar;31(1):6-13. Review