CHRONIC KIDNEY DISEASE

- Patients with chronic kidney disease (CKD) can safely undergo surgery with appropriate medical management. The first step is to document the history of pre-existing renal disease and its severity. It is important to identify their baseline creatinine and any major problems in the past (e.g., renal failure during an admission for sepsis). Preoperative measurement of the serum creatinine/BUN and electrolytes is appropriate for these patients.
- The next step is to assess their estimated creatinine clearance (CrCl). At many centers the laboratory is reporting an estimation of the CrCl using the formulas developed from the Modification of Diet in Renal Disease (MDRD) Study[1]. Some of these same formulas are available on line as well[2,3].
- When that information is not available, an alternative is to use the Cockcroft-Gault equation:

$$\text{CrCl} = \frac{(140\text{-Age})\ (\text{weight in Kg})}{(72)\ (\text{serum creatinine})} \times 0.75 \text{ for women}$$

- Remember, that these formulas assume the patient to be at a steady state. If their creatinine is rising acutely, these formulas tend to OVERESTIMATE the patient's renal function.
- It is extremely helpful to include the estimated CrCl in your note and highlight it, so that all of the team members are aware of the issue and take appropriate precautions. The patient's renal function and electrolytes should be monitored closely for the first few days following surgery, and repeated if the patient is nauseated, vomiting, undergoing diagnostic testing or is otherwise in an unstable medical situation.
- A 'normal' creatinine clearance is generally > 100 ml/min. Patients start needing adjustments to most commonly used medications when the CrCl falls below 50 ml/min.

TYPICAL PERIOPERATIVE MEDICATIONS AND THEIR DOSE ADJUSTMENT

DRUG	Cr Cl > 50	Cr Cl >10-50	CrCl =< 10
Cefazolin (IV)	1-2 g Q 6-8 hrs	½ dose Q 12 hrs	½ dose Q 24 hrs
Piperacillin /Tazobactam	3.375 g Q 6 hrs	2.25 g Q 6 hrs	2.25 g Q 8 hrs
Levofloxacin	500 mg Q 24 hrs	500 mg x 1, then 250 mg Q 24 hrs	500 mg x 1, then 250 mg Q 48 hrs
Metoclopramide	10 mg Q 6 hrs	7.5 mg Q 6 hrs	5 mg Q 6 hrs
Ranitidine (IV)	50 mg Q 8 hrs	50 mg Q 24 hrs	consider alternative

Micromedex (available through Healthlinks), other websites, textbooks, and pharmacists are excellent resources for dose adjustment recommendations depending on the medication and the patient's estimated CrCl.

Other common management issues:

- Monitor the medication list (scheduled and PRN) looking for drugs that may impair renal function or which require dose adjustment.
- Use caution re-instituting ACE inhibitors and angiotensin receptor blockers (ARBs). Patients need appropriate monitoring of the renal function and electrolytes.
- In general, avoid standing orders for potassium in maintenance IVF and standing orders for electrolyte replacement.
- Avoid adding the standard electrolyte packets to TPN. Best to add NaCl (~100 meq/L), NaAcetate 50-100 meq/L, amino acids, glucose and vitamins only.
- Avoid non-steroidal anti-inflammatory agents (NSAIDS), like ketorolac (Toradol) when at all possible.
- Patients who are dialysis dependent should also be followed by the inpatient Renal service. Dialysis is typically arranged for the day prior to surgery.
- The Renal Transplant service should be notified when renal transplant patients are admitted

- Avoid Fleet's (phospho-soda) enemas for surgical bowel preps or for constipation—this can cause volume depletion, hypotension, and hyperphosphatemia. Golytely is preferred. Mag citrate should also be used with caution because of risk of hypermagnesemia.
- Consider pre-hydration and the use of N-acetylcysteine prior to contrast procedures.
  - Acetylcysteine, at a dose of 600 to 1200 mg orally twice daily, can be administered the day before and on the day of the procedure. If bicarbonate is used as the hydration solution, some authors prefer administering acetylcysteine at a dose of 1200 mg orally twice daily the day before and the day of the procedure because this was the regimen used in the REMEDIAL trial[4].
  - If the patient can tolerate volume expansion with sodium bicarbonate (and the glucose load), consider treatment before and after contrast studies. The patient should receive a bolus of 3 mL/kg of isotonic bicarbonate for one hour prior to the procedure, and continued at a rate of 1 mL/kg per hour for six hours after the procedure. This solution can be prepared by adding 150 meq of sodium bicarbonate (three 50 mL ampules of 1 meq/mL sodium bicarbonate) to 850 mL of 5 percent dextrose in water[5].
- Morphine and meperidine each have metabolites which can accumulate with renal insufficiency. Hydromorphone and fentanyl are the preferred narcotic agents for patients with renal insufficiency
- The clearance of enoxaparin is impaired by renal insufficiency. Use caution with this drug in patients with renal impairment. When it is used, the dose must be adjusted and anti-factor Xa levels should be monitored. For Crcl > 60: 1mg/kg q12h (standard dosing), for patients with CrCl 30-60: 0.85mg/kg q12h, and for patients with CrCl < 30: 1mg/kg q24h (or use IV heparin). More info available at http://uwmcacc.org/Enoxaparin.html

References

[1] Levey AS, Coresh J, Greene T, et al. Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. Ann Intern Med. 2006; 145:247-254.
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[4] Briguori C, Airoldi F, D'Andrea D, et al. Renal Insufficiency Following Contrast Media Administration Trial (REMEDIAL): a randomized comparison of 3 preventive strategies. Circulation. 2007;115:1211-1217.
[5] Rudnick MR. Prevention of radiocontrast media-induced acute kidney injury (acute renal failure). UpToDate. January 2009. http://www.uptodateonline.com