PREOPERATIVE RENAL FUNCTION TESTS

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Creatinine value
Creatinine is the end-product of skeletal muscle catabolism. Creatinine is disposed almost entirely by glomerular filtration. Normal ranges of serum creatinine are 0.5 to 1.5 mg/dl. Creatinine production is proportional to skeletal muscle mass, so elderly patients may have normal values despite reduction in GFR. Also patients may still have impaired renal function even thought the values are within normal. For example if a patient’s baseline creatinine is 0.6 mg/dl then it jumps to 1.2 mg/dl an approximate 50% decrease in GFR has occurred despite the values being within normal. More accurate assessment of renal function is obtained from creatinine clearance.

Blood Urea Nitrogen (BUN)
Urea is an end product of protein metabolism and it’s a product reflects diet protein intake and protein catabolic rate. Urea is excreted by GFR, it’s reabsorbed along the tubules, especially in sodium-avid extracellular volume contraction. Normal BUN to creatinine concentration ratio in serum is 10:1. The ratio can be increased in volume depletion (dehydration), catabolic states such as infection, corticosteroid use (catabolic drug), increase protein intake (diet), GI hemorrhage, degradation of blood from hematoma, and obstructive uropathy. Normal BUN values are 8-20 mg/dl.

Disadvantage of BUN/Creatinine is that they are insensitive measurement of renal function. Changes are usually not evident till there is a 50-75% decrease in GFR.

Creatinine Clearence
Reasonable way to estimate GFR, although 10% of creatinine is excreted by tubular secretion so that creatinine clearance is an overestimation of true GFR especially in azotemia. Daily excretion of creatinine is 10-20 mg/kg or 110-150 mg/min. 24 hour urine collection is obtained to measure creatinine clearance. Mild, moderate and severe impairment correspond to values of 40-60 ml/min, 20-40 ml/min, and less than 20 ml/min respectively. Keep in mind that in pregnancy creatinine clearance is elevated 30-50% over normal values.

\[ Ccr = \frac{Ucr x (U/Pcr)}{V} \]

Ccr: Clearance of creatinine (ml/min)
Ucr: Urine creatinine (mg/ml)
V: Volume of urine (ml/min) (for 24-hr volume: divide by 1440)
Pcr: Plasma creatinine (mg/ml)

Renal Tubule Function (Urinary sodium and FeNa)
Measurement evaluates the kidney’s ability to maintain salt and water balance and acid-base homeostasis. Urine concentrating ability can be assessed by fluid restriction for 18 to 24 hours. If a polyuric patient is suspected of having a urinary concentrating defect, administration of 5 units vasopressin may be given. If central DI is present the patient will be able to double urinary osmolality whereas nephrogenic DI doesn’t respond.

Urinary sodium can be useful for volume status. Values below 20 mEq/L suggests intravascular volume depletion. Above 40 may suggest decrease ability of renal tubule reabsorption of sodium as seen in acute tubular necrosis (ATN).
FeNa (Fractional excretion of sodium) is the fraction of sodium filtered at the glomerulus thus excreted in the urine. FeNa is most useful in differential diagnosis of acute oliguria. FeNa < 1% is normal or hypovolemia. FeNa >1% is suggestive of tubular damage (ATN).

FeNa: \((\text{Una}/\text{Pna}) \times (\text{Pcr}/\text{Ucr})\)

FeNa : Fractional excretion of sodium  
Una: Urine sodium (mEq/L)  
Pna: Plasma sodium (mEq/L)  
Pcr: Plasma creatinine (mg/dl)  
Ucr: Urine creatinine (mg/dl)

Urine pH is useful in patient with acid base disorders. Failure to acidify urine in presence of systemic acidosis suggests distal renal tubular acidosis. Example, in a patient with systemic acidosis (pH <7.3) urine pH should be less than or equal to 5.3.

Urinary Protein  
Normal individuals excrete < 150 mg/day of protein. Glomerular basement membrane prevents high molecular weight proteins to pass such as albumin and renal tubules can reabsorb small amounts of protein that may have been filtered. Proteinuria may be transient in individuals with febrile illness, CHF, or after vigorous exercise. Although persistent proteinuria indicates renal disease. Patients who excrete > 3.5 gm of protein usually always have glomerular disease. Less than 3.5 gm can be both glomerular or tubular disease.

Reference: