

Blood Chem Impaired Kidney Function and Other Metabolic Problems Review

KIDNEYS

- **Function.** The kidneys regulate fluid levels, filter waste and toxins from the blood, release hormones that regulate blood pressure and red blood cell production, activate vitamin D for healthy bones, and maintain balance of sodium, phosphorus, and potassium.
- **Chronic kidney disease (CKD)** indicates the presence of kidney damage, urinary albumin excretion of 30 mg/kg per day or more, decreased kidney function, and/or an eGFR below 60 for three or more months irrespective of the cause.
 - Symptoms include fatigue; weakness; difficult and painful urination; foamy urine or pink and dark urine, which is indicative of hematuria; increased need to urinate, especially at night; puffy eyes; swelling of the face, hands, abdomen, ankles, and feet; and increased thirst.

CAUSES OF CKD

- Top two causes are diabetes and hypertension.
- Decreased renal perfusion due to hypovolemia can be caused by vomiting, diarrhea, diuretic use, etc.; hypotension; infection; or use of NSAIDs and ACE inhibitors.
- Nephrotoxic drugs including aminoglycoside antibiotics, NSAIDs, and ACE inhibitors. The use of these should be avoided in diabetics.
- Urinary obstruction.

KIDNEY STONES

- Most common stones are made of calcium oxalate.
- Factors that increase risk of kidney stones
 - Fat-soluble vitamin imbalance (vitamin A, D, or K2). Excess vitamin D in absence of sufficient vitamin A and K2 is a particular concern.
 - Excess sodium intake.
 - Magnesium deficiency.
 - Very low-carb diets (increase demand for vitamin C).
 - Excess fructose intake.
 - High-protein diet with adequate carb intake will not necessarily increase risk for kidney stones unless you already have kidney disease.

MARKERS FOR IMPAIRED KIDNEY FUNCTION

Marker	Level
BUN	High
Creatinine	High
eGFR	Low
Phosphorus	High
Sodium	High
Potassium	High
AST	High
ALT	High
GGT	High

FOLLOW-UP TESTING FOR IMPAIRED KIDNEY FUNCTION

Marker
Urinalysis with microscopy
Urine microalbumin / creatinine ratio
Ultrasound (to check for obstruction)
Cystatin-C

If you suspect the patient has kidney dysfunction, you can either refer them to a nephrologist immediately or do further workup. Note that it is better to refer early than late.

Proteinuria is the most common finding in kidney disease due to metabolic disorders and hypertension. High cystatin C levels are indicative of reduced glomerular filtration and kidney disease.

LABORATORY AND FUNCTIONAL RANGES FOR KIDNEY MARKERS

Marker	Lab Range	Functional Range
BUN	5–18 mg/dL	13–18 mg/dL
Creatinine	M: 0.72–1.27; W: 0.57–1.0	M: 0.85–1.1; W: 0.7–1.0
eGFR	Age/gender specific	Use lab range
Phosphorus	2.5–5.3 mg/dL	3.0–4.0 mg/dL
Sodium	134–144 nmol/L	135–140 nmol/L
Potassium	3.5–5.2 nmol/L	4.0–4.5 nmol/L
AST	0–40 IU/L	F: 0–23 IU/L; M: 0–25 IU/L
ALT	0–24 IU/L	F: 0–20 IU/L; M: 0–26 IU/L
GGT	0–60 IU/L	F: 0–21 IU/L; M: 0–29 IU/L

- When only BUN is elevated, and there aren't any other markers of kidney dysfunction, the two most likely causes are dehydration or high protein intake. With dehydration, RBC and/or hemoglobin will often be slightly above the upper limit of the functional range but not out of the lab range.
- Potential causes of a high BUN-to-creatinine ratio include heart failure, liver cirrhosis, very-high protein diet, and upper GI bleeding.
- BUN-to-creatinine ratio over 20 indicates the problem is prerenal, meaning before the kidney. Dehydration or hypoperfusion from hypovolemia, vomiting, diarrhea, diuretic use, hypotension, infection, and use of NSAIDs and ACE inhibitors are the most common causes in this case.
- One possible cause of slightly elevated creatinine alone is increased muscle mass.

Functional treatment of impaired kidney function almost exclusively involves addressing underlying causes. People with kidney disease have a decreased ability to excrete byproducts and waste products, and some botanicals contain substances that people with kidney disease need to limit.

PROMOTE OVERALL KIDNEY HEALTH AND PROTECT AGAINST KIDNEY STONES

1. Balance fat-soluble vitamin intake (vitamins A, D, and K2).
2. Ensure adequate magnesium intake.
3. If you have a patient with obesity, metabolic syndrome, and hypertension, experiment with salt intake.

- a. Moderate sodium intake.
- b. Be careful not to go too low. Very low sodium intake is associated with higher risk of cardiovascular disease, just like very high sodium intake.

GOUT

- Type of inflammatory arthritis caused by elevated levels of uric acid in the blood, forming crystal deposits in the joints, tendons, and surrounding tissue.
 - Typically affects the feet, specifically the big toe joint.
- Purines are higher in many Paleo friendly foods, such as red meat, turkey, organ meats, and certain types of fish and seafood. Patients with gout are often advised to reduce or eliminate these purine-rich foods with the goal of preventing excess uric acid production and thereby reducing the symptoms of gout.
- Purine intake alone is not enough to trigger these attacks and systemic inflammation (western diets) is likely a key factor.
- Studies have shown that purine restriction doesn't improve gout.
- Other risk factors include:
 - Excess fructose intake, mostly in the form of liquid fructose as fructose in whole foods is less likely to contribute to metabolic disease
 - Insulin resistance
 - Dehydration
 - Vitamin C deficiency
 - Increased alcohol intake
 - Iron overload

RHABDOMYOLYSIS

- Involves a rapid breakdown of skeletal muscle tissue.
- May see elevated LDH, AST, ALT, and potassium as well as low serum calcium.
- Primary diagnostic marker is creatine kinase, which may be five times above the normal upper limit.
 - Also high LDH, AST, ALT, Potassium with low calcium.
- Possible symptoms include muscle pain, tenderness, weakness, swelling of the affected muscles, and tea-colored (brownish) urine, caused by the myoglobin in urine.
- Uncommon but documented side effect of statin drugs.
- Refer to a nephrologist immediately, as this can cause irreversible kidney damage.