
Anemia and Chronic Kidney Disease

This is the sixth in the series of articles about chronic kidney disease.

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Diseased kidneys can't make enough erythropoietin

Healthy kidneys make erythropoietin, a hormone that stimulates bone marrow to make red blood cells. Anemia generally develops in chronic kidney disease due to an erythropoietin deficiency. Diseased kidneys cannot make enough erythropoietin, resulting in normocytic, normochromic anemia.

Who should be worked-up for anemia?

- Start checking for anemia at Stage 3 and above (GFR ≤ 60 mL/min/1.73m²)
- Or if Hgb < 11 g/dL in pre-menopausal women and pre-pubertal patients
- Or if Hgb < 12 g/dL in adult men and post-menopausal women
- At altitudes > 6000 feet increase the thresholds for evaluation by 1g/dL for both men and women.

Use hemoglobin to quantify the level of anemia.

- Hemoglobin is the preferred lab test for anemia assessment in CKD. Hemoglobin is measured quantitatively and is not greatly affected by plasma water; length of time stored prior to analyses; nor is it falsely elevated in hyperglycemia as is the calculated hematocrit

Anemia evaluation

- Check Hgb; red blood cell indices; and reticulocyte count
- Check iron status: serum iron; total iron binding capacity (TIBC); percent transferrin saturation (TSAT); and serum ferritin
- Test for occult blood in the stool

If serum creatinine is greater than 2 mg/dL, and no other cause for anemia is found, the anemia is most likely due to an erythropoietin deficiency. Routine determination of erythropoietin level is not recommended.

Target hemoglobin

- $< 6000'$ elevation: 11 - 12 g/dL
- $> 6000'$ elevation: 12 - 13 g/dL

Iron status

Inadequate iron in CKD is multifactorial. Low protein diets; blood loss; infection and inflammation; hyperparathyroidism; aluminum toxicity; and coexisting disease can all contribute to iron deficiency in CKD. No single lab value will

definitively diagnose functional iron deficiency in CKD.

Transferrin saturation (TSAT) and serum ferritin are both used to assess iron status in CKD. Transferrin saturation reflects iron that can be used to make red blood cells. Serum ferritin reflects iron stored in the liver, spleen, and bone marrow.

Target TSAT and Ferritin, needed to maintain target Hgb

- TSAT $> 20\%$ (not to exceed 50%)
- Ferritin > 100 ng/mL (not to exceed 800 ng/mL)

How to treat the anemia of CKD

1. Use synthetic erythropoietin substitutes: epoetin alpha "EPO" (Procrit, Ortho Biotech; or Epogen, Amgen) or darbepoetin alfa "DPO" (Aranesp, Amgen)
 - Subcutaneous administration is preferred over intravenous administration
 - For adults, start treatment when Hgb is below target
 - EPO: 10,000 u subcutaneous every week
 - DPO: 60 mcg subcutaneous every 2 weeks (due to its longer half-life)
 - Rotate injection sites between upper arm, thigh, and abdominal wall areas
2. Use iron (intravenous or oral) if indicated
 - 200 mg of elemental iron per day divided into 2 - 3 doses is recommended when using oral iron supplements
 - Oral iron supplements should be given one hour before or two hours after a meal for best absorption
 - For patients unresponsive to oral iron (i.e., unable to achieve and maintain ferritin >100 and TSAT $>20\%$), intravenous iron supplementation should be considered. Iron dextran can be given in doses up to 500 mg but a test dose is required, the dose must be infused slowly, and the incidence of serious acute reactions is 0.7 %. New injectible iron formulations do not appear to pose the same risk for anaphylaxis as iron dextran and can administered more rapidly, although in lower doses. Test doses are not recommended for iron sucrose injection (Venofer), and it can be administered by slow IV push (100 mg over 5 minutes). We have found this to be a convenient way to administer intravenous iron in a busy outpatient setting

Monitoring of anemia

- Check Hgb every two weeks until stable, then monthly
- Check TSAT and ferritin at least once every 3 months