Anemia: an Overview

Description/Etiology
Anemia is defined as a deficiency in hemoglobin (Hgb) that results in an impaired ability of red blood cells (RBCs) to transport oxygen from the lungs to the tissues and to transport carbon dioxide from the tissues to the lungs. Anemia ranges in severity from asymptomatic to life-threatening depending on several factors, including the degree and type of the anemia, the underlying cause, the rate of onset of the anemia, the duration of the anemia, and the presence of comorbid conditions (e.g., cardiopulmonary disease). The numerous types of anemia can be divided in three groups based on the blood-related abnormality that is present; the three groups are impaired or decreased red blood cell production, increased hemolysis (i.e., red blood cell destruction), and loss of blood. Anemia caused by many different etiologies is included in each of the three groups.

Hemolytic anemia results from blood loss or from hemolysis. Hemolytic anemia can be inherited (e.g., sickle cell anemia [SCA], thalassemia, glucose-6-phosphatedehydrogenase [G-6-PD] deficiency) or acquired (e.g., due to antibody-mediated transfusion reaction, infection, disseminated intravascular coagulation [DIC], hypersplenism, or drug/toxin exposure). Hypoproliferative anemia results from deficient production of erythropoietin (EPO) or impaired response of bone marrow to EPO, which leads to decreased or defective RBC production. Causes of hypoproliferative anemia include iron deficiency (called iron deficiency anemia [IDA], which is the most common type of anemia), vitamin B12 deficiency, folate deficiency, decreased EPO production (e.g., secondary to renal dysfunction), insufficient production of new blood cells resulting from blood stem cell injury (called aplastic anemia), and cancer and other inflammatory conditions. Bleeding from the gastrointestinal (GI) tract, epistaxis, trauma, and menorrhagia (i.e., heavy menstrual bleeding) can cause anemia. (For more information on the types of anemia, see series of related Quick Lessons and Evidence-Based Care Sheets).

A gradual reduction in Hgb of up to 50% can generally be tolerated by an otherwise healthy person. More severe anemia can cause signs and symptoms related to tissue hypoxia, including fatigue, weakness, dizziness, dyspnea on exertion, palpitations, cognitive impairment, and intolerance to exercise and/or cold. Potential complications of severe anemia include heart failure, paresthesias, delirium, shock, hypotension, and pulmonary insufficiency. Depending on the cause of anemia, various other abnormalities associated with the underlying disease may occur (e.g., SCA is associated with increased risk of stroke and pulmonary hypertension).

Anemia is diagnosed based on patient and family history, clinical presentation of the patient, and results of a variety of hematologic studies, including Hgb, hematocrit, reticulocyte count, mean corpuscular volume, and red cell distribution width. Other studies and procedures that may be performed include serum levels of iron, vitamin B12, folate, haptoglobin (i.e., protein that binds free Hgb), and erythropoietin; tissue biopsy; and bone marrow aspiration.

Treatment depends on the underlying cause and may include vitamin and mineral supplementation, nutritional counseling, blood transfusions, and administration of erythropoiesis-stimulating agents (e.g., epoetin alfa [Procrit], darbepoetin alfa [Aranesp]). Additional pharmacologic interventions may be necessary for patients with certain types of anemia; for example, patients with SCA are often treated with hydroxyurea (Hydrea).
chemotherapy to reduce the frequency of severe pain crises and acute chest syndrome, and patients with aplastic anemia are commonly treated with immunosuppressive therapy. Bone marrow transplantation may be curative in patients with SCA, thalassemia, or aplastic anemia.

Facts and Figures
The World Health Organization defines anemia as having a Hgb value of < 12.5 g/dL in adults, < 12 g/dL in children who are 6–14 years of age, and < 11 g/dL in children who are 5 months to 6 years of age. Approximately 65% of iron in the body is found in Hgb that is in circulating RBCs. Anemia affects one-quarter of the world population, and has a higher prevalence in preschool-aged children (48%) and pregnant women (42%). The prevalence of anemia is 2–5 times higher in developing countries than in the United States. Using the higher limits of 13.5 g/dL for men and 12.5 g/dL for women, which are the values commonly used to define anemia in the U.S., ~ 4% of men and 8% of women in the U.S. have anemia.

Risk Factors
Risk factors for anemia include family history of anemia (e.g., in cases of SCA, thalassemia, or G-6-PD deficiency), medical conditions associated with chronic blood loss (e.g., hookworm infection, peptic ulcer disease, inflammatory bowel disease, gastric or colon carcinoma, liver disease, or chronic use of nonsteroidal anti-inflammatory drugs [NSAIDs] or aspirin), poverty, frequent blood donation, pregnancy, kidney disease, trauma, burns, frostbite, certain dietary factors (e.g., strict vegetarian or vegan diet unless supplemented with iron and vitamin B12). Certain types of anemia are more common in men (e.g., X-linked anemia such as that caused by G-6-PD deficiency), and other types are more common in women (e.g., IDA due to blood loss during menses and increased iron demands in pregnancy). SCA primarily affects persons of African, Mediterranean, Middle Eastern, and Asian Indian ancestry. Thalassemia is most common in persons from tropical and subtropical regions of Asia, the Mediterranean, and the Middle East.

Signs and Symptoms/Clinical Presentation
› For information regarding clinical presentation, see Description/Etiology, above, and the series of related Quick Lessons and Evidence-Based Care Sheets

Assessment
› Patient History
  • Obtain a complete medical history, including history of signs and symptoms, history of anemia, and possible sources of blood loss; ask about dietary intake, use of medications and supplements, and family history of anemia
› Laboratory Tests That May Be Ordered
  • Laboratory tests that may be performed in the diagnosis and classification of anemia include CBC, levels of Hgb and Hct, cytology, iron studies, serum vitamin B12 and folate levels, erythropoietin levels, certain genetic tests, and Hgb electrophoresis
  • Histologic examination of biopsied bone marrow samples may be performed to assess for the cause of hypoproliferative anemia
› Other Diagnostic Tests/Studies
  • Colonoscopy and upper endoscopy may be performed to assess for GI sources of bleeding

Treatment Goals
› Promote Resolution of Anemia and Optimum Physiologic Function
  • Monitor vital signs, access all physiologic systems, and frequently review laboratory/other diagnostic test results; immediately report abnormalities and treat, as ordered
  • Administer prescribed medications, as ordered; monitor treatment efficacy and for adverse effects; medications that may be prescribed include
    – supplements (e.g., ferrous sulfate, vitamin B12, folate)
    – erythropoiesis-stimulating agents (e.g., epoetin, darbepoetin) to stimulate the bone marrow to produce RBCs
    – analgesics (e.g., for pain associated with SCA)
    – antibiotics for prophylaxis and treatment of bacterial infection in patients with anemia associated with increased risk of infection, including SCA, thalassemia, and aplastic anemia
    – hydroxyurea in patients with SCA
  • Administer prescribed iron therapy (e.g., oral supplements or injections), as ordered
Monitor iron levels in patients who are receiving iron therapy to avoid iron toxicity; administer iron chelation therapy, if ordered

- Follow facility pre- and postsurgical protocols if the patient becomes a candidate for surgery (e.g., for bone marrow transplantation or for splenectomy in patients with severe hemolytic anemia); reinforce pre- and postsurgical education and verify completion of facility informed consent documents
- Promote optimal nutrition and request referral to a registered dietitian for patient evaluation and education regarding the prescribed diet, as appropriate

Provide Emotional Support and Educate

- Assess patient/family anxiety level and for knowledge deficits regarding anemia and its treatment; provide emotional support, educate, and encourage discussion about the diagnosis, potential complications, treatment risks and benefits, and individualized prognosis

Food for Thought

- SCA and thalassemia are autosomal recessive inherited disorders that are characterized by abnormal Hgb synthesis in homozygotes (i.e., individuals who inherit two defective genes); heterozygotes (i.e., carriers of one defective gene) are unaffected or have only minor disease manifestations, and are relatively protected from developing malaria. (For more information, see Evidence-Based Care Sheet ... Hemoglobinopathies: Resistance to Malaria)
- Anemia develops in ~60% of patients with solid tumors who are treated with chemotherapy; among patients with cancer, the incidence of anemia is increased in those with lung cancer (71%) and gynecologic cancers (65%) because these cancers are treated with platinum-based chemotherapy
- Researchers in a study of 591 adult patients with chemotherapy-induced anemia observed that treatment with EPO was associated with increased Hgb levels and decreased psychological distress (Del Prete et al., 2014)
- Vitamin D deficiency, which is increasingly linked to a wide range of health conditions, may be a risk factor for anemia. Investigators who analyzed data from 10,410 children and adolescents from the 2001–2006 National Health and Nutrition Examination Survey found that lower vitamin D levels were associated with increased risk of anemia (Atkinson et al., 2014)

Red Flags

- Anemia with a Hgb of < 6 g/dL is considered life-threatening
- Potential complications of parenteral iron include anaphylaxis, muscle necrosis, and phlebitis
- EPO-stimulating agents have been associated with increased risk of death and severe cardiovascular events, and should be prescribed at the lowest dose possible

What Do I Need to Tell the Patient/Patient’s Family?

- Emphasize the importance of strict adherence to the prescribed treatment regimen and continued medical surveillance for patient monitoring

References