

Anemia of Inflammation and Chronic Disease

National Hematologic Diseases Information Service



National Institute of
Diabetes and Digestive
and Kidney Diseases

What is anemia?

Anemia is a condition in which a person has a lower than normal number of red blood cells or the amount of hemoglobin in the red blood cells drops below normal, which prevents the body's cells from getting enough oxygen. Hemoglobin is an iron-rich protein that gives blood its red color and lets red blood cells transport oxygen from the lungs to the body's tissues. Therefore, low numbers of red blood cells or low levels of hemoglobin also cause low blood iron levels.

People with anemia may feel tired because their blood does not supply enough oxygen to the body's organs and tissues. If anemia becomes severe and prolonged, the lack of oxygen in the blood can lead to shortness of breath or exercise intolerance—a condition in which a person becomes easily fatigued during or after physical activity—and eventually can cause the heart and other organs to fail.

What is anemia of inflammation and chronic disease (AI/ACD)?

Anemia of inflammation and chronic disease is a type of anemia that commonly occurs with chronic, or long term, illnesses or infections. Cancer and inflammatory disorders, in which abnormal activation of the immune system occurs, can also cause AI/ACD.

AI/ACD is easily confused with iron-deficiency anemia because in both forms of anemia levels of iron circulating in the blood are low. Iron in the body is found both circulating in the blood and stored in body tissues. Circulating iron is necessary for red blood cell production. Low blood iron levels occur in iron-deficiency anemia because levels of the iron stored in the body's tissues are depleted. In AI/ACD, however, iron stores are normal or high. Low blood iron levels occur in AI/ACD, despite normal iron stores, because inflammatory and chronic diseases interfere with the body's ability to use stored iron and absorb iron from the diet. AI/ACD is the second most common form of anemia, after iron-deficiency anemia.¹

¹Agarwal N, Prchal JT. Anemia of chronic disease (anemia of inflammation). *Acta Haematologica*. 2009;122(2–3):103–108.

Who gets AI/ACD?

While AI/ACD can affect people at any age, older adults are especially at risk because they have the highest rates of chronic disease. AI/ACD is also common among hospitalized patients, particularly those with chronic illnesses.

More than 130 million Americans live with at least one chronic illness.² Addressing the causes of anemia in people with chronic disease can help improve their health and quality of life.

What causes AI/ACD?

Anemia of inflammation and chronic disease is caused by red blood cells not functioning normally, so they cannot absorb and use iron efficiently. In addition, the body cannot respond normally to erythropoietin (EPO), a hormone made by the kidneys that stimulates bone marrow to produce red blood cells. Over time, this abnormal functioning causes a lower than normal number of red blood cells in the body.

Some of the chronic diseases that lead to AI/ACD include infectious and inflammatory diseases, kidney disease, and cancer. Certain treatments for chronic diseases may also impair red blood cell production and contribute to AI/ACD.

Infectious and inflammatory diseases. As part of the immune system response that occurs with infectious and inflammatory diseases, cells of the immune system release proteins called cytokines. Cytokines help heal the body and defend it against infection. However, they can also affect normal body functions. In AI/ACD, immune cytokines interfere with the body's ability to absorb and use iron. Cytokines may also interfere with the production and normal activity of EPO.

Infectious diseases that cause AI/ACD include

- tuberculosis, an infection in the lungs
- HIV/AIDS, an infection that destroys the immune system
- endocarditis, an infection in the heart
- osteomyelitis, a bone infection

Sometimes, acute infections—those that develop quickly and may not last long—can also cause AI/ACD.

Inflammatory diseases that can lead to AI/ACD include

- rheumatoid arthritis, which causes pain, swelling, stiffness, and loss of function in the joints
- lupus, which causes damage to various body tissues, such as the joints, skin, kidneys, heart, lungs, blood vessels, and brain

²Chronic diseases and health promotion. Centers for Disease Control and Prevention website. www.cdc.gov/nccdphp/overview.htm. Updated August 13, 2012. Accessed July 24, 2013.

- diabetes, in which levels of blood glucose, also called blood sugar, are above normal
- heart failure, in which the heart cannot pump enough blood to meet the body's needs
- inflammatory bowel disease (IBD), diseases that cause inflammation and irritation in the intestines

IBD, including Crohn's disease, can also cause iron deficiency due to poor absorption of iron by the diseased intestine and bleeding from the gastrointestinal (GI) tract.

Kidney disease. People with kidney disease can develop anemia for several different reasons. Diseased kidneys often fail to make enough EPO. In addition, kidney disease results in abnormal absorption and use of iron, which is typical of AI/ACD. Anemia worsens as kidney disease advances. Therefore, most people with kidney failure have anemia. Kidney failure is described as end-stage kidney disease, sometimes called ESRD, when treated with a kidney transplant or blood-filtering treatments called dialysis.

People with kidney failure can also develop iron deficiency due to blood loss during hemodialysis, a type of dialysis that uses a special filter called a dialyzer to remove wastes from the blood. Low levels of iron and folic acid—another nutrient required for normal red blood cell production—may also contribute to anemia in people with kidney disease.

Cancer. AI/ACD can occur with certain types of cancer, including Hodgkin's disease, non-Hodgkin's lymphoma, and breast cancer. Like infectious and inflammatory diseases, these types of cancer cause inflammatory cytokines to be released in the body. Anemia can also be made worse by chemotherapy and radiation treatments that damage the bone marrow, and by the cancer's invasion of bone marrow.

What are the symptoms of AI/ACD?

Anemia of inflammation and chronic disease typically develops slowly and, because it is usually mild, may cause few or no symptoms. Symptoms of anemia may also be masked by the symptoms of the underlying disease. Sometimes, AI/ACD can cause or contribute to

- fatigue
- weakness
- pale skin
- a fast heartbeat
- shortness of breath
- exercise intolerance

How is AI/ACD diagnosed?

To diagnose AI/ACD, a health care provider orders a blood test called a complete blood count (CBC). A blood test involves drawing a person's blood at a health care provider's office or commercial facility and sending the sample to a lab for analysis. The CBC includes a measurement of a person's hematocrit, the percentage of the blood that consists of red blood cells. The CBC also measures the amount of hemoglobin in the blood and can show whether a person has a lower than normal number of red blood cells.

In addition to measuring hematocrit and hemoglobin, the CBC includes two other measurements to show whether a person has enough iron:

- The ferritin level indicates the amount of iron stored in the body. A ferritin score below 200 nanograms per liter is a sign that a person may have an iron deficiency.
- The transferrin saturation (TSAT) is a score that indicates how much iron is available, or circulating, to make red blood cells. A TSAT score below 20 percent is another sign of iron deficiency.³

A CBC result that shows low iron levels in the blood yet normal measures of iron stores in the body is a hallmark of AI/ACD.

How is AI/ACD treated?

Anemia of inflammation and chronic disease often is not treated separately from the condition with which it occurs. In general, health care providers focus on treating the underlying illness. If this treatment is successful, the anemia usually resolves. For example, antibiotics prescribed for infection and anti-inflammatory medications prescribed for rheumatoid arthritis or IBD can cause AI/ACD to disappear. However, AI/ACD is increasingly being viewed as a medical condition that merits direct treatment.

For people with cancer or kidney disease who have low levels of EPO, a synthetic form of EPO may be prescribed. A health care provider usually injects EPO subcutaneously—under the skin—two or three times a week. A person may be taught how to inject the EPO at home. People on hemodialysis who cannot tolerate EPO shots may receive EPO intravenously during hemodialysis.

If iron deficiency has a role in causing AI/ACD, a person may need iron supplements to raise hematocrit to a target level. Iron supplements can be taken by pill, subcutaneously, or intravenously during hemodialysis.

People with kidney disease and AI/ACD may also be advised to take vitamin B12 and folic acid supplements. A person should talk with a health care provider before taking any supplements.

Read more in *Anemia in Kidney Disease and Dialysis* at www.kidney.niddk.nih.gov.

³Besarab A, Coyne DW. Iron supplementation to treat anemia in patients with chronic kidney disease. *Nature Reviews Nephrology*. 2010;6(12):699–710.

Eating, Diet, and Nutrition

People with anemia caused by iron, vitamin B12, or folic acid deficiencies are usually advised to include sources of these nutrients in their diets.

Dietary sources of iron include

- beans
- breakfast cereals
- chicken
- enriched bread
- spinach
- turkey

Dietary sources of vitamin B12 include

- beef liver
- breakfast cereals
- chicken
- clams
- fish
- turkey

Dietary sources of folic acid include

- beans
- breakfast cereals
- chicken
- enriched bread
- rice
- turkey

Points to Remember

- Anemia is a condition in which a person has a lower than normal number of red blood cells or the amount of hemoglobin in the red blood cells drops below normal, which prevents the body's cells from getting enough oxygen.
- Anemia of inflammation and chronic disease (AI/ACD) is a type of anemia that commonly occurs with chronic illnesses, infections, cancer, or inflammatory disorders.
- AI/ACD typically develops slowly and, because it is usually mild, may cause few or no symptoms. Sometimes, AI/ACD can cause or contribute to fatigue, weakness, pale skin, a fast heartbeat, shortness of breath, and exercise intolerance.
- To diagnose AI/ACD, a health care provider orders a blood test called a complete blood count (CBC).
- AI/ACD often is not treated separately from the condition with which it occurs. In general, health care providers focus on treating the underlying illness.

Hope through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), through its Division of Kidney, Urologic, and Hematologic Diseases, conducts and supports research on anemia and other blood diseases. The NIDDK also conducts and supports basic research on the regulation of iron absorption, storage, and utilization, and on some of the chronic diseases associated with AI/ACD. For example, the NIDDK's End-stage Renal Disease Program promotes research aimed at reducing medical problems stemming from blood, bone, nervous system, metabolic, GI, cardiovascular, and endocrine abnormalities in end-stage kidney failure.

Clinical trials are research studies involving people. Clinical trials look at safe and effective new ways to prevent, detect, or treat disease. Researchers also use clinical trials to look at other aspects of care, such as improving the quality of life for people with chronic illnesses. To learn more about clinical trials, why they matter, and how to participate, visit the NIH Clinical Research Trials and You website at www.nih.gov/health/clinicaltrials. For information about current studies, visit www.ClinicalTrials.gov.

References

Weiss G, Goodnough LT. Anemia of chronic disease. *New England Journal of Medicine*. 2005;352(10):1011–1023.

For More Information

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You may also find additional information about this topic by visiting MedlinePlus at www.medlineplus.gov.

This publication may contain information about medications and, when taken as prescribed, the conditions they treat. When prepared, this publication included the most current information available. For updates or for questions about any medications, contact the U.S. Food and Drug Administration toll-free at 1-888-INFO-FDA (1-888-463-6332) or visit www.fda.gov. Consult your health care provider for more information.

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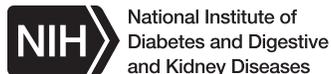
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