

# Anemia of Inflammation and Chronic Disease

*National Hematologic Diseases Information Service*



U.S. Department  
of Health and  
Human Services

NATIONAL  
INSTITUTES  
OF HEALTH

**NIDDK**  
NATIONAL INSTITUTE OF  
DIABETES AND DIGESTIVE  
AND KIDNEY DISEASES

## What is anemia?

Anemia is a condition in which the blood has a lower-than-normal number of red blood cells (RBCs). RBCs contain hemoglobin, an iron-rich protein that gives blood its red color and allows RBCs to transport oxygen from the lungs to the tissues of the body. Because RBC numbers are low in anemia, blood hemoglobin levels are also low.

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 cause the heart and other organs to fail.

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

AI/ACD 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. Some people develop AI/ACD without having any signs of these health problems.

AI/ACD is easily confused with iron-deficiency anemia because in both forms of anemia, levels of iron circulating in the blood are low. Circulating iron is necessary for RBC production. Low blood iron levels

occur in iron-deficiency anemia because levels of iron stored in the body's tissues are depleted. In AI/ACD, however, iron stores are normal or high. Low blood 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. Certain treatments for chronic diseases may also impair RBC production and contribute to AI/ACD. AI/ACD is the second most common form of anemia, after iron-deficiency anemia, but it is rarely severe.

While AI/ACD can affect people at any age, older adults are especially susceptible 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 chronic conditions.<sup>1</sup> Addressing the causes of anemia in people with chronic conditions can help improve their health and quality of life.

## What causes AI/ACD?

A number of chronic diseases can cause anemia for different reasons.

**Infectious and inflammatory diseases.** As part of the immune response that occurs with infection and noninfectious inflammatory diseases, cells of the immune system release

<sup>1</sup>Chronic disease overview. Centers for Disease Control and Prevention Web site. <http://www.cdc.gov/nccdphp/overview.htm>. Updated March 20, 2008. Accessed April 1, 2008.

proteins called cytokines. These proteins help heal and defend the body against infection. But 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 erythropoietin (EPO), a hormone made by the kidneys that stimulates bone marrow to produce RBCs.

Infectious diseases that cause AI/ACD include tuberculosis, HIV, endocarditis—infection in the heart—and 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, lupus, diabetes, heart failure, degenerative joint disease, and inflammatory bowel disease (IBD). 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 tract.

**Kidney disease.** People with kidney disease can develop anemia for several different reasons. For one, 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. Because anemia worsens as kidney disease advances, nearly everyone with end-stage kidney disease has anemia.

People with kidney failure can also develop iron deficiency due to blood loss during hemodialysis, a procedure that removes blood from an artery, purifies it, and returns it to a vein, thereby doing the job that the kidneys no longer can. Low levels of iron and of folic acid—another nutrient required for normal RBC 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 chronic inflammatory disorders and infections, these types of cancer cause inflammatory cytokines to be released in the body. The anemia of AI/ACD can also be made worse by cancer chemotherapy and radiation treatments that damage the bone marrow—where RBCs are produced—and by the cancer's invasion of bone marrow.

## What are the symptoms of AI/ACD?

AI/ACD typically develops slowly and, because it is usually mild, may cause few or no symptoms. Or its symptoms may be masked by the symptoms of the underlying disease. Sometimes AI/ACD can cause or contribute to

- tiredness
- low energy and listlessness
- weakness
- pale skin
- fast heartbeat
- shortness of breath
- exercise intolerance

## How is AI/ACD diagnosed?

Health care providers can test people with chronic illnesses for AI/ACD during their regular appointments. A complete blood count (CBC)—a laboratory test performed on a sample of a patient’s blood—can reveal anemia by determining the hematocrit level, which reflects the number of RBCs in the blood. A CBC also measures the level of blood hemoglobin. Low hematocrit and hemoglobin levels indicate anemia. Blood tests can also show low iron levels in the blood but normal measures of iron stores in the body—a hallmark of AI/ACD.

## How is AI/ACD treated?

AI/ACD often is not treated separately from the condition with which it occurs. In general, doctors focus on treating the underlying illness. If this treatment is successful, the anemia usually resolves. For example, antibiotics prescribed for infection and anti-inflammatory drugs prescribed for rheumatoid arthritis or IBD can cause the anemia of 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 this normal hormone may be prescribed. People with kidney disease and AI/ACD may also be advised to take vitamin B12 and folic acid supplements. If iron deficiency has a role in causing the anemia, iron supplements may be given.

## Points to Remember

- Anemia is a condition in which the blood has a lower-than-normal number of red blood cells, which carry oxygen from the lungs to the body's organs and tissues.
- Anemia of inflammation and chronic disease (AI/ACD) commonly occurs with chronic illnesses, infections, inflammatory disorders, and cancer.
- AI/ACD is usually mild and may cause no symptoms or may contribute to tiredness, low energy, weakness, shortness of breath, and exercise intolerance.
- AI/ACD is diagnosed through blood tests.
- AI/ACD often is not treated separately from the condition with which it occurs. In general, doctors have focused on treating the underlying illness but may treat the anemia directly more often in the future.

## Hope through Research

Scientists are studying ways to

- better understand the development of AI/ACD, including the role of hepcidin, a hormone involved in controlling iron in the body
- refine how the disease is diagnosed
- develop novel treatments that improve the way AI/ACD is managed

The National Heart, Lung, and Blood Institute and the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) of the National Institutes of Health conduct and support 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, gastrointestinal, cardiovascular, and endocrine abnormalities in end-stage kidney failure.

Participants in clinical trials can play a more active role in their own health care, gain access to new research treatments before they are widely available, and help others by contributing to medical research. For information about current studies, visit [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov).

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