

# Imaging Manifestations of Neurologic Complications in Anemia



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## KEYWORDS

• Imaging • Neurologic complications • Anemia

## KEY POINTS

- The hallmark signs and symptoms of anemia are directly related to a decrease in oxygen delivery to vital tissues and organs and include pallor, fatigue, lightheadedness, and shortness of breath. Neurologic complications are often nonspecific and can include poor concentration, irritability, faintness, tinnitus, and headache.
- If undiagnosed or untreated, depending on the cause, anemia can progress to cognitive dysfunction, psychosis, encephalopathy, myelopathy, peripheral neuropathy, as well as more focal syndromes, such as stroke, seizures, chorea, and/or transverse myelitis.
- Imaging can play a very important role in the early diagnosis and treatment of these neurologic and systemic complications associated with anemia, and hence, better outcome.

## INTRODUCTION

Anemia, the most common disorder of the blood, affects more than 3 million Americans.<sup>1</sup> It is defined as a condition marked by a deficiency of red blood cells (RBCs) and/or hemoglobin diminishing the blood's ability to carry oxygen to vital organs leading to symptoms such as fatigue, lightheadedness, and shortness of breath. Anemia is divided into 3 main classes based on pathophysiology, including

1. Blood loss,
2. Increased destruction,
3. Impaired production of RBCs.

More commonly, anemia is classified by various causes and RBC parameters, including size/volume and hemoglobin content of the RBC. This morphologic

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classification is based on mean corpuscular volume (MCV) and on hemoglobin content of the RBC. The categories include normocytic (MCV between 80 and 100 fL), microcytic (MCV <80 fL), and macrocytic (MCV >100 fL), as well as normochromic (normal hemoglobin content) and hypochromic (low hemoglobin content).

The clinical manifestations of anemia vary markedly due to various causes, rate of progression, and severity. The hallmark signs and symptoms of anemia are directly related to a decrease in oxygen delivery to vital tissues and organs and include pallor, fatigue, lightheadedness, and shortness of breath. Neurologic complications are often nonspecific and can include poor concentration, irritability, faintness, tinnitus, and headache. If undiagnosed or untreated, depending on the cause, anemia can progress to cognitive dysfunction, psychosis, encephalopathy, myelopathy, peripheral neuropathy, as well as more focal syndromes, such as stroke, seizures, chorea, and/or transverse myelitis. Imaging can play a very important role in the early diagnosis and treatment of these neurologic and systemic complications associated with anemia, and hence, better outcome.

### **IMAGING MODALITIES**

Anemia is a diagnosis made by routine blood workup. Type and associated cause are invariably diagnosed by clinical examination, blood smear, and bone marrow examination. Imaging is not a commonly used technique for evaluation of anemia. However, imaging plays an important role in the early diagnosis of the neurologic and systemic complications associated with anemia. Commonly used imaging techniques include plain radiography, ultrasonography, nuclear medicine, computed tomography (CT), and MRI.

Plain radiography is a fast and relatively inexpensive imaging technique for evaluation of bones, chest, and soft tissues. However, because of its low specificity and sensitivity, compared with the newer imaging techniques, it has lost its importance and application in the evaluation of the early disease process. Ultrasound is inexpensive, is easy to perform, and does not use ionizing radiation. It is predominantly used to assess the intra-abdominal and soft organ abnormalities. Bone radionuclide scan is mainly used to assess bony abnormalities, such as metastasis and bone marrow abnormalities. It is very sensitive but lacks specificity to the abnormality. The advent of PET-CT and PET MR, which provide whole body evaluation, has provided a modality that is very useful in staging and assessing the response to various hematologic malignancies following therapy. CT remains the primary modality of choice in the evaluation of various neurologic disorders because of its easy availability and shorter scanning time. It is sensitive in diagnosing various acute neurologic complications, like intracranial hemorrhage, infarctions, and parenchymal and calvarial metastasis. However, it lacks sensitivity to detect posterior fossa lesions, leptomeningeal and dural abnormalities, or metabolic-related disorders. MRI remains the modality of choice for most brain and spine abnormalities because of its excellent soft tissue differentiation and multiplanar acquisition. It is very sensitive in diagnosing abnormalities ranging from neoplastic, metabolic, and inflammatory to infection. In respect to the hematologic disorders, it is very sensitive in diagnosing intracranial bleeds, infarctions, and leptomeningeal and dural abnormalities. It is also very sensitive in the diagnoses of bone marrow abnormalities.

### **IRON DEFICIENCY ANEMIA**

Iron deficiency anemia (IDA) is the most common cause of anemia, often related to decreased dietary intake or an overall decrease in iron due to chronic bleeding (eg,

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