Emergent Neuroimaging in the Oncologic and Immunosuppressed Patient

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KEYWORDS

• Emergency • Neuroimaging • Oncologic • Immunosuppressed • Infection • HIV • Cerebritis • Meningitis

KEY POINTS

- Intracranial hemorrhage risk is increased in patients with melanoma, lung, breast, and renal cell carcinoma; high-grade glioma; leukemia; and in hematopoietic stem cell transplant with thrombocytopenia.
- Both intracranial metastases and primary brain tumors increase the risk of cerebral infarction.
- Imaging findings in immunosuppressed patients with infection may be atypical, and significant enhancement and edema may be absent if the patient is unable to mount an appropriate immune response.
- Meningitis is the most frequent intracranial infection in immunosuppressed patients and patients with cancer, and may be complicated by hydrocephalus or subdural empyema.
- Of the many medication-related chemotherapy complications, tacrolimus and cyclosporine A are associated with increased risk of seizure and posterior reversible encephalopathy syndrome.

INTRODUCTION

As the population in North America ages and treatments improve for many malignancies and chronic diseases, the neuroimaging performed in the emergency department increasingly involves patients at increased risk for acute neurologic complications from malignancy and immunosuppression. This includes patients with known malignancy and those who are immunosuppressed because of organ transplantation, chronic disease (eg, diabetes mellitus) or treatment of chronic disease, and human immunodeficiency virus (HIV) positivity. These patients are susceptible to the same infections and emergencies as immunocompetent patients, but may present differently with common illnesses and are susceptible to a variety of other diseases. New drug therapies for these patients introduce new potential neurologic complications or increase their frequency. In addition, the timely availability of important clinical information for the radiologist has often not kept pace with patient disease complexity, although it is essential to imaging interpretation to provide a more accurate and customized diagnosis and treatment. This article reviews important patient risk factors, emergent central nervous system (CNS) abnormalities, and their imaging findings to help optimize imaging in this complex group of patients.

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IMAGING APPROACH

In general, noncontrast head computed tomography (CT) is the initial imaging study for acute intracranial abnormalities because of its sensitivity, rapidity of image acquisition, and availability. Although CT may not be specific enough to definitively diagnose some acute intracranial processes, it remains an excellent triage tool and allows for rapid disposition in the emergency department at a low cost. Noncontrast CT is almost always the initial modality, with intravenous contrast reserved for imaging maxillofacial infections and masses, and for imaging patients unable to undergo MR imaging.

MR imaging is more sensitive and specific for most emergent intracranial abnormalities, although less suited as a first-line imaging modality because of the time required to perform the imaging, MR compatibility, cost, and availability. Increased availability of MR imaging in the emergency department and development of shorter protocols for acute imaging will improve the ease of use of MR imaging as a first-line imaging modality in the near future.

For acute imaging of the spine, radiography and CT are helpful for evaluation of new back pain, especially in the setting of trauma. In patients with suspected cord compression, MR is a much more sensitive and specific modality for epidural masses that can cause spinal canal narrowing obscured on CT.

In patients with known malignancy, MR imaging of the head and spine are performed with intravenous contrast at the authors' institution. The brain MR imaging includes a postcontrast spin echo sequence and thin section axial three-dimensional postcontrast images with coronal and sagittal reformations. In the absence of known malignancy, imaging in patients with altered mental status and back pain are usually performed without intravenous contrast. MR angiography of the circle of Willis is performed without intravenous contrast and MR angiography of the neck with contrast, unless contraindicated.

CEREBRAL HERNIATION AND INTRACRANIAL HEMORRHAGE

Because of limited intracranial volume, many intracranial abnormalities can lead to increased intracranial pressure. When acute, this causes rapid effacement of the extra-axial spaces, midline shift, and cerebral herniation, resulting in altered mental status, cardiovascular collapse, and even death. There are three cerebral herniation syndromes (subfalcine, uncal, and transtentorial) and all may occur simultaneously depending on the location of the lesion and extent of mass effect. Parafacine herniation can compress the anterior cerebral artery against the falx, causing occlusion and infarction. Uncal herniation typically presents as third nerve palsy and can progress to hemiplegia and respiratory failure as brainstem is compressed. Transtentorial herniation, either downward or less commonly upward from posterior fossa lesions, causes altered mental status, and can progress to coma and death. Initial imaging in these cases is almost always noncontrast CT of the head because of patient instability and altered mental status.[1]

In oncologic patients, increased intracranial pressure and cerebral herniation is most commonly caused by a combination of cerebral edema and tumor enlargement from either primary brain or metastatic malignancy. Symptomatic intracranial metastatic disease occurs in approximately 8% to 10% of all patients with cancer and is more common by an order of magnitude.[2,3] Intracranial metastases are typically seen in lung (16%–19%), renal cell (6%–10%), breast (5%), melanoma (7%), and colorectal carcinomas (2%).[4] With advances in cancer treatment, however, malignancies that were not historically prone to metastasize to the brain, such as prostate cancer, are now occurring more frequently because of improved life expectancy.

In addition to mass effect from underlying disease, hemorrhage in this population can also cause cerebral herniation. Tumor hemorrhage is more common in melanoma, lung and breast cancers, renal cell carcinoma, high-grade glioma, and leukemia. The risk of intracranial hemorrhage is particularly high in patients with acute myeloid leukemia because of hyperleukocytosis, with subdural hemorrhage being one of the most common intracranial complications in this group.[5] Patients undergoing allogenic or autologous stem cell transplantation with prolonged thrombocytopenia are also at increased risk of intracranial hemorrhage. Other causes of intracranial hemorrhage in patients with cancer include vascular injury following radiotherapy and hemorrhage caused by development of secondary cavernomas, often years after whole-brain radiation.

SEIZURE AND POSTERIOR REVERSIBLE ENCEPHALOPATHY SYNDROME

Seizure is common in patients with cancer and has many causes, such as tumor itself, chemotherapy