Imaging of Nontraumatic Neuroradiology Emergencies

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KEYWORDS

• Subarachnoid hemorrhage • Vasogenic edema • Hydrocephalus • Neurologic abnormalities

KEY POINTS

- Emergency neuroradiology can be challenging because of the wide range of conditions that present with acute neurologic symptoms or signs.
- Nonenhanced computed tomography (NECT) of the head is almost always the most appropriate first imaging test and is extremely useful for excluding life-threatening conditions.
- The imaging findings of a variety of neurologic abnormalities overlap on NECT, however, and the differential diagnosis may be extremely broad.
- The first step to narrowing the differential diagnosis and providing imaging workup includes classifying the NECT findings into a broad category, as the authors have tried to do in this article.
- Based on the type of imaging abnormality, further imaging workup may include computed tomographic angiography (CTA), digital subtraction angiography (DSA), and/or MR imaging.
- Familiarity with specific imaging finding that suggests a specific diagnosis may help further facilitate appropriate clinical workup and treatment.

INTRODUCTION

NECT is the imaging study of choice for the evaluation of acute neurologic conditions referable to the brain. NECT is fast, widely available, and well tolerated by critically ill patients. NECT is excellent at excluding most life-threatening conditions including intracranial hemorrhage, brain herniation, acute hydrocephalus, and large mass. The emergency radiologist must be able to not only identify these conditions but also come up with a succinct, relevant differential diagnosis in order to facilitate patient triage, direct further evaluation and management, and alert the referring provider to diagnoses, which may not have been considered.

This article approaches the broad spectrum of nontraumatic neurologic emergencies by discussing patterns of findings on NECT and differential diagnoses, suggesting algorithms for further workup, and highlighting key difficult or important diagnoses. Specific angiographic or MR imaging features that might lead to a particular diagnosis are also discussed.

SCENARIO 1: SUBARACHNOID HEMORRHAGE

Imaging Protocol

Thunderclap headache is the classic presenting symptom of patients with spontaneous

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subarachnoid hemorrhage (SAH), and NECT is the preferred imaging study for suspected SAH.[1] If the result is negative, lumbar puncture should be performed.[2]

Because ruptured aneurysms account for approximately 85% of spontaneous SAHs,[3] excluding aneurysm is crucial. DSA is the gold standard, although CTA is sensitive for aneurysms greater than 3 mm.[4,5] Magnetic resonance (MR) angiography is not sensitive enough to conclusively exclude small aneurysm. If the result of CTA is negative, DSA is the next step, unless the pattern of blood meets criteria for perimesencephalic hemorrhage (PMH, see below). Some investigators suggest that negative result of CTA is sufficient to exclude aneurysm in this setting,[6] although practice varies, with most centers obtaining at least 1 and possibly 2 subsequent DSAs. If the criteria for PMH are not met, DSA is indicated, and if the result is negative, the examination is often repeated at 1 week.[4]

Findings

SAH manifests as hyperdense blood in the cerebrospinal fluid (CSF) spaces, including the basilar cisterns and sulci, with possible redistribution into the ventricles. The pattern of SAH may suggest the underlying cause.[7]

Differential Diagnosis

Diffuse or basilar predominant subarachnoid hemorrhage

Aneurysmal subarachnoid hemorrhage About 85% of spontaneous SAH is caused by rupture of aneurysm.[3] Aneurysms appear as saccular outpouchings at vascular branch points, and SAH patterns may suggest a particular aneurysm. For example, SAH centered on the sylvian fissure suggests middle cerebral artery aneurysm, whereas SAH in the anterior interhemispheric fissure suggests anterior cerebral artery aneurysm. Asymmetric SAH around the medulla or inferiorly in the posterior fossa should suggest anterior or posterior inferior cerebellar artery aneurysm.

Focal contour abnormality of the aneurysm sac on vascular imaging suggests a rupture point. Aneurysms occur most commonly in the anterior circulation, but specific areas to inspect when evaluating CTA for aneurysm include terminal internal carotid artery, anterior communicating artery, middle cerebral artery bifurcation/trifurcation, posterior communicating artery, basilar tip, and posterior inferior cerebral artery origin.

Benign perimesencephalic subarachnoid hemorrhage Spontaneous SAH can be classified as non-aneurysmal or benign PMH approximately 10% of the time.[8] Specific imaging criteria are required to make this diagnosis: NECT obtained within 3 days of ictus showing hemorrhage centered anterior to the midbrain or within the quadrigeminal plate cistern. The hemorrhage cannot extend to the lateral portions of the sylvian fissures or anterior part of the interhemispheric fissure. Some layering of blood in the lateral ventricles is permitted, but frank intraventricular hemorrhage is not and no parenchymal hematoma is allowed (**Fig. 1**).[9]

Patients with PMH tend to have a less severe clinical course than those with aneurysmal SAH, and rebleeding does not occur. Venous bleeding from a cisternal vein is believed to be the cause.[3]

Other As listed in **Table 1**, a variety of other vascular lesions may also cause diffuse or perimesencephalic SAH, most of which can be excluded

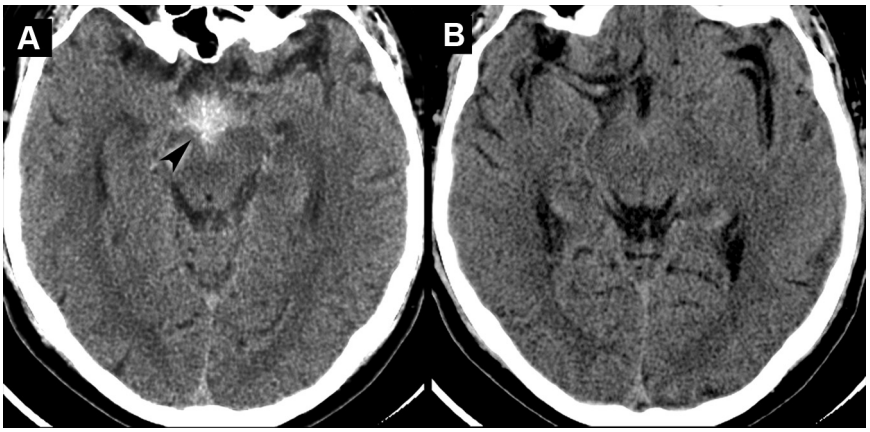

Fig. 1. Benign perimesencephalic hemorrhage. NECT demonstrates subarachnoid hemorrhage centered anterior to the midbrain (*arrowhead, A*). There is no extension to the sylvian fissures or anterior interhemispheric fissure (*B*).