

AAEM Clinical Practice Committee Statement

CTA of the Brain Is a Reasonable Option to Consider to Help Rule out Subarachnoid Hemorrhage in Select Patients (12/12/2014)

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Executive summary

Computed tomography angiography (CTA) of the brain is a reasonable test to consider when evaluating select patients for subarachnoid hemorrhage after a negative non-contrast computed tomography of the brain. The benefits and risks of CTA of the brain need to be considered by the treating physician.

Discussion:

Acute onset headache is a common presenting complaint in the emergency department and failure to diagnose a subarachnoid hemorrhage is associated with significant morbidity.¹ Recently, clinical decision rules have been proposed that have a sensitivity of up to 98-100% and specificity up to 28%.² Traditionally, the standard of care is for a patient to have a noncontrast computed tomography scan (NCCT) and, if negative, then a lumbar puncture (LP). Because of limitations in the sensitivity of NCCT to detect subarachnoid hemorrhage, lumbar puncture may be necessary to be reasonably confident that a subarachnoid hemorrhage is not missed, particularly in higher risk patients. Lumbar puncture has been shown to be 100% sensitive and have a negative predictive value of 100% for SAH.³

Its sensitivity notwithstanding, a lumbar puncture has some drawbacks. The procedure is somewhat painful, time consuming, and may be difficult, especially in patients who are overweight, uncooperative, or in those with a history of spine surgery. Patients may be reluctant to undergo the procedure because they view it as invasive. There are also potential risks in performing an LP such as prolonged post-lumbar puncture headaches and the rare severe complication of epidural hematomas. Clinicians may have difficulty interpreting equivocal results and there is no definitive way to distinguish blood from a traumatic tap from that of a subarachnoid hemorrhage.^{4,5} The specificity of LP is approximately 65%.³

There have been significant advances in computed tomography scanning. 64-slice CT scanners and improvements in imaging software have improved the sensitivity of NCCT. If done within the first 6 hours of the headache onset, one large prospective cohort study found a sensitivity of 100% (97.0% to 100.0%),

specificity of 100% (99.5% to 100%), negative predictive value of 100% (99.5% to 100%), and positive predictive value of 100% (96.9% to 100%).⁶ NCCT sensitivity decreases as the time from the onset of the headache increases.⁷ It is estimated that current NCCT is over 90% sensitive for diagnosing SAH in the first 24-48 hours, with some studies reporting sensitivities in 97% range if the study is done in the first 12 hours after the onset of headache.⁸⁻¹⁰

CTA is very sensitive and specific for the detection of aneurysms in the setting of SAH. A recent study showed 64-slice CTA to be 98% sensitive and 100% specific for detecting aneurysms larger than 3 mm.¹¹ 85% of SAH are caused by AVMs or aneurysms. SAH from other causes tend to carry a better prognosis. CTA is a reasonable strategy to consider for excluding SAH in select patients in those hospitals where ct angiography is available. It may be an appropriate alternative in those patients at higher risk for SAH after a negative NCCT and in those situations where a diagnostic LP is either refused by the patient or the results of the LP equivocal

A major drawback to vascular imaging is the discovery of aneurysms that are not the cause of the headache with the consequent exposure of the patient to the risks of additional testing and potentially unnecessary procedures. CTA also exposes the patient to approximately 4 msv of radiation, as well as possible harm from the administration of IV contrast (nephrotoxicity, allergic reactions). In addition, CTA is an expensive study, and can require significant time to perform and interpret. A template for having discussions regarding possible testing strategies (that can be adjusted based on the local availability of imaging modalities) is provided as an appendix.

A recent analysis of the utility of CTA in the work-up of possible SAH determined that, if the pretest probability of SAH is 15% or less (acute-onset headache, nonfocal neurological exam), then a negative NCCT and negative CTA would correlate to a less than 1% chance of SAH due to AVM or aneurysm.¹² These authors stated that in patients with a higher pretest probability (e.g., those with classic presentation, abnormal neurological exam, or risk factors), a strategy incorporating NCCT, CTA, and LP may be appropriate.

Appendix:

Approaches to work-up of severe headache. Please note, these strategies are designed for new, onset sudden severe headaches. Individualized strategies for non-severe and non-acute headaches are out of the context of this document, although it is worth noting that patients with normal neurological exams and a lack of red flags are rarely helped by imaging. (<http://www.choosingwisely.org/doctor-patient-lists/imaging-tests-for-headaches/>)

The main reason to do tests when you are having a concerning headache is to rule out bleeding in your brain and problems with your blood vessels (aneurysms – which are stretched out parts of your brain arteries that can burst and cause severe disability and death).

Approach	Benefits	Risks
CT plus LP (lumbar puncture or “spinal tap”)	Well known performance (rules out disease well)	Pain, headache, small risk of serious complications, possibly test will not give diagnostic results (traumatic tap), radiation from CT scan, additional time to await results from LP
CT alone	Simple, quick, likely performs well within 6 hours of headache onset	Does not exclude aneurysm, radiation, may not pick up older (a headache that started 24 hours ago or more) blood well.
CT plus CTA	Reliably identifies aneurysms (can rule out disease well)	More radiation, IV contrast, time, cost. May identify aneurysms or other findings that have nothing to do with headache and lead to additional testing or surgeries that aren’t needed
MRI alone	Likely identifies blood well, although not historically used much in emergency setting; no radiation. Can identify a large number of alternate causes of headache (although most headaches have no structural cause)	Less certain performance of test. Similar to CT alone, will not necessarily identify aneurysms. Cost, claustrophobia, access to scanner can be limited in many EDs
MRI plus MRA	Reliably identifies aneurysms and also blood (again, not used	Same as MRI. In addition, same problem as CTA in potentially identifying aneurysms or other findings that have nothing to do with headache and lead to additional testing or

	frequently in ED setting), no radiation	surgeries that isn't needed and might be harmful
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