Subarachnoid hemorrhage (SAH) is one of the most serious causes of acute headache in emergency department patients, with cited prevalence of 3-16% (McCormack) and mortality of 40%. The currently accepted diagnostic evaluation of patients with suspected SAH includes a non-contrast head CT followed by lumbar puncture (LP) which is nearly 100% sensitive (McCormack). Unfortunately, LP is invasive and has been associated with adverse effects including post-LP headache, infection, and bleeding. Furthermore LP is often technically challenging in patients with a larger body habitus and is contraindicated in patients on anticoagulation. Finally, interpretation of LP results can be challenging and indeterminate results may be present 15-20% of the time (McCormack et al). Computed Tomography Angiography (CTA) has been cited as an alternative diagnostic strategy in patients with acute headache suspected of having SAH. This journal club attempted to evaluate the absolute need for LP following a negative CT and possible alternative diagnostic strategies for subarachnoid hemorrhage, including CT/CTA and non-contrast head CT only. Three studies were specifically reviewed and are outlined below.

**Can computed tomography angiography of the brain replace lumbar puncture in the evaluation of acute-onset headache after a negative noncontrast cranial computed tomography scan?**

McCormack RF, Hutson A.

The objective of this study was to determine if CTA could replace LP to exclude the diagnosis of aneurysmal SAH. The authors developed a mathematical probability model to determine the post-test probability of CT/CTA to exclude aneurysmal or AVM SAH. The mathematical model determined the post-test probability of a negative CT/CTA to exclude aneurysmal or AVM induced SAH to be 99%. It should be noted that the test characteristics of 64 detector CTA for diagnosis of aneurysms in SAH are good, with a sensitivity of 98% and 100% specificity. In development of this mathematical probability model, several assumptions were made, including a 2.5% incidence of SAH and that 85% of SAH are aneurysmal. Perhaps the biggest challenge of this study is the fact that the CT/CTA strategy will miss those patients with SAH not due to aneurysm or AVM bleeding. It was postulated that these patients, (approximately 15% of all comers with SAH) have a less severe illness and better prognosis. This assumption is the biggest limitation of the current study.

**Sensitivity of newer-generation computed tomography scanners for subarachnoid hemorrhage: a Bayesian analysis.**

Gee C, Dawson M, Bledsoe J, Ledyard H, Phanthavady T, Youngquist S, McGuire T, Madsen T.

The objective of this study was to establish the sensitivity of 16 slice CT scanner (or better) in the diagnosis of SAH. There has been much discussion of the sensitivity of non contrast head CT in the diagnosis of SAH and sensitivity often ranges from 90-100% (Gee et al) but is impacted by the time of
onset of headache, etiology of SAH, as well as the CT technology being used (multi-slice, 16 slice or greater). LP is the traditionally accepted gold standard for diagnosis, with a sensitivity of almost 100% (McCormack), however it is limited by its invasive nature, technical difficulty in obese patients, difficulty interpreting (indeterminates 15-20%), and post lumbar puncture complications (including headache, infection, persistent bleeding). 134 patients were identified with SAH during the retrospective study period. 131 of these 134 had SAH identified on CT scan. Of the three where SAH was not noted on non-contrast head CT, 2 had no aneurysms identified on further testing (felt to be perimesencephalic bleeding and outcomes were excellent) and 1 had a small aneurysm noted that required no intervention. This resulted in a 97.3% sensitivity for 16 slice or better non-contrast head CT for SAH.

Cost-effectiveness of diagnostic strategies for evaluation of suspected subarachnoid hemorrhage in the emergency department.


This study attempted to determine the relative cost-effectiveness of diagnostic studies for SAH in the emergency department. Potential diagnostic pathways that were evaluated included the CT only, CT/LP, CT/CTA, and CT/MRA. CT only was the most cost-effective diagnostic pathway, and CT/LP was not more cost effective than CT/CTA or CT/MRA. The authors’ concluded that when factoring in costs, outcomes, sensitivity analyses, and the current medicolegal environment, CT-only and CT followed by lumbar puncture are the preferred strategies to diagnose SAH in patients presenting to the ED with concerning headache. Given the variable sensitivity of CT only, based on timing of onset of action and CT technology, CT followed by lumbar puncture should remain the preferred diagnostic strategy for evaluating patients with concern for SAH.

Bottom line: We do not yet have an equally sensitive non-LP pathway for diagnosis of SAH from all causes (aneurysm, AVM and idiopathic bleeds.)

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