Revisiting the Need for Computed Tomography/Lumbar Puncture in Subarachnoid Hemorrhage Detection

Perry JJ, Spacek A, Forbes M, et al. Is the combination of negative computed tomography result and negative lumbar puncture result sufficient to rule out subarachnoid hemorrhage? Ann Emerg Med 2008;51:707–13.

Study Overview

Objective. To determine if a negative computed tomography (CT) result and negative lumbar puncture (LP) result are sensitive in excluding subarachnoid hemorrhage.

Design. Observational, multicenter, cohort study.

Setting and participants. All patients aged ≥ 15 years who presented to 2 tertiary care Canadian academic emergency departments (EDs) between November 2000 and November 2003 with a chief complaint of a nontraumatic acute headache or syncope associated with a headache were enrolled. The 2 study sites were the only neurosurgical sites in the region. Patients were included if they were alert (Glasgow Coma Scale score, 15), had no recent trauma to the head over the previous 7 days, and had acute headaches reaching maximal intensity in < 1 hour and presented to the ED within 14 days of headache onset. Informed patient consent was waived because patients were treated according to current practice.

Main outcome measure. Presence of a subarachnoid hemorrhage as defined by (1) neuroradiology report of subarachnoid blood on CT, (2) xanthochromia in the cerebrospinal fluid (CSF) by visual inspection of the centrifuge supernatant, (3) red blood cells > 5×10^6 cells/L in the CSF, with an aneurysm on cerebral angiography, or (4) autopsy confirmation of subarachnoid hemorrhage. Patients completed telephone interviews at least 6 months after the initial ED visit to confirm if they had a subsequent subarachnoid hemorrhage or experienced any adverse events.

Results. Of 592 patients enrolled, 61 (10%) had subarachnoid hemorrhage. 89.6% of patients followed-up either by telephone interview or repeat visit to one of the hospitals after the study. When using the strategy of noncontrast head CT followed by LP, sensitivity was 100% (95% confidence interval [CI], 94%–100%) and specificity was 67% (95% CI, 63%–71%) for detecting subarachnoid hemorrhage.

Conclusion. A negative result on noncontrast head CT plus a negative result on LP sufficiently rules out the risk of subarachnoid hemorrhage in alert patients who present with acute headache.

Commentary

Subarachnoid hemorrhage is an acute life-threatening cause of headache and usually results from a ruptured saccular aneurysm. This condition affects an estimated 30,000 Americans every year [1], and rebleeding after a subarachnoid hemorrhage has a 50% risk of death or severe disability [2]. Thus, detection of subarachnoid hemorrhage in patients who present with acute headaches is critical. The current standard of practice for patients with suspected subarachnoid hemorrhage is to perform noncontrast CT of the head. If CT is negative and there are no contraindications, LP is subsequently performed to detect bleeding that may have been missed by CT. The rationale for this approach is that blood in the CSF can be demonstrated by hyperdense areas on noncontrast CT of the head. However, CT becomes less sensitive for detecting acute bleeds over time because the blood diffuses and becomes less concentrated in the CSF [3,4]. Conversely, as time passes, LP becomes increasingly sensitive for detecting blood in the CSF, as blood moves away from the original intracranial source and breaks down to produce xanthochromia [3].

The study performed by Perry et al confirms that negative findings on both CT and LP can safely rule out the risk of subarachnoid hemorrhage, per standard practice. For this cohort, the sensitivity of negative noncontrast head CT was 90% (55/[55+6], where sensitivity = total positive results/[total positive results + false-negative results]), which is reflective of previous study sensitivity rates ranging from 91% to 98% [5,6]. The addition of negative LP increased the sensitivity to 100% (61/[61+0]). For conditions such as subarachnoid hemorrhage that carry a significant risk of death or disability, sensitivity rates of 100% are ideal because these conditions can be reliably ruled out with a negative result; this was accomplished in this particular cohort.

This study provides confirmatory evidence of current best practices. With the rapidly evolving CT technology, clinicians might believe that recent technology is more sensitive in detecting subarachnoid hemorrhages than technology used in previous studies. A recent study by Byyny et al [5]

challenges this assumption, finding variable sensitivity rates of 91% to 94% using multidetector cranial CT depending on patient presentation.

Limitations of this study should be noted. Approximately 20% of patients did not have telephone follow-up after initial CT and LP. However, participants who would have developed subarachnoid hemorrhage would likely have been identified given that the 2 centers involved in the study were the only neurosurgical centers in the region. Although not the objective of the study, another factor that may impact the implications of this study is the increasing use of CT angiography to detect brain aneurysms. Because subarachnoid hemorrhage is often the result of a ruptured aneurysm, angiography is often used to evaluate vascular anatomy of the brain. Although CT angiograms are not as detailed as angiograms, they are often faster and easier to obtain [7]. With the need to evaluate patients efficiently and reduce throughput times comes the challenge of balancing diagnostic efficiency and sensitivity.

Applications for Clinical Practice

Physicians should continue to evaluate suspected subarachnoid hemorrhages with a diagnostic workup that includes both noncontrast CT of the head and LP. Negative results on CT should be followed by LP to rule out the possibility of a missed subarachnoid hemorrhage.

—Review by Ula Hwang, MD, MPH

References

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