

Critical Review Form

Diagnostic Test

Sensitivity of Noncontrast Cranial Computed Tomography for the
Emergency Department Diagnosis of Subarachnoid Hemorrhage

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Objectives: “To further define the sensitivity of multidetector cranial CT in diagnosing subarachnoid hemorrhage in ED patients with various clinical presentations and among the subgroup of patients with arteriovenous vascular malformations and vascular aneurysms”. (p. 698)

Methods: This was a retrospective medical record review at the UCLA Emergency Medical Center for all patients transferred or presenting with SAH between August 2001 and December 2004. During this time, the hospital used a 4-slice, 4-detector GE Light Speed Scanner CT. Patients with SAH were identified from three record sources: all-patients with non-contrast cranial CT (radiology records), and discharge ICD-9 codes for subarachnoid hemorrhage (430) or cerebral aneurysm (437.3). The authors made no attempt to identify patients who were evaluated for suspected SAH but did not have SAH, so specificity and LR’s cannot be estimated from this data.

The only listed exclusion criteria is traumatic LP defined as $\geq 30\%$ drop in CSF red blood cells from Tube 1 to Tube 4. ([Heasley 2005](#)) In total, the investigators excluded 333 subjects from the analysis for reasons that are not detailed.

Two abstractors independently reviewed the medical record of each patient. SAH patients were classified as headache with Glasgow Coma Scale (GCS) 15, headache with abnormal GCS, or abnormal level of consciousness without headache. The criterion standard for SAH is not described, although CT angiography and MRA are two variables that the authors report collecting. History of aneurysm or AV malformation were presumed absent if not recorded in the ED record, admission history, and/or discharge summary. Interrater reliability ([Kappa](#)) was assessed for the presence of SAH, aneurysm, and normal mental status. Sensitivity of cranial CT for SAH were assessed for headache with GCS 15, headache with abnormal GCS, and abnormal mental status without headache.

The authors do not reference established [chart review methods](#) or [STARD](#) criteria in the manuscript.



Guide		Comments
I.	Are the results valid?	
A.	Did clinicians face diagnostic uncertainty?	Uncertain. There is no clear statement about the timing or sequence of CT and LP. Because 80% of subjects were transferred to the ED from an outside hospital with established or strongly suspected SAH, these are not undifferentiated headache patients.
B.	Was there a blind comparison with an independent gold standard applied similarly to the treatment group and to the control group?	No, there is no clear statement about what gold standard was used or whether the Radiologist establishing the presence or absence of SAH was blinded to other clinical data.
C.	Did the results of the test being evaluated influence the decision to perform the gold standard?	Yes, only those with an abnormal CT or LP would have proceeded to angiography (CT or MRA).
II.	What are the results?	
A.	What likelihood ratios were associated with the range of possible test results?	<ul style="list-style-type: none"> • 149 SAH patients (mean age 53 years, 59% female) were included in the analysis including 79% with a vascular lesion (75% with a cerebral aneurysm). • 58% presented with headache and normal mental status. • CT identified 139/149 (93%, 95% CI 88-97%) of SAH patients and 94% of SAH in those with a vascular lesion (95% CI 88-98%). • In the subset with headache and normal mental status CT identified 91% (95% CI 82-97%) and only missed 1/61 SAH patients with an abnormal mental status. • Among the 10 SAH patients missed by CT ages ranged from 15-79, 60% were female, and four had headache duration <12 hours. Another three had duration <24 hours and the maximum duration was nine days. No aneurysm was identified in four and AVM was identified in one. Abnormal LP results included xanthochromia in three of these cases (Table 3, page 700). • Agreement between chart abstracters included $\kappa=0.85$ for presence of spontaneous SAH, $\kappa=0.92$ for presence of aneurysm and $\kappa=0.75$ for presence of normal mental status.

III.	How can I apply the results to patient care?	
A.	Will the reproducibility of the test result and its interpretation be satisfactory in my clinical setting?	Uncertain. This was a testing referral center with neuroradiologists. Does the sensitivity reflect the neuroradiologists' interpretation in which case sensitivity may be overestimated? On the other hand, does it reflect the referring hospitals where general radiologists' or emergency physicians' interpretation may underestimate the sensitivity of cranial CT's? Do newer generation CT scanners improve the sensitivity for SAH?
B.	Are the results applicable to the patients in my practice?	Yes, for a tertiary referral setting. Additional demographic details would help to better gauge external validity.
C.	Will the results change my management strategy?	No, the current standard of care is CT then LP if the CT is negative. Since a sensitivity of 94% is inadequate to definitively exclude SAH when a relatively safe and simple confirmatory diagnostic test (LP) exists, LP is still indicated when suspected SAH has non-diagnostic CT.
D.	Will patients be better off as a result of the test?	Yes, if clinicians and patients recognize that CT is not 100% accurate. In weighing the risks of LP (iatrogenic meningitis, cranial nerve palsies, epidural hematoma, back ache, headache) against the additional 10% of SAH identified, physicians must recognize and communicate the limitations of CT to facilitate shared decision making with patients and families.

Limitations

- 1) Failure to reference or use [STARD](#) guidelines (timing of studies experience of radiologist, etc.)
- 2) No [assessment](#) of specificity, LR's or prevalence.
- 3) Failure to assess CSF rbc as continuous variable ([interval likelihood ratios](#)).
Where did they get 200 rbc/hpf as criterion standard for SAH?

- 4) No clear statement of the gold standard for SAH.
- 5) **Insufficient demographics** (mean headache duration, past medical history of migraines) and no details are provided about the 333 excluded patients.

Bottom Line

Non-contrast cranial CT for ED patients with suspected SAH is not sufficiently sensitive (94% among all-comers, 91% among those with headache and normal mental status) to identify SAH in all those who have SAH. Unfortunately, sensitivity is only half of the story and investigators failed to assess specificity, or LR's for CT or LP. In addition, the external validity of these results are unclear for patients presenting to their first hospital for evaluation of acute, severe headache because 80% of SAH cases were transferred from an outside hospital. Future research should establish pre-test risk factors for SAH (clinical decision rule) and evaluate sensitivity AND specificity of CT for SAH using STARD methods and current generation CT scanners. In future studies, CSF red blood cells should be analyzed as a continuous variable so that investigators can report interval likelihood ratios.

