Critical Review Form

Diagnostic Test

Determining the Sensitivity of Computed Tomography Scanning in Early Detection of Subarachnoid Hemorrhage

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Objectives: **"To determine the sensitivity of modern CT scanners (multidetector CT scanners, first introduced in 1998) in detecting SAH and to determine whether there is a continued need for lumbar puncture to exclude the diagnosis". (p. 901)**

Methods: **Retrospective study of all patients referred to the neurosurgical unit at Aalborg University in Jutland Denmark from January 2000 to December 2005. The hospital records were used as the source of information for these patients and were reviewed by two experienced members of the neurosurgical staff, including the CT scan, angiography, cerebrospinal fluid (CSF) analysis, clinical history, examination findings, and time from onset of symptoms (days).**

All patients had head CT's. If the CT demonstrated SAH, angiography was performed. If the CT was negative, lumbar puncture was done no sooner than 12 hours after symptom onset. All CSF samples were analyzed for xanthochromia by spectrophotometry. All lumbar puncture complications resulting in prolonged hospitalization or readmission were recorded.

No details are provided on chart review methods, CT or LP methods employed, or the experience of radiologists interpreting the CT scans.

Guide		Comments
I.	**Are the results valid?**	
A.	**Did clinicians face diagnostic uncertainty?**	Yes, at the time clinicians recorded initial findings they were presumably unaware of CT, LP, or angiography results. However, these represent a subset of patients at higher risk for SAH than the undifferentiated HA patient in the ED in that they have been pre-filtered before referral to the neurosurgery clinic (*spectrum bias*).

B.	**Was there a blind comparison with an independent gold standard applied similarly to the treatment group and to the control group?**	No. The gold standard would be angiography or MRA, but only those with positive head CT had angiography. A "bronze standard" would be xanthochromia on CSF, but only those with a negative head CT had LP performed. This is called *double-gold standard bias* and tends to falsely increase sensitivity and specificity for diseases that resolved spontaneously.
C.	**Did the results of the test being evaluated influence the decision to perform the gold standard?**	Yes, the test being evaluated (CT) influenced the decision whether to obtain the gold standard (angiography) or bronze standard (LP).
II.	**What are the results?**	
A.	**What likelihood ratios were associated with the range of possible test results?**	• 510 patients admitted to neurosurgery unit with suspected SAH but 11 excluded (8 with no LP, 2 with angioreticuloma, 1 with a spinal hemorrhage on MRI). • 499 patients included in the analysis including 296 diagnosed with SAH (**prevalence = 59%**) but no demographics are provided on age, gender, race, presenting symptoms, or prior aneurysms. • 72.9% (364/499) presented within one-day of symptom onset, and an additional 5.6% within 2-days, and an additional 4.4% within 3-days. • **From days 1 to 5 CT had sensitivity 100% and specificity 100%** (no 95% CI provided). From days 1 to > 1 week sensitivity 99.7% (95% CI 98.1-99.9%) and specificity 100% (95% CI 98.2-100%). • 7.4% (15/499) experienced post-dural headaches severe enough to prolong hospitalization or require readmission.
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 is a different subset of patients (spectrum bias) with a study design at risk of *incorporation bias* and *double-gold standard bias*. Therefore, additional data using STARD criteria will be needed for more confident estimates of diagnostic test accuracy.
B.	**Are the results applicable to the patients in my practice?**	No, unless they are referred from neurosurgery clinic with concerns of SAH.
C.	**Will the results change my management strategy?**	No, there are too many potential forms of bias. Additional SAH diagnostic accuracy research is needed, preferably using the STARD criteria.
D.	**Will patients be better off as a result of the test?**	Yes, if subsequent research which minimizes the various forms of bias possible in diagnostic studies confirms that CT-alone is sufficient to exclude SAH in new-onset (< 3 days) headache without LP.

Limitations

1) **Failure to incorporate STARD criteria with risk of various forms of diagnostic research bias:**
    a. **Spectrum bias – limits external validity**
    b. **Incorporation bias**
    c. **Double-gold standard bias**
    d. **Temporal bias**

2) **Failure to describe technical methods of CT or LP, including experience level of those interpreting studies and performing procedures.**

3) **No chart review methods or references.**

4) **Failure to identify the majority of existing contemporary literature or the topic of CT SAH accuracy (Perry et al 2008, Perry et al 2011) or the role of clinical decision rules to supplement decision making.**

5) **No analysis of likelihood ratios.**

6) **No report of patient symptoms to assess diagnostic accuracy of history/physical exam for SAH.**

Bottom Line

Single-center neurosurgery clinic based retrospective analysis of Danish patients referred with suspicion of SAH assessing the sensitivity and specificity of CT alone using multidector scanners. Multiple potential forms of bias that all falsely increase sensitivity limits any confident conclusions about diagnostic accuracy from this research.