

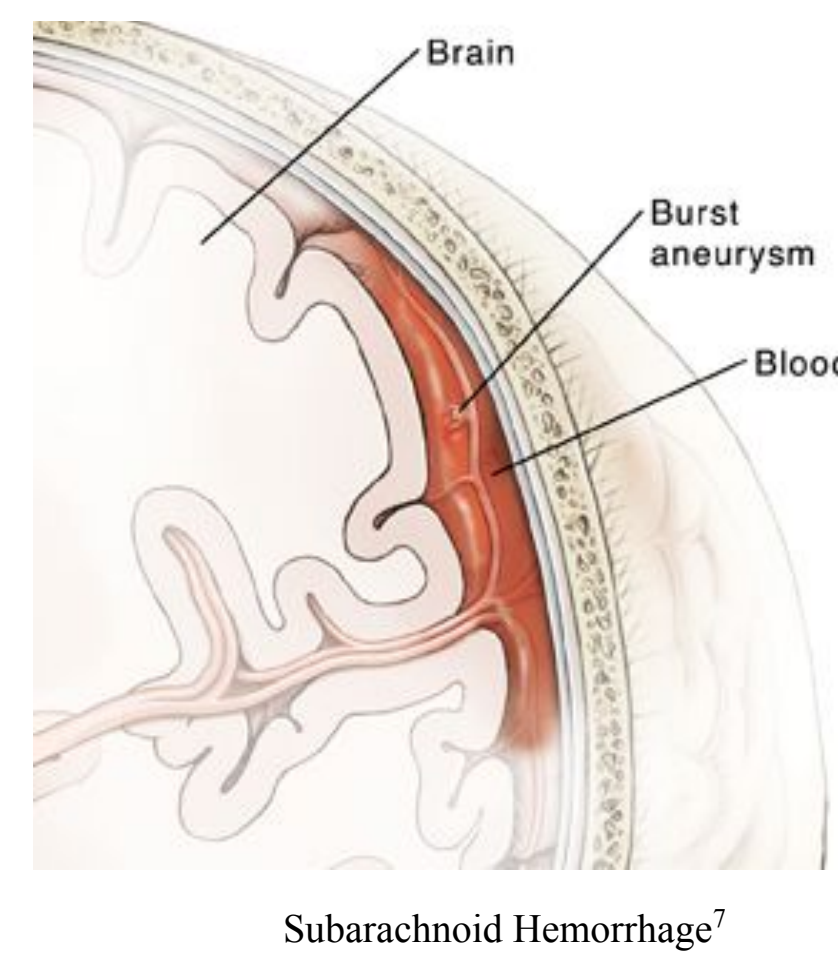


Is a Lumbar Puncture Necessary? Identifying the need for a LP with a Negative CT Scan when Diagnosing a Non-traumatic Subarachnoid Hemorrhage

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Introduction

A subarachnoid hemorrhage (SAH) is a bleed in the space that surrounds the brain, which can be due to a traumatic or non-traumatic cause. The most common cause of non-traumatic SAHs occur when a weak bulging blood vessel (aneurysm) on the surface of the brain ruptures.



Due to the limited space around the brain, the accumulating blood causes a rise in the intracranial pressure that will result in devastating complications or death if left undiagnosed. Most patients with a non-traumatic SAH will present with a severe sudden onset headache, often described as “the worst headache of my life,” also known as a thunderclap headache.¹ It is estimated that in the United States there are about 10 to 14 per 100,000 people who will have a SAH.²

Due to the high morbidity and mortality of a SAH, the current recommendations are that all patients presenting with a severe, rapid onset headache should include a workup for a SAH. The current standard of care if a SAH is suspected is to first obtain a CT scan of the individual’s brain within 6 hours of the onset of symptoms. If the CT scan is negative and there is a high enough clinical suspicion, the next step is to obtain a lumbar puncture and assess for high opening pressure, a raised RBC count, or xanthochromia. If these are seen in the CSF, it can be diagnostic for a SAH and treatment would start immediately.¹

The sensitivity of a negative CT scan within 6 hours of presenting symptoms, read by an experienced radiologist is 100%. Research has shown that the longer time spent between symptom onset and imaging readings shows a decline in the sensitivity.¹ With the advancements in CT technology it has been questioned whether a negative CT scan within 24 hrs is sufficient in ruling out a SAH.

The aim of this meta-analysis is to determine if patients over the age of 16 presenting with a sudden onset headache suggestive of a subarachnoid hemorrhage, is getting a negative CT scan within 24 hours as effective in ruling out SAH as compared to getting a lumbar puncture following a negative CT?

Methods

Our initial search began on PubMed using the search terms “Subarachnoid Hemorrhage,” and “Spinal Puncture.” The search yielded 108 results, with zero duplicates. Inclusion criteria included primary research, full text articles, that were published within the last ten years. Reasons for article exclusions included not primary studies, research that was done primarily on CSF analysis or the validation of the Ottawa SAH rule, or if the SAH was due to iatrogenic, malignancy or traumatic causes. After our initial screen we found 6 full text articles that examined the role of Lumbar Punctures after a negative head CT. We further excluded 3 of the articles due to the fact that the time of initial head CT from symptom onset was not examined. This left us with 3 articles that studied the necessity of a lumbar puncture to rule out a SAH following a negative head CT performed within 24 hours of symptom onset.

Objective

To assess the current standard for the detection of subarachnoid hemorrhage (SAH), and evaluate the need for a lumbar puncture with a negative head CT. Is a negative head CT thorough enough to definitively rule out a SAH?

Results

Retrospective studies include; Bianchi et al. (2021), Chee et al. (2020) Tulla et al.(2018). All three studies showed that a negative CT scan less than 24 hours after presenting symptoms is sufficient imaging in detection of a SAH.

Study	Bianchi et al.	Chee et al.	Tulla et al.
Patients, N	N = 310	N = 999	N = 539
Population	Patients >16 yo presenting with symptoms suggestive of non-traumatic SAH	Patients >17 yo presenting with a clinical suspicion of a non-traumatic subarachnoid hemorrhage	Patients 17-96 yo presenting with symptoms suggestive of non-traumatic SAH
Primary interest	Detection of Subarachnoid hemorrhage	Detection of Subarachnoid hemorrhage	Detection of Subarachnoid hemorrhage
Patient Categorization	Risk Stratification: Low, intermediate or high probability of SAH based on presentation and symptoms	Time of symptom onset to initial head CT 1. <6 h 2. 6-24 h 3. >24 h 4. All patients	Time of symptom onset to initial head CT 1. <6h 2. 6-12 h 3. 12-24 h 4. >24 h
Intervention	All patients underwent a head CT followed by a lumbar puncture if CT was negative 1. NCCT + LP (<6 hrs.) 2. NCCT + CTA + LP (≥12 h) 3. NCCT + CTA + LP (≥24 h)	All patients underwent a head CT followed by a lumbar puncture if CT was negative Patients with positive LP got a CTA or MRA or IADSA	All patients underwent a head CT followed by a lumbar puncture + CTA or + MRA or + DSA (if negative CT)
Sensitivity (95% CI) of CT for detection of SAH <24 hours of symptom onset	1. 87.5%(47.3-99.7) 2. 100% (63.1-100) 3. 100% (63.1-100)	1. <6 h - 100% (93.9-100) 2. 6-24 h - 100% (92.5-100) 3. >24 h - 94.5% (86.6-98.5) 4. All patients - 97.2% (93.6-99.1)	<24 h- 100% (95-100) All patients- 95% (89-98)

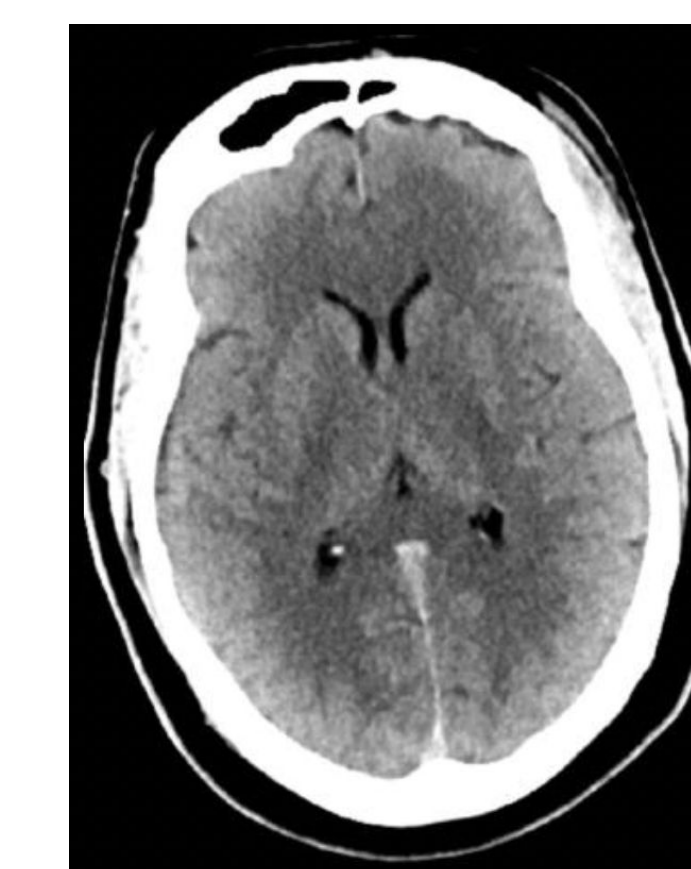
Discussion

All of the studies reviewed followed the standard of care of a lumbar puncture following a negative head CT. Even though Bianchi et al. study had the smallest population size, they had the most organized approach by using a risk stratification and identifying the approach for each patient’s clinical workup. It was easiest to understand their clinical reasoning and diagnostic approach to each patient. This provides strength in the data collected, as it specifically highlights that the time frame of symptoms onset should not be the only consideration when determining the necessity of an LP. A limitation of this study was that not all patients underwent the same diagnostic workup. This makes the reader question whether the increase in sensitivity is due to the improvement of CT technology or the addition of contrast to the head CT.

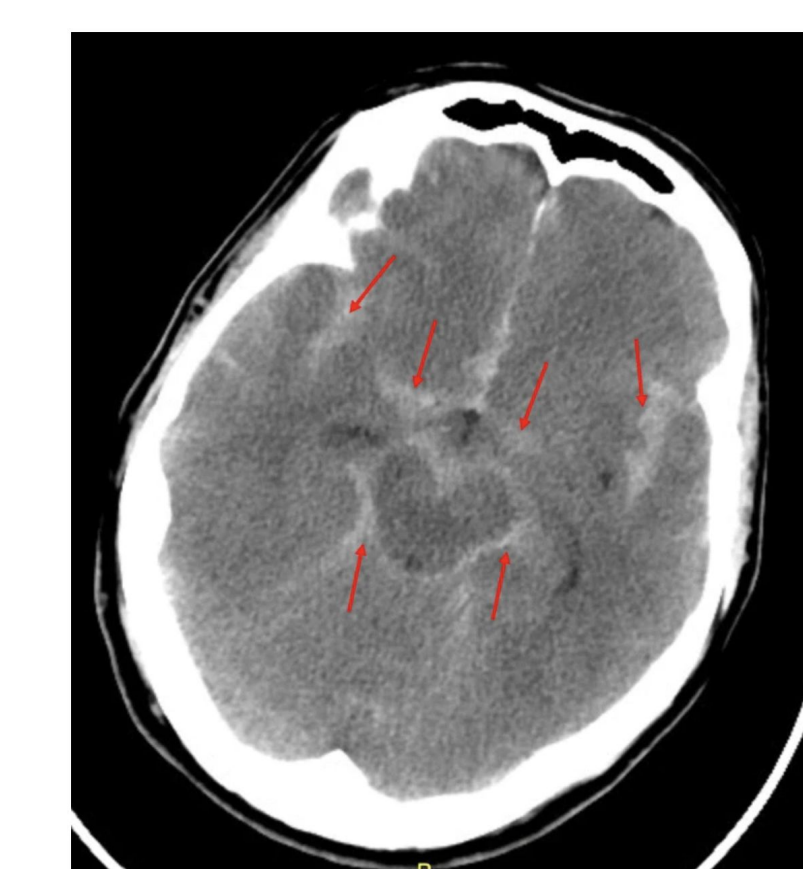
Chee et al. and Tulla et al. were very similar in their data collection, and patient criteria. Both studies included all patients presenting with symptoms suggestive of SAH who’s diagnostic workup included both a LP following a negative non-contrast head CT. Chee et al. study included the largest sample size and organized all patients into data sets based on time of symptom onset to initial head CT. Similar to the other studies they found that the sensitivity of a non-contrast head CT drastically reduces after 24 hours of symptom onset. Similar to study 2 study 3, tulla et al., also organized their patients into categories based on time of symptom onset to initial head CT. Even though the patients were placed into these categories, they did not provide sensitivity for all 4 groups. Although the data show a sensitivity of 100% if a head CT is done within 24 hours, having the specific data and confidence intervals for each group would be beneficial in identifying if there is a more sensitive approach.

Conclusion

There is strong evidence to show that when patients with symptoms indicative of a SAH present and get a head CT within 24 hours of symptom onset, with a 3rd gen. scanner, the imaging should be sufficient in ruling out a SAH in patients. The data also showed that there is diagnostic value in including a CTA to the diagnostic workup.



Normal Head CT³



Positive for SAH Head CT³

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