

Evaluation of Headache for Subarachnoid Hemorrhage in the Emergency Department

Jarone Lee*, Martine Silver and Kaushal Shah

Massachusetts General Hospital, Harvard Medical School, South Boston, MA 02127, USA

Abstract

Headache is a major presenting symptom of subarachnoid hemorrhage (SAH) along with nausea/vomiting, photophobia, meningeal signs and even loss of consciousness and seizures. In this paper we discuss the standard evaluation of SAH, including how to distinguish true SAH from traumatic lumbar puncture (LP). Also, we discuss how to interpret computed tomography (CT) of the brain and LP results in relation to the onset of symptoms.

Keywords: Subarachnoid hemorrhage; Lumbar Puncture; Traumatic Lumbar Puncture; Traumatic Tap; Headache

Introduction

A spontaneous Subarachnoid hemorrhage (SAH) usually arises from non-traumatic causes such as berry aneurysms or arteriovenous malformations (AVM). Headache is a major presenting symptom of SAH along with nausea/vomiting, photophobia, meningeal signs (neck stiffness or back pain) and even loss of consciousness and seizures. SAH has a worldwide incidence of 6-9 cases per 100,000 patients, with a case fatality rate from 30-60% [1-3]. Approximately, 2% of all emergency visits have the complaint of headache [4]. It is estimated that 11-25% of patients presenting to the emergency department (ED) with sudden onset, severe headaches may have a SAH [5]. There are approximately 30,000 patients in the United States each year that have a non-traumatic SAH of which 25% are misdiagnosed on initial presentation [4]. Among these patients, two thirds go on to develop permanent neurological disability or death [6]. As a result, early diagnosis and treatment are extremely important.

Case Presentation

A 40 year old healthy male with no past medical or surgical history presented to the ED with a three day history of worsening headache. He reported that the headache started out mild in his occipital area and progressively worsened over the last three days. Additionally, he developed persistent a traumatic lower back pain over the last day. The headache was accompanied by nausea and one episode of non-bloody, non-billous vomiting. He denied any fevers, chills, diarrhoea, recent travel, nor a family history of brain tumors or aneurysms. On physical examination, he was afebrile with normal vital signs, but looked very uncomfortable. His neurological examination demonstrated photophobia and neck stiffness without focal deficit. The remainder of his physical examination was unremarkable. Routine laboratory tests and a computed tomography (CT) of his brain were normal (Figure 1). The lumbar puncture (LP) showed pink-colored cerebral spinal fluid (CSF) in all four tubes (Figure 2) concerning for SAH or traumatic LP. Laboratory analysis of the CSF showed 90,000 red blood cells (RBCs) in the first tube and 60,000 RBCs in the fourth, with xanthochromia reported as positive. The patient was admitted to the neurosurgical intensive care unit (ICU), where a confirmatory CT angiogram and interventional angiogram of the brain showed a large 4-5mm aneurysm in the anterior communicating artery aneurysm (Figure 3). The aneurysm was coiled and the patient was discharged home on hospital day six.

Discussion

Our patient was ultimately diagnosed with a SAH from a bleeding aneurysm. Headache is a major presenting symptom of SAH along with

nausea/vomiting, photophobia, meningeal signs (neck stiffness or back pain) and even loss of consciousness and seizures. Unfortunately, many times SAH is only one of many diagnoses being considered. Below, we discuss the standard evaluation of SAH, including how to distinguish true SAH from traumatic LP.

CT Scan and LP

When a patient presents with a possible SAH, the first test to obtain is a non-contrast CT scan of the brain. During the first 24 hours after ictus, the sensitivity of a CT to diagnose a SAH is reported to be around 90-98%, and possibly higher if the CT is completed within 6-12 hours [7,8]. As time from onset of headache increases, the sensitivity of CT decreases [7,8]. The ability for CT to detect SAH decays due to circulation of cerebrospinal fluid and subsequent dilution and catabolism of blood in the CSF [7]. Since the sensitivity of CT is not 100%, a negative CT does not completely rule out this serious disease [9]. Therefore, in cases of suspected SAH, a LP should be performed in the setting of a negative CT. Our patient presented three days after the onset of headache and had a CT that was negative for haemorrhage. In this setting, CT is only 80% sensitive and as a result, we performed an LP that was positive for blood and highly suggestive of SAH, ultimately resulting in the diagnosis of bleeding aneurysm.

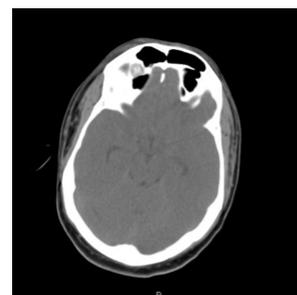


Figure 1: Normal non-contrast Computed Tomography Scan of the Brain.

*Corresponding author: Jarone Lee, MD MPH, Massachusetts General Hospital, Harvard Medical School, South Boston, MA 02127, USA, E mail: Lee.jarone@mgh.harvard.edu

Received June 05, 2013; Accepted July 01, 2013; Published July 03, 2013

Citation: Lee J, Silver M, Shah K (2013) Evaluation of Headache for Subarachnoid Hemorrhage in the Emergency Department. Family Med Medical Sci Res 2:107. doi:10.4172/2327-4972.1000107

Copyright: © 2013 Lee J, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

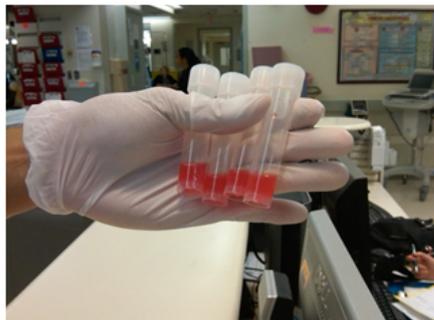


Figure 2: Cerebral Spinal Fluid: traumatic tap or true SAH?



Figure 3: CT angiogram of the Brain with an Aneurysm

LP Considerations

As discussed, an LP should be considered when patients are very high risk of a subarachnoid hemorrhage, however has negative CT of the head. However, LPs are not benign and carry a small, but significant risk of bleeding that result in an epidural hematoma, infections including meningitis, and brain stem herniation when there is a space-occupying lesion in the brain. More commonly, patients report back discomfort from the local trauma and post-dural puncture headaches that typically resolve spontaneously with conservative treatment. Occasionally these headaches require the instillation of a blood patch. All these risks of an LP must be weighed against the consequences of missing a life-threatening subarachnoid haemorrhage from a cerebral aneurysm.

Evaluating LP Results

The algorithm for evaluation of a possible SAH is simple, unfortunately interpretation of the LP results can be challenging. Currently, the standard practice is to send three or four samples of CSF for microscopic analysis. Comparison of RBC results of the first and last samples is then used to diagnose or exclude SAH. Difficulty arises when there is a traumatic LP and there are RBCs in both the first and last samples. Unfortunately, there is no criterion standard for how many RBCs should be in the CSF to reliably diagnose or exclude SAH. Bynny et al. [8] performed a retrospective review of 149 patients with diagnosed spontaneous SAH [9]. In this study, CT diagnosed 139 of the cases and 10 were diagnosed by LP. Of these 10 LPs, the amount of RBCs in the last tube varied greatly, with some as low as 700 when presenting in less than 24 hours and 300 among those presenting at three days.

Returning to our case, the microscopic analysis of the CSF showed

90,000 RBCs in the first tube and 60,000 RBCs in the fourth tube. Although there was a decline in the number of RBCs, the absolute number was high and the drop off was minimal. In combination with the clinical presentation, our post-test probability for SAH was very high and we admitted the patient to the neurosurgical service for further evaluation.

What is a Traumatic Tap?

Traumatic taps are caused by puncture of the venous plexuses accompanying the spinal sac or cauda equina. When CSF is analyzed, one parameter that is measured is the number of RBCs. Fortunately, the testing of RBCs in the CSF has a sensitivity of 100% (there should be no concern for SAH when there are no RBCs in the last CSF tube), however the specificity is approximately 80%, due to an estimated 20% incidence of traumatic taps [10]. Most practitioners interpret a significant drop in RBCs between the first tube and last tube as a traumatic tap. However, the exact definition of “significant drop” has never been clearly defined. In this scenario, testing for xanthochromia may assist in diagnosing SAH.

What is Xanthochromia?

Xanthochromia is a yellow discoloration of CSF due to catabolism of hemoglobin.

When RBCs degrades, hemoglobin is released into the CSF and forms oxyhemoglobin. This gives the CSF a pink or pink-orange color. Oxyhemoglobin can be formed in-vivo or in-vitro and happens in the first few hours after RBCs are introduced into the CSF. Oxyhemoglobin is then enzymatically metabolized to bilirubin, which is the substance that gives CSF the yellow hue. Since this process is enzyme-dependent, the presence of bilirubin signifies blood was present prior to LP. Though bilirubin is absent in the first hours, it usually forms within 12 hours and remains in CSF for a couple of weeks. As a result, xanthochromia can be absent in the first few hours immediately after ictus. Our patient presented 3 days after onset of the headache and therefore we would expect xanthochromia, which was present. Other causes of xanthochromia to consider are jaundice, increased CSF proteins, rifampin intake, and excess carotenoids ingestion [11].

Most hospitals identify xanthochromia with visual inspection, while a minority utilizes a spectrophotometer. Sidman et al. [4] conducted a blinded study in which experienced laboratory technicians visually examined unmarked samples for the presence or absence of xanthochromia [4]. RBCs were lysed in vitro and serial dilutions were prepared for inspection. Technicians were asked to interpret samples in standard sized tubes and then in larger diameter tubes. The absorbance of each sample was measured in a spectrophotometer. Sensitivity of visual inspection in standard diameter tubes was 26.6%. In the larger tubes, the sensitivity slightly increased to 55%. The spectrophotometer had a sensitivity of 97.9 %. Therefore, it appears that using a spectrophotometer is much more sensitive than visual inspection, but most hospitals continue to use visual inspection alone.

Is Opening Pressure Helpful?

Additionally, opening pressure can be a useful tool in distinguishing traumatic tap from a true SAH. A study performed in the pre-CT era looked at 213 patients with SAH and found that 60% had pressures above 20cm of H₂O [10]. As stated previously, CSF may appear clear in cases of true SAH. In this case, the opening pressure was high at 26cm, which increased our clinical suspicion for SAH.

MR Angiography and CT Angiography

Technology continues to improve drastically, with CT scanners able to visualize smaller and finer structures. This is especially true when contrast is given and CT angiography has replaced conventional angiography for many procedures, including evaluation of cerebral aneurysm. This is also true of MR technology, where MR angiography and MRI with FLAIR imaging can detect smaller lesions and at times with better sensitivity than CT angiography. However, getting an MRI quickly done and read by a radiologist in the acute setting is difficult in many emergency departments and other out-patient settings. Generally, an MR is reserved for very specific and limited indications in the emergency department because of limited resources, which typically does not include evaluation of cerebral aneurysm rupture. Additionally, many patients cannot receive an MR because of implanted hardware, or other contraindications. Lastly, very few patients that arrive to the ED with a headache have a subarachnoid hemorrhage. Even in the most resource avid system with multiple MRIs available, if all patients that required a rule-out for subarachnoid hemorrhage received an MRI, the system's resources would be quickly over-loaded and those MRI scanners could not be used for other non-urgent and urgent indications. As with everything in medicine, the risk and benefits of an MRI versus other testing modalities must be considered carefully, in discussion with the patient and in conjunction with your pre-test probability of disease.

Summary

CT scan is highly sensitive in patients presenting within 6 hours of headache onset or ictus. If CT is negative, an LP should still be performed to determine if RBCs or xanthochromia are present. When evaluating headache patients, the suspicion of SAH should be considered and any CT and LP results should be analyzed in the context of the timing of presentation. If an LP is performed in the first 12 hours, CSF should exhibit RBCs and might not have xanthochromia. Between 12hrs and 2 weeks, CSF may not have RBCs however it should be positive for

xanthochromia. If the LP was performed after 2 weeks, both RBCs and xanthochromia may be nonexistent. If your clinical suspicion is still high, consider neurosurgical consultation or angiography.

References

1. Hop JW, Rinkel GJ, Algra A, van Gijn J (1997) Case-fatality rates and functional outcome after subarachnoid hemorrhage: a systematic review. *Stroke* 28: 660-664.
2. Nieuwkamp DJ, Setz LE, Algra A, Linn FH, de Rooij NK, et al. (2009) Changes in case fatality of aneurysmal subarachnoid haemorrhage over time, according to age, sex, and region: a meta-analysis. *Lancet Neurol* 8: 635-642.
3. Vadikolias K, Tsvigoulis G, Heliopoulos I, Papaioakim M, Aggelopoulou C, et al. (2009) Incidence and case fatality of subarachnoid haemorrhage in Northern Greece: the Evros Registry of Subarachnoid Haemorrhage. *Int J Stroke* 4: 322-327.
4. Sidman R, Spitalnic S, Demelis M, Durfey N, Jay G (2005) Xanthochromia? By what method? A comparison of visual and spectrophotometric xanthochromia. *Ann Emerg Med* 46: 51-55.
5. Dupont SA, Wijidicks EF, Manno EM, Rabinstein AA (2008) Thunderclap headache and normal computed tomographic results: value of cerebrospinal fluid analysis. *Mayo Clin Proc* 83: 1326-1331.
6. Schievink WI (1997) Intracranial aneurysms. *N Engl J Med* 336: 28-40.
7. Edlow JA, Malek AM, Ogilvy CS (2008) Aneurysmal subarachnoid hemorrhage: update for emergency physicians. *J Emerg Med* 34: 237-251.
8. Byyny RL, Mower WR, Shum N, Gabayan GZ, Fang S, et al. (2008) Sensitivity of noncontrast cranial computed tomography for the emergency department diagnosis of subarachnoid hemorrhage. *Ann Emerg Med* 51: 697-703.
9. Edlow JA, Caplan LR (2000) Avoiding pitfalls in the diagnosis of subarachnoid hemorrhage. *N Engl J Med* 342: 29-36.
10. Shah KH, Edlow JA (2002) Distinguishing traumatic lumbar puncture from true subarachnoid hemorrhage. *J Emerg Med* 23: 67-74.
11. Fishman R (1992) Composition of the Cerebrospinal Fluid. (2nd edn). *Cerebrospinal Fluid in Diseases of the Central Nervous System*. WB Saunders, Philadelphia.