Defending a Traditional Practice in the Modern Era: Lumbar Puncture as a Viable and Affordable Alternative to Angiography in the Investigation of CT Negative Subarachnoid Hemorrhage

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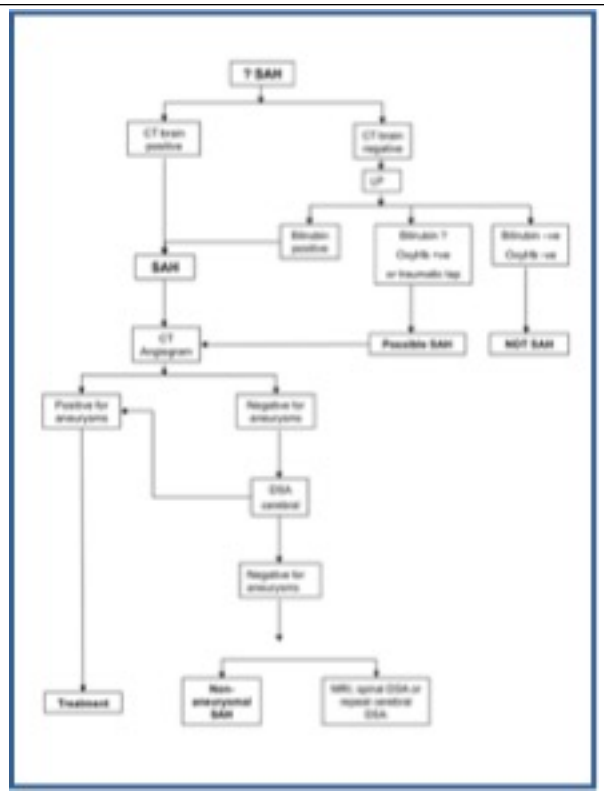
Introduction

Investigation of the neurologically intact patient with headache is a common scenario and involves potentially difficult decision-making for emergency department (ED) and acute medical physicians. Headache is the presenting feature in approximately 2% of all ED visits, with subarachnoid haemorrage (SAH) accounting for between 1-3% of these headaches. The majority of spontaneous SAH arise as the result of a ruptured cerebral aneurysm, and identification of bleeds from aneurysms is vitally important, as timely intervention is necessary to prevent rebleeding and other complications related to SAH [1-3].

Patients suspected of having SAH are typically evaluated with an unenhanced computed tomography (CT) scan followed by a lumbar puncture (LP) if the CT scan is negative, in accordance with the College of Emergency Medicine's guidelines for the investigation of lone acute severe headache [4]. If LP indicates bleeding, by the detection of bilirubin in the cerebrospinal fluid (CSF) using spectrophotometry, the patient undergoes angiography to investigate for cerebral aneurysms or other vascular anomalies [5-7].

Recently the CT-LP-algorithm has come into question. Three recent studies have indicated that modern third generation CT is sufficiently sensitive to detect SAH if performed early and interpreted by expert neuroradiologists [8-10]. In addition, CT angiography (CTA) is today a routine technique widely available in both the elective and emergency settings, though this is not always the case in district hospitals.



Algorithm for the investigation of possible SAH.

In theory, it might be useful to directly perform CTA after a negative CT, if resources allowed, an approach with excellent hypothetical sensitivity for aneurysmal SAH [10]. However, compared to the CT-LP algorithm, both the CT alone and in combination with CTA have been shown in practice to carry risks of missing non-aneurysmal SAH [10, 11], and indeed, this algorithm does not indicate whether or not an identified vascular anomaly has or has not actually bled, and so does not inform the treatment decision for these cases in the emergency setting.

The West of Scotland has a high proportion of deprived areas in relation to the rest of the United Kingdom, and resources are a premium as part of a socialized healthcare model. To that end, we aim to assess the proportion of patients with conclusive LP results following a negative CT scan in suspected SAH to determine the diagnostic efficacy of LP in order to re-validate this as a useful, cheap test.

Methods

CSF spectrophotometric absorbance data from all centres in a regional health board were identified for consecutive patients over a 6-month period. Results were stratified as conclusive (positive/negative), or inconclusive according to national guidelines.

Results

239 of 255 (93.7%) results were conclusive (table 1). 89.0% of all samples were negative (227 of 255), excluding SAH in these cases, assuming LP was performed more than 12 hours post-ictus.

4.7% of results were positive (12 of 255). 8 of these patients were transferred for angiography: 4 cerebral aneurysms requiring treatment were identified, 3 were coiled and 1 was clipped. The remaining 4 did not show any clear vascular anomaly. Those not transferred for further investigation in all cases had alternative explanations for their raised CSF bilirubin. 1 had hepatic encephalopathy and a markedly raised serum bilirubin; 1 was a child with hypoxic brain injury from birth; 1 had severe bacterial meningitis; 1 was in status epilepticus and had suffered a traumatic SAH.

16 out of 255 (6.3%) samples were inconclusive. Only 5 patients were transferred for angiography – 1 showing an aneurysm that was coiled, 1 revealed reversible segmental vasoconstriction syndrome and 3 were negative for any cerebral vascular anomaly. 5 cases were not thought to be SAH following senior medical review and were not referred to neurosurgery or an alternative diagnosis was made. 1 sample was uninterpretable by spectrophotometry, due to antibiotic interference. The remaining 5 samples were insufficient (<1ml CSF obtained), none required transfer to neurosurgery.

23 patients were referred to neurosurgery. 10 (43.5%) with negative

Conclusions

LP has a high diagnostic yield, eliminating the requirement for neurosurgical opinion or investigation in almost 90% of cases. This study has also demonstrated that the local sensitivity of picking up SAH on CT head scans performed within 6 hours or 72 hours of ictus (as proposed by other groups) is not 100%. Therefore we could not justify abandoning LP, even for this group of patients who present early after SAH. The procedure is cost effective, time efficient and avoids unnecessarily exposing patients to the risks of radiation and contrast agents. However it is the ability to rule-out alternative diagnostic possibilities in a "real-world" context, that is the true strength of the lumbar puncture.

The test is both cost and time efficient and subjects only a small number of patients to the radiation and contrast risks of angiography. This has important implications for socialized healthcare systems, and in areas that can ill afford the increased cost of angiography becoming the "gold standard" in SAH exclusion following a negative CT scan.

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