Letter from the editor

Subarachnoid haemorrhage: still a diagnostic headache for emergency physicians

A recent large prospective study by Perry and colleagues [1] suggests that a negative computed tomography (CT) scan followed by a negative lumbar puncture (LP) is sufficient to rule out a diagnosis of subarachnoid haemorrhage (SAH) in patients presenting with acute severe headache. This combination of tests is currently the recommended protocol for diagnosis of SAH, and has been successfully used for many years. However, as the article by Perry et al demonstrates, while this combination is highly sensitive (100%), it lacks specificity. Is there is a more effective diagnostic strategy for SAH? Here, we highlight several important considerations in this area that are the subject of ongoing discussion in the literature.

Subarachnoid haemorrhage (SAH) has an incidence of approximately 6–7 per 100,000 patient-years and is responsible for about 3% of patients presenting with headache to the emergency department (ED).[2] Diagnosis of SAH is challenging, and is missed in 1 in 20 patients during the ED episode, with patients presenting with less-severe symptoms appearing to be at highest risk of misdiagnosis.[3] Currently, there are no evidence-based guidelines to assist the ED doctor in the diagnosis of potential SAH. Recommendations in the UK, which are similar to those in the USA, advocate immediate brain CT scanning. If the CT scan is negative, LP is recommended as a supporting test to determine the presence of xanthochromia.[4]

Given the large numbers of people who present with headache to an ED, and the low incidence of SAH, can we correctly assign pre-test probability for SAH and identify which patient requires further investigation? Sudden-onset headache is the characteristic symptom of SAH, although patients often neglect to mention the type of onset when they seek medical advice.[5] Previous studies suggest that up to 40% of patients experience a "sentinel" headache prior to SAH, but the evidence is weak and preceding headache does not seem to aid in the diagnosis.[6] A recent study demonstrated that ED physicians were able to discriminate SAH with a moderate degree of accuracy.[7] Using an a priori pre-test probability of 2%, the authors calculated the sensitivity and specificity of clinicians' judgement and found an area under the receiver–operator curve of 0.87 (95% CI 0.80 to 0.93).[7] However, the study also highlighted that three quarters of these same physicians would be uncomfortable about not ordering investigations for most patients. Interestingly, the diagnostic accuracy in this study was similar to that in previous studies assessing ability to assign accurate pre-test probability in ankle (area under ROC: O.88) and knee (0.87) fractures,[8][9] raising the possibility of future development of decision rules for risk stratification in SAH.

Once we have decided to investigate a patient with a presumed SAH, what is the appropriate strategy, and how does each result affect our subsequent management? Unenhanced CT scan of the brain performed as soon as possible from symptom onset remains the usual initial investigation. Most EDs in resource-rich settings can offer ready access to CT scans. However, previous studies have demonstrated that obtaining a CT scan is only the first step in diagnosing SAH, and, as SAH is difficult to diagnose, interpretation of the scan by an experienced senior doctor is invaluable.[3] The timing of the scan also needs to be considered carefully, as CT accuracy falls off after the first 24 hours. It has been reported that third-generation scanners miss 5% of cases of SAH at 24 hours after symptom onset, and up to 27% at 3 days.[10] The sensitivity of CT for detecting SAH with modern scanners, when all

abnormalities attributable to SAH are taken into account, has been reported to be as high as 98%.[11] Some authorities have suggested that such a strong negative likelihood ratio of normal CT might render subsequent LP unnecessary in patients with a low pre-test probability for SAH.[7][12] However, a recently published 3-year retrospective study of 149 patients diagnosed with spontaneous SAH has countered this argument, with lower reported sensitivities of 94% (95% CI 88% to 98%) for new multidetector CT scanners.[13] The authors additionally reported that the sensitivity was even lower at 90% (95% CI, 81% to 95%) in the 67 patients with Glasgow Coma Score (GCS) of 15 (normal conscious level) — which is perhaps the very population for which test results might be the most useful as a decision-making tool as the clinical picture is the most difficult to assess for these patients.

There are several other valid reasons to question whether LP is the most appropriate test to follow CT in the diagnosis of SAH: the procedure is invasive with a reasonably high complication rate; up to a third of patients will suffer a resulting post-procedure headache; and, although uncommon, significant bleeding and infection have been reported.[14] As stated earlier, the diagnosis of SAH is time critical, and yet general consensus is that LP should not be performed until 12 hours after onset of symptoms, as this is the time required for the breakdown of haemoglobin to bilirubin: conversion of haemoglobin to bilirubin requires enzymes that are present only in vivo, and so presence of bilirubin cannot be attributable to a traumatic tap. Most authors would agree that cerebrospinal fluid spectrophotometry for xanthochromia is superior to visible inspection,[15] but this requires expertise that not all hospitals have available 24 hours a day, introducing further delays to the diagnosis. The technical process of performing LP can be difficult and needs expertise to perform, and even in expert hands there is still a significant risk of a traumatic tap. This can also potentially confound the diagnosis with the presence of oxyhaemoglobin in the CSF. Several studies have investigated whether the presence of d-dimer in the CSF can rapidly distinguish between traumatic tap and SAH, but with inconclusive results.[16][17]

Given the limitations of LP, is there a better test to perform in those low-risk patients with a normal CT but enough clinical suspicion to merit further investigation? Other imaging techniques (magnetic resonance imaging (MRI), angiography, CT angiography, and MR angiography) have been utilised in the diagnosis of SAH. Surprisingly, there have been few studies looking at MRI as a diagnostic tool in SAH. The largest of these looked at several different modalities of MRI with variable sensitivities and specificities, finding T2 weighted and FLAIR the most sensitive (94% and 81%, respectively).[18] A more recent, smaller study reported disappointing results for FLAIR MRI, with only two positive scans in 12 confirmed cases of SAH, although both of these studies lack power.[19] Traditional catheter angiography is associated with a significant risk of ischaemic neurological complications (8%) and with further rupture of cerebral aneurysms (1–2%).[6] CT angiography has a 95% sensitivity for detecting aneurismal rupture, has the advantage of being relatively quick to perform, and can be carried out immediately after the brain CT. MR angiography has similar test characteristics to CT angiography, with the added advantage of not requiring contrast.[6] All of these investigations are expensive and the resources are not always available to every ED.

SAH has a mortality rate of 50%, and survivors may experience significant neurological morbidity. Given the catastrophic consequences of missing the diagnosis, and that both mortality and morbidity increase with delays in treatment, early diagnosis is essential.[20] Reviewing the current literature certainly raises the hope for future improvements in the diagnosis of SAH and investigation of the patient presenting to the ED with a sudden onset severe headache. However, there is still insufficient evidence to support the routine use of these newer investigatory modalities, and the cornerstone of diagnosis of SAH in the ED therefore remains the emergency physician’s clinical acumen in determining those patients who warrant further investigation with CT followed by LP.

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