Clinical Outcomes of Oxyhaemoglobin Positive CSF Scans

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Introduction

Subarachnoid haemorrhage (SAH), arterial bleeding into the subarachnoid space, has an incidence of about 8 per 100,000 per year[1] and prognosis is poor. Early diagnosis and treatment result in an improved prognosis; early detection is therefore essential. Up to 50% of patients will suffer a subsequent bleed[2] making an accurate diagnosis essential in ensuring optimal follow-up. Spectrophotometric scanning of cerebrospinal fluid (CSF) for the presence of bilirubin and oxyhaemoglobin is a second-line test, carried out following a negative computerised tomography (CT) scan result when clinical suspicion of SAH is high. Bilirubin in the CSF confirms the diagnosis of SAH, however there is uncertainty over the significance of oxyhaemoglobin alone; which could indicate either an early bleed or introduction of peripheral blood into the CSF. The next investigation, catheter angiography, is a resource-intensive and invasive procedure with a small risk of morbidity and mortality.

The aim of this study was to retrospectively audit the investigations carried out and outcomes of patients who presented to Wishaw General Hospital (WGH) during the period 1st January 2004 - 31st December 2005 who had a negative CT scan and a CSF scan that was reported as negative for bilirubin and positive for oxyhaemoglobin.

Spectrophotometric Investigation of SAH

Following a haemorrhage into the CSF, red blood cells undergo lysis and phagocytosis to produce oxyhaemoglobin[3]. Oxyhaemoglobin is, in turn, gradually converted to bilirubin; this process occurs for about one week after the onset of bleeding[2].

Spectrophotometric scanning is the most reliable method of detection of oxyhaemoglobin and bilirubin in the CSF.[3] An absorption maximum at 415nm in the UV/visible spectrum of CSF is suggestive of the presence of oxyhaemoglobin. An absorption maximum of 476nm in the UV/visible spectrum indicates the presence of bilirubin. The presence of bilirubin in the CSF is diagnostic of SAH, however the presence of oxyhaemoglobin alone may be due to a SAH or due to artefactual introduction of peripheral blood into the CSF. A large peak of oxyhaemoglobin may mask a smaller bilirubin peak. In some cases oxyhaemoglobin may be present alone soon after a bleed however this would not be expected if the lumbar puncture is carried out at least 12 hours after the onset of symptoms. Introduction of peripheral blood into the CSF following a previous, failed attempt at lumbar puncture, or contamination with peripheral blood at the time of sampling (traumatic tap) is more likely. This pattern is found in about 30% of specimens and has a low predictive value for SAH[4].

Methods

Clinical notes were examined for all patients who had a negative CT scan and a CSF scan showing presence of oxyhaemoglobin but not bilirubin during the time period 1st January 2004 - 31st December 2005. Lumbar puncture details were analysed to determine if there had been any previous, failed attempts which may have led to introduction of peripheral blood, or a traumatic tap where peripheral blood may have been introduced during the procedure. A control group of CT scan negative, bilirubin negative, oxyhaemoglobin negative notes were also examined to determine the incidence of traumatic taps and multiple lumbar puncture attempts to establish if there is a difference between the groups.

Control Group

Random case notes from 21 patients presenting with symptoms of SAH (table 1a), with no evidence of oxyhaemoglobin or bilirubin were examined. There were no details of the lumbar puncture in 4 of the patients and these were excluded. In 5 of the patients (29%) there was more than one attempt. Published data suggests up to 20% of lumbar punctures are traumatic, with introduction of blood into the CSF[4]. It is not clear from the notes whether the subarachnoid space was entered and no CSF was obtained, or whether the attempt failed to penetrate into the subarachnoid space. In one patient there was a small amount of oxyhaemoglobin present visually on the scan, however a negative report had been issued as it was below the net oxyhaemoglobin absorption (NOA) cut-off of 0.1. In this patient, CSF was obtained on the second attempt, under sedation, and was documented in the case notes as being 'very traumatic'. Red blood cells were apparent after centrifugation of the sample. In two out of the four patients, it was documented that a clear specimen was obtained. There was no evidence of trauma or more than one attempt at lumbar puncture in the other 12 patients.

Oxyhaemoglobin Positive Group

There were 21 patients who had a negative CT scan with a CSF scan positive for oxyhaemoglobin and negative for bilirubin (table 1b). There were no lumbar puncture details in the case notes of 2 patients who were excluded. 16 of the 19 lumbar punctures (84%) were documented as being traumatic or there were previous failed attempts. The outcome/ follow-up of these patients is presented in table 2. Two of the three patients referred for angiography were discharged without follow-up, either before or after imaging. The third patient referred to neurology had continuing symptoms and was diagnosed with a spontaneous dural rupture. The large oxyhaemoglobin peak (figure 1) could have been entirely due to the dural bleed, or it may have been a combination of bleeding within the central nervous system (CNS) and introduction of peripheral blood at the time of sampling. Due to the size of the peak, it is likely that the oxyhaemoglobin peak was masking the bilirubin peak, rather than no bilirubin being detected. From examination of the lumbar puncture and follow-up details in the case notes, it can be concluded that the rest of the positive oxyhaemoglobin results (95%) were due to introduction of peripheral blood into the CSF, either due to a traumatic lumbar puncture, or at the time of a previous failed attempt.

Conclusions

Contamination of CSF with peripheral blood may result in detection of oxyhaemoglobin on spectrophotometric scanning of CSF. It is not possible to tell from the scan if the oxyhaemoglobin peak is due to a bleed within the CNS or from contamination with peripheral blood. In this study it can be seen that there is a higher incidence of events where peripheral blood may be introduced into the CSF in samples which are positive for oxyhaemoglobin. It cannot be assumed that any samples which are oxyhaemoglobin positive, bilirubin negative are always due to contamination with peripheral blood. There was one patient in this sample population who showed this pattern and had in fact suffered a significant bleed within the CNS. The CSF sample was also visibly bloodstained suggesting that there may have been contamination with peripheral blood. This case highlights the importance of following up patients where there is high clinical suspicion of a CNS bleed, a negative CT scan and CSF scanning shows detection of oxyhaemoglobin alone.

Detection of oxyhaemoglobin without bilirubin on CSF scanning carries a low predictive value for SAH, however it does not exclude it. Details of the lumbar puncture procedure and the clinical picture should be considered when interpreting the CSF scan results and patients where suspicion of SAH is high should be followed up appropriately.

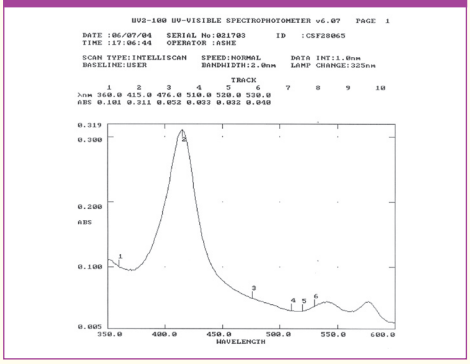
Table 1: Lumbar Puncture Documentation in case notes of:

a) Control Group (Mean age = 36yr (range 18 – 53))					
	CSF obtained on 1st attempt	At least 1 previous, failed attempt	Traumatic tap	Traumatic tap + failed attempt(s)	No lumbar puncture details
Number of Patients	12	4	0	1	4
b) Oxyhaemoglobin Positive Group (Mean age = 40 y (range 22 – 67))					
	CSF obtained on 1st attempt	At least 1 previous, failed attempt	Traumatic tap	Traumatic tap + failed attempt(s)	No lumbar puncture details
Number of Patients	3	11	3	2	2

Table 2: Diagnosis/Outcome of patients with Oxyhaemoglobin Positive, Bilirubin Negatve CSF Scans

Diagnosis/ Follow-up	Number of Patients
Discharged with no follow-up. No further related admission to date	8
Discharged with GP/ out-patient follow-up	6
Diagnosis of migraine	1
Referred for CT angiogram - results not consistentwith SAH, discharged with no follow-up	2 (1 patient discharged before angiography as it was considered unnecessary)
Continuing symptoms, referred to neurology. Dx spontaneous dural rupture, neurology out-patient follow-up	1
No details of follow-up	1
Referral to stroke clinic	1

Figure 1: CSF Scan showing presence of Oxyhaemoglobin Bilirubin



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