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Suspected SAH – Do we still need the needle?

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OBJECTIVES & BACKGROUND

There is growing evidence that, due to advances in technology, early computed tomography of the head (CTH) can now reliably exclude subarachnoid haemorrhage (SAH) in neurologically intact people[1,2]. Despite this, current guidelines still demand that all CTH-negative patients undergo lumbar puncture (LP) to detect any remaining occult SAH[3]. Bayesian analysis reveals that, for every additional SAH identified by LP, potentially hundreds of patients are subjected to the risks of LP[4]. Of note, SAH detected by LP only is often non-aneurysmal and not requiring treatment[5]. We aimed to develop a clinical decision rule (CDR) that identifies patients at low risk of occult aneurysmal SAH in whom LP might be safely omitted.

METHODOLOGY

We devised the following candidate CDR: In neurologically intact patients with suspected SAH and negative CTH, LP is mandatory only if one or more of the following apply: Haematocrit less than 0.3, SAH high-risk factor present (defined as transient loss of consciousness, neck stiffness, diplopia, seizure, known unruptured intracranial aneurysm, history of intracranial aneurysm in at least one 1st-degree relative, previous SAH, family history of SAH, autosomal dominant polycystic kidney disease, Ehlers-Danlos syndrome type IV, fibromuscular dysplasia or pseudoxanthoma elasticum) or interval between headache onset and CTH greater than 48h. We chose the 48h cut-off point because the probability of a positive LP within that timeframe is less than 1% (see **Figure 1**) - a level of risk known to be acceptable to patients in relation to negative outcomes from a range of diseases and treatments.

Time from onset of headache to CT	CT sensitivity	SAH post-test probability	LP NNI
<6h	100%	No LP needed	
<12h	98%	0.2%	500
<24h	93%	0.6%	167
<48h	89%	0.9%	111
<3 days	83%	1.4%	71
<4 days	75%	2.0%	50
<5 days	70%	2.4%	42
<6 days	58%	3.4%	29
<7 days	57%	3.5%	28
1 week or more	50%	4.0%	25
>2 weeks	No data	LP sensitivity too low; angiography needed	

Figure 1: Number of LPs required ('Number-Needed-to-Investigate') per additional SAH diagnosed in CT-negative patients with headache suspicious for SAH

Underlying assumptions: CT sensitivities are those widely quoted in the medical literature, Pre-test probability of SAH 7.7% in ED patients with suspicious headache[1], CT 99.9% specific for SAH[4]

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Next, we reviewed all cerebrospinal fluid (CSF) samples analyzed for bilirubin at our institution between Feb 2012 and Jan 2015. Patients with ruptured aneurysms in those with a positive or equivocal bilirubin spectrophotometry result were identified from their medical records. In addition, we searched our radiology information system (RIS) for ruptured intracranial aneurysms and identified those that had only been detected on repeated imaging. This was done in an effort to overcome a real-world limitation of our study arising from the fact that not every CTH-negative patient had actually undergone the LP mandated by current guidance.

To maximize our chances of identifying any potentially remaining cases of aneurysmal SAH, we also scrutinized the Trust's governance systems for complaints, incidents, claims and inquests relating to such patients. The case histories of all patients with as identified by the above method were analyzed against our candidate CDR.

RESULTS

- 712 CSF samples had been analyzed for bilirubin during the study period. Angiography had confirmed aneurysmal SAH In 4 patients (see **Figure 2**). This indicates that in our Trust 178 LPs are currently performed for every additional aneurysmal SAH detected.
- 3 further ruptured intracranial aneurysms were identified from the RIS. No further cases came to light during our governance systems review.
- Our candidate CDR correctly predicted the need for LP in all 7 patients with initial negative CTH who had aneurysmal SAH (see **Figure 3**).

LP result (bilirubin spectrophotometry)	Number of patients	Angiography performed		No angiography	
		Ruptured aneurysm	Normal angiography	Plausible alternative diagnosis	Diagnosis undetermined from records
Negative	**671** (94.2%)				
Equivocal	**32** (4.5%)	**1**	**15**	**15**	**1** (still alive 3 years after event)
Positive	**9** (1.3%)	**3**	**4**	**1**	**1** (still alive 2 years after event)

Figure 2: LP outcomes and final diagnosis

Patient	Identified by	Need for LP predicted by
44 M	LP	Time to CT >48h (5 days)
53 F	LP	High-risk factor (previous aneurysm)
62 M	LP	Time to CT >48h (6 days)
57 F	LP	Time to CT >48h (3 days)
44 F	Repeat-imaging	High-risk factor (diplopia)
68 F	Repeat-imaging	Time to CT >48h (4 weeks)
83 F	Repeat-imaging	High-risk factor (diplopia)

Figure 3: Characteristics of patients with aneurysmal SAH identified on LP or repeat imaging

CONCLUSIONS

Our findings suggest that a clinical decision rule (see **Figure 4**) can identify CTH-negative patients at risk of occult aneurysmal SAH. Since omission of LP is at variance with current guidelines, decisions to do so should at present be taken jointly with patients.

If validated, our findings could lead to a significant reduction in the number of patients requiring 'the needle'.

In neurologically intact adults with suspected SAH and negative CTH,
LP is mandatory only if one or more of the below apply:

- **Interval between pain onset and CTH >48h**
- **Haematocrit <0.3**
- **SAH high-risk factor present**
- **Patient re-attending during same episode (unless LP already performed during initial attendance)**

Figure 4: Our clinical decision rule

REFERENCES

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