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Title: Optimising the use of lumbar puncture in patients with suspected subarachnoid haemorrhage

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Introduction:

Atraumatic subarachnoid haemorrhage (SAH) is a brain haemorrhage that usually results from a ruptured aneurysm. It is difficult to diagnose and has a high rate of morbidity and mortality, especially if not picked up early. The typical presentation for SAH is a sudden onset severe headache. Current practice for diagnosis of suspected SAH is a brain CT scan. If this imaging is negative, a lumbar puncture is performed which can detect the presence of blood products in the cerebral spinal fluid. However there are several disadvantages to lumbar puncture. It is unpleasant for the patient, time-consuming, technically difficult in some patients, and has potential complications such as ongoing headache and local bleeding. The question amongst clinicians is whether current CT scanning technology has high enough sensitivity in detecting SAH that lumbar puncture is unnecessary in most patients.

Aim:

1. Establish the sensitivity of current generation CT scanning to identify SAH
2. Describe the use of other investigations including LP and MRI
3. Investigate the clinical presentation pattern of patients that have false negative CT results

Impact:

If it is shown that the sensitivity of current generation CT scanners in detecting SAH is sufficiently high, this may lead to a reduction in unnecessary use of lumbar puncture.

Method:

All patients with a discharge diagnosis of SAH at Christchurch Hospital from 1Jan2008 to 31Dec2017 were identified through ICD-10 coding. Various measures concerning clinical presentation, investigations, diagnosis, treatment and outcome were recorded. This data was crosschecked with the neurosurgical database where available. The coroners' database was searched for any community deaths due to subarachnoid haemorrhage and these patients were searched for any prior potential SAH related admissions.

Results:

Table 1. CT results

Time from symptom onset to CT (hours)	CT positive	CT negative	Total
<12	150	3	153
12-24	103	0	103
24-48	40	1	41
48-72	8	1	9
72-96	4	0	4
96+	24	13	37

A total of 347 cases of SAH were included in the analysis. Of these cases, 329 were picked up by CT while the remaining 18 had negative CT results. Majority of patients (74%) presented within 24 hours of symptom onset and almost all of these cases were diagnosed by CT. There were 3 cases that presented within 12 hours of symptom onset and had negative CT results. These were noted to all be non-aneurysmal bleeds.

While most patients who presented between 48 and 96 hours after symptom onset were diagnosed by CT, the numbers in these groups are too low to draw reliable conclusions. The group of patients presenting more than 96 hours after symptom onset were much more likely to have a negative CT and therefore be diagnosed by another modality.

Table 2. Primary outcome – sensitivity of CT

Time from symptom onset to CT (hours)	% Sensitivity (95% CI)
All patients	94.8 (91.8 to 96.8)
<12	98.0 (93.9 to 99.5)
<24	98.8 (96.3 to 99.7)
<48	98.7 (96.4 to 99.6)
<72	98.4 (96.0 to 99.4)
<96	98.4 (96.1 to 99.4)
96+	64.9 (47.4 to 79.3)

The overall sensitivity of CT in detecting SAH was determined to be 94.8%. However when stratified by time from symptom onset to CT it was calculated that the sensitivity was over 98% for those presenting within 24 hours, which represents most patients. While sensitivity appears to remain high from 48 to 96 hours, there were very low numbers in these groups. There is a clear drop in sensitivity, down to 64.9%, when patients present more than 96 hours after symptom onset.

Conclusion:

For patients that present within 24 hours of symptom onset, CT is highly sensitive in detecting subarachnoid haemorrhage. It is difficult to make comments about those presenting between 24 and 96 hours due to the low numbers in our sample but it is clear that for patients presenting more than 96 hours after symptom onset lumbar puncture should be considered in the case of a negative CT result.

To further this research it would be of value to extend the approach to nationwide data. This would provide an increased sample size and thus a clearer indication of CT sensitivity for a delayed presentation. It may also be of interest to compare these results to data on the number of negative lumbar punctures performed due to suspected subarachnoid haemorrhage. This could help to quantify the benefit of reducing unnecessary lumbar punctures. This is also consistent with the Choosing Wisely campaign which encourages clinicians to reduce unnecessary tests.