Lumbar puncture for the assessment of subarachnoid haemorrhage
When should it be done?

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What is subarachnoid haemorrhage?
Subarachnoid haemorrhage (SAH) is bleeding into the fluid which fills the space around the brain and spinal cord. This fluid is referred to as Cerebrospinal Fluid (CSF). The arachnoid space is one layer of the lining (“meninges”) of the brain and spinal cord. Blood is irritating to the meninges, and can cause pain. The blood, and the irritation it causes, can lead to swelling, and/or “spasm” of the blood vessels, either of which can be damaging to the brain. SAH can be a sign of an arterial aneurysm (weak blood vessel). Aneurysms may bleed again, and the chance of rebleeding can be reduced by treatment. Treatment has improved considerably in recent years.

Who is at risk of subarachnoid haemorrhage?
Investigation for SAH is particularly appropriate in patients over the age of 15 years of age, with new severe non-traumatic headache, which has increased within one hour. High risk patients are those who have any of the following:
- age over 40 years of age;
- neck pain or neck stiffness
- witnessed loss of consciousness
- onset during exertion
- instant onset of severe pain (“thunderclap headache”)
- limited neck flexion

This “Ottawa rule” was shown to have a good sensitivity (over 97%) for subarachnoid haemorrhage, though most people who fulfil one of these criteria will not have SAH (specificity 15%). It is a guide, and other factors may also influence clinical decisions for such patients.

What are the tests that should be done to assess for subarachnoid haemorrhage?
A plain CT of the head may show blood in the CSF. If blood is present in the CSF, then neurosurgical consultation should be sought for further management. A CT angiogram should be acquired if available. If plain CT does not show blood and CTA does not show an aneurysm, another cause for the symptoms and if there are no features suggesting increased intracranial pressure, then lumbar puncture (LP) should be performed. Up to 20% of SAH can have no blood visible on CT.

Opening pressure and appearance of CSF should be documented. Collection of 10-20mL of CSF is recommended from adults, and up to 5mL in children. CSF testing should include the following:
- cell count (WBC and RBC)
- measurement of xanthochromia
- protein and glucose – these should also be tested on a blood sample taken at the same visit
- gram stain (can request as “m/c/s”)
- other tests for assessment of infections, see www.internationalencephalitisconsortium.org (refer to the “for physicians” section)
When should this testing be done?
Patients with SAH have a significant risk of rebleeding (~20%), and most repeat haemorrhage occurs within the first six hours. CT and consideration for LP should not be delayed. Many aneurysms can be treated acutely.

This replaces previous recommendations of delaying (up to 12hr) CSF collection, in order to use xanthochromia to distinguish between SAH (“old blood”) and a “bloody tap” (“new blood”). A “bloody tap” is when the LP procedure introduces blood into the sample during collection. Xanthochromia is a brown-yellow colour present following the degradation of haemoglobin, a sign of previous haemorrhage. Neither normal serum nor normal CSF have xanthochromia (both should be clear).

Xanthochromia is often present in CSF which has been taken as soon as possible, signifying that occult bleeding and/or thrombosis has occurred prior to presentation.

How to interpret the results?
A raised RBC count (eg. >2000x10⁶ cells/L) OR the presence of xanthochromia (even if only visual inspection) in CSF should be considered evidence for SAH. Such patients should proceed to further angiography to assess for aneurysms, ideally under neurosurgical care.

A lower level of RBC without xanthochromia may indicate a bloody tap. A reduction in RBC counts in the sequence of tubes of CSF taken has previously been suggested as an indication of a bloody tap, but this has since been demonstrated to not be sufficiently specific or sensitive.

4 Differentiation between traumatic tap and aneurysmal subarachnoid hemorrhage: prospective cohort study Jeffrey J Perry, BMJ 2015;350:h568
5 Differentiation between traumatic tap and aneurysmal subarachnoid hemorrhage: prospective cohort study Jeffrey J Perry, BMJ 2015;350:h568