Diagnostic Imaging Pathways - Headache (Thunderclap)

Population Covered By The Guidance

This pathway provides guidance on the imaging of adult patients with acute severe ('thunderclap') headache.

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Quick User Guide

Move the mouse cursor over the PINK text boxes inside the flow chart to bring up a pop up box with salient points.
Clicking on the PINK text box will bring up the full text.
The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

Pathway Diagram

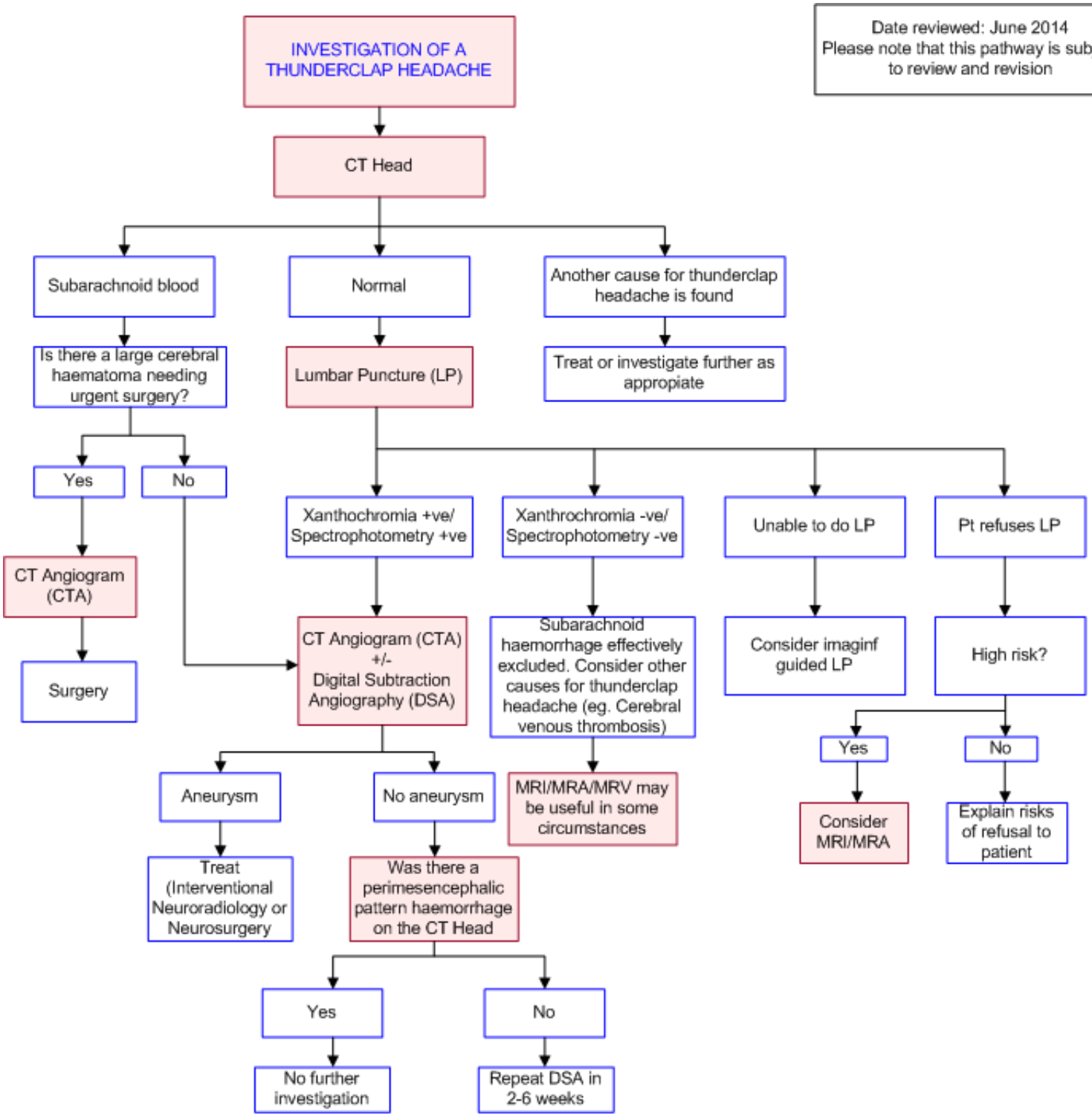
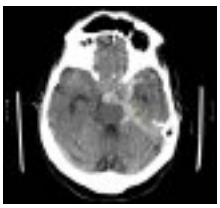


Image Gallery

Note: These images open in a new page

1a **Subarachoid Haemorrhage**

Image 1a and 1b (Computed Tomography): Pre and post-contrast images of a large left sided subarachnoid haemorrhage with blood surrounding the



Circle of Willis (Image 1a arrow) and extending into the ventricles (Image 1b arrow).

1b

1c

Perimesencephalic Haemorrhage

- Perimesencephalic haemorrhage was first described in 1985 and describes a form of subarachnoid haemorrhage more benign in nature when compared to aneurysmal SAH 36
- Approximately ten percent of spontaneous SAH are due to non aneurismal perimesencephalic haemorrhage 37
- In 95 percent of patients with a perimesencephalic pattern of haemorrhage in SAH the cause will be non-aneurysmal and this is an important clinical distinction as the prognosis for these patients is generally favourable. 38 The other 5 percent are typically due to vertebrobasilar aneurysm 39 with rarer causes including vascular tumours, arteriovenous malformations, dural arteriovenous fistula and trauma 37
- Perimesencephalic haemorrhage is defined as the following 37
    - Blood centered immediately anterior to the mid-brain or pons and may involve to differing degrees the interpedunculuar, crural, ambient, quadrigeminal, prepontine or carotid cisterns
    - In addition to this, blood may thinly extend into the suprasellar cistern and the basal portions of the sylvian and interhemispheric fissures but not into the distal portions of the sylvian or interhemispheric fissures
    - There maybe small amounts of blood that may sediment in the occipital horns of the lateral ventricles however there is no frank intraventricular haemorrhage

Computed Tomography (CT) of the Head

Imaging modality of choice for investigation of thunderclap headache 1-3

- High (greater than 90%) sensitivity for subarachnoid haemorrhage (SAH) if performed within 24 hours of haemorrhage 4-6
- In a large multi center prospective cohort study, 953 patients who were neurologically intact and imaged within 6 hours of headache onset CT had a sensitivity of 100 percent and specificity of 100 percent. 7 Overall for 3132 patients enrolled the sensitivity of CT for SAH was 92.9 percent and specificity 100 percent. This has lead further discussion as to whether CT can be considered as a ‘rule out’ for SAH. At this stage there remains conjecture over this proposal. The results acquired

in this trial relied upon the availability of third generation CT scanners and dedicated neuroradiology expertise, logistical considerations that are not currently widely available
- Provides an estimate of the extent of the haemorrhage, and allows recognition of associated intracerebral haemorrhage, intraventricular haemorrhage, hydrocephalus, and risk of subsequent vasospasm 4
- A normal CT does not exclude subarachnoid haemorrhage
- Limitations
    - Loss of sensitivity with increasing time between onset of headache and neuroimaging 4
    - False negative results in cases of small-volume bleeding 4
    - Possible false negative results for blood with a haematocrit of less than 30%
- Cerebral venous thrombosi, another cause of thunderclap headache has the following CT features 8
    - On pre-contrast CT the acute thrombus may be visible as an elongated high attenuation lesion within the dural sinus or cortical vein - '*the cord sign or dense triangle sign*'
    - On post-contrast images a filling defect may be seen as the dura enhances but the thrombus does not - '*the empty delta sign*'
    - CVT is found primarily in children and young adult and accounts for 1-2 percent of strokes 9
- Information on CT for consumers InsideRadiology

Computed Tomography Angiography (CTA)

- Non-invasive imaging modality for demonstrating vascular anatomy, with greater than 90% sensitivity for depiction of cerebral aneurysms greater than 3mm in size 10
- There are reports in the existing literature of CTA being able to detect active bleeding from aneurysms 11,12
- Experience with CTA is still in its early stages and most patients will also have digital subtraction angiography (DSA) for definite diagnosis and management decisions. However, some neurosurgeons are using 3D-CT angiography in place of DSA in the diagnosis of ruptured aneurysms and for defining vascular anatomy before surgery 10,13-15
- Advances in imaging technology have lead to the improved diagnostic accuracy of CTA. In a 2012 study 16 CTA had a sensitivity of 97.8 percent and specificity of 88.7 percent for the detection of intracranial aneurysms when compared against 3D DSA. Importantly these figures included the detection of aneurysms less than 3mm, a previous limitation with earlier technology. The results of this trial were concordant with other trials investigating these parameters. 16-21 A 2012 systematic review and meta-analysis found the pooled sensitivity and specificity of CT Angiography for detected cerebral aneurysms in acute SAH as 98 precent and 100 percent respectively 22
- Limitations
    - Limited evaluation of collateral pathways and cerebral haemodynamics
    - Inferior spatial resolution compared to DSA
    - Does not provide precise information about intracranial haemodynamics
    - Does not offer therapeutic opportunity
- Information on CT for consumers InsideRadiology

Digital Subtraction Angiography (DSA)

- Digital subtraction angiography is a procedure where a control radiograph is taken prior to contrast. Contrast is the administered into a blood vessel and a radiograph is again taken, before sophisticated computer software highlights the vascular structure with contrast and removes

surrounding tissues
- Gold standard for the detection of ruptured intracranial aneurysms and depicting the cerebral vascular anatomy 3,23
- Highly sensitive for detection of small aneurysms, small arteriovenous malformations and dural vascular malformations 23
- SAH is found to have no vascular origin with initial catheter angiography in approximately 15 percent of cases 24
- If the initial DSA is normal and the pattern of haemorrhage on original CT is perimesencephalic in distribution there is generally considered no need for a repeat angiogram 13,14
- For patients with an initial negative DSA and where repeat DSA is conducted, a 2013 study found that in the subsequent instances a cause of SAH was found in 4.5 percent of cases reviewed. 27 A similar trial analysing the utility of repeat DSA in patients with perimesencephalic subarachnoid haemorrhage had similar results with 3.3 percent of cases demonstrating a causative vascular lesion 27 though in a larger study the diagnostic yield of repeat angiography in patients with perimesencephalic haemorrhage was 0 percent 24
- Advantages
    - Offers therapeutic opportunity
    - Better outcome in terms of disability at 1 year with endovascular coiling compared to neurosurgical clipping 28
- Disadvantages
    - Invasive procedure with potential complications

Lumbar Puncture

- Performed in cases of suspected subarachnoid haemorrhage (SAH) with negative, equivocal or technically inadequate CT 5,6,29
- If SAH is suspected, the lumbar puncture should be performed at least 6, and preferably 12 hours CT after the onset of suspected SAH 30
- CSF should be examined for xanthochromia by means of spectrophotometry 30
- If CT or lumbar puncture indicates the presence of SAH, digital subtraction angiography is indicated to identify the cause 1
- If the CT and lumbar puncture are both normal subarachnoid haemorrhage has been effectively excluded 1,3,32
- Limitations 7
    - Invasive with potential exacerbation of symptoms
    - Possible misinterpretation of 'traumatic tap' as SAH

Magnetic Resonance Imaging (MRI) / MR Angiography (MRA) / MR Venography (MRV)

- The combination of MRI and magnetic resonance venography (MRV) is the imaging modality of choice for the investigation of suspected cerebral venous thrombosis (CVT) 33
- Cerebral venous thrombosis has the following features 33
    - Highly variable and non specific presentation from thunderclap headache to symptoms of raised cerebral venous pressure such as headache, vomiting and papilloedema
    - Imaging findings can be direct when the thrombus is visible within the cerebral venous system or indirect when there are ischaemic changes visible related to the venous outflow obstruction 34

- On MRI acute thrombus is isointense to brain on T1-weighted images and hypointense on T2-weighted images. Between 3 and 7 days after thrombus formation the clot becomes hyperintense on T-1 weighted images 8
- MRI is also sensitive to the parenchyma and haemorrhagic changes of venous infarction 35
- Information on Magnetic Resonance Imaging for consumers InsideRadiology

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Date of literature search: June 2014

The search methodology is available on request. Email

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. Download the document

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