

# Diagnostic Imaging Pathways - Headache (Adult)

## Population Covered By The Guidance

This pathway provides guidance on the imaging of adult patients with recent onset headache. Criteria have been developed to risk stratify patients, prior to imaging.

**Date reviewed: October 2017**

**Date of next review: October 2020**

**Published: February 2018**

## 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.

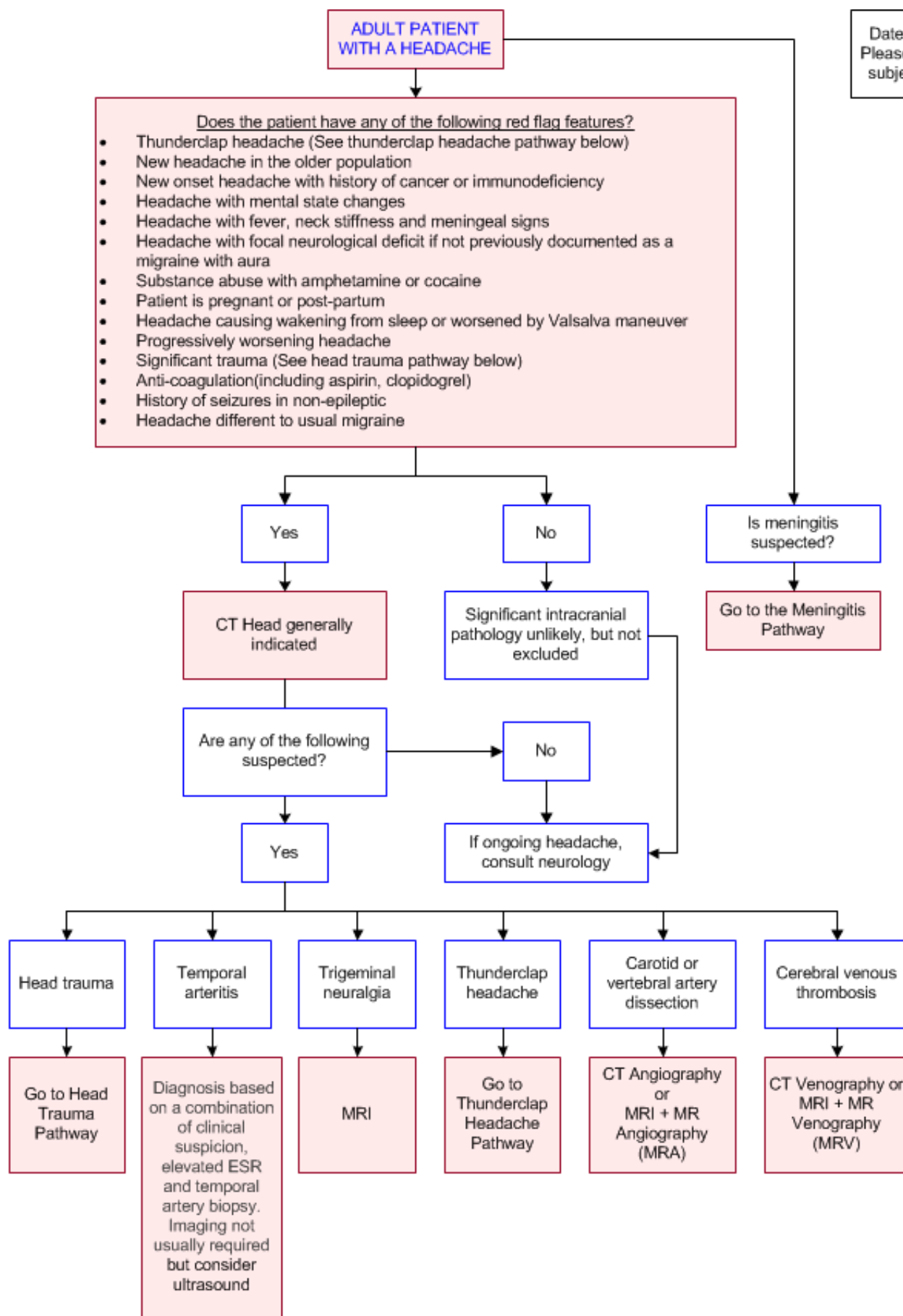
The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

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

## Pathway Diagram



Date reviewed: October 2017  
 Please note that this pathway is subject to review and revision



## Image Gallery

*Note: These images open in a new page*

1



### Glioblastoma Multiforme

Image 1 (Computed Tomography): Post-contrast CT showing an irregular lesion in the region of the left caudate nucleus with enhancement. The features are suspicious of a glioblastoma multiforme (Grade IV astrocytoma).

2a



### Glioblastome Multiforme

Image 2a: Post-mortem specimen showing a high grade glioma arising within the brainstem with central necrosis and haemorrhage.

2b

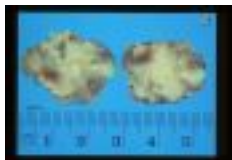


Image 2b: Post-mortem specimen showing a Glioblastoma (note the presence of necrosis and haemorrhage).

2c



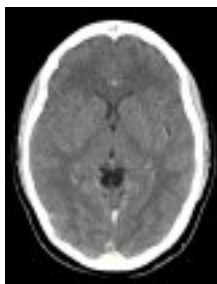
Image 2c (H&E, x20) : Histological section showing a hypercellular population of atypical fibrillary cells palisading around a central area of necrosis (asterisk) with microvascular proliferation (blue arrows). Scattered mitotic figures are also present. The features amount to a glioblastoma multiforme (Grade IV astrocytoma).

2d



Image 2d (H&E, x20): Histological section showing pleomorphic cells and nuclear atypia, features consistent with a glioblastoma.

3



### Superior Sagittal Sinus Thrombosis

Image 3 (Computed Tomography): There is a filling defect in the superior sagittal sinus (arrow) indicative of superior sagittal sinus thrombosis.

4



### Fibrillary Astrocytoma

Image 4a: Post-mortem specimen showing a low grade fibrillary astrocytoma.

4b

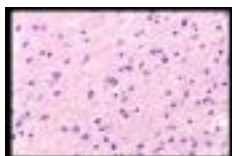


Image 4b : Histological section showing features of a low grade fibrillary astrocytoma (note the absence of necrosis or microvascular invasion).

5

### Astrocytoma



Image 5: Post-mortem specimen showing an astrocytoma.

**6**  **Craniopharyngioma**

Image 5: Histological section showing features of an Adamantinomatous Craniopharyngioma .

**7**  **Dysembryoplastic Neuroepithelial Tumour**

Image 5: Histological section showing features of a Dysembryoplastic Neuroepithelial Tumour.

**8**  **Angiomatous Meningioma**

Image 8: Histological section showing features consistent with an angiomatous meningioma (numerous vessels prevailing on the background of an otherwise typical meningioma).

**9**  **Metastatic Breast Carcinoma**

Image 9: Histological section showing features consistent with metastatic brain disease with breast as primary source of malignancy.

## Teaching Points

- 'Red flags' warrant further imaging
  - New headache in the older population
  - New onset headache in a patient with a history of cancer or immunodeficiency syndrome
  - Headache with mental state changes
  - Headache with fever/neck stiffness/meningeal signs
  - Headache with focal neurological deficit if not previously recognised in the context of a migrainous aura
  - Headache causing waking from sleep
  - Headache in a patient with recent ingestion of amphetamine/cocaine
  - Headache in pregnancy/post-partum
  - Headache worsened by Valsalva and progressively worsening headache
- CT head is the initial imaging modality of choice
- Further imaging, MRI ± MRA (Magnetic Resonance Angiography) or MRV (Magnetic Resonance Venography) is dependant on the clinical context

## Red Flags

- Most patients that present with headache in the primary care setting will not have a serious underlying condition but those with any of the 'red flag' features should probably be imaged with CT [1](#)
- A number of the 'red flags' have been based on the US Headache Consortium Evidence-Based Guidelines for Neuroimaging in patients with non-acute headache [1,2](#)
- These features are mostly based on small retrospective studies and do not have sufficient sensitivity or specificity to rule out intracranial pathology [2,3](#)
- An abnormal neurological examination finding increases the likelihood of a significant abnormality on neuroimaging [4-6](#)
- Two studies have shown a trend towards more significant abnormalities on CT with older patients

#### [4, 7](#)

- One study has shown an increase in the likelihood of significant pathology, most commonly a Chiari malformation, with headaches that worsen with the Valsalva maneuver [4](#)
- CT is generally not indicated in suspected meningitis unless there are clinical signs which predict for abnormal radiological findings (e.g. age >60 years, immunocompromised, history of CNS disorder, associated new onset seizures, mental state changes or focal neurological deficits). If CT is required, blood cultures and antibiotics should not be delayed [8, 9](#)

## Computed Tomography (CT)

- Generally considered the initial investigation of choice for headache [5](#)
- There have been very few studies comparing CT and MRI in the investigation of headache. One study showed MRI to be more sensitive in the detection of white matter lesions but in general CT is favoured because it is less expensive and more widely available [10](#)

## Temporal Arteritis

- Imaging has a limited role in the diagnosis of temporal arteritis. It is usually diagnosed on a combination of clinical suspicion, elevated ESR and temporal artery biopsy [11](#)
- One small study found the presence of a dark halo around the lumen of the temporal artery on ultrasound had 100% specificity for the diagnosis of temporal arteritis. [11](#)
- However another study found it only had a specificity of 79%, although it did increase to 93% if the halo was at least 1mm thick [12](#)

## Trigeminal Neuralgia

- The aim of imaging patients with symptoms of trigeminal neuralgia is to detect those with a structural cause for their symptoms such as a demyelinating lesion, mass lesion in the cerebellopontine angle or an ectatic vessel [13](#)
- Precise indications for imaging in patients with typical symptoms of trigeminal neuralgia are not clear [14](#)
- One retrospective study failed to find any features on history or examination that could reliably predict high risk patients and concluded it may be prudent to consider MRI for all patients with trigeminal neuralgia to exclude structural lesions [15](#)
- Several studies have shown that approximately 10-15% of cases of trigeminal neuralgia are secondary to a tumour or other structural lesion [13, 15, 16](#)

## Carotid and Vertebral Artery Dissection

- Once thought to be a rare cause of ischaemic stroke. However, dissection is a major cause of stroke in young and middle aged patients, accounting for 10-25% of cases. (18) The overall incidence is 2-2.5 per 100 000 for spontaneous carotid artery dissection, and 1-1.5 per 100 000 for vertebral artery dissection in US and French populations [17](#)
- Spontaneous dissection of the carotid & vertebral arteries usually arise from an intimal tear. Blood enters the wall of the artery forming an intramural haematoma, which may result in stenosis of the arterial lumen resulting in an ischaemic insult to the brain or brainstem [18](#)



- Clinical features that may suggest arterial dissection include [17, 19](#)
  - Carotid artery dissection: Initial presenting symptom is pain. Typically pain is unilateral facial, orbital or neck (upper anterolateral). It may present gradually or acutely, and is generally a constant steady ache. After several days (median 4), patients may develop neurological symptoms such as partial Horner's syndrome (miosis, ptosis), cranial nerve palsies of the lower cranial nerves (particularly hypoglossal), pulsatile tinnitus or transient ischaemic attacks
  - Vertebral artery dissection: Pain is the initial presenting symptom. Pain is less distinct than with carotid artery dissection and can often be mistaken for musculoskeletal pain. Pain may be localised to the back of neck or occiput, unilaterally or bilaterally. Nature of pain can be steady or throbbing. After (median) 2 weeks, patients may develop neurological symptoms such as lateral medullary syndrome, unilateral pain or weakness of an arm
- Conventional angiography has long been the gold standard for diagnosing arterial dissections. However, it has some important limitations. It is an invasive test, and carries additional risks compared with non-invasive imaging. Also, it cannot demonstrate intramural haematomas [19, 20](#)
- Non-invasive imaging (particularly MRI and CT) is commonly used to investigate headaches and partially accounts for the increased recognition and diagnosis of craniocervical arterial dissections [19](#)
- There are a few small head-to-head studies comparing MRI/MRA to MDCT/CTA for evaluating craniocervical arterial dissections. Eljovich et al. used a retrospective series of 7 patients, and found that 7/7 dissections were diagnosed on CTA vs 5/7 for MRI/MRA. [21](#) Vertinsky et al. used 18 retrospective cases and found that MDCT was able to visualise more features of cervical & vertebral artery dissection and was generally preferred over MR imaging by the reviewing neuroradiologists [20](#)
- A review of 21 studies by Provenzale et al. suggested that MRI/MRA and CTA had similar test characteristics, and concluded that there was limited evidence to suggest the superiority of one technique over the other [22](#)

## Cerebral Venous Thrombosis (CVT)

- Has a highly variable and non specific presentation from thunderclap headache to symptoms of raised cerebral venous pressure such as headache, vomiting and papilloedema [23](#)
- Imaging findings can be direct when the thrombus is visible within the cerebral venous system or indirect when there are ischaemic changes related to the venous outflow obstruction [23, 24](#)
- The combination of MRI and magnetic resonance venography (MRV) is the imaging modality of choice for the investigation of suspected CVT [9, 25, 26](#)
- CT Venography (CTV) is a viable alternative to MRV in the examination of patients with suspected dural sinus thrombosis especially in acute settings [27](#)
- The CTV is not affected by flow-related artefacts and is considered superior to MRV in identification of cerebral veins (particularly smaller ones with slow flow) and sinuses and at least equivalent to MRI/MRV in the diagnosis of cerebral venous sinus thrombosis (CVST) [26, 27](#)
- CTV also has the advantage that it may be used in the uncooperative patient as acquisition times are only approximately 1 min and is useful when MRI is contraindicated [9](#)
- MR techniques have the benefit of avoiding intravenous contrast and ionising radiation and are more sensitive than CT to cerebral parenchymal changes [9, 28](#) which are present in 40-70% patients with CVST [29](#)
- 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 [24](#)
- On post-contrast images a filling defect may be seen as the dura enhances but the thrombus does not - the empty delta sign [24](#)

- 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 and is easier to recognize but this may interfere with time of flight MRV studies [23, 24](#)
- MRI is also sensitive to the parenchyma and haemorrhagic changes of venous infarction. High signal intensity lesions on fluid-attenuated inversion-recovery sequence and T2-weighted imaging that do not correspond to an arterial territory may suggest CVT [30](#)

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Date of literature search: October 2017

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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