

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: August 2014

Date of next review: 2017/2018

Published: December 2014

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: August 2014
 Please note that this pathway is subject to review and revision

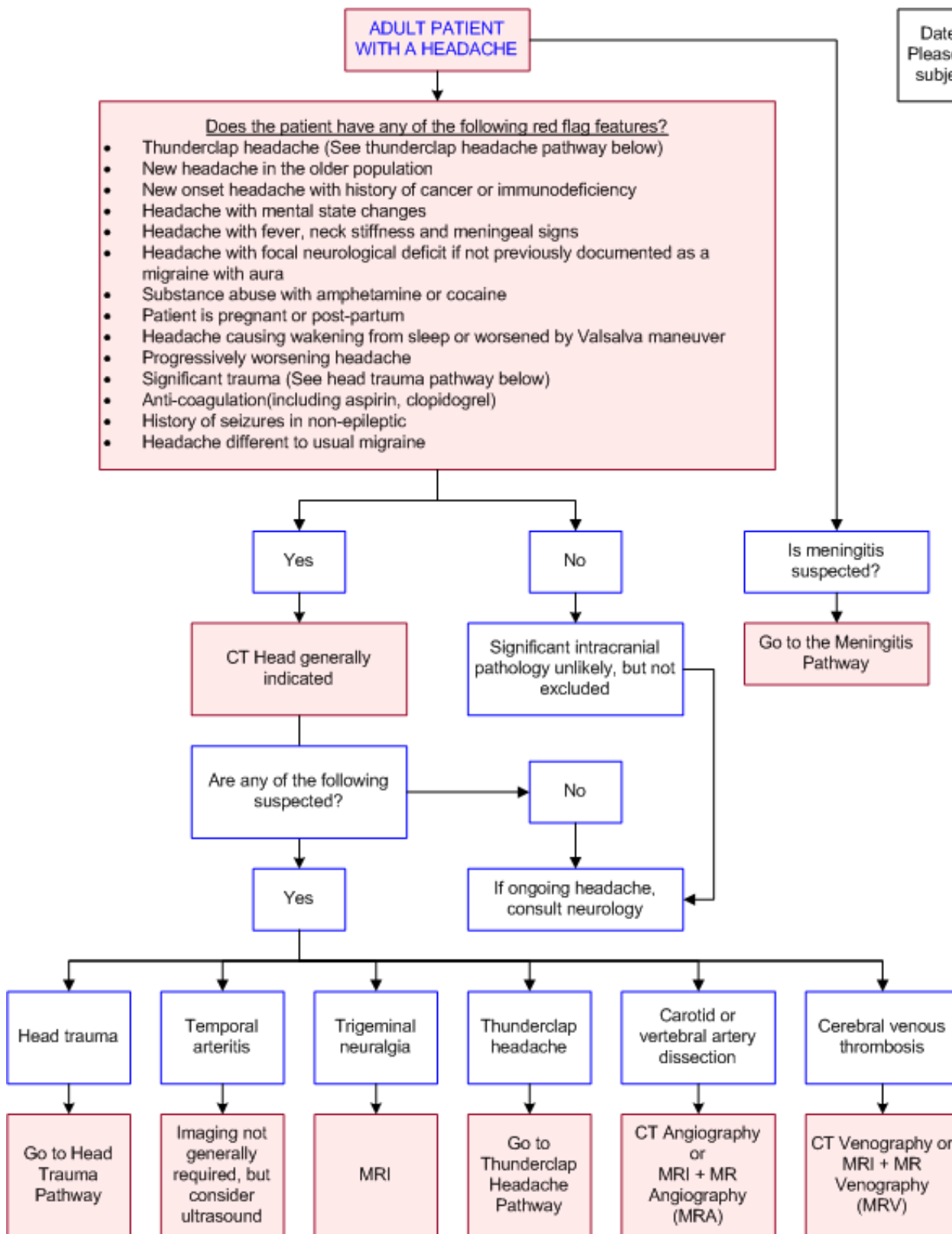


Image Gallery

Note: These images open in a new page

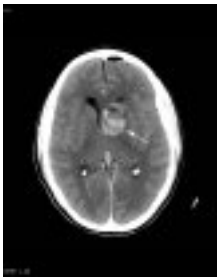


Image 1 (Computed Tomography): Post-contrast CT showing an irregular lesion in the region of the left caudate nucleus with enhancement. The features are suspicious of a glioblastoma multiforme (Grade IV astrocytoma).

2a



Glioblastome Multiforme

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

2b

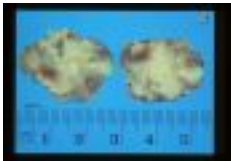


Image 2b: Post-mortem specimen showing a Glioblastoma (note the presence of necrosis and haemorrhage).

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

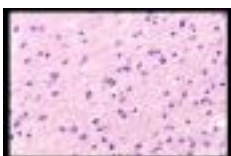


Image 4b : Histological section showing features of a low grade fibrillary astrocytoma (note the absence of necrosis or microvascular invasion).

5



Astrocytoma

Image 5: Post-mortem specimen showing an astrocytoma.

6

Craniopharyngioma

Image 5: Histological section showing features of an Adamantinomatous



Craniopharyngioma .

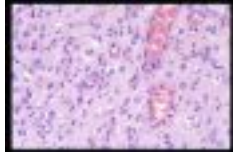
7



Dysembryoplastic Neuroepithelial Tumour

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

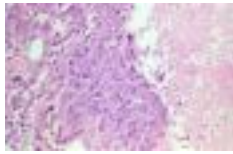
8



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

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
- 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 [1](#)
- 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 [2](#)

Computed Tomography (CT)

- Generally considered the initial investigation of choice for headache
- 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 [18](#)

Carotid and Vertebral Artery Dissection

- Once thought to be rare cause of ischaemic stroke. However, is a major cause of stroke in young and middle aged patients, accounting for 10-25% of cases. Overall incidence 2-2.5 per 100000 for spontaneous carotid artery dissection, 1-1.5 for vertebral artery dissection in US and French populations [30](#)
- 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
- Clinical features that may suggest arterial dissection include [30](#)
 - 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 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, transient ischaemic attacks
 - Vertebral artery dissection: Pain is the initial presenting symptom. Pain is less distinct than with carotid artery dissection & can often be mistaken for musculoskeletal pain. Pain may be localised to 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 [31](#)
- 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
- 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. [32](#) 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 [31](#)
- 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 [33](#)

Examinations

- [Red Flags](#)
- [Computed Tomography](#)
- [Carotid and Vertebral Artery Dissection](#)
- [Temporal Arteritis](#)
- [Trigeminal Neuralgia](#)

- [Cerebral Venous Thrombosis \(CVT\)](#)

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
- 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 [11](#)
- These features are mostly based on small retrospective studies and do not have sufficient sensitivity or specificity to rule out intracranial pathology [10,11](#)
- An abnormal neurological examination finding increases the likelihood of a significant abnormality on neuroimaging [12-16](#)
- Two studies have shown a trend towards more significant abnormalities on CT with older patients [14,17](#)
- 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 [14](#)
- 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 [20,21](#)

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
- 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 [5](#)
- The combination of MRI and magnetic resonance venography (MRV) is the imaging modality of choice for the investigation of suspected CVT [6,22](#)
- CT Venography (CTV) is a viable alternative to MRV in the examination of patients with suspected dural sinus thrombosis especially in acute settings [23,24](#)
- The CTV is not affected by flow-related artifacts 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 CVST [23,24](#)
- 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 [22](#)
- MR techniques have the benefit of avoiding intravenous contrast and ionising radiation and are more sensitive than CT to cerebral parenchymal changes [22,26](#) and they are present in 40-70% patients with CVST [27,28](#)
- 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 [5](#)
- On post-contrast images a filling defect may be seen as the dura enhances but the thrombus does not - the empty delta sign [5](#)
- 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 [5](#)



- 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 [7](#)

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
- Precise indications for imaging in patients with typical symptoms of trigeminal neuralgia are not clear
- 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 [3](#)
- Several studies have shown that approximately 10-15% of cases of trigeminal neuralgia are secondary to a tumour or other structural lesion [3,419](#)

References

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

- [1.](#) Schmidt WA, Kraft HE, Vorpahl K, et al. **Color duplex ultrasonography in the diagnosis of temporal arteritis.** N Engl J Med. 1997;337:1336-42. (Level III evidence)
- [2.](#) Salvarani C, Silingardi M, Ghirarduzzi A, et al. **Is duplex ultrasonography useful for the diagnosis of giant-cell arteritis?** Ann Intern Med. 2002;137:232-8. (Level II evidence). [View the reference](#)
- [3.](#) Goh BT, Poon CY, Peck RH. **The importance of routine magnetic resonance imaging in trigeminal neuralgia diagnosis.** Oral Surg Oral Med Oral Path Oral Radiol Endod. 2001;92:424-9. (Level III evidence)
- [4.](#) Cheng TMW, Cascino TL, Onofrio BM. **Comprehensive study of diagnosis and treatment of trigeminal neuralgia secondary to tumours.** Neurology. 1993;43:2298-302. (Level III evidence)
- [5.](#) Lee SK, terBrugge KG. **Cerebral venous thrombosis in adults: the role of imaging evaluation and management.** Neuroimag Clin N Am. 2003;13:139-52. (Review article)
- [6.](#) Tsai FY, Wang AM, Matovich VB, et al. **MR staging of acute dural sinus thrombosis: correlation with venous pressure measurements and implications for treatment and prognosis.** AJNR Am J Neuroradiol. 1995;16:1021-9. (Level III evidence)
- [7.](#) Forbes KP, Pipe JG, Heiserman JE. **Evidence for cytotoxic edema in the pathogenesis of cerebral venous infarction.** AJNR Am J Neuroradiol. 2001;22:450-5. (Level III evidence)
- [8.](#) Levy C, Laissy JP, Raveau V, et al. **Carotid and vertebral artery dissections: three dimensional time-of-flight MR angiography and MR imaging versus conventional angiography.** Radiology. 1994;190:97-103. (Level II evidence). [View the reference](#)
- [9.](#) Kasner SE, Hankins LL, Bratina P, et al. **Magnetic resonance angiography demonstrates vascular healing of carotid and vertebral artery dissections.** Stroke. 1997;28:1993-7. (Level III evidence)
- [10.](#) Silberstein SD. **Evaluation and emergency treatment of headache.** Headache. 1992;32:396-407. (Review article)
- [11.](#) US Headache Consortium. **Evidence-based guidelines in the primary care setting:**

- neuroimaging in patients with nonacute headache.** American Family Physician, 2000 (online) (accessed Jan 2015). (Evidence based guidelines). [View the reference](#)
12. Cala LA, Mastaglia FL. **Computerized axial tomography findings in a group of patients with migrainous headaches.** Proc Aust Assoc Neurol. 1976;13:35-41. (Level IV evidence)
 13. Carrera GF, Gerson DE, Schnur J, McNeil BJ. **Computed tomography of the brain in patients with headache or temporal lobe epilepsy: findings and cost-effectiveness.** J Comput Assist Tomogr. 1977;1:200-3. (Level IV evidence)
 14. Duarte J, Sempere AP, Delgado JA, et al. **Headache of recent onset in adults; a prospective population-based study.** Acta Neurol Scand. 1996;94:67-70. (Level III evidence)
 15. Larson EB, Omenn GS, Lewis H. **Diagnostic evaluation of headache. Impact of computerized tomography and cost-effectiveness.** JAMA. 1980;243:359-62. (Level IV evidence)
 16. Mitchell CS, Osborn RE, Grosskreutz SR. **Computed tomography in the headache patient: is routine evaluation really necessary?** Headache. 1993;33:82-6. (Level II evidence). [View the reference](#)
 17. Baker HL Jr. **Cranial CT in the investigation of headache: cost-effectiveness for brain tumors.** J Neuroradiol. 1983;10:112-6. (Level III evidence)
 18. Kuhn MJ, Shekar PC. **A comparative study of magnetic resonance imaging and computed tomography in the evaluation of migraine.** Comput Med Imaging Graph. 1990;14:149-52. (Level II evidence). [View the reference](#)
 19. Tan EK, Lim SH, Chan LL. **Trigeminal neuralgia: should MRI be done routinely?** Aust N Z J Med. 1998;28:827-9. (Level II evidence)
 20. de Campo J, Villanueva EV. **Diagnostic imaging clinical effectiveness fact sheet: suspected meningitis - role of lumbar puncture and computed tomography.** Australas Radiol. 2005;49:252-3. (Review article)
 21. Hasbun R, Abrahams J, Jekel J, Quagliarello VJ. **Computed tomography of the head before lumbar puncture in adults with suspected meningitis.** N Engl J Med. 2001;345(24):1727-33. (Level III evidence)
 22. Renowden S. **Cerebral venous sinus thrombosis.** Eur Radiol. 2004;14(2):215-26. (Review article)
 23. Khandelwal N, Agarwal A, Kochhar R, Bapuraj JR, Singh P, Prabhakar S, Suri S. **Comparison of CT venography with MR venography in cerebral sinovenous thrombosis.** AJR Am J Roentgenol. 2006;187(6):1637-43. (Level III evidence)
 24. Ozsvath RR, Casey SO, Lustrin ES, Alberico RA, Hassankhani A, Patel M. **Cerebral venography: comparison of CT and MR projection venography.** AJR Am J Roentgenol. 1997;169(6):1699-707. (Level III evidence)
 25. Casey SO, et al. **Cerebral CT venography.** Radiology. 1996;198(1):163-170. (Level III evidence)
 26. Connor SE, Jarosz JM. **Magnetic resonance imaging of cerebral venous sinus thrombosis.** Clin Radiol. 2002;57(6):449-61. (Review article)
 27. Vogl TJ, Bergman C, Villringer A, Einhaupl K, Lissner J, Felix R. **Dural sinus thrombosis: value of venous MR angiography for diagnosis and follow-up.** Am J Roentgenol. 1994;162:1191-8. (Level III evidence)
 28. Dormont D, Anxionnat R, Evrard S, Louaille C, Chiras J, Marsault C. **MRI in cerebral venous thrombosis.** J Neuroradiol. 1994;21(2):81-99. (Level III evidence)
 29. Hollingworth W, et al. **The diagnostic accuracy of computed tomography angiography for traumatic or atherosclerotic lesions of the carotid and vertebral arteries: a systematic review.** Eur J Radiol. 2003;48(1):88-102. (Level I evidence)
 30. Schievink WI. **Spontaneous dissection of the carotid and vertebral arteries.** N Engl J Med. 2001;344(12):898-906. (Review article)
 31. Vertinsky AT, Schwartz NE, Fischbein NJ, Rosenberg J, Albers GW, Zaharchuk G. **Comparison of multidetector CT angiography and MR imaging of cervical artery dissection.** AJNR Am J Neuroradiol. 2008;29(9):1753-60. (Level III evidence)



32. Eljovich L, Kazmi K, Gauvrit JY, Law M. **The emerging role of multidetector row CT angiography in the diagnosis of cervical arterial dissection: preliminary study.** *Neuroradiology.* 2006;48(9):606-12. (Level III evidence)
33. Provenzale JM, Sarikaya B. **Comparison of test performance characteristics of MRI, MR angiography, and CT angiography in the diagnosis of carotid and vertebral artery dissection: a review of the medical literature.** *AJR Am J Roentgenol.* 2009;193(4):1167-74. (Review article)

Information for Consumers

| Information from this website | Information from the Royal Australian and New Zealand College of Radiologists' website |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Consent to Procedure or Treatment</p> <p>Radiation Risks of X-rays and Scans</p> <p>Angiography (Angiogram)</p> <p>Computed Tomography (CT)</p> <p>Computed Tomography (CT) Angiography</p> <p>Magnetic Resonance Angiography (MRA)</p> <p>Magnetic Resonance Imaging (MRI)</p> | <p>Angiography</p> <p>Computed Tomography (CT)</p> <p>Contrast Medium (Gadolinium versus Iodine)</p> <p>Gadolinium Contrast Medium</p> <p>Iodine-Containing Contrast Medium</p> <p>Magnetic Resonance Imaging (MRI)</p> |

Copyright

© Copyright 2015, Department of Health Western Australia. All Rights Reserved. This web site and its content has been prepared by The Department of Health, Western Australia. The information contained on this web site is protected by copyright.

Legal Notice

Please remember that this leaflet is intended as general information only. It is not definitive and The Department of Health, Western Australia can not accept any legal liability arising from its use. The information is kept as up to date and accurate as possible, but please be warned that it is always subject to change

File Formats



Some documents for download on this website are in a Portable Document Format (PDF). To read these files you might need to download Adobe Acrobat Reader.



[Legal Matters](#)