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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.

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Date of next review: October 2020

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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

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

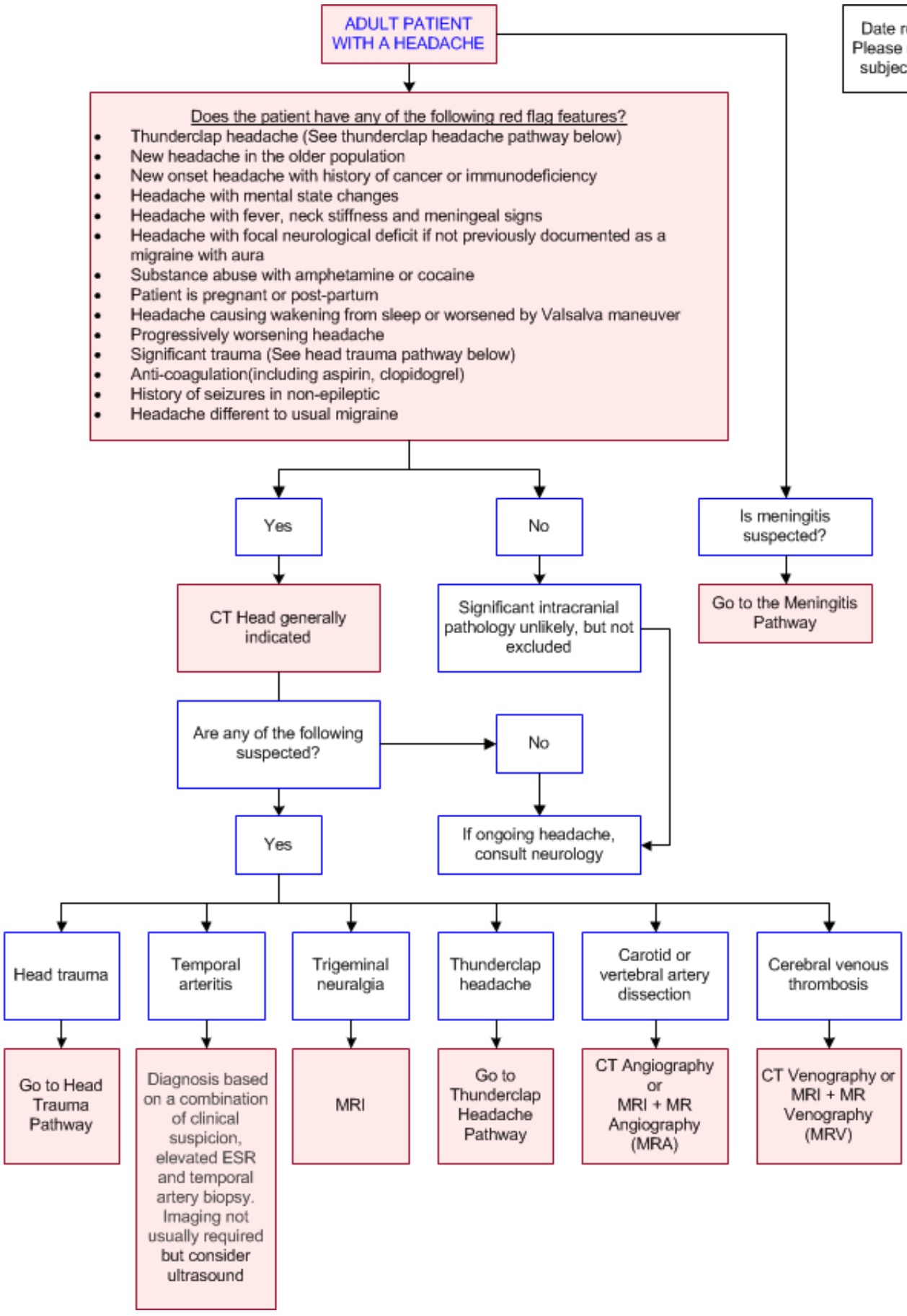

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Image Gallery

Note: These images open in a new page

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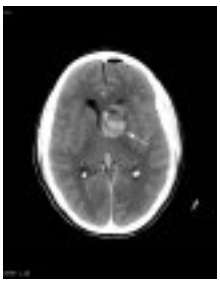


Gliobastoma Multiforme

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

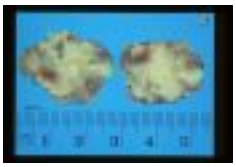


Image 2b: Post-mortem specimen showing a Glioblastoma (note the presence of necrosis and haemorrhage).

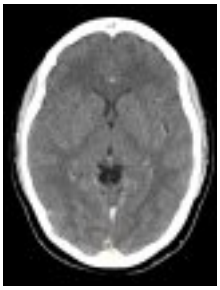
2c

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

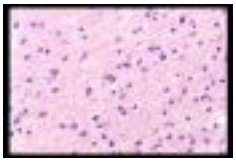


Image 4b : Histological section showing features of a low grade fibrillary astrocytoma(note the absence of necrosis or microvascular invasion).

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Astrocytoma

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Image 5: Post-mortem specimen showing an astrocytoma.

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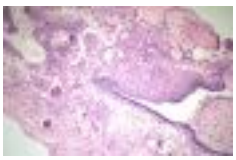
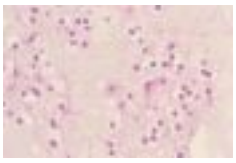
6 

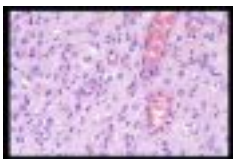
Craniopharyngioma

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 wakening 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

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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

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- 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. Elijovich 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 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

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- 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

References

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

1. Becker WJ, Findlay T, Moga C, Scott NA, Harstall C, Taenzer P. **Guideline for primary care management of headache in adults.** Canadian Family Physician. 2015;61(8):670-9. (Guidelines). View the reference
2. US Headache Consortium. **Evidence-based guidelines in the primary care setting: neuroimaging in patients with nonacute headache:** American Family Physician; 2000. (Guidelines). View the reference
3. Silberstein SD. **Evaluation and emergency treatment of headache.** Headache. 1992;32(8):396-407. (Review article). View the reference
4. Duarte J, Sempere AP, Delgado JA, Naranjo G, Sevillano MD, Claveria LE. **Headache of recent onset in adults: a prospective population-based study.** Acta Neurol Scand. 1996;94(1):67-70. (Level III evidence). View the reference
5. Holle D, Obermann M. **The role of neuroimaging in the diagnosis of headache disorders.** Ther Adv Neurol Disord. 2013;6(6):369-74. (Review article). View the reference
6. Mitchell CS, Osborn RE, Grosskreutz SR. **Computed tomography in the headache patient: is routine evaluation really necessary?** Headache. 1993;33(2):82-6. (Level II evidence). View the reference
7. Dumas MD, Pexman JH, Kreeft JH. **Computed tomography evaluation of patients with chronic headache.** CMAJ: Canadian Medical Association Journal. 1994;151(10):1447-52. (Level III evidence). View the reference
8. De Campo J, Villanueva EV. **Diagnostic Imaging Clinical Effectiveness fact sheet: Suspected meningitis – role of lumbar puncture and computed tomography.** Australasian Radiology. 2005;49(3):252-3. (Review article). View the reference
9. 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). View the reference
10. 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(2):149-52. (Level II evidence). View the reference
11. Bnaya A, Nesher G, Sonenblick M, Breuer GS. **Giant cell arteritis--old questions, current answers.** Harefuah. 2014;153(12):747-51. (Review article). View the reference
12. Salvarani C, Silingardi M, Ghirarduzzi A, Lo Scocco G, Macchioni P, Bajocchi G, et al. **Is duplex ultrasonography useful for the diagnosis of giant-cell arteritis?** Ann Intern Med. 2002;137(4):232-8. (Level II evidence). View the reference
13. Tan E-K, Lim S-H, Chan L, Wong Z-W. **Trigeminal neuralgia: should MRI be done routinely?** Trigeminal neuralgia: should MRI be done routinely? View the reference

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14. Chun-Cheng Q, Qing-Shi Z, Ji-Qing Z, Zhi-Gang W. **A single-blinded pilot study assessing neurovascular contact by using high-resolution MR imaging in patients with trigeminal neuralgia.** Eur J Radiol. 2009;69(3):459-63. (Level II evidence). View the reference
15. Goh BT, Poon CY, Peck RH. **The importance of routine magnetic resonance imaging in trigeminal neuralgia diagnosis.** Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2001;92(4):424-9. (Level III evidence). View the reference
16. Masuda Y. **Diagnosis and treatment of trigeminal neuralgia.** Nihon Rinsho. 2001;59(9):1722-6. (Review article). View the reference
17. Schievink WI. **Spontaneous dissection of the carotid and vertebral arteries.** N Engl J Med. 2001;344(12):898-906. (Review article). View the reference
18. Haneline MT, Rosner AL. **The etiology of cervical artery dissection.** Journal of Chiropractic Medicine. 2007;6(3):110-20. (Review article). View the reference
19. Mashhood A, Kim P, Almaguel F, McWilliams G, Jacobson JP. **Cerebral Misery Perfusion on Susceptibility Weighted Imaging in Acute Carotid Dissection.** J Radiol Case Rep. 2016;10(10):1-6. (Review article). View the reference
20. 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). View the reference
21. Elijovich 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 View the reference
22. 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). View the reference
23. Bonneville F. **Imaging of cerebral venous thrombosis.** Diagn Interv Imaging. 2014;95(12):1145-50. (Review article). View the reference
24. Lee SK, terBrugge KG. **Cerebral venous thrombosis in adults: the role of imaging evaluation and management.** Neuroimaging Clin N Am. 2003;13(1):139-52. (Review article). View the reference
25. Tsai FY, Wang AM, Matovich VB, Lavin M, Berberian B, Simonson TM, 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(5):1021-9. (Level III evidence). View the reference
26. Saba L, Anzidei M, Piga M, Ciolina F, Mannelli L, Catalano C, et al. **Multi-modal CT scanning in the evaluation of cerebrovascular disease patients.** Cardiovasc Diagn Ther. 2014;4(3):245-62. (Review article). View the reference
27. Khandelwal N, Agarwal A, Kochhar R, Bapuraj JR, Singh P, Prabhakar S, et al. **Comparison of CT venography with MR venography in cerebral sinovenous thrombosis.** AJR Am J Roentgenol. 2006;187(6):1637-43. (Level III evidence). View the reference
28. Connor SE, Jarosz JM. **Magnetic resonance imaging of cerebral venous sinus thrombosis.** Clin Radiol. 2002;57(6):449-61. (Review article). View the reference
29. 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). View the reference
30. Forbes KP, Pipe JG, Heiserman JE. **Evidence for cytotoxic edema in the pathogenesis of cerebral venous infarction.** AJNR Am J Neuroradiol. 2001;22(3):450-5. (Level III evidence). View the reference

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