Unexplained seizure in patients 16 years and older

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In general, all patients with the diagnosis of new seizure will require an MRI, whether they have had a CT scan or not. A common practice in the past has been for the patient to have a CT scan and see a specialist, who then requests an MRI scan which is discussed at a second consultation. For those patients in whom there is a confident diagnosis of seizure, it saves them time, money and exposure to radiation to have an MRI rather than CT before seeing the neurologist.

Urgent investigation is required for new onset seizure in patients with a history of head injury, alcohol or drug abuse, decreased conscious state, persistent neurological signs, and signs, symptoms or biochemical evidence of systemic illness (e.g. fever). An expedited MRI appointment can usually be arranged if the GP phones and discusses the case with the MRI radiologist.

There are many causes for seizure that show up on MRI and not CT, including many tumours, mesial temporal sclerosis, vascular malformations and cortical dysplasias. The MRI is tailored specifically for this indication with selected sequences and planes, so it is important that the request makes it clear that the clinical problem is seizures, and includes other important clinical features such as evidence of systemic illness.

Unexplained chronic headache

Headache (HA) is one of the most common medical symptoms. Although the majority of headache disorders are benign, it is a crucial (and challenging) task to decipher the benign variants from conditions that threaten life and neurological function. Usually a clinical history and examination is sufficient to diagnose a primary headache disorder, but when there is clinical doubt, investigations are required to exclude serious and treatable causes. Deciding who needs investigation truly draws on a combination of the "science and art of medicine". There are no easy answers, but there are a number of "red flags" that increase the chances of a serious underlying cause. These include a new onset or new type or worsening pattern of existing headache, new level of pain (e.g. "worst ever), HA triggered by valsalva or cough, by exertion, by sexual activity (pre-orgasmic, orgasmic), HA during pregnancy and puerperium (venous sinus thrombosis), HA where there are associated neurological signs

Figure 1(a) and (b): Arterial dissection
Figure 1(a) and (b): (left) T2 image of the skull base shows absent (normally black) flow in the right internal carotid artery (red arrow).

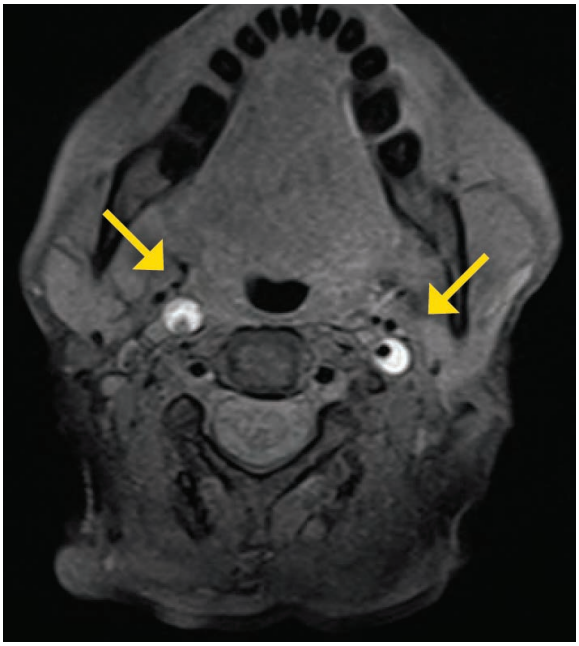

Figure 1(b): (right) Fat suppressed. T1 image below skull base shows blood in the wall of both internal carotid arteries narrowing the lumen (yellow arrows).

or symptoms, or evidence of systemic illness including features of sepsis, immunosuppression, weight loss and cancer. New onset side-locked HA can be a symptom of arterial dissection, and postural HA is a symptom of spontaneous intracranial hypotension.

CT or MRI?

MRI is superior to CT for diagnosing most of the serious causes of chronic headache. CT remains the investigation of choice in HA associated with recent trauma, and in "thunder clap" HA that raises the possibility of subarachnoid haemorrhage. CT and MRI are comparable in accuracy for diagnosing arterial dissection and venous sinus thrombosis, although dedicated CT angiography and venography (respectively) are necessary to make each diagnosis, and other causes of HA can easily be missed with these techniques. A "routine" MRI will detect a large number of causes of HA, and the sensitivity of MRI can be improved further by tailoring the examination to the patient. For this reason, it is even more important for MRI than CT that the request form contains the key clinical information. This is viewed by the radiologist before the MRI scan is performed, and the study is protocolled accordingly. As MRI does not involve ionising radiation, and most patients with HA do not require IV contrast, investigation for HA is a safe, non-invasive process. Whilst many scans performed for HA will return a normal finding, the cost benefit comes from the reassurance to the patient and their doctor when the study is normal, and the vital benefit of detecting those patients with a serious, treatable condition before serious complications (including death) have occurred.

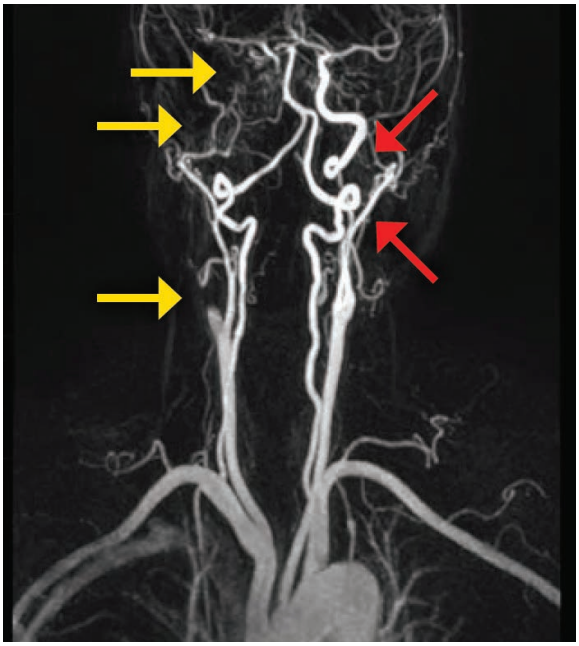

Figure 2: Arterial dissection. MR Angiogram shows absent flow in right common carotid artery (yellow arrows) and narrowed left common carotid artery (red arrow).

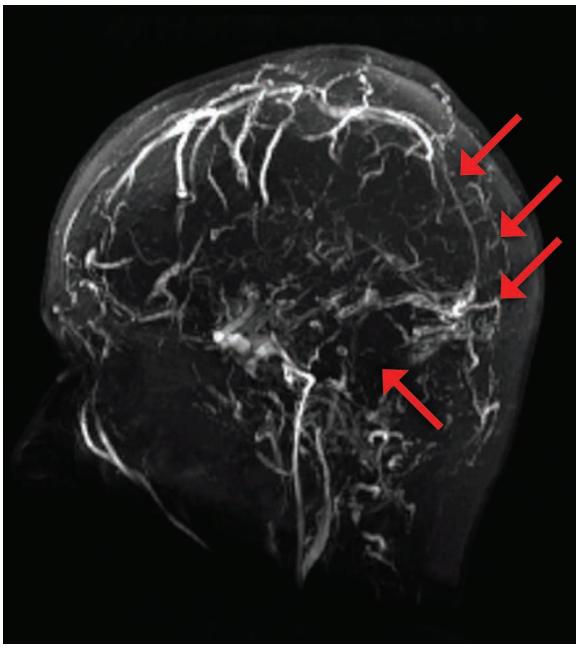

Figure 3: Venous sinus thrombosis.MR venogram shows absent flow in superior sagittal and transverse sinuses.

Raised intra-cranial pressure

Patients with clinical features of rapid onset raised intracranial pressure require imaging urgently, and CT may be appropriate to exclude a neurosurgical emergency (such as subdural haematoma or rapid onset hydrocephalus.) That said, a quick phone call to the radiologist can often secure an expedited MRI examination in an acceptable time period. MRI will show the cause of raised pressure with greater accuracy, and will also reveal other conditions that may mimic raised pressure.

Focal neuropathy

MRI is superior to CT in detecting the common causes of focal neuropathy; stroke and demyelination (multiple sclerosis), as well as the many rarer causes. The study will be tailored to the patient's potential clinical condition(s), so it is important that the MRI request contains detailed clinical information.

Familial history of aneurysm

MR angiography (MRA) and CT angiography (CTA) are comparable in accuracy and both are very good for detecting cerebral aneurysms. The advantages of MRA are:

1) it does not require intravenous contrast (CTA requires rapid IV bolus injection of iodinated contrast) and:
2) no ionising radiation. CTA may be more appropriate in patients who are claustrophobic, and who may have difficulty keeping still, as CTA is much more rapid to perform.

Figure 4: Aneurysms. MR angiogram shows bilateral internal carotid artery aneurysms.

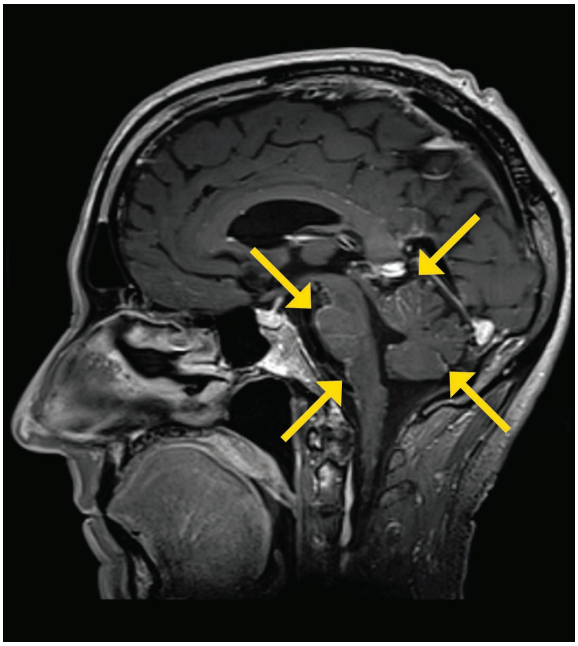

Figure 5: Meningeal metastatic disease. T1 post contrast image shows enhancing tumour coating brain stem and cerebellar folia.

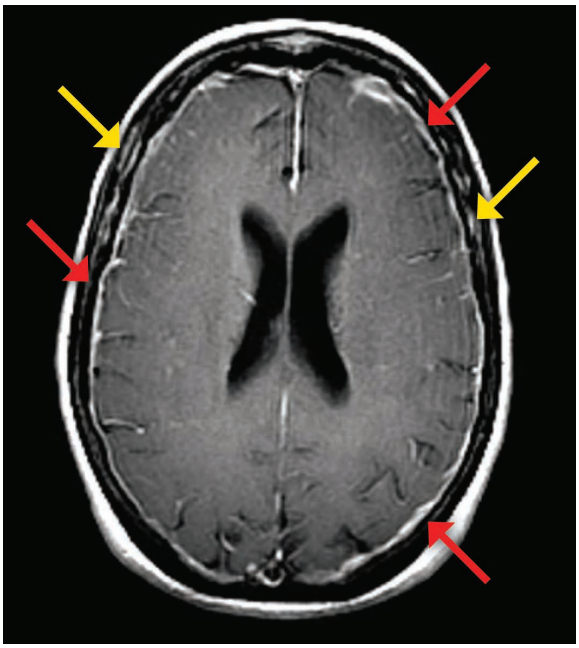

Figure 6: Meningeal metastatic disease. T1 post contrast images shows extensive enhancing tumour in the dura (red arrows). Bone metastases also enhance (yellow arrows).

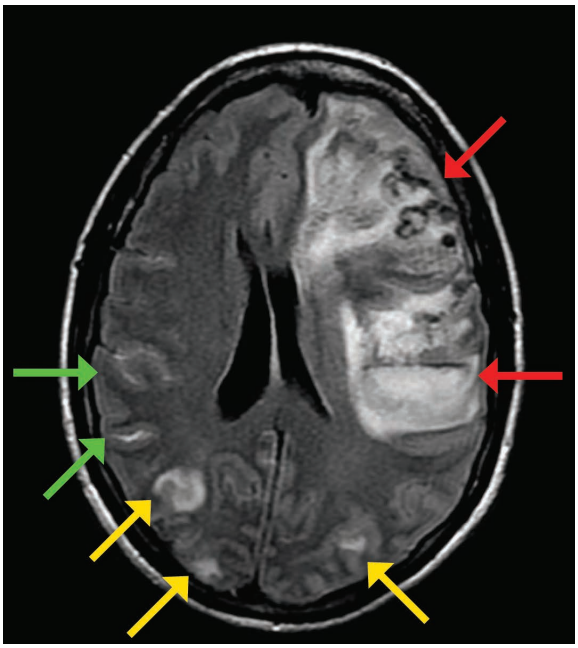

Figure 7: Posterior Reversible Encephalopathy Syndrome (PRES). FLAIR T2 image shows lesions of (PRES) (yellow arrows) complicated by cerebral (red arrows.) and sub arachnoid (green arrows) haemorrhage.

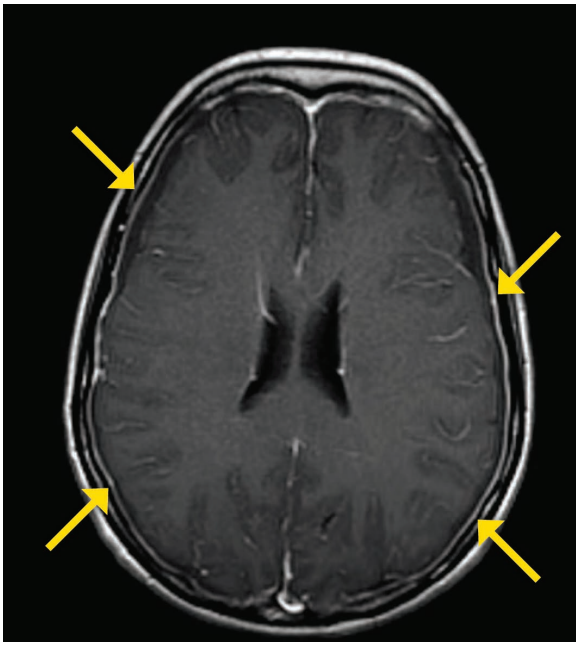

Figure 8: Spontaneous Intracranial Hypotension. Post contrast T1 image shows abnormal dural enhancement due to decreased intracranial pressure.

Figure 9: Spontaneous Intracranial Hypotension. PD image shows bilateral secondary subdural fluid collections.

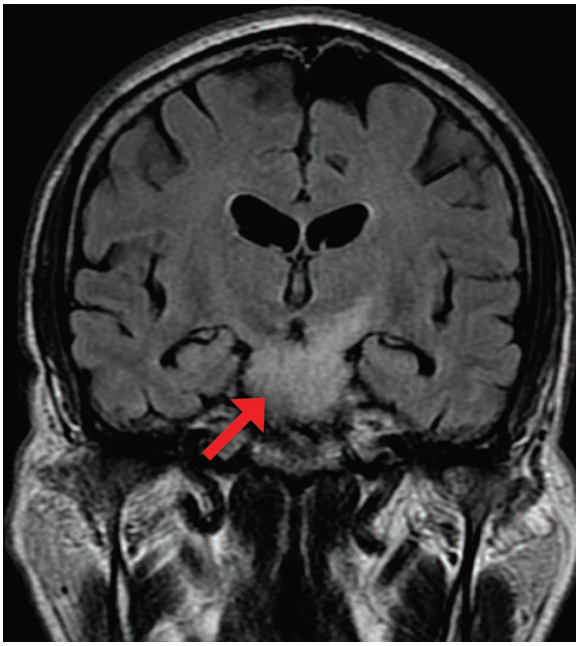

Figure 10: Coronal FLAIR T2 image shows brainstem encephalitis in a patient presenting with headache and fever.

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Radiologist

After training in radiology at The Royal Melbourne Hospital, Dr Ian Cox undertook a one year Fellowship in body imaging and musculoskeletal MRI at the Medical College of Wisconsin, Milwaukee, followed by a two year Fellowship in diagnostic neuroradiology, including head and neck imaging and paediatric neuroradiology at the prestigious UCSF, San Francisco.

Concurrent with sessional appointments in MRI over many years at St. Vincent's Hospital, Melbourne, and then Monash Medical Centre, Dr Cox has been director of MRI at Cabrini Malvern for over twenty years.

Dr Ian Cox is an experienced general radiologist with a special interest in MRI. He has particular interest in neuroradiology and musculoskeletal imaging,and has experience in almost all facets of MRI.

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