HEADACHE: WHEN IS NEUROIMAGING NEEDED?

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One of the most common complaints encountered by neurologists or GPs

- As many as 95% of young women and 91% of young men experienced headache during a 12-month period; 18% of these women and 15% of these men consulted a physician because of their headache
- 1-3% of Emergency dept. visits.
- The list of differential diagnoses for headaches is one of the longest in medicine.

- The cause or type of most headaches can be determined by a careful history, supplemented by a general and neurologic examination.

- In most cases, there is no reason to order neuroimaging examinations.
Two types of headache: primary and secondary

- Headaches are diagnostically and therapeutically divided into two categories: primary and secondary
- Most are primary with no organic disease.
- Common examples of primary headaches are
  - Migraine
  - Cluster headache
  - Tension type headaches
### Table 1. — Acute Primary Headache Disorders (7)

#### More common

- Migraine with or without aura
- Tension-type headache
- Cluster headache
- Less common

- Paroxysmal hemicrania
- Idiopathic stabbing headache
- Cold-stimulus headache
- Benign cough headache
- Benign exertional headache
The most important diagnostic challenge for the clinician is to rule out secondary headaches, which are caused by an underlying organic disease.

Secondary headache may be a symptom of benign conditions (e.g. sinusitis) or potentially life-threatening conditions (e.g. ruptured intracranial aneurysm with SAH)
<table>
<thead>
<tr>
<th>Headache associated with head trauma</th>
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<tbody>
<tr>
<td>• Acute post-traumatic headache</td>
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<tr>
<td>• Epidural, subdural or intracerebral hematoma</td>
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<tr>
<th>Headache associated with vascular disorders</th>
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<tr>
<td>• Subarachnoid hemorrhage</td>
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<td>• Acute stroke (ischemic cerebrovascular disorder)</td>
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<td>• Unruptured vascular malformation</td>
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<td>• Arteritis (e.g., temporal arteritis)</td>
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<td>• Carotid or vertebral artery pain</td>
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<td>• Venous or dural sinus thrombosis (which may cause intracranial hypertension)</td>
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<td>• Arterial hypertension</td>
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<tr>
<th>Headache associated with nonvascular intracranial disorder</th>
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<tr>
<td>• Benign intracranial hypertension (pseudotumor cerebri, which is frequently associated with venous or dural sinus thrombosis)</td>
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<td>• Intracranial infection</td>
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<td>• Low cerebrospinal fluid pressure (e.g., headache subsequent to lumbar puncture)</td>
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<th>Headache associated with substance use or withdrawal</th>
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<tr>
<td>• Acute use or exposure</td>
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<td>• Chronic use or exposure</td>
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<tr>
<th>Headache associated with noncephalic infection</th>
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<tbody>
<tr>
<td>• Viral infection</td>
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<td>• Bacterial infection</td>
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<th>Headache associated with metabolic disorder</th>
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<tbody>
<tr>
<td>• Hypoxia</td>
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<tr>
<td>• Hypercapnia</td>
</tr>
<tr>
<td>• Mixed hypoxia and hypercapnia</td>
</tr>
<tr>
<td>• Hypoglycemia</td>
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<tr>
<td>• Dialysis</td>
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<td>• Other metabolic abnormality</td>
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<tr>
<th>Headache or facial pain associated with disorder of cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cranial structures</th>
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<tr>
<td>Cranial neuralgias, nerve trunk pain and deafferentation pain</td>
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• When is neuroimaging not needed for headache?
When confronted with patients with headaches, many clinicians tend to err on the side of caution, and refer their patients for neuroimaging studies, such as (CT) or (MRI) of the brain.

The decision to order a CT or MRI scan of the brain is often influenced by non-medical reasons, such as anxiety of patients and family members as well as medico-legal concerns.
MOST OF THESE EXAMINATIONS ARE NORMAL
Moreover, CT and MRI scans of the brain are expensive and, in some cases, reveal incidental abnormalities, which may cause further unnecessary tests.
In a study in USA and Canada, patient expectations and medico-legal concerns accounted for 17% of the referrals for a CT scan of the brain in patients with headaches.

The main indications for ordering neuroimaging studies in patients with headaches were suspicion of an intracranial tumor (49%) or SAH (9%).
It should be kept in mind that the yearly incidence of brain tumors is rather low (49/100000)/y in USA, only 8.2% of those patients present with isolated headache as a first and only symptom.

The incidence of SAH on CT is even lower, 6/100000/Year
In a meta analysis results of multiple studies performed since 1977 for a total of 3026 scans reveals the overall percentages of various pathologies in patients with headaches as:

- brain tumors 0.8%;
- AVM 0.2%;
- hydrocephalus 0.3%
- Aneurysm 0.1%
- subdural hematoma, 0.2%;
- strokes, including chronic ischemic processes, 1.2%
Based on the accumulated evidence, ACR and Emergency have concluded that screening patients with isolated headache by CT or MRI is generally not warranted.

They also recommend that the pain response to therapy should not be used as the sole diagnostic indicator of the underlying etiology of an acute headache.
White matter signal abnormalities have been reported on MRI studies of patients with all types of migraine, with a range from 12% to 46%.

The cause of these white matter abnormalities in migraine is not certain.

Cerebral atrophy has been variably reported as more frequent and not more frequent in migraineurs compared with controls.
To summarize, the yield of neuroimaging studies in the evaluation of patients with headache and a normal neurologic examination is quite low.

Neuroimaging studies do not affect the treatment of primary headaches, there is no reason to order a head scan for these patients.
When is neuroimaging needed for headache: “red flags”?

- A minority of headaches are labeled as “secondary”; however, this category contains the most life-threatening conditions, and the diagnosis should not be missed.

- Secondary headaches present so-called “red flag” features, which warrant further investigation, including neuroimaging studies.

- Red flags are those signs or symptoms that indicate headache with a serious cause, including potentially life-threatening conditions.
1-Sudden onset of the “worst headache ever”, also known as “thunderclap” headache.

This is a sudden excruciating headache that reaches its maximal intensity within seconds and indicates acute SAH.
2-Onset of “new” or “different” headaches. Increase in frequency and severity of headaches may point to a mass lesion, subdural hematoma, or medication abuse.

Nausea or vomiting, indicating intracranial hypertension.
3-Focal neurological signs and symptoms including:
progressive visual or neurological changes
signs of meningeal irritation
paralysis
weakness, ataxia or loss of co-ordination
asymmetric pupillary response
sensory loss, numbness
4-Altered mental status (drowsiness, confusion, memory impairment or loss of consciousness).

- Onset of headache after age of 50 years. This can indicate, among other conditions, an intracranial mass lesion.
6-Headache subsequent to head trauma. Post-traumatic causes of headache include SAH, SDH, EDH, ICH, post-concussion syndrome.
7- Papilloedema (indicates intracranial hypertension, e.g. due to a mass lesions, pseudotumor cerebri or meningitis).

8- Onset of headache with exertion, sexual activity or coughing.

9- Signs or symptoms of a systemic illness (fever, infection, rash, stiff neck) can indicate meningitis, encephalitis or possibly Lyme disease.
10-New onset of headaches in patients with pre-existing diseases, such as HIV infection or cancer, which are at high-risk for intracranial disease.
NEUROIMAGING OF HEADACHE: CT OR MRI?
Though MRI provides an intrinsically higher soft tissue contrast resolution than CT, nearly every life threatening condition that could cause a headache can be seen on a non-contrast CT.
For the identification of an acute intracranial hemorrhage, non-contrast CT of the brain is the preferred technique.

In particular, patients presenting with a thunderclap headache and abnormal findings on neurological examination should undergo a non-contrast CT scan of the brain to detect subarachnoid (or intracerebral) hemorrhage.
• SAH found in CT: CTA to document the presence of one or more intracranial aneurysms, and the patient will be referred for treatment.

Although cerebral angiography is still the golden standard in the diagnosis of neurovascular diseases, CT angiography

• (CTA) with 3D volume rendering of intracranial vessels has a high sensitivity and specificity for the detection of intracranial aneurysms
CTA is increasingly used as the primary imaging modality in the diagnosis and pre-therapeutic planning of patients with aneurysmal subarachnoid hemorrhage.

If the initial non-contrast CT is negative, a lumbar puncture should be performed within the first 48 hours to rule out subarachnoid hemorrhage.
• CT scan of the brain also serves as a check for a mass lesion or for hydrocephalus, and to determine whether it is safe to perform a diagnostic lumbar puncture.

A lumbar puncture is useful to assess the cerebrospinal fluid for blood, infection and cellular abnormalities.

• In addition to subarachnoid hemorrhage, all other types of intracranial bleedings can be detected by non contrast CT.
There are some conditions causing headaches which can be found with MRI and not with CT. They include intracranial venous sinus thrombosis, and vasculitis.
Most intracranial tumors causing headache can be detected by noncontrast CT of the brain, because they have grown to a considerable size and/or show mass-effect with peri-tumoral edema.

- Subsequent contrast-enhanced CT confirms the presence of the tumor.
- The next step is usually a MRI scan.
To summarize,

In acute onset headache or to rule out most causes of secondary headaches, a non-contrast CT scan of the brain is the first examination of choice. MRI is usually not indicated in uncomplicated migraine or chronic daily headaches.

In general, neuroimaging studies yield a low percentage of clinically significant results in patients with nonfocal headaches.
THANK YOU...