Headache: When to Worry

Stead TS¹, Singh D², Rastogi V³ and Hedna VS⁴

1 Lake Nona HS, 12500 Narcoossee Rd., Orlando, FL 32827, USA
2 La Jolla Institute for Allergy & Immunology, La Jolla, CA, USA.
3 Department of Neurology, University of Florida College of Medicine, Gainesville, FL, USA
4 Department of Neurology, Health Sciences Center, University of New Mexico, Albuquerque, NM 87131-0001, USA

Corresponding author: Hedna VS
vshedna@salud.umn.edu
MD, Associate Professor of Neurology and Stroke Director, Department of Neurology, MSC10 5620, Health Sciences Center, University of New Mexico, Albuquerque, NM 87131-0001, USA.
Tel: 352-246-1252

Citation: Stead TS, Singh D, Rastogi V, et al. Headache: When to Worry. J Headache Pain Manag. 2016, 1:3.

Abstract
Headaches are a common emergency department presentation, and workup should focus on looking for potentially dangerous etiologies. In this paper, the authors review causes of non-benign headache, including cervical artery dissection, cerebral venous thrombosis, pseudotumor cerebri, hypertensive encephalopathy, acute angle glaucoma, hydrocephalus, giant cell arteritis, meningitis, and subarachnoid hemorrhage.

Keywords: Headache; Cervical artery dissection; Cerebral venous thrombosis; Pseudotumor cerebri; Hypertensive encephalopathy; Acute angle glaucoma; Hydrocephalus; Giant cell arteritis; Meningitis; Subarachnoid hemorrhage

Abbreviations: SAH: Subarachnoid Hemorrhage; CVST: Cerebral Venous Sinus Thrombosis; CAD: Cerebral Artery Dissection; ICAD: Internal Carotid Artery Dissection; CN: Cranial Nerve; ICP: Intracranial Pressure; CSF: Cerebrospinal Fluid; IIH: Idiopathic Intracranial Hypertension; LP: Lumbar Puncture; GCA: Giant Cell Arteritis; CT: Computerized Tomography; SIADH: Syndrome of Inappropriate Diuretic Hormone

Introduction
Headache is a common complaint, and as per the latest World Health Organization estimates approximately 50% of the adults suffer from minimum one headache episode in a year. About 1.7-4% of the adults in the world suffer from headaches more than fifteen days in a month [1]. Periodic headaches are characterized as headache disorders. These disorders have significant effect on the quality of life of people including their financial and social aspects. Only a small percentage of people have a proper diagnosis of headache disorders which has resulted in the under-treatment of this condition further exacerbating the problem.

The most common headache disorders found in the clinical setting include Migraine, Cluster headache and Tension-type headache. Migraine is usually unilateral pulsating headache of moderate to severe intensity that lasts for hours to 2-3 days. Tension-type headache is bilateral pressure type headache that can last from couple of minutes to days. Cluster headaches are unilateral and begin retro-orbitally that lasts from 15 min to multiple hours and can occur multiple times in a day [1]. These are also characterized as primary headache disorders. Secondary headache disorders occur as a result of any other systemic or neurological ailment. Both primary and secondary headaches are a part of chronic daily headaches depending on the headache frequency or duration.

Chronic daily headaches are best managed by neurologists in outpatient setting.

Patients present with very severe headaches presenting to the emergency department, these are classified as sudden onset headaches and deem urgent intervention. They account for up to 2% of emergency department visits [2]. In this review we will focus the etiologies for sudden onset headaches. Headache is often dismissed as a triviality; however, a number of malignant sequelae can result from an uninvestigated case. In this review, the authors will:

- List etiologies and incidence for dangerous causes (Table 1).
- Identify signs & symptoms associated with high-morbidity and mortality causes.
- Describe diagnostic tests used to elucidate specific headache etiologies.
Table 1 Incidence of headache etiologies [44-50].

| Etiology of headache                                      | Incidence per 100,000 |
|-----------------------------------------------------------|-----------------------|
| Subarachnoid Hemorrhage (SAH)                             | 2-16                  |
| Pseudotumor Cerebri (PHT)                                 | Gen pop: 0.5-2        |
|                                                           | During pregnancy: 12-20 |
| Temporal Arteritis                                        | Age 50-80: 15-25      |
|                                                           | Age >80: 44.7         |
| Hydrocephalus                                             | 1                     |
| Brain mass                                                | 70,000                |
| Cerebral Venous Sinus Thrombosis (CVST)                   | Gen pop: 0.3-0.4      |
|                                                           | During pregnancy: 12  |
| Cervical Artery Dissection (CAD)                          | 100                   |
| Meningitis                                                | 0.1-0.2               |
| Acute angle closure glaucoma                              | 1000                  |
| Hypertensive encephalopathy                               | 1                     |

Methods

The etiologies of acute or sudden onset headache were identified. A systematic search was performed for publications in Medline from 1980–2015 with keywords ‘Cervical artery dissections’, ‘pseudotumor cerebri’, ‘hydrocephalus’, ‘cerebral venous sinus thrombosis’, ‘hypertensive encephalopathy’, ‘acute angle closure glaucoma’, ‘Giant cell arteritis’, ‘Temporal arteritis’, ‘Meningitis’ and ‘Subarachnoid hemorrhage’. A number of other online resources such as Uptodate were also used to attain the most updated information regarding the etiologies and their management. Those studies where only abstracts were available and those that were in any language except English, such as Chinese, were excluded from the review.

Cervical artery dissections

There are two main sites for cervical artery dissections: internal carotid artery dissection (ICAD) and vertebral artery dissections (VAD) (Table 2) [3]. Together, they account for 1/5 of strokes in persons <45 yrs of age. They are less frequent (~2.5%) in the elderly population [4]. The risk of recurrence is 1%, usually in a different vessel [5]. A history of antecedent neck trauma (including chiropractic manipulation [6], sudden head turning, minor neck trauma from motor vehicle collisions (MVC) and weight lifting) may be elicited ~40% of time. Another 15-20% has underlying disease such as fibromuscular dysplasia, cystic medial necrosis or Marfan’s syndrome. Pain is part of the chief complaint 60-85% of the time. Signs of cerebral ischemia can be delayed hours to days after initial headache which likely signals initial intimal tear.

Cerebral venous sinus thrombosis

CVST is the presence of an acute blood clot or thrombosis in the dural venous sinuses, which drain blood from the brain. The most commonly involved sinus is the sagittal sinus. The most commonly implicated bacterial agent is Fusobacterium necrophorum. Aseptic thrombosis can also occur in a myriad of patients [7]. Thrombosis results in an increase in intracranial pressure (ICP), which causes the headache. It is more common in women and the elderly, possibly reflecting greater incidence of thromboembolic disease in this age group. It is difficult to estimate incidence, but over 250 cases are reported in the literature. CVST is a relatively rare cause of headache, affecting about 3 million/year [8]. Risk factors for CVST include: hypercoagulable states, trauma, oral contraceptive use, congenital heart disease, cancer, Behçet’s disease, and sickle cell disease. Headache is the most common presenting symptom, present in 70-100% of cases. Other associated symptoms can vary based on the sinus involved, and in general are due to resultant increased ICP. These can include: Papilledema, elevated opening pressure on LP (Lumbar Puncture), fever, seizures, altered mental status, psychiatric symptoms, and focal neurologic deficits such as CN palsies, internuclear ophthalmoplegia, and visual disturbances. While CVST is relatively rare in the Western world, it is relatively common in the developing world, where the etiology is infectious.

Mainstay of CVST management is anticoagulation. Therapy is begun with heparin to an aPTT of 50-70, and then warfarin is started with goal INR of 2-3. The Cochrane evidence cites: “Based on limited evidence available (2 trials, 79 patients), anticoagulant treatment for cerebral sinus thrombosis appeared to be safe and associated with as potentially important reduction in the risk of death or dependence, which did not reach statistical significance” [9]. Antibiotics are given for septic cases, and surgical evacuation is considered for case with elevated ICP.

Pseudotumor cerebri

Pseudotumor cerebri syndrome is a recently coined term that describes symptoms related to increase in ICP without evidence of a mass lesion, ventriculomegaly, central nervous system infection or malignancy. It has a primary and secondary form; idiopathic intracranial hypertension (IIH) is the primary form. The secondary form can be caused by various medical conditions (mainly hormonal) such as polycystic ovarian syndrome, medication toxicity such as lithium toxicity, or vascular abnormalities such as CVST. Both forms are clinically similar. As the name suggests, IIH [10] has no established etiology and is typically seen in obese females of childbearing age. The incidence in this patient cohort is 12-20 in 100,000 as compared to 0.5-2 in 100,000 in general population. Increased cerebrospinal fluid (CSF) formations and reduced CSF outflow along with elevated venous sinus pressure are the main elements of the pathophysiology of IIH [11].

The history will typically reveal a young overweight female that presents with headache, nausea, vomiting and visual disturbance. Headache is most prevalent symptom and is present in 84% of patients [12]. Patients complain of daily headache that can be frontal or retro-orbital, bilateral and pressure-like. It can also be unilateral or focal or global throbbing and may be associated with as potentially important reduction in the risk of death or dependence, which did not reach statistical significance” [9]. Antibiotics are given for septic cases, and surgical evacuation is considered for case with elevated ICP.
The prognosis of IIH is good except for the peril of permanent vision loss, which can be seen in 1-2% of the patients. Follow-up with repeat LP, or funduscropy & visual fields in about one month is required after an acute episode. On a long-term basis, weight loss and follow-ups are essential in order to prevent disease recurrence [11].

Hypertensive encephalopathy

Hypertensive encephalopathy is a diagnosis that is given to symptoms occurring as a result of cerebral edema, which is caused by sudden increase in the blood pressure. It is a part of hypertensive emergency syndrome which is demarcated by rapid rise in the systolic or diastolic pressures to >180 mmHg and >120 mmHg respectively and resulting in end organ damage especially to vital organs including heart, brain, kidney and liver. Hypertensive encephalopathy is seen in 16% of hypertensive emergencies [15]. In normal conditions, the blood pressure in the brain is auto-regulated in order to maintain a cerebral perfusion pressure of 60-120 mmHg. If the hypertensive crisis is not controlled it can lead to end organ damage causing symptoms like headache, nausea, vomiting, disorientation, seizures, and even death. In the hypertensive crisis there is disruption of this auto-regulatory mechanism, resulting in vasodilatation of the blood vessels and increased blood flow to the brain. There is disruption of the blood brain barrier. Hypertensive encephalopathy is a diagnosis that is always made after exclusion of other possible causes for increases in intracranial pressure such as intracranial hemorrhage, tumors, etc. [11].

Exam reveals optic disk swelling and blurring of the disk margins, which signify papilledema. Visual acuity and field-testing can show enlarging blind spot and nasal field deficit. Patients should also be evaluated for abducens nerve palsy. Ocular ultrasound can assess the papilledema [14]. IIH is essentially a diagnosis of exclusion and neuroimaging including magnetic resonance imaging (MRI) and magnetic resonance venography (MRV) and is important in ruling out other causes of intracranial hypertension. Elevated opening pressure can be appreciated on LP, it also helps in excluding other etiologies [11]. Diagnosis is based on the Dandy criteria (Table3) [13].

Acute management of IIH is necessary because if not properly treated it carries a risk of optic atrophy and precipitous onset of blindness. Acetazolamide is the initial drug of choice. Acetazolamide decreases the CSF production by carbonic anhydrase inhibition. It should be started at 10-30 mg/kg/day to max daily dose of 4 g. The patients frequently can’t tolerate acetazolamide, which is why it should be started with lower doses and slowly titrated to the maximum dose. Twice a day dosing might also be effective in this regard [10]. Other medications that can be prescribed include furosemide, topiramate and octreotide [10]. Sodium restriction is recommended to lower CSF production but the effect is minimal. Other strategies include weight loss and low sodium diet with daily exercise is good regimen for these patients [11].

The prognosis of IIH is good except for the peril of permanent vision loss, which can be seen in 1-2% of the patients. Follow-up with repeat LP, or funduscropy & visual fields in about one month is required after an acute episode. On a long-term basis, weight loss and follow-ups are essential in order to prevent disease recurrence [11].

### Table 2 Cerebral artery dissection differentiation on the basis of location [5-7, 51-60].

| Location                          | Internal carotid artery dissection (ICAD)                                                                 | Vertebral artery dissection (VAD)               |
|----------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Side                             | Ipsilateral                                                                                                                                               | Usually ipsilateral but can be bilateral       |
| Location                         | Frontal orbital, peri orbital, and Anterior neck                                                             | 30-60% of time [59]                            |
| Typical presentation             | • Unilateral headache                                                                                                                                      | • Severe unilateral posterior headache         |
|                                  | • Ipsilateral ocular sympathetic paresis (incomplete painful Horner’s)                                                                                      | • Gradual neck pain                             |
|                                  | • Signs of cerebral ischemia localizing to opposite side                                                     | • Signs of ischemia to medulla                |
| Physical examination clues       | 46% have audible carotid bruit or at least patient reports pulsatile tinnitus [53]                                                                          | Headache may precede neuro symptoms by up to 2 |
|                                  | • 2-8% have cranial nerve palsies [60]                                                                            | weeks, mean is 3 days                         |
|                                  | • 12th cranial nerve palsy is the most common cranial nerve palsy, considered sensitive for ICAD                                                          | Signs of posterior circulation ischemia:       |
|                                  | • Transient monocular visual loss (7%)                                                                              | • Vertigo                                     |
|                                  | • Less than 5% have massive stroke as initial presentation [60]                                                  | • Nystagmus (including vertical)              |
| Epidemiology                     | Spontaneous cases 2 times more frequent                                                                          | • Limb ataxia                                 |
| Prognosis                        | Overall good                                                                                               | • Dysphagia, hoarseness                       |
|                                  | Worse when associated with subarachnoid hemorrhage, stroke as initial presentation, older age or presence of underlying disease | • Contralateral loss of pain and temperature sensation |
|                                  | • 2-8% have cranial nerve palsies [60]                                                                            | • Ipsilateral arm, trunk or leg weakness      |
| Prognosis                        | 10% die in acute phase                                         |                                              |
|                                  | For those that survive, most (~80%) make complete recovery                                                   |                                              |

© Under License of Creative Commons Attribution 3.0 License
and visual disturbances (blurred vision, diplopia). Idiopathic raised ICP. Signs of this include: Headache, nausea, vomiting, alteration of sensorium, loss of consciousness, headache, vomiting, visual disturbances and seizures [15].

Differential diagnoses include ischemic and hemorrhagic stroke, infection, and reversible cerebral vasoconstriction syndrome [16]. Rapid blood pressure lowering is the main treatment strategy, however, decrease in mean arterial pressure should not be more than 20-25% in the first hour of medication administration. Intravenous Labetalol and Nicardipine are first line of choice. Other medications include Sodium Nitroprusside, Nitroglycerine, Enalapril etc. Antiepileptic medications are used to control seizures, and they might also potentiate lowering of blood pressure. Continuous monitoring in an intensive care setting is advocated for these patients [15].

**Hydrocephalus**

Hydrocephalus, as the name suggests, is ‘water in the brain’. It is a condition where there is abnormal accumulation of CSF in the ventricles and/or subarachnoid space leading to a pathologic enlargement of these spaces. This enlargement (mainly ventriculomegaly) results in an increase in ICP [17]. CSF is produced by the choroid plexus and travels through a series of ventricles and is absorbed by the subarachnoid villi at the end. Hydrocephalus usually occurs if there is an obstruction in the route of CSF flow (obstructive or non-communicating hydrocephalus) or if there is a decrease in absorption by the subarachnoid villi (communicating hydrocephalus). Impaired CSF absorption is usually the etiology for normal pressure hydrocephalus. Rarely hydrocephalus can be caused by an increase in CSF production as seen in Choroid plexus papilloma [18]. Hydrocephalus ex vacuo is a subtype which is usually after traumatic brain injury or stroke, it is not associated with increased ICP. Insults to brain can cause brain atrophy, thus, there is enough space in the brain for ventricles to expand without raising the ICP. The most common etiologies include: infection, tumor, and hemorrhage [19].

The symptoms in hydrocephalus are mainly attributed to raised ICP. Signs of this include: Headache, nausea, vomiting, and visual disturbances (blurred vision, diplopia). Idiopathic normal pressure hydrocephalus, which is more common in the elderly, has a classic triad of gait instability, dementia and urinary incontinence. Ophthalmologic examination may show papilledema [20]. Neuroimaging (computerized tomography, MRI) plays an important role in the diagnosis. LP can also assist in diagnosing hydrocephalus, however, neuroimaging should always precede LP in order to prevent herniation [19]. Hydrocephalus frequently has a progressive course but it can also present acutely such as in subarachnoid hemorrhage patients. Surgical intervention with shunt placement or third ventriculostomy is the best treatment modality [18]. Third ventriculostomy is useful only in obstructive cases. Repeated LP can be used in posthemorrhagic hydrocephalus, still it is not very effective. Medical management can be initiated in patients who have slowly progressing hydrocephalus and are at high risk for surgery. Furosemide and Acetazolamide can provide interim relief by decreasing CSF production in these patients. Timely treatment ensues a good prognosis for hydrocephalus patients [19].

**Acute angle closure glaucoma**

Angle closure glaucoma precipitates when the iris apposes to the trabecular network, which results in obstruction of the anterior chamber angle by at least 270°. This reduces the aqueous humor outflow, ultimately resulting in a buildup of pressure in the eye that is responsible for glaucoma symptoms. It can be divided into primary and secondary angle closure glaucoma on the basis of anatomy [21]. Primary angle closure glaucoma occurs due to pupillary block in most of the cases that prevents the outflow of aqueous humor from the posterior chamber to the anterior chamber. Thus, aqueous accumulates posteriorly to the iris and causes the closure of angle. This closure of the angle can occur acutely, sub-acutely or chronically. Females, older people and people of Asian descent are at a higher risk as compared to general population [21].

Acute closure is deemed as an ocular emergency as it can result in blindness. The typical presentation comprises of eye pain, redness, blurriness, and headache accompanied by nausea and emesis. On ophthalmologic examination, corneal edema, mid-dilated or non-reactive pupil, and vascular congestion can be appreciated.
Giant cell arteritis

Giant cell arteritis (GCA) is the most prevalent primary systemic vasculitis and is characterized by the granulomatous inflammation of medium to large sized arteries by giant multinucleated cells. Since there is a predilection towards the temporal artery, it is also termed as temporal arteritis. The etiology is idiopathic in most cases. It usually affects adults aged over 50 and there is a female preponderance with an incidence rate of 3:1 for women: men. Incidence increases with age as 15-25 cases per 100,000 have been reported in individuals aged more than 50 yrs [24] and it increased to 44.7 per 100,000 in individuals aged more than 80 yrs [25]. The Scandinavian population has been shown to have a higher incidence rate as compared to any other population [26].

Headache is the most common symptom of GCA and is present in roughly 72% of patients. However, it is the initial symptom in only 33% of patients [27]. The headache is persistent and is accompanied by scalp tenderness. It may be acute or sub-acute in onset, unilateral (similar to a migraine) or bilateral, throbbing or aching in the distribution of temporal or occipital artery. Jaw or tongue pain can also be present. Visual symptoms include amaurosis fugax, diplopia and vision loss. These symptoms can be seen simultaneously in both eyes or in progression with one eye being affected before the other. Vision loss is the most prevalent complication of GCA and makes this condition an emergency [26]. Other neurologic symptoms include stroke, dementia and neuropathy [27]. Systemic involvement can be seen in 40% patients with symptoms including fever, weight loss and anorexia. Approximately 50% of patients with temporal arteritis also have polymyalgia rheumatica that is characterized by pain and stiffness in shoulders, pelvis and torso. It can also be the initial symptom in some patients [26].

On physical examination thickened tender temporal arteries with absent pulsation and scalp tenderness can be appreciated. Ophthalmologic examination can reveal ipsilateral or bilateral visual loss, disk swelling, pallor or optic atrophy. Claudication of the masseter, temporalis, and tongue muscles can be appreciated on physical [27]. Normal physical examination can also be seen in a number of patients. Diagnostic evaluation includes blood workup, temporal artery biopsy and neuroimaging. Elevated acute phase reactants such as ESR and C-reactive protein are important in the diagnosis, however, there is no specific blood marker for GCA [24]. Normochromic anemia and reactive thrombocytosis can also be noted. The definitive diagnosis of GCA is temporal artery biopsy [28]. MRI and angiography can aid in diagnosis, especially in biopsy negative patients. Differentials include various other vasculitides such as Takayasu arteritis, Varicella Zoster virus (VZV) infection, systemic amyloidosis and neoplastic disorders such as lymphoma [24]. In biopsy negative GCA patients VZV infection should be contemplated. Gilden et al. revealed that VZV antigen was found in 74% of GCA patients in comparison to 8% normal postmortem temporal arteries, this suggests that there might be a role of VZV in the causation of GCA [29].

Treatment with corticosteroids should be initiated as soon as GCA is suspected, steroids should never be withheld for temporal artery biopsy. Early steroid initiation can prevent blindness. In patients who don’t have visual symptoms or jaw claudication prednisone should be initiated at 40-60 mg daily and in those who already have visual loss the dose should not be less than 60 mg daily (Smith and Swanson [26]). In cases where there is evolution of visual loss or there is a history of GCA symptoms in past bolus dose (500 mg to 1000 mg) intravenous methylprednisolone should be administered daily for 3 days followed by a maintenance dose [27]. NSAIDS can be given for the pain. ESR and C-reactive protein assist in monitoring of the disease activity. Long-term corticosteroid treatment is associated with various adverse effects such as pelvic fracture. Disease-modifying agents such as methotrexate, hydroxychloroquine, infliximab assist in discontinuation of steroids along with maintenance of disease remission [26].

Around 15-20% of GCA patients suffer from vision loss, prompt institution of steroids prevents the vision loss and is associated with good prognosis [26].

Meningitis

Inflammation in the leptomeninges surrounding the brain is termed as meningitis and is evident by CSF pleocytosis. Fever, nuchal rigidity, and alteration of consciousness form the classic presentation of acute meningitis [30]. However, this is seen in less than 50% of patients. Other symptoms that may be present include headache, photophobia and malaise. Positive Kernig and Brudzinski sign on physical examination signify nuchal rigidity and assist in the diagnosis. Altered mental status is seldom seen in cases with viral meningitis. Meningitis can present either acutely (hours to days) or chronically (more than 4 weeks). Subacute presentation can be seen in some cases. The etiology can be either infectious or non-infectious, acute cases usually have infectious etiology with bacteria being the predominant one. CSF analysis helps in identification of the underlying etiology as bacterial meningitis usually presents with very high WBCs and elevated CSF opening pressure (Table 4) [31]. *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Listeria monocytogenes*, *© Under License of Creative Commons Attribution 3.0 License*
group B *streptococci*, and *Haemophilus influenzae* are the most prevalent bacteria that cause meningitis in the community; of which *Streptococcus pneumonia* is the most common among all age groups except infants less than 2 months [32]. Enteroviruses, herpes viruses, arbo viruses, and HIV usually cause viral meningitis. Approximately 60% of the viral meningitis cases are caused by Enteroviruses and is more common in summers [33].

Drawing blood for cultures and thereafter initiation of empirical antibiotic therapy comprise the initial management. LPs are pivotal in the identification of etiology of meningitis (Table 2) and aids in relieving the headache. In some cases CT head should be performed before the puncture in order to prevent cerebral herniation. Studies have shown that CT head needs to be done in immunocompromised patients, age older than 60 yrs, recent seizure, history of central nervous disease (mass lesion, stroke), altered sensorium and focal neurologic deficits [33].

Empirical antibiotic therapy depends on the age and any associated comorbidities, most of the recommended regimens include a third or fourth generation cephalosporins along with vancomycin [32]. When there is a suspicion for Listeria monocytogenes especially in immunocompromised host, ampicillin should also be added to this regimen [34]. Broad coverage can be stopped and directed antimicrobial therapy can be started as soon as the blood culture results are back. Intravenous corticosteroids have shown to be effective in acute bacterial meningitis and facilitate functional recovery in adult patients. Dexamethasone (10 mg every 6 h for 2-4 days) should be initiated prior to or with the first antibiotic dose. It should be discontinued if the etiology is non-bacterial [32].

Meningitis is associated with a mortality of 20% or higher in adults, however, the incidence has decreased over time. The prognosis improves with timely institution of appropriate treatment [32].

### Subarachnoid hemorrhage (sah)

SAH accounts for 10% of the acute strokes [35] and has an incidence rate of 2-16/100,000 with females being at a slightly higher risk [36]. Trauma is the most common etiology of SAH [35]. Spontaneous or nontraumatic SAH is seen secondary to ruptured intracranial aneurysms in 80% cases; posterior communicating artery aneurysm is most commonly involved in men and in women anterior communicating artery is mostly involved. Arteriovenous malformations can also give rise to spontaneous SAH in 5% of the cases [37]. Hypertension, cigarette smoking, sympathomimetic drug use and pregnancy/parturition are the most common risk factors for SAH. The classic presentation includes sudden onset severe headache ‘thunderclap headache’ with the patient describing it as the ‘worst headache of his/her life’. Other common symptoms include nausea, vomiting, photophobia, meningismus, neck pain and brief syncope [36]. The patient can also have focal and diffuse neurological deficits with/without alteration of sensorium. Sudden death can also be seen in a small proportion of these patients. Pre-retinal hemorrhage (Terson syndrome) can be seen in up to 40% patients and is a marker of poorer prognosis [36]. Various grading systems are used to analyze the severity of SAH, which includes the Hunt and Hess scale and the World Federation of Neurological Surgeons (WFNS) scale score [38, 39].

Head CT scan is 98-100% sensitive in the first 12 h of symptom onset for the detection of SAH and is the best initial diagnostic test for this condition. Hyperdensity is noticeable in the basal subarachnoid cisterns as a result of extravasated blood. Blood is also visible in perimesencephalic cisterns (‘star’ or ‘crab’), along the falx, or in the Sylvian fissure [40]. If head CT is equivocal but there is a strong clinical suspicion of SAH, LP can be performed in order to look for elevated RBCs that do not decrease significantly from tubes one to four. Xanthochromia (degraded RBC) can be seen at 12 h from symptom onset and is classic for SAH. ECG may demonstrate inverted T waves at acute onset [37].

Management usually involves admitting for intensive monitoring and blood pressure control with IV esmolol, labetolol, or hydralazine and, if possible, means arterial pressure should be kept under 110 mmHg [36]. Glucose and electrolytes should be monitored carefully and titrated whenever required. Patient should be made NPO except for medications and normal saline should be administered. Stool softeners (minimize Valsalva), analgesics, nimodipine [41] (vasospasm prophylaxis) and anti-epileptic treatment are required in order to prevent any further complications and pain relief [36]. The provision of anti-epileptics is not completely clear as they can cause aggravation of manifestations especially Phenytoin. Cerebral angiogram is necessary in most cases to evaluate the intracranial pathology. Neurosurgical or endovascular intervention is indicated in a number of cases [37].

SAH can emanate in a wide variety of complications including systemic inflammatory response syndrome (SIRS), neurologic, pulmonary and cardiac (arrhythmias) complications. SIRS is seen in more than 75% of the SAH patients [36]. Fever in SAH ensures a poor prognosis and is in itself the most common non-neurologic complication. Neurologic complications are more prevalent in SAH, in the acute phase rebleeding, hydrocephalus (immediately due to clot) and hypertension whereas vasospasm, delayed hydrocephalus and electrolyte imbalances can be observed in subacute phase [37]. The biggest predictors for the development of neurologic complications and prognosis are the volume of SAH and the intensity of neurologic symptoms at onset [37].
Rebleeding is the most common complication in the first 24 h [36]. Early administration of antifibrinolytic agents such as aminocaproic acid and endovascular coiling or surgical clipping of aneurysms can decrease the risk of this complication. Endovascular coiling is favored over surgical clipping in case of unruptured aneurysm [37].

Hydrocephalus can occur in approximately one-fifth of the SAH patients and is usually seen in the first week. Placement of external ventricular drain (EVD) is essential for treatment, usually only temporary shunting is needed, and occasionally permanent ventriculo-peritoneal shunt might be required [17].

Vasospasm is the most common SAH complication after the first 24 h. Fisher grade is used to ascertain the risk of development of vasospasm, it is based on the hemorrhage pattern visible on CT. Vasospasm can cause delayed cerebral ischemia which is described as a focal or global neurologic deterioration that is present for at least an hour and cannot be explained by any neurologic or systemic condition except cerebral ischemia [36]. Examples include anterior cerebral artery vasospasm that commonly presents with abulia and middle cerebral artery vasospasm that may present with worsening hemiparesis/paresthesia or aphasia. Frequent monitoring is necessary especially in younger patients (less than 65 yrs), a WFNS score >3, and Fisher grade ≥ 3 [37]. Transcranial Doppler evaluation can be helpful in monitoring flow velocity trends in major intracranial vessels. An acute increase in velocity correlating with clinical deterioration may signify vasospasm [42]. Head CT needs to be performed to rule out other etiologies (hydrocephalus, rebleed, intracerebral hemorrhage). Emergent cerebral angiogram may demonstrate vessel vasospasm and is the gold standard for the detection. It can also be therapeutic as subsequent angioplasty can be done and even intra-arterial papaverine can be administered [36]. Nimodipine is the current standard of care for the prevention and treatment of SAH induced vasospasm. “Triple H” therapy is a rescue therapy that can be given if there is development of delayed cerebral ischemia. It comprises of Hypertension, Hypervolemia and Hemodilution (only for clipped aneurysms). The theory behind this therapy is to increase systemic blood pressure to increase blood flow through constricted cerebral vessels. Fluids are essential until optimal preload is achieved and pressors and inotropes can also be administered to increase the blood pressure [37].

Electrolyte imbalances are common in SAH and hyponatremia is the most common one. Hyponatremia usually emerges secondary to cerebral salt wasting or syndrome of inappropriate antidiuretic hormone (SIADH). Cerebral salt wasting stems into a hypovolemic state, however, SIADH results in euvolemia or hypervolemia (Suarez, 2015). Hyponatremia can be recognized in approximately 30% of patients and is considered as a poor prognostic indicator as it can predispose development of cerebral edema [36]. Strict monitoring of input and output and aggressive treatment of hypovolemia is required in order to prevent ischemia and vasospasm. Hypertonic saline (e.g., 1.5-3% NaCl) can be used as needed for the correction of the imbalance [37].

SAH is associated with high mortality as well morbidity with the mortality rates, ranging from 8% to 67% in various studies, this number does not include the pre-hospital mortality which is estimated at 10-15% [43]. With the advancement in medicine and development of new neurocritical care managements, endovascular treatments and surgical procedures, there has been a decrease in the mortality rates in these cases, however, morbidity is still high. A large percentage of these patients can’t achieve their previous level functioning even after 5 yrs, thus, significantly affecting the quality of life [37].

Summary

Headaches are a common emergency department presentation, and workup should focus on looking for potentially dangerous etiologies. This includes taking a careful history of trauma, rapid neck movement, heavy lifting, coagulopathy, hypertension, and family history of cerebral aneurysms. Vitals signs, particularly blood pressure, are important. Physical examination should include a through neurologic and ophthalmologic exam. Laboratory analysis may include complete blood count, electrolytes, coagulations studies, and occasionally ESR, and C-reactive protein. Imaging such as CT is often indicated.

Acknowledgements

None.

Funding

We have no sources of funding to disclose.

Competing and Conflicting Interests

The authors have no competing and conflicting interests to disclose.
References

1. World Health Organization (2016) Headache Disorders.
2. Friedman BW, Grosberg BM (2009) Diagnosis and management of the primary headache disorders in the emergency department setting. Emerg Med Clin North Am 27: 71-87.
3. Yoshimoto Y, Wakai S (1997) Unruptured intracranial vertebral artery dissection: Clinical course and serial radiographic imagings. Stroke 28: 370-374.
4. Evans RW, Mokri B (2002) Headache in cervical artery dissections. Headache 42: 1061-1063.
5. Schievink WI, Mokri B, O'Fallon WM (1994) Recurrent spontaneous cervical-artery dissection. N Engl J Med 330: 393-397.
6. Silbert PL, Mokri B, Schievink WI (1995) Headache and neck pain in spontaneous internal carotid and vertebral artery dissections. Neurology 45: 1517-1522.
7. Lawson W, Reino AJ (1997) Isolated sphenoid sinus disease: an analysis of 132 cases. Laryngoscope 107: 1590-1595.
8. Kriss TC, Kriss, VM, Warf BC (1996) Cavernous sinus thrombophlebitis: case report. Neurosurgery 39: 385-389.
9. Stam J, De Bruijn SF, DeVeber G (2002) Anticoagulation for cerebral sinus thrombosis. Cochran Database Syst Rev.
10. Mallery RM, Friedman DI, Liu GT (2014) Headache and the pseudotumor cerebri syndrome. Curr Pain Headache Rep 18: 446.
11. Markey KA, Mollan SP, Jensen RH, Sinclair AJ (2016) Understanding idiopathic intracranial hypertension: mechanisms, management, and future directions. Lancet Neurol 15: 79-81.
12. Wall M, Kupersmith MJ, Kieburz KD, Corbett JJ, Felden SE (2014) The idiopathic intracranial hypertension treatment trial: clinical profile at baseline. JAMA Neurol 71: 693-701.
13. Friedman DI, Liu GT, Digre KB (2013) Revised diagnostic criteria for the pseudotumor cerebri syndrome in adults and children. Neurology 81: 1159-1165.
14. Mollan SP, Markey KA, Benzimra JD, Jacks A, Matthews TD (2014) A practical approach to, diagnosis, assessment and management of idiopathic intracranial hypertension. Pract Neurol 14: 380-390.
15. Manning L, Robinson TG, Anderson CS (2014) Control of blood pressure in hypertensive neurological emergencies. Curr Hypertens Rep 16: 436.
16. Adeabajo O, Rogers RL (2015) Hypertensive Emergencies in the Emergency Department. Emerg Med Clin North Am 33: 539-551.
17. Dauzer RC (1987) Evaluation of hydrocephalus shunts in the emergency room. Emerg Med Clin North Am 5: 709-717.
18. Pattisapu JV (2001) Etiology and clinical course of hydrocephalus. Neurosurg Clin N Am 12: 651-659.
19. Rigamonti D (2014) Adult Hydrocephalus. Cambridge: Cambridge University Press.
20. Chahlavi A, El-Babaa SK, Luciano MG (2001) Adult-onset hydrocephalus. Neurosurg Clin N Am 12: 753-760.
21. Weinreb RN, Aung T, Medeiros FA (2014) The pathophysiology and treatment of glaucoma: a review. JAMA 311: 1901-1911.
22. Alsaff Z, Aung T, Ang LP, Chew PT (2000) Long-term clinical course of primary angle-closure glaucoma in an Asian population. Ophthalmology 107: 2300-2304.
23. Patel K, Patel S (2014) Angle-closure glaucoma. Dis Mon 60: 254-262.
24. Kale N, Eggenberger E (2010) Diagnosis and management of giant cell arteritis: a review. Curr Opin Ophthalmol 21: 417-422.
25. Carroll SC, Gaskin BJ, Danesh-Meyer HV (2006) Giant cell arteritis. Clin Experiment Ophthalmol 34: 159-173.
26. Smith JH, Swanson JW (2014) Giant cell arteritis. Headache 54: 1273-1289.
27. Caselli RJ, Hunder GG, Whisnant JP (1988) Neurologic disease in biopsy-proven giant cell (temporal) arteritis. Neurology 38: 352-359.
28. Breuer GS, Nesher G, Nesher R (2009) Rate of discordant findings in bilateral temporal artery biopsy to diagnose giant cell arteritis. J Rheumatol 36: 794-796.
29. Gilden D, White T, Khmeleva N, Heintzman A, Choe A, et al. (2015) Prevalence and distribution of VZV in temporal arteries of patients with giant cell arteritis. Neurology 84: 1948-1955.
30. Keroack MA (1987) The patient with suspected meningitis. Emerg Med Clin North Am 5: 807-826.
31. Dougherty JM, Roth RM (1986) Cerebral spinal fluid. Emerg Med Clin North Am 4: 281-297.
32. Roos KL (2015) Bacterial Infections of the Central Nervous System. Continuum (Minneap Minn) 21: 1679-1691.
33. Bartt R (2012) Acute bacterial and viral meningitis. Continuum (Minneap Minn) 18: 1255-1270.
34. Roos KL, van de Beek D (2010) Bacterial meningitis. Handb Clin Neurol 96: 51-63.
35. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, et al. (2014) Heart disease and stroke statistics–2014 update: a report from the American Heart Association. Circulation 129: e28-e292.
36. Connolly ES, Rabinstein AA, Carhuapoma JR, Derdeyn CP, Dion J, et al. (2012) Guidelines for the management of aneurysmal subarachnoid hemorrhage: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke 43: 1711-1737.
37. Suarez JI (2015) Diagnosis and Management of Subarachnoid Hemorrhage. Continuum (Minneap Minn) 21: 1263-1287.
38. Hunt WE, Hess RM (1968) Surgical risk as related to time of intervention in the repair of intracranial aneurysms. J Neurosurg 28: 14-20.
39. Report of World Federation of Neurological Surgeons Committee on a Universal Subarachnoid Hemorrhage Grading Scale. J Neurosurg 68: 985-986.
40. Fink KR, Benjert JL (2015) Imaging of Nontraumatic Neuroradiology Emergencies. Radiol Clin North Am 53: 871-890.
41. Raya AK, Diringer MN (2014) Treatment of subarachnoid hemorrhage. Crit Care Clin 30: 719-733.
42. Kumar G, Alexandrov AV (2015) Vasospasm Surveillance with Transcranial Doppler Sonography in Subarachnoid Hemorrhage. J Ultrasound Med 34: 1345-1350.
43. Lovelock CE, Rinkel GJ, Rothwell PM (2010) Time trends in outcome of subarachnoid hemorrhage: Population-based study and systematic review. Neurology 74: 1494-1501.
44. Peterson AA (2016) Headache and Neck Pain–When to Suspect Cervical Artery Dissection. American College of Emergency Physicians.
45 Piazza G (2012) Cerebral venous thrombosis. Circulation 125: 1704-1709.
46 Brain Tumor Statistics (2016) American Brain Tumor Association.
47 Sasaki-Adams D, Elbabaa SK, Jewells V, Carter L, Campbell JW, et al. (2008) The Dandy-Walker variant: a case series of 24 pediatric patients and evaluation of associated anomalies, incidence of hydrocephalus, and developmental outcomes. J Neurosurg Pediatr 2: 194-199.
48 Meningococcal Disease (2016) Centers for Disease Control and Prevention.
49 Tham YC, Li X, Wong TY, Quigley HA, Aung T, et al. (2014) Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. Ophthalmology 121: 2081-2090.
50 Susanto I (2016) Hypertensive Encephalopathy. Emedicine Medscape.
51 Lyrer P, Engelter S (2010) Antithrombotic drugs for carotid artery dissection. Cochrane Database Syst Rev 6: CD000255.
52 Findlay JM, Ashforth R, Dean N (2002) "Malignant" carotid artery dissection. Can J Neurol Sci 29: 378-385.
53 Mokri B, Silbert PL, Schievink WI, Piepgras DG (1996) Cranial nerve palsy in spontaneous dissection of the extracranial internal carotid artery. Neurology 46: 356-359.
54 Schievink WI, Mokri B, Whisnant JP (1993) Internal carotid artery dissection in a community. Rochester, Minnesota, 1987-1992. Stroke 24: 1678-1680.
55 Havelius U, Hindfelt B, Brismar J, Cronqvist S (1982) Carotid fibromuscular dysplasia and paresis of lower cranial nerves (Collect-Sicard syndrome). J Neurosurg 56: 850-853.
56 Lieschke GJ, Davis S, Tress BM, Ebeling P (1988) Spontaneous internal carotid artery dissection presenting as hypoglossal nerve palsy. Stroke 19: 1151-1155.
57 Waespe W, Niesper J, Imhof HG, Valavanis A (1988) Lower cranial nerve palsies due to internal carotid dissection. Stroke 19: 1561-1564.
58 Panisset M, Eidelman BH (1990) Multiple cranial neuropathy as a feature of internal carotid artery dissection. Stroke 21: 141-147.
59 Chang AJ, Mylonakis E, Karanasias P, De Orchis DF, Gold R (1999) Spontaneous bilateral vertebral artery dissections: case report and literature review. Mayo Clin Proc 74: 893-896.
60 Stahmer SA, Raps EC, Mines DI (1997) Carotid and vertebral artery dissections. Emerg Med Clin North Am 15: 677-698.