NCC Pediatrics Continuity Clinic Curriculum: **Headache** ***Faculty Guide***

Goals & Objectives:

To understand the common causes and the assessment of severe headache in children:

- Know the historical "red flags" in the assessment of headache.
- List the treatment modalities used in the treatment of migraine headache.
- Know the indications for imaging studies and referral in a child with headache.

Pre-Meeting Preparation:

Please read the following enclosures:

- "Approach to the child with headache" (UpToDate, Jan 2012)
- Excerpt from "Management of migraine headache" (UpToDate, July 2011)
- Table 5 from "Headache in Childhood" (PIR, 1999), *with addendum*
- **Prepare for Headache "Show & Tell" (see below)**

Conference Agenda:

- Review Headache Quiz
- Complete Headache Case
- **Headache "Show & Tell":** Go around table and residents should present one of the following: (1) an interesting HA patient they have been following; (2) a recent HA RCT or other study; or (3) a current event article on a clinical controversy related to HAs.

Post-Conference: Board Review Q&A

Extra-Credit:

- Approach to Children with Chronic Daily Headaches (Child Neurology, 2006)
- Neuro-imaging in Migraine and Chronic Daily Headache (Headache, 2000)
- Management of Migraine Headache (UpToDate, July 2011)
- Complementary, Holistic, and Integrative Medicine: Headaches (PIR, 2006)

Approach to the child with headache

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INTRODUCTION — Headache (pain located above the orbitomeatal line) is a common complaint in children and adolescents. The frequency increases with increasing age, and the etiologies range from anxiety regarding school issues to life-threatening infections and brain tumors (table 1). Children who complain of headache usually are brought to medical attention by their parents, who seek reassurance that the headaches are not a sign of a brain tumor or other serious illness. A thorough history, physical and neurologic examination, and appropriate diagnostic testing (if indicated) will usually enable the clinician to distinguish a benign primary headache from a more serious disease with a secondary headache.

An overview of the causes, evaluation, and management of headache in children will be presented here. The emergent evaluation of headache in children, specific primary headache syndromes in children, and headache related to exertion are discussed separately:

- (See "Emergent evaluation of headache in children".)
- (See "Classification of migraine in children".)
- (See "Pathophysiology, clinical features, and diagnosis of migraine in children".)
- (See "Management of migraine headache in children".)
- (See "Tension-type headache in children".)
- (See "Primary exertional headache".)

EPIDEMIOLOGY — Headaches are common in children [1-3]. In a systematic review of 50 population based studies, nearly 60 percent of children reported having had headaches over periods of time (ranging from one month to “lifetime”) [3]. By age 18 years, more than 90 percent of children report having had a headache [1].

Frequent and severe headaches also are common in children. In the United States, approximately 20 percent of children aged 4 to 18 years report having had frequent or severe headaches (including migraine) in the past 12 months [4]. The prevalence of frequent and severe headaches increases with increasing age from 4.5 percent among children 4 to <6 years to 27.4 percent among children 16 to 18 years [4]. In a population-based study, 1.5 percent of middle-school students (age 12 to 14 years) had chronic daily headache [5]. (See 'Chronic daily headache' below.)

The prevalence of headaches among boys and girls is similar before 12 years of age (approximately 10 percent) [4]. After age 12 years, the prevalence is increased in girls (approximately 28 to 36 percent versus 20 percent) [2,4].

Headaches occur more often during the first 12 months after school entry and in children who have a family history of headaches in first- or second-degree relatives [6-8]. Children who have headaches are more likely to have multiple medical problems, physical symptoms, psychiatric symptoms, and headache in adulthood [4,9,10].

ETIOLOGY — Headache in children and adolescents may be due to a primary headache syndrome (ie, migraine headache, tension-type headache, cluster headache (table 2)) or secondary to an underlying medical condition. Secondary headaches usually are related to an acute febrile illness (eg, upper respiratory infection, influenza) but may be due to central nervous system infection or space-occupying lesion.

Childhood headaches rarely are caused by a serious underlying disorder [11]. The most common headache etiologies vary depending upon the setting in which the child is evaluated. Most children who present to pediatric emergency departments with acute headache have a viral illness or an upper respiratory infection as the cause of their headache, although more serious conditions occasionally are diagnosed [12,13]. (See "Emergent evaluation of headache in children", section on 'Causes'.)

In the primary care setting, primary headaches, psychosocial (eg, family or school problems) etiologies, and infectious etiologies are most common [14-16]. In a historical cohort of 48,575 children aged 5 to 17 years who were seen by primary care providers for complaint of headache, 19 percent were diagnosed with primary headache at the time of presentation, 1.1 percent were diagnosed with secondary headache, and 79.7 percent received no formal diagnosis (5.4 percent of these were diagnosed with primary headaches in the subsequent year) [16].

Primary headache — The most common primary headache syndromes in children are migraine headache, tension-type headache, and cluster headache (table 2). Chronic daily headache may evolve from migraine or tension-type headache.

Migraine headache — Migraine is the most frequent acute-recurrent headache syndrome in childhood. It is characterized by periodic episodes of headache accompanied by nausea, vomiting, abdominal pain, and desire to sleep (table 3A). Autonomic symptoms are essential to the diagnosis of migraine and include photophobia, phonophobia, nausea, and vomiting [17]. In children, particularly young children, the duration of headache may be as short as one hour [18,19], and the headache may be bilateral (bifrontal or bitemporal). Occipital headaches may have an organic cause and need to be investigated further. (See 'Worrisome findings' below.)

The clinical features, diagnosis, and management of migraine headaches in children are discussed separately. (See "Pathophysiology, clinical features, and diagnosis of migraine in children".)

Migraine headaches may be complicated by hemiplegia, ophthalmoplegia, tinnitus, vertigo, ataxia, weakness, confusion, and paresthesias [17]. Children who have complicated migraine headaches should be thoroughly evaluated because other diagnoses (eg, intracranial tumor, hemorrhage, ischemic stroke, or infection) must be excluded. (See 'Evaluation' below.)

Migraine "variants" traditionally include benign paroxysmal vertigo, cyclic vomiting, and abdominal migraine. Benign torticollis, comprised of recurrent, often short-lived, and spontaneously recovering attacks of head tilt in infants, also has been proposed as a variant of migraine [20,21]. (See "Classification of migraine in children", section on 'Childhood periodic syndromes' and "Acquired torticollis in children", section on 'Benign paroxysmal torticollis'.)

Tension-type headaches — Tension-type headaches are characterized by a bilateral pressing tightness that occurs anywhere on the cranium or suboccipital region (table 3B). The headache is non-throbbing, of mild to moderate intensity, and lasts from 30 minutes to several days. Tension headache may be associated with photophobia or phonophobia but usually is not accompanied by nausea or vomiting, nor aggravated by routine physical activity [17]. The overlap of some of these symptoms with those of migraine headache can make differentiation between the two headache types difficult [18]. Tension-type headaches in children are discussed separately. (See "Tension-type headache in children".)

Cluster headaches — Cluster headaches are always unilateral and usually frontal-periorbital in location (table 3C). The pain of cluster headaches is severe and lasts less than three hours. Cluster headaches usually are associated with ipsilateral autonomic findings, including lacrimation, rhinorrhea, ophthalmic injection, and occasionally a Horner syndrome (ipsilateral miosis, ptosis, and facial anhidrosis) [17].

Cluster headaches have been reported in children as young as three years of age, but they are rare in children younger than 10 years. They become more apparent between the ages of 10 and 20 years. Cluster headaches

are discussed separately. (See "Cluster headache: Epidemiology, clinical features, and diagnosis", section on 'Clinical features'.)

Chronic daily headache — Chronic daily headache (CDH) is defined as headache that is present for more than 15 days a month for more than three months in the absence of detectable organic pathology [22]. CDH encompasses four subtypes of daily headache defined by the International Headache Society (IHS): chronic migraine, chronic tension-type headache, new daily persistent headache, and hemicrania continua [17]. (See "Overview of chronic daily headache", section on 'Subtypes'.)

CDH is a considerable problem in children. In a population-based study of middle school students (age 12 to 14 years), the overall prevalence was 1.5 percent [5]. CDH was more common in girls than boys (2.4 versus 0.8 percent). Most of the adolescents with CDH had chronic tension-type headache or chronic migraine (66 and 7 percent, respectively) by IHS criteria. Most had headaches with features of migraine, although they did not satisfy IHS criteria for migraine, confirming the findings of a previous study [23].

Avoidance of analgesic overuse may be an important step in the prevention of CDH [24]. Medication overuse has been reported in 20 to 36 percent of adolescents with daily headache and is an independent predictor of CDH persistence [5,17,25-27]. Major depression is another independent predictor of CDH persistence [27].

Secondary headache — Secondary headaches are caused by an underlying medical problem [28]. Secondary headaches may provide a clue to a serious underlying condition that requires prompt intervention. Children with these conditions usually have other symptoms or signs to suggest intracranial pathology (table 4). (See 'Worrisome findings' below.)

Conditions that may cause secondary headache in children include [28]:

- Acute febrile illness (eg, influenza, upper respiratory infection, sinusitis). (See appropriate topic reviews.) Such infections are the most common cause of secondary headache in children [12,13]. If persistent headache is the dominant feature of sinusitis, neuroimaging may be indicated to exclude intracranial complications. (See "Acute bacterial sinusitis in children: Clinical features and diagnosis", section on 'Complications of ABS'.)
- Head trauma (see "Intracranial epidural hematoma in children: Clinical features, evaluation, and management", section on 'Clinical features' and "Intracranial subdural hematoma in children: Clinical features, evaluation, and management", section on 'Clinical features')
- Medications (eg, oral contraceptives, glucocorticoids, selective serotonin reuptake inhibitors, serotonin-norepinephrine reuptake inhibitors, among others)
- Acute and severe systemic hypertension (may cause headache or be a response to increased intracranial pressure) (see "Evaluation of hypertension in children and adolescents", section on 'Initial evaluation')
- Acute or chronic meningitis (see "Clinical features and diagnosis of acute bacterial meningitis in children older than one month of age", section on 'Clinical features' and "Viral meningitis: Clinical features and diagnosis in children", section on 'Clinical features')
- Brain tumor (see "Clinical manifestations and diagnosis of central nervous system tumors in children", section on 'Clinical manifestations')
- Idiopathic intracranial hypertension (see "Idiopathic intracranial hypertension (pseudotumor cerebri): Clinical features and diagnosis")
- Hydrocephalus (see "Hydrocephalus", section on 'Clinical features')
- Intracranial hemorrhage (sudden severe unilateral headache)

CLINICAL PRESENTATION — Young children respond to pain differently than older children and adolescents [29,30]. Headache pain may not be apparent to parents of younger children, who react by crying, rocking, or hiding. Chronic pain may cause developmental regression, anxiety, depression, and behavior problems and

affect the child's ability to eat, sleep, or play. Older children are better able to perceive, localize, and remember pain. Emotional, behavioral, and personality factors become more important as the child enters adolescence. The variability in presentation in children of different ages may lead to difficulty when applying the standard headache diagnostic criteria (eg, International Headache Classification) [31].

EVALUATION — The evaluation of headache in children includes a thorough history (table 5) and physical examination (table 6), with particular attention to the clinical features suggestive of intracranial infection or space-occupying lesion (table 4). The headache pattern helps to determine the etiology (table 1).

History — The headache history provides most of the necessary diagnostic information in the evaluation of childhood headaches (table 5). A thorough history helps to focus the physical examination and prevent unnecessary investigation and neuroimaging.

The history of headache for a child, particularly a child who is younger than 10 years of age, is best obtained with input from the parents. Nonetheless, the child should always be given the opportunity to describe his or her headache first. It is often useful to ask a child to “draw the headache,” particularly any visual symptoms. Children and adolescents frequently are able to identify specific circumstances that cause headache (eg, the return to school may precipitate tension-type headaches, riding in a car may precipitate migraine). Motion sickness precipitated by reading in a car is a common feature in migraine sufferers, and may be elicited as the sole symptom in some family members [10,32].

A diary in which the quality, location, severity, timing, precipitating and palliating factors, and associated features of the headache are recorded prospectively is a useful adjunct (table 7). A diary is not subject to recall error, may reveal a pattern that is typical for a certain type of headache (table 1), and provides important diagnostic information for children who are unwilling or unable to provide sufficient detail during the office interview [33,34].

Headache pattern — Using historical information, the examiner can classify the headache into one of the following patterns, which helps to determine the etiology (table 1) [29]:

- Acute
- Acute and recurrent
- Chronic and nonprogressive
- Chronic and progressive
- Mixed pattern (eg, chronic nonprogressive headaches with superimposed acute recurrent headaches)

Physical examination — The physical examination is usually normal in children with primary headaches (eg, migraine headache, tension-type headache). (See "Pathophysiology, clinical features, and diagnosis of migraine in children", section on 'Diagnosis' and "Tension-type headache in children", section on 'Examination'.)

In contrast, the physical examination is usually abnormal in children with secondary headaches, providing clues to the underlying diagnosis (eg, sinus tenderness in a child with sinusitis; fever and nuchal rigidity in a child with meningitis). In most cases of brain-tumor-induced headache, some aspect of the neurologic examination is abnormal. (See "Clinical manifestations and diagnosis of central nervous system tumors in children", section on 'Headache'.)

Depending upon the clinical situation, the physical examination of the child with headache may include (table 6):

- General appearance
- Vital signs, including temperature, blood pressure, and pulse
- Measurement of height, weight, and head circumference
- Auscultation of the neck, eyes, and head for bruit
- Examination and palpation of the head, neck, shoulders, and spine

Visual field testing

- Funduscopy for papilledema and retinal hemorrhages
- Otoscopy for otitis media and hemotympanum
- Examination of the oropharynx for signs of infection, dental decay/abscess
- A functional neurologic examination including getting up from a seated position without any support; walking on tiptoes and heels; cranial nerve examination; tandem gait and Romberg test; and symmetry of motor, sensory, reflex, and cerebellar (coordination) tests
- Examination of the skin for signs of neurocutaneous disorders
- Examination of the spine for signs of occult dysraphism

Worrisome findings — Predictors for intracranial pathology (ie, space-occupying lesion or central nervous system infection) have been identified in small observational studies (table 4) [35-40]. It is particularly important to ask about and look for these symptoms and signs of increased intracranial pressure, intracranial infection, and progressive neurologic disease. The presence of findings is an indication for further evaluation and/or neuroimaging. (See "Elevated intracranial pressure in children", section on 'Presentation'.)

Neuroimaging — Neuroimaging studies (eg, computed tomography [CT] or magnetic resonance imaging [MRI]) may detect a variety of disorders that cause secondary headache, including:

- Congenital malformations
- Hydrocephalus
- Cranial infections and their sequelae
- Trauma and its sequelae
- Neoplasms
- Vascular disorders (such as arteriovenous malformations)

However, most children who present to primary care with headaches have primary or uncharacterized headaches and do not require neuroimaging [16]. Neuroimaging of children with headaches in the absence of neurologic abnormalities on examination and/or symptoms of neurologic abnormalities on history has a low yield of clinically significant findings (0.9 to 1.2 percent) [40-43]. Neuroimaging of such children may detect incidental findings that require additional evaluation or follow-up [41,42,44,45]. Other potential adverse effects of neuroimaging include radiation exposure, exposure to anesthesia if sedation is required, and false reassurance from an inadequate study [46].

Indications — Decisions regarding neuroimaging in children with headaches should be made on a case-by-case basis [46]. Children who have features worrisome for an intracranial process (table 4) generally should undergo neuroimaging with CT or MRI. The level of urgency is determined by the status of the patient and the speed with which the situation is evolving [14]. (See 'Which imaging study?' below.)

The American Academy of Neurology (AAN) and the American College of Radiology (ACR) have developed guidelines for neuroimaging in children with headache [40,41]. In addition, the multidisciplinary US Headache Consortium provides guidelines that are not specific for children [46].

Neuroimaging for children with acute head trauma, suspected infection (eg, sinusitis, meningitis, encephalitis), or other obvious cause is discussed separately. (See appropriate topic reviews.)

Indications for neuroimaging in children (3 to 18 years) with recurrent headaches that are not associated with acute trauma, fever, or other obvious provocative cause may include (but are not limited to) [40,41,46]:

- Abnormal neurologic examination and/or seizures
- Recent onset of severe headache
- Change in type or character of headache (for children with recurrent or chronic headaches)
- Suspicion of meningitis, encephalitis, or sinusitis with intracranial extension

Severe headache in a child with underlying disease process that predisposes to intracranial pathology (eg, immune deficiency, sickle cell disease, neurofibromatosis, history of neoplasm, coagulopathy, hypertension)

Neuroimaging generally is not indicated for children with chronic nonprogressive headaches and no signs or symptoms of neurologic dysfunction or increased intracranial pressure [40,41,46]. Neuroimaging also usually is not indicated for children with migraine headaches who lack neurologic abnormalities. However, it may be difficult to differentiate early migraine episodes from headache secondary to a space-occupying lesion because the International Headache Society criteria for migraine headache will not have been met (table 3A) [40]. Neuroimaging often is warranted in children who have complicated migraines or atypical migraine features, or do not fulfill the strict criteria for migraine [40,46].

The yield of neuroimaging in detecting clinically significant intracranial abnormalities in children without neurologic abnormalities is extremely low. In a systematic review of six studies in which 605 of 1275 children with recurrent headaches underwent neuroimaging, imaging abnormalities were found in 97 children (16 percent) [35,40,47-51]. However, in 79 of these children, the abnormalities did not require further intervention. Among the remaining 18 children, 14 had lesions requiring surgery (10 tumors, three vascular malformations, one arachnoid cyst with mass effect), and four had lesions that required medical treatment. All of the children who had surgically treatable lesions had abnormal findings on neurologic examination, including papilledema, abnormal eye movements, or motor or gait dysfunction.

Which imaging study? — The AAN practice parameter, ACR appropriateness criteria, and Headache Consortium guidelines do not make a specific recommendation for MRI or CT in patients who require neuroimaging [40,41,46]. Head CT without contrast is typically performed in acute situations in which hemorrhage is suspected or rapid diagnosis of a space-occupying lesion is necessary. In nonacute situations, the increased risk of radiation-induced tumors associated with CT imaging in children is an important factor in selecting the imaging modality. (See "Approach to neuroimaging in children", section on 'Computed tomography'.)

MRI usually is preferred in other situations (or if there is persistent concern despite a normal head CT scan) because MRI demonstrates sellar lesions, craniocervical junction lesions, posterior fossa lesions, white matter abnormalities, and congenital anomalies more accurately than does CT. However, MRI may require sedation and is more expensive and time-consuming than is CT. (See "Approach to neuroimaging in children", section on 'Magnetic resonance imaging'.)

CT angiography or MR angiography may be indicated if subarachnoid blood or parenchymal blood is identified on initial CT, MRI, or lumbar puncture [41]. (See 'Lumbar puncture' below.)

Laboratory evaluation — Laboratory testing rarely is helpful in the evaluation of childhood headache [34,40,52]. The AAN practice parameter indicates that the evidence is insufficient to support any recommendation regarding the value of routine laboratory studies or lumbar puncture in the evaluation of recurrent headache in children [40]. However, laboratory testing may be indicated if the history and/or physical examination suggest that the headaches are secondary to an underlying condition.

Lumbar puncture — Lumbar puncture (LP) generally should be performed in children in whom intracranial infection, subarachnoid hemorrhage, or idiopathic intracranial hypertension (pseudotumor cerebri) is suspected. Neuroimaging typically is performed before LP because LP is contraindicated in patients with space-occupying lesions. However, in patients in whom bacterial meningitis is suspected, the risks of delaying the LP and administration of antibiotics while awaiting neuroimaging must be considered. (See "Lumbar puncture: Indications, contraindications, technique, and complications in children", section on 'Indications' and "Lumbar puncture: Indications, contraindications, technique, and complications in children", section on 'Contraindications'.)

Patients in whom idiopathic intracranial hypertension is suspected may require reassurance or sedation before undergoing the lumbar puncture, because an accurate opening pressure measurement is crucial to the diagnosis. (See "Idiopathic intracranial hypertension (pseudotumor cerebri): Clinical features and diagnosis", section on 'Lumbar puncture'.)

Other tests — Other tests should be performed as indicated to evaluate suspected underlying medical conditions. These tests should be tailored to evaluate conditions suggested by information from the history and examination. Examples include [14]:

- Complete blood count with differential and erythrocyte sedimentation rate (if infection, vasculitis, or malignancy is suspected)
- Serum or urine toxicology screens (if acute intoxication is suspected)
- Thyroid function tests (if thyroid dysfunction is suspected hypothyroidism) (see "Clinical manifestations and diagnosis of hyperthyroidism in children and adolescents", section on 'Diagnostic evaluation' and "Acquired hypothyroidism in childhood and adolescence", section on 'Diagnosis')

Electroencephalography — Electroencephalography is not recommended in the routine evaluation of a child with recurrent headaches [40]. It is unlikely to be useful in determining the cause or distinguishing migraine from other types of headache.

DIAGNOSIS — The diagnosis of primary headache disorders is made clinically, based upon the criteria of the International Headache Society [17]:

- Migraine headache (table 3A) (see 'Migraine headache' above)
- Tension-type headache (table 3B) (see 'Tension-type headaches' above)
- Cluster headache (table 3C) (see 'Cluster headaches' above)

The diagnosis of chronic daily headache is also made clinically in children with headache on more than 15 days a month for more than three months in the absence of detectable organic pathology [22]. (See 'Chronic daily headache' above.)

The diagnosis of secondary headaches depends upon identification of the underlying condition. (See 'Secondary headache' above.)

MANAGEMENT — The management of recurrent and chronic headache in children and adolescents depends upon the underlying etiology. The management of migraine headache and tension-type headaches is discussed separately. (See "Management of migraine headache in children" and "Tension-type headache in children", section on 'Treatment'.)

The discussion below provides general strategies for the management of chronic headaches in children and adolescents (whether or not they meet criteria for a primary headache syndrome or chronic daily headache). It is critical to address excessive school absence and overuse of over-the-counter analgesic medications (eg, acetaminophen, ibuprofen, naproxen) [14,24,53]. Analgesic agents should probably not be given more than two days per week to avoid the risk of medication-overuse headache [54,55].

Treatment of chronic headaches requires a systematic approach over several months through which the child returns to normal activities of daily living [56]. Specific measures may include [53,57]:

- Providing realistic expectations (ie, the frequency and severity of the headaches may decrease over weeks to months of therapy, but the headaches may continue) (see 'Outcome' below)
- Return to school for children who have been absent; if necessary, they can go to the school nurse or office once daily for 15 minutes when headache pain peaks
- Avoidance of headache triggers (eg, lack of sleep, inadequate hydration)
- Daily exercise for 20 to 30 minutes
- Addressing comorbid sleep problems (eg, delayed sleep onset, frequent night waking), mood problems, and/or anxiety

Additional nonpharmacologic approaches may include electrophysiologic-guided biofeedback, guided imagery,

physical therapy, acupuncture, hypnosis, meditation, massage, and counseling or psychologic consultation [14,54].

Medications are an adjunct to nonpharmacologic treatments. “Rescue” analgesic medications should be used judiciously; the benefit of early relief must be balanced with the risk of developing chronic daily headaches if rescue medications are used more than twice per week. Prophylactic agents may be necessary for children with headaches more than four times per month or headaches that adversely affect the child’s activities [54].

Treatment of chronic headaches related to medication overuse consists of discontinuation of analgesic medications. An observational study suggests that daily preventive agents may not be necessary or beneficial when analgesics are discontinued for medication-overuse headache in children and adolescents [58].

INDICATIONS FOR REFERRAL — Primary care providers usually can manage children and adolescents with acute recurrent and chronic nonprogressive headaches. Indications for referral may include [14,59]:

- Secondary headache requiring specialist management (eg, space-occupying lesions, idiopathic intracranial hypertension)
- Headaches associated with mood disturbance or anxiety
- Uncertain diagnosis
- Headaches refractory to primary care management
- Chronic daily headache (the primary care provider should know the plan and help with its implementation)

OUTCOME — Headache that begins in childhood often changes in its characteristics with time and may remit or improve. In one study, 100 children and adolescents with headache were seen eight years after the initial visit [60]. Remission occurred in 44 percent of children with tension headache and 28 percent of children with migraine headache. Migraine without aura persisted in the same form in 44 percent and became episodic tension headache in 26 percent. Episodic tension headache persisted in the same form in 26 percent and changed to migraine without aura in 11 percent. Psychiatric comorbidity at the initial visit was associated with worsening or unchanged clinical status at follow-up [61].

In another long-term study of 103 children with chronic daily headache (CDH), CDH persisted in 25 percent at two years and 12 percent at eight years [62]. Early onset was associated with a protracted disease course.

RESOURCES

- The American Committee for Headache Education (www.achenet.org/) provides information and resources for patients and providers.
- The American Headache Society (www.americanheadachesociety.org/) provides resources for clinicians.
- The National Headache Foundation (http://www.headaches.org/) provides information and resources for patients and providers.

INFORMATION FOR PATIENTS — UpToDate offers two types of patient education materials, “The Basics” and “Beyond the Basics.” The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on “patient info” and the keyword(s) of interest.)

- Beyond the Basics topics (see "Patient information: Headache in children")

SUMMARY

- Approximately 20 percent of children aged 4 to 18 years report having had frequent or severe headaches in the past 12 months. (See 'Epidemiology' above.)
- Headache in children and adolescents may be due to a primary headache syndrome (ie, migraine headache, tension-type headache, cluster headache (table 2)) or secondary to an underlying medical condition. Secondary headaches usually are related to fever or infection (eg, upper respiratory infection, influenza), but may be due to central nervous system infection or space-occupying lesion. (See 'Etiology' above.)
- The evaluation of headache in children includes a thorough history (table 5) and physical examination (table 6), with particular emphasis on clinical features suggestive of intracranial pathology (table 4). The headache pattern helps to determine the etiology (table 1). (See 'Evaluation' above.)
- Neuroimaging (head computed tomography without contrast or magnetic resonance imaging without contrast) should be performed in children with headache and neurologic signs or symptoms suggestive of intracranial pathology (table 4). (See 'Neuroimaging' above.)
- Routine laboratory evaluation usually is not necessary for children with recurrent or chronic headaches. The laboratory evaluation for secondary headache should be tailored to evaluate conditions suggested by information from the history and examination. (See 'Laboratory evaluation' above.)
- The diagnosis of primary headache disorders is made clinically, based upon the criteria of the International Headache Society (table 3A-C). The diagnosis of chronic daily headache also is made clinically (headache on >15 days per month for >3 months in the absence of detectable organic pathology). The diagnosis of secondary headaches depends upon identification of the underlying condition. (See 'Diagnosis' above.)
- The treatment of chronic headaches requires a systematic approach over several months through which the child returns to normal activities of daily living. It is critical to address excessive school absence and overuse of over-the-counter analgesic medications. (See 'Management' above.)

GRAPHICS

Etiologic classification of headache

Acute
Localized
Associated with URI (sinusitis, otitis media) or viral infection (influenza)
Post-traumatic
Related to oral cavity (dental abscess, TMJ dysfunction)
Brain abscess
First migraine
Generalized
Fever
Systemic infection (influenza)
Central nervous system infection (meningitis, viral encephalitis)
Hypertension, hypertensive encephalopathy
Intracranial hemorrhage
Exertional
First migraine headache
Trauma
Toxins (eg, carbon monoxide), medications (eg, amphetamines, oral contraceptives), or illicit substances
Acute and recurrent
Migraine headache
Cluster headache
Chronic and non-progressive
Tension-type headache
Psychiatric (depression, school phobia)
Post-traumatic, postconcussive
Medication overuse
Chronic and progressive
Idiopathic intracranial hypertension
Space-occupying lesion (tumor, abscess, hemorrhage, hydrocephalus, vascular malformation)
Post-traumatic, postconcussive

URI: upper respiratory infection; TMJ: temporomandibular joint. *Adapted from:*

1. *Morton L. Headache. In: Clinical Handbook of Pediatrics, Schwartz MW (Ed), Williams and Wilkins, Baltimore*

1995, p.316.
2. *Rothner DA. Headache in adolescence. Adolescent Health Update. 2006; 18:1.*
3. *Strasburger VC, Brown RT, Braverman PK, et al. Headache. In: Adolescent Medicine A Handbook for Primary Care, Lippincott Williams & Wilkins, Philadelphia 2006. p.25.*

Characteristics of common headache syndromes in children and adolescents

Symptom	Migraine headache	Tension headache	Cluster headache
Location	Commonly bilateral in young children; in adolescents and young adults, unilateral in 60 to 70 percent and bifrontal or global in 30 percent	Bilateral	Always unilateral, usually begins around the eye or temple
Characteristics	Gradual in onset, crescendo pattern; pulsating; moderate or severe intensity; aggravated by routine physical activity	Pressure or tightness that waxes and wanes	Pain begins quickly, reaches a crescendo within minutes; pain is deep, continuous, excruciating, and explosive in quality
Patient appearance	Patient prefers to rest in a dark, quiet room	Patient may remain active or may need to rest	Patient remains active
Duration	1 to 72 hours	Variable	30 minutes to 3 hours
Associated symptoms	Nausea, vomiting, photophobia*, phonophobia*; may have aura (usually visual, but can involve other senses or cause speech or motor deficits)	None	Ipsilateral lacrimation and redness of the eye; stuffy nose; rhinorrhea; pallor; sweating; Horner syndrome; focal neurologic symptoms rare; sensitivity to alcohol

* May be inferred from the behavior of young children.

International Headache Society diagnostic criteria for migraine

Migraine without aura
A. At least five attacks fulfilling criteria B through D
B. Headache attacks lasting 4 to 72 hours (untreated or unsuccessfully treated)
C. Headache has at least two of the following characteristics:
Unilateral location
Pulsating quality
Moderate or severe pain intensity
Aggravation by or causing avoidance of routine physical activity (eg, walking or climbing stairs)
D. During headache at least one of the following:
Nausea, vomiting, or both
Photophobia and phonophobia
E. Not attributed to another disorder
Migraine with aura
A. At least two attacks fulfilling criterion B
B. Migraine aura fulfilling criteria B and C for one of the following subforms:
Typical aura with migraine headache

Typical aura with nonmigraine headache
Typical aura without headache
Familial hemiplegic migraine
Sporadic hemiplegic migraine
Basilar-type migraine
C. Not attributed to another disorder
Migraine with typical aura
A. At least two attacks fulfilling criteria B through D
B. Aura consisting of at least one of the following, but no motor weakness:
Fully reversible visual symptoms including positive (eg, flickering lights, spots, or lines) and/or negative features (ie, loss of vision)
Fully reversible sensory symptoms including positive (ie, pins and needles) and/or negative features (ie, numbness)
Fully reversible dysphasic speech disturbance
C. At least two of the following:
Homonymous visual and/or unilateral sensory symptoms
At least one aura symptom develops gradually over ≥5 minutes and/or different aura symptoms occur in succession over ≥5 minutes
Each symptom lasts ≥5 and ≤60 minutes
D. Headache fulfilling criteria B through D for migraine without aura begins during the aura or follows aura within 60 minutes
E. Not attributed to another disorder
Features of migraine in children
Attacks may last 1 to 72 hours
Headache is commonly bilateral; an adult pattern of unilateral pain usually emerges in late adolescence or early adulthood
Occipital headache is rare and raises diagnostic caution for structural lesions
Photophobia and phonophobia may be inferred by behavior in young children

Adapted from: Headache Classification Committee of the International Headache Society. The International Classification of Headache Disorders. Cephalalgia 2004; 24:1.

Tension-type headache (ICHD-2 criteria)

A. At least 10 episodes fulfilling criteria B through E. The number of days per month with such headache determines the subtype:
<1 day a month: infrequent episodic TTH
1 to 14 days a month: frequent episodic TTH
≥15 days a month: chronic TTH
B. Headache lasting from 30 minutes to 7 days for episodic TTH; headache lasts hours or may be continuous for chronic TTH
C. At least two of the following pain characteristics:
Pressing/tightening (nonpulsating) quality
Mild or moderate intensity (may inhibit but does not prohibit activities)
Bilateral location
No aggravation by walking stairs or similar routine physical activity

D. Both of the following:
No nausea or vomiting (anorexia may occur)
Photophobia and phonophobia are absent, or one but not the other may be present
E. Not attributed to another disorder

Reproduced with permission from: Headache classification subcommittee of the International Headache Society. The International Classification of Headache Disorders: 2nd edition. Cephalalgia 2004; 24(Suppl 1):9.

ICHD-2 diagnostic criteria for cluster headache

A. At least five headache attacks fulfilling criteria B through D:
B. Severe or very severe unilateral orbital, supraorbital, and/or temporal headache attacks, which last untreated for 15 to 180 minutes. During part (but less than half) of the time course of the cluster headache, attacks may be less severe, less frequent, or of shorter or longer duration.
C. The headache is accompanied by at least one of the following symptoms:
1. Ipsilateral conjunctival injection or lacrimation
2. Ipsilateral nasal congestion and/or rhinorrhea
3. Ipsilateral eyelid edema
4. Ipsilateral forehead and facial sweating
5. Ipsilateral miosis and/or ptosis
6. A sense of restlessness and agitation
D. The attacks have a frequency from one every other day to eight per day.
E. History and physical and neurologic examinations do not suggest any other disorder, and/or such a disorder is ruled out by appropriate investigations, or such disorder is present but attacks do not occur for the first time in close temporal relation to the disorder.
Episodic cluster headache: At least two cluster periods lasting seven days to one year separated by pain-free periods lasting one month or longer.
Chronic cluster headache: Attacks occur for more than one year without remission or with remission less than one month.
Probable cluster headache: Attacks fulfilling all but one criteria for cluster headache.

Headache Classification Subcommittee of the International Headache Society. The International Classification of Headache Disorders: 2nd edition. Cephalalgia 2004; 24 Suppl 1:9.

Clinical features that may indicate intracranial pathology in children with headache

Headache characteristics
Headache awakens the child or occurs upon waking
Sudden severe headache ("thunderclap" headache, "worst headache of my life")
Associated neurologic signs and symptoms (eg, persistent nausea/vomiting, altered mental status, ataxia, etc)
Headache worsened in recumbent position or by cough, micturition, or defecation
Absence of aura
Chronic progressive headache pattern
Change in quality, severity, frequency, or pattern of headache
Occipital headache

Recurrent localized headache
Lack of response to medical therapy
Headache duration of less than six months
Examination findings
Abnormal neurologic examination (eg, ataxia, weakness, diplopia, abnormal eye movements)
Papilledema or retinal hemorrhages
Growth abnormalities (increased head circumference, short stature or deceleration of linear growth, abnormal pubertal progression, obesity)
Nuchal rigidity
Signs of trauma
Cranial bruits
Skin lesions that suggest a neurocutaneous syndrome (neurofibromatosis, tuberous sclerosis complex)
Patient history
Risk factor for intracranial pathology (eg, sickle cell disease, immune deficiency, malignancy or history of malignancy, coagulopathy, cardiac disease with right-to-left intracardiac shunt, head trauma, neurofibromatosis type 1, tuberous sclerosis complex)
Age <3 years
Family history
Absence of family history of migraine

Data from:

1. *Lewis DW, Ashwal S, Dahl G, et al. Practice parameter: evaluation of children and adolescents with recurrent headaches: report of the Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society. Neurology 2002; 59:490.*
2. *Newton RW. Childhood headache. Arch Dis Child Educ Pract Ed 2008; 93:105.*
3. *Prince JS, Gunderman R, Coley BD, et al. Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria. Headache - child. American College of Radiology, Reston, VA, 2008. http://www.acr.org/SecondaryMainMenuCategories/quality_safety/app_criteria/pdf/ExpertPanelonPediatricImaging/HeadacheChildDoc3.aspx (Accessed on March 17, 2011).*
4. *Strasburger VC, Brown RT, Braverman PK, et al. Headache. In: Adolescent Medicine A Handbook for Primary Care, Lippincott Williams & Wilkins, Philadelphia 2006. p.25.*
5. *Wilne S, Koller K, Collier J, et al. The diagnosis of brain tumours in children: a guideline to assist healthcare professionals in the assessment of children who may have a brain tumour. Arch Dis Child 2010; 95:534.*

Important components of the headache history for children and adolescents

Historical feature	Possible significance
Headache history	
Age at onset	• Migraine headaches frequently begin in the first decade of life. • Chronic nonprogressive headaches begin in adolescence.
Mode of onset	Abrupt onset of severe headache ("thunderclap headache" or "worst headache of my life") may indicate intracranial hemorrhage.
What is the headache pattern: acute, acute recurrent, chronic progressive, nonprogressive daily, or mixed?	Helps to determine the cause (see table "Etiology of headache").

How often does the headache occur?	• Migraines typically occur 2 to 4 times per month; almost never daily. • Chronic nonprogressive headaches may occur 5 to 7 days per week. • Cluster headaches typically occur 2 to 3 times per day for several months.
How long does the headache last?	• Migraines typically last 1 to 3 hours in young children and may last longer (48 to 72 hours) in adolescents. • The duration of tension headaches is variable; they may last all day. • Cluster headaches usually last 5 to 15 minutes but may last for 60 minutes.
Is there an aura or prodrome?	Aura or prodrome is suggestive of migraine headaches; if the warning symptoms are focal and repeatedly located to the same side of the body, a seizure or vascular or structural cause should be suspected.
When do the headaches occur?	• Headaches that wake the child from sleep or occur on waking may indicate increased intracranial pressure/space-occupying lesion. • Tension-type headaches typically occur late in the day.
What is the headache quality (throbbing/pulsating, dull aching, squeezing, etc)?	• Migraine headaches have a throbbing/pulsating quality. • Chronic nonprogressive headaches have a squeezing pressure or tightness that waxes and wanes. • Cluster headaches have a deep continuous pain.
Where is the pain?	• Occipital location may indicate posterior fossa neoplasms but also may occur in basilar migraine. • Cluster headaches are usually temporal or retro-orbital. • Localized pain may suggest a specific secondary etiology (eg, sinusitis, otitis, dental abscess).
What brings the headache on or makes it worse?	• Headache in the recumbent position or with straining/valsalva may indicate an intracranial process. • Migraines may be triggered by certain foods, odors, bright lights, noise, lack of sleep, menses (in girls), and strenuous activity. • Tension-type headaches may worsen with stress, bright lights, noise, strenuous activity. • Cluster headaches may be worsen with lying down or resting.
What makes the headache go away?	• Migraines typically respond to analgesic medications, dark, quiet room, cool compress, or sleep. • Chronic tension-type headaches may respond to sleep (but not to analgesic medications).
Are there associated symptoms?	• Neurologic deficits (eg, ataxia, altered mental status, binocular horizontal diplopia) may indicate increased intracranial pressure and/or a space-occupying lesion. • Fever may indicate infection, or rarely intracranial hemorrhage. • Stiff neck may indicate meningitis, complicated pharyngitis, or intracranial hemorrhage. • Localized pain may indicate localized infection (eg, otitis media, pharyngitis, sinusitis, dental abscess). • Autonomic symptoms (eg, nausea, vomiting, pallor, chills, flushing, fever, dizziness, syncope, etc) may indicate migraine or cluster headache. • Dizziness, numbness, and/or weakness may occur with idiopathic intracranial hypertension.
Do symptoms continue between headaches?	• Persistence of symptoms (neurologic symptoms or nausea/vomiting) between headache episodes is suggestive of increased intracranial pressure and/or mass lesions. • Resolution of symptoms between episodes is characteristic of migraine headaches.
Headache burden	

Do the headaches impair normal functioning (eg, school attendance, activity) and quality of life?	Children with chronic nonprogressive headaches have frequent school absences; impaired function may warrant referral.
Additional information	
Past medical history	Certain underlying conditions increase the likelihood of intracranial pathology (eg, sickle cell disease, immune deficiency, malignancy or history of malignancy, coagulopathy, cardiac disease with right-to-left intracardiac shunt, head trauma, neurofibromatosis type 1, tuberous sclerosis complex).
Medications and vitamins	Medications that may cause headache include oral contraceptives, glucocorticoids, selective serotonin reuptake inhibitors, and serotonin-norepinephrine reuptake inhibitors, among others. Medications associated with idiopathic intracranial hypertension include growth hormone, tetracyclines, vitamin A (in excessive doses), and withdrawal of glucocorticoids.
Recent change in weight or vision	May be associated with intracranial process (eg, pituitary tumor, craniopharyngioma, idiopathic intracranial hypertension).
Recent changes in sleep, exercise, or diet	May precipitate headaches; may be associated with mood disorder.
Change in school or home environment	May be a source of psychosocial stress.
Family history of headache or neurologic disorder	Migraine headaches and some tumors and vascular malformations are heritable.
What do child and parents think is causing the pain?	Indicates their levels of anxiety about the headache.
Mental health history/symptoms, psychosocial stressors	Chronic nonprogressive headaches may be associated with depression or anxiety.

Information compiled from:

1. *Lewis DW, Koch T. Headache evaluation in children and adolescents: When to worry? When to scan? Pediatr Ann 2010; 39:399.*
2. *Rothner AD. The evaluation of headaches in children and adolescents. Semin Pediatr Neurol 1995; 2:109.*
3. *Strasburger VC, Brown RT, Braverman PK, et al. Headache. In: Adolescent Medicine A Handbook for Primary Care, Lippincott Williams & Wilkins, Philadelphia 2006. p.25.*

Important aspects of the examination of a child with headache

Examination feature	Possible significance
General appearance	Altered mental status may indicate meningitis, encephalitis, intracranial hemorrhage, elevated intracranial pressure, hypertensive encephalopathy.
Vital signs	• Hypertension may cause headache or be a response to increased intracranial pressure. • Fever suggests infection (most commonly upper respiratory infection) but may occur with intracranial hemorrhage or central nervous system malignancy.
Head circumference	Macrocephaly may indicate slowly progressive increases in intracranial pressure.
Height and weight	Abnormal or altered trajectories may indicate intracranial pathology.

trajectories	
Auscultation of the neck, eyes, and head for bruit	Bruit may indicate arteriovenous malformation.
Palpation of the head and neck	• Localized scalp tenderness may occur in migraine and tension-type headaches. • Scalp swelling may indicate head trauma. • Sinus tenderness may indicate sinusitis. • Temporomandibular joint (TMJ) and/or masseter tenderness suggests TMJ dysfunction. • Nuchal rigidity may indicate meningitis. • Posterior neck pain may indicate an anatomic abnormality (eg, Chiari malformation). • Thyromegaly may indicate thyroid dysfunction.
Visual fields	Visual field abnormalities may indicate increased intracranial pressure and/or a space-occupying lesion.
Funduscopy	• Papilledema may indicate increased intracranial pressure. • Retinal hemorrhages may indicate increased intracranial pressure or head trauma.
Otoscopy	May demonstrate otitis media; hemotympanum may indicate trauma.
Oropharynx	Signs of pharyngitis? Dental decay or abscess?
Neurologic examination (see text for details)	Abnormal neurologic examination (particularly mental status, eye movements, papilledema, asymmetry, coordination disturbance, abnormal deep tendon reflexes) may indicate intracranial pathology but also may occur with migraine headache.
Skin examination	Signs of neurocutaneous disorders (eg, neurofibromatosis, tuberous sclerosis complex, which are associated with intracranial neoplasms) or trauma (bruises, abrasions, etc).
Spine	Signs of occult spinal dysraphism (eg, midline vascular of pigment changes), which may be associated with structural abnormalities (eg, Chiari malformation).

Data from:

1. *Great Ormond Street Hospital for Children Clinical Guideline. Headache. http://www.gosh.nhs.uk/clinical_information/clinical_guidelines/cmg_guideline_00045. Accessed on March 29, 2011.*
2. *Lewis DW, Koch T. Headache evaluation in children and adolescents: When to worry? When to scan? Pediatr Ann 2010; 39:399.*
3. *Newton RW. Childhood headache. Arch Dis Child Educ Pract Ed 2008; 93:105.*

Pediatric headache diary

Date / time start / time finish	Location* / quality•	Severity$^{\Delta}$	Symptoms before headache$^{\diamond}$	Trigger(s)§	Associated features$^{¥}$	Relieving factors

* Left side, right side, both sides, front, back, behind eye, all around head.
• Throbbing (pulsating), dull, squeezing/tightening, splitting, stabbing, etc.
Δ Rate from 1 to 10, with 10 being the most severe.
◇ Flashing lights, blind spots, blurred vision, nausea, numbness, tingling, etc.
§ Foods, odors, light, heat, exercise, traveling in car, lack of sleep, etc.
¥ Nausea, vomiting, numbness, tingling, weakness, etc.
‡ Medication (including dose), sleep, inactivity, darkness, cold compresses, etc.

Management of migraine headache in children

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INFORMATION FOR PATIENTS — UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Beyond the Basics topic (see "Patient information: Headache in children")

RECOMMENDATIONS — Because of the paucity of definitive data in children, the management of migraine headache varies among clinicians. The following recommendations represent our suggested approach.

General — The patient and family should be educated about the management of migraine headache. A headache calendar should be maintained in order to identify triggering factors and to document response to treatment. Precipitating factors, if identified, should be avoided. When symptoms develop, the child should rest and/or sleep in a quiet dark room with a cool cloth applied to the forehead. (See 'General measures' above.)

Abortive treatment recommendations

- For children with acute migraine headache, we suggest initial abortive treatment with an analgesic, either acetaminophen or ibuprofen, both of which have proven efficacy for migraine in children in randomized, controlled trials. The initial choice depends upon individual preference. If the patient does not respond to one, the other can be tried. (See 'Abortive treatment' above.)

  Ibuprofen is given in an initial dose of 10 mg/kg. This dose may be repeated in four to six hours if needed. No more than four doses should be given in 24 hours (maximum daily dose 40 mg/kg). Alternatively, acetaminophen can be given in a dose of 10 to 20 mg/kg (usually as one or two 325 mg tablets), with a maximum dose of 1000 mg. This may be repeated in two to four hours if symptoms persist but should not exceed three doses in 24 hours. (See 'NSAIDs and acetaminophen' above.)

  An antiemetic is given to children with nausea and vomiting. We prefer promethazine in a dose of 0.25 to 0.5 mg/kg rectally and repeat as needed at intervals of four to six hours. (See 'Antiemetics' above.)

- For children who have acute migraine headache without vomiting that is refractory to analgesics, we suggest initial treatment with oral triptans. Our preferred agent is oral sumatriptan starting at 25 mg, with a maximum dose of 50 mg. For children who do not respond to oral sumatriptan, alternatives include rizatriptan (5 mg wafer), zolmitriptan (2.5 or 5 mg), and almotriptan (6.25 or 12.5 mg). For

adolescents with migraine who have early nausea or vomiting, we prefer the orally disintegrating tablet formulations of zolmitriptan and rizatriptan. (See 'Oral triptans' above.)

- In children at least five years of age, if analgesics do not provide relief or if persistent vomiting precludes the use of oral medications, we suggest a trial of sumatriptan nasal spray due to its proven efficacy in randomized, controlled trials in adolescents. In addition, it is generally more tolerable to children than an injection. We prefer to start with 5 mg and repeat once in four to six hours if initially effective but the headache returns. If there is no benefit, 10 mg nasal spray (two 5 mg units given together) may be tried. We suggest similar doses of nasal spray in older children, with a maximum daily dose of 20 mg. One limitation to nasal sumatriptan is the associated bad taste, which limits its acceptability in children. This problem can be mitigated by having children suck on a piece of hard candy. (See 'Nasal sumatriptan' above.)

- As alternative, zolmitriptan 5 mg nasal spray can be used, given the randomized clinical trial evidence cited earlier that this agent is safe and effective for the treatment of migraine in adolescents. In the clinical experience of some experts, zolmitriptan nasal spray has a less objectionable taste than sumatriptan nasal spray. (See 'Nasal zolmitriptan' above.)

Prophylactic treatment recommendations — Prophylactic treatment is used when headaches are frequent (more than four times per month) or if severe and prolonged headache results in frequent school absences or prevents important daily activities. (See 'Prophylactic treatment' above.)

In the absence of better evidence from clinical trials, we suggest the following approach:

- In children younger than six years of age, we suggest cyproheptadine (Periactin) in a dose of 4 to 12 mg per day, given orally once at bedtime. (See 'Cyproheptadine' above.)

- In older children, we suggest propranolol in a starting dose of 1 mg/kg in three divided doses, with a maximum dose of 4 mg/kg per day. Heart rate and orthostatic blood pressure should be monitored periodically. The heart rate should be >60 bpm after one minute of exercise. This drug is often discontinued by children who participate in strenuous physical activities. (See 'Beta blockers' above.)

- If propranolol is not well tolerated, we suggest valproate for prophylaxis. Valproate is given primarily to boys older than five years of age. We suggest **not** using this drug in adolescent females because of concerns about weight gain and polycystic ovary syndrome. Prior to use, the potential side effects are discussed with the parents and child. Valproate is started in a dose of 10 to 15 mg/kg in two to three divided doses orally. The dose can be increased in increments of 15 mg/kg to a maximum dose of 60 mg/kg per day. Serum valproic acid concentration should be monitored every three to six months to document compliance and to help adjust doses to avoid toxicity. Complete blood counts, liver function tests, and electrolyte concentrations also should be monitored periodically. (See 'Valproate' above.)

- If there is a mixed headache disorder or possible depression, we suggest amitriptyline, starting with a single daily 5 mg oral dose, given at night. If frequent headaches persist, the dose is advanced slowly by 5 mg increments, with at least two weeks between changes. The dose should rarely exceed 60 mg daily. An electrocardiogram should be obtained before using higher doses. (See 'Amitriptyline' above.)

- Where available outside the United States, flunarizine 5 mg daily is a reasonable first line agent, but weight gain and drowsiness are significant side effects. (See 'Flunarizine' above.)

- Biofeedback and relaxation techniques may be helpful. (See 'Biofeedback and relaxation techniques' above.)

REFERENCES

Pediatrics in Review Vol. 20 No. 2 February 1999

TABLE 5. Drug Dosages in the Treatment of Migraine

Acute Episode	
Simple analgesics	
Acetaminophen	Initial dose of 20 mg/kg PO followed by 10 to 15 mg/kg q 4 h up to a maximum dose of 65 mg/kg per day (maximum, 3,000 mg/day)
Ibuprofen	*1 to 12 years:* 10 mg/kg PO q 4 to 6 h *More than 12 years:* 200 to 400 mg PO q 4 h; maximum dose, 1,200 mg/day
Naproxen	5 mg/kg PO q 12 h; maximum dose, 750 mg/day
Antiemetics	
Promethazine	Initial dose of 1 mg/kg PO (maximum, 25 mg); can be repeated at doses of 0.25 to 1 mg/kg q 4 to 6 h
Metoclopramide	0.1 to 0.2 mg/kg PO (maximum, 10 mg)
Chlorpromazine	1 mg/kg IM for severe attacks
Other Drugs	
Sumatriptan	6 mg SC
Dihydroergotamine mesylate	0.5 to 1 mg IV over 3 min in children >10 y. Can be repeated q 8 h. Often used in combination with metoclopramide.
Prophylactic Agents	
Amitriptyline	*6–12 years:* 10 to 30 mg/day bid *Adolescents:* 10 to 50 mg/day tid
Cyproheptadine	*Less than 6 years:* 0.125 mg/kg bid or tid; dose should not exceed 12 mg/d *6–14 years:* 4 mg bid or tid; dose should not exceed 16 mg/d
Propranolol	1 to 4 mg/kg per day; start at low dose and increase slowly
Riboflavin	400 mg/day as a single dose

The 2004 AAN treatment parameter for migraine in children and adolescents recommended that **nasal sumatriptan** be considered for acute treatment; however, data were lacking to make a decision regarding the available oral triptans at that time. The more recently released European guidelines discuss 3 different triptans for use in children but no specific one was recommended.

Currently, 6 of the 7 available triptans have been studied for efficacy and safety in the pediatric population; however, only a few well controlled clinical studies have been conducted. Sumatriptan has the most available data on outcomes in general, with nasal sumatriptan showing the most positive results. Nasal sumatriptan is approved in children older than 12 years of age in Europe. **Oral sumatriptan** does not show any clinical benefit versus placebo in children. Rizatriptan and zolmitriptan have conflicting efficacy and safety data, with most studies favoring the use of **oral rizatriptan** and **nasal zolmitriptan**. **Almotriptan** is the first triptan to obtain a US FDA indication in adolescents with migraines lasting 4 or more hours. This approval was based upon two studies, one large clinical trial and one very small, open-label, pilot study. At this time, there are insufficient data to recommend **naratriptan, eletriptan,** or **frovatriptan** for first- or second-line use in pediatric patients with migraines. Adverse effects of triptans and pharmacokinetic data in children and adolescents are similar to those in adults. (Pediatric Drugs: Dec 2010 - Volume 12 - Issue 6 - pp 379-389).

Headache Quiz

1. Name the **"red flag" symptoms** of headache.

Box 1 Red flag features leading to serious consideration of further investigation

- Headache worse in recumbency or with coughing and straining.
- Headache waking up child (note the difference between headache present on awakening which is not uncommon in migraine).*
- Associated confusion, and/or morning or persistant nausea or vomiting.
- Recent change in personality, behaviour or educational performance.
- Physical signs to include field defect, short stature or cranial bruit; cerebellar signs and signs of raised intracranial pressure.

*Many people with a migraine wake and then feel the gradual onset of head pain as opposed to being woken by severe pain which could well represent a space-occupying lesion.

Arch Dis Child Educ Pract Ed 2008;**93**:105–111.

2. Name 3 "**periodic syndromes**" thought to be associated with migraine headaches.

-Cyclical vomiting: Stereotypical episodes of vomiting regarding onset (acute) and duration (hours to days) AND the absence of nausea and vomiting between episodes.

-Abdominal migraine: Recurrent episodes of abdominal pain, midline or poorly localized, dull and moderate to severe intensity. Often associated with N/V.

-Benign Paroxysmal Vertigo: Brief attacks of positionally-induced vertigo most often observed in preschool children. Often associated with rapid eye movements, dizziness.

3. Define **chronic daily headaches**. What are associated co-morbid conditions?

HA present for >15 days/month over 3 months lasting (often > 4hrs/day); associated with sleep disturbance, worsening anxiety/mood, and school absence.

4. **Complicated Migraine** is a migraine associated with transient focal neurologic abnormality; the first episode **should**/should not be evaluated with head CT or MRI.

5. Fill in the following **Migraine Management Table**, starting with 1st-line options:

Abortive Treatment	**Prophylactic Treatment:** Indicated when **HA freq> 4/month**
1. Motrin, TLN, ± Phenergan	1. Periactin (< 6 yrs)
2. Oral Triptans (tablet or dissolvable)	2. Propranolol (older children)
3. Triptan nasal spray (>5 yrs)	3. AEDs (VPA, Topamax)
	4. Amitriptyline (? Depression)

6. What is the **outcome** for childhood headaches?

In one study, 100 children and adolescents were seen 8 years after initial visit. Remission occurred in 44% with tension HA and 28% with migraine HA. In a study of children with CDH, it persisted in 25% at 2 years and 12 % at 8 years.

Headache *Mega*-Case

Lucy is a healthy 16 yo female who presents as a walk-in to the Adolescent Clinic with complaint of a "HORRIBLE headache" that started this morning. She describes the headache as sharp, stabbing pain behind her eyes. Since waking up this morning, it has gotten progressively worse. She says that she was unable to eat breakfast this morning due to nausea. She took 200mg of Motrin before school with minimal relief. She called her Mom to pick her up after lunch because she was unable to concentrate in calculus class. She has had similar headaches in the past. On ROS, Lucy admits to nasal drainage for the past 4-5 days and occasional chills. She denies fever, emesis, focal weakness or loss of consciousness.

What *general* category/pattern of headaches do Lucy's symptoms fall under?
Hard to tell from this initial history . . . Likely **acute and recurrent**, but would need more history to determine whether possibly chronic non-progressive or chronic progressive *(See UtD table for HA Etiology Classification)*. Also need more H&P to determine **primary** vs. **secondary**.

List at least 3 diagnoses to consider in this patient based on the history:
- Migraines
- Tension headache *(Refer to UtD table for distinction between migraine & tension HA)*
- Headache associated with a viral illness
- Sinusitis

Less likely causes: space-occupying lesion, refractive error, post-traumatic HA, CNS infection

What additional history do you want to obtain from Lucy?
(Review UtD table—important components of HA history)
- Description of prior HA—frequency, severity, association with menses?
- Family history of migraines? (found in **80%** of cases)
- Associated symptoms – nausea, vomiting, photophobia/phonophobia, relieving factors, vision changes (blurry vision, double visions, scotomas), dizziness.
- Stressors in her life?
- Does she wear glasses?
- Red flag symptoms – Did headache wake her from sleep? Are sxs different from prior ones? *(Faculty-- Review UtD table for clinical features indicating intracranial pathology)*
- Any recent fevers? Recent travel?
- Any problems with blood pressure in the past?
- HEADSS exam—any drug use?

Lucy's headaches occur "maybe every other week?" since starting her period at 15. She endorses photophobia/phonophobia with her headaches. Generally, she has mild nausea with the headaches and occasionally experiences vomiting. Typically, these headaches last 4-5 hours and resolve with sleep. Lucy's mother has a history of similar headaches for which she treats with "some sort of injection". Lucy's HEADSS exam is unremarkable; although, she provides only brief answers to your questions due to her discomfort.

Her physical exam is as follows:

VS: T 100.5, HR 98, BP 118/77, RR 20, SaO2 100%

On exam, she is wearing dark sunglasses – when she removes the sunglasses, you notice dark circles under her eyes. Neuro: PERRLA, EOMI, CN 2-12 intact, normal cerebellar function and DTR's are also normal. No cranial bruits appreciated. VA 20/20 OU.

(Faculty—Review UtD table for other KEY physical exam findings)

What is the most likely diagnosis and why? Does she have chronic daily headache?

- **Migraine headaches.** Using IHS criteria, she likely fits "migraine without aura" (at least 5 attacks; lasts 4-72 hrs; characterized by severe pain causing avoidance of physical activity; associated with N/V/photo/phonophobia). *See UtD table of IHS criteria.*
- **Not CDH**—although >3 months of symptoms, not >15 days/month.

Is the location of Lucy's headaches unusual, given your most likely diagnosis? No— the typical unilateral pattern in adults is often not seen in children. Commonly bilateral in young children. Unilateral in 60-70% of young adults and adolescents, and bifrontal or global in 30%.

Is this the end of your evaluation? Why or why not? Yes . . .

- No lab testing is needed to support the diagnosis of migraines.
- Neuroimaging is not needed given none of the following: abnormal neuro exam; recent onset of severe HA; change in type of HA; suspicion of meningitis or other intracranial process; underlying disease that predisposes to intracranial pathology)

What *non-pharmacologic* measures could you suggest to Lucy to manage her symptoms?

- Manage expectations **–** Educate your patient that the frequency and severity of headaches may decrease over weeks to months of therapy, but the headaches may continue.
- Return to school, if possible.
- Headache diary –helps identify any specific triggers of headaches. *(See UtD for example)*
- Identify headache triggers and avoid if possible – inadequate hydration; poor sleep (too much, too little, napping); stress, **certain foods** (e.g. **caffeine, chocolate, aged cheese, alcohol, meats with nitrates, foods with MSG, ice cream**)
- Daily exercise for 20-30 minutes.
- Biofeedback therapy, guided imagery, acupuncture, hypnosis, massage, counseling, etc.

What *pharmacologic* measures will you recommend *today*? What are possible side effects?

- Abortive therapy with **Motrin**—increase initial dose to 400mg and instruct to take q4h with max daily dose of 1200mg. *Do not take more than **2 days/week** for risk of medication-overuse headache.*
- Add **anti-emetic** (Phenergan, Reglan, Compazine), given vomiting history.
- If truly refractory to Motrin (or Tylenol), start with PO **Sumatriptan**. Start with 25mg. (*UpToDate* says repeat in 20min; *Harriet Lane* says repeat in 2hr to max 200mg/day).

Does Lucy need long-term therapy for her headaches? If so, what would you recommend?
This is up for discussion. . . According to UpToDate: "Prophylactic agents may be necessary for children with headaches > 4x/mo or headaches that adversely affect the child's activities." One could argue that Lucy's migraines adversely affect her activities. However, it may be prudent to do 2-4 wk trial of adequate abortive therapy before starting prophylaxis.

If you decide to proceed with long-term therapy, what is your duration of treatment?
This is also up for discussion . . . The approach presented in the UpToDate article is 6-12 months of prophylaxis, then tapered over several weeks.

When would you refer and to whom?

- Consider referral to Peds Neuro if HA is refractory to above abortive and prophylactic therapy options. *After referral, however, it is important to "recapture" patient and help with implementation of Neurology plan.*
- Consider referral to Behavioral Health or Adolescent Medicine *IF* mood or anxiety symptoms become more prominent as treatment progresses.

How would your diagnosis change with the following history?

a) Her temperature is 102.9 and she appears confused. Consider **CNS infection** (e.g. encephalitis, encephalopathy, meningitis).
b) Her headaches are worse in the morning; she has recently developed problems with peripheral vision. Consider **space-occupying lesion**.
c) She has unilateral pain with lacrimation on one side; the headaches appear at approximately the same time every day. Consider **Cluster headache**. *(See UtD table for differences between cluster and migraine HA.)*
d) She has a 3-day history of fevers ranging 100.2-101.8 and a history of seasonal allergies. Consider **sinusitis**.

Headache Board Review

1. 1. A 17-year-old girl presents with complaints of recurring headaches that are becoming more frequent. She was diagnosed with migraine headaches 2 years ago. Previously she had an average of one migraine per month, but she now has one per week. She has no double vision, vomiting, or awakening from sleep with headaches. Headaches can occur at any time of day, are throbbing and bifrontal, and are associated with nausea and phonophobia. They are relieved by nonsteroidal anti-inflammatory drugs and by lying down in the dark. They rarely last more than 4 hours. The adolescent and her mother are concerned that the increased headache frequency could be due to a brain tumor or aneurysm.

Of the following, the MOST appropriate next step is:
A. brain magnetic resonance angiography to rule out aneurysm
B. brain magnetic resonance imaging to rule out brain tumor
C. head computed tomography scan with contrast to rule out brain tumor
D. lumbar puncture with manometry to rule out elevated intracranial pressure
E. perform no diagnostic testing at this time.

When evaluating a child who has a headache, the first decision point is whether to perform medical diagnostic testing, particularly neuroimaging such as head computed tomography (CT) scan or brain magnetic resonance imaging (MRI). This decision is based on an assessment of the likelihood of a primary headache (eg, migraine, tension, cluster) or a secondary headache (due to disease). Primary headaches are painful paroxysmal events occurring in isolation or, more commonly, as part of a chronic, recurring pain disorder. No underlying lesion is causing the pain. Most children, adolescents, and adults presenting to the primary care physician with headache, including the girl described in the vignette, have primary headaches, and no medical diagnostic testing is needed as part of validated standard of care.

A family history of aneurysms may increase the risk for aneurysms (and anxiety), but it is not an indication for neuroimaging testing for aneurysms in a patient younger than age 30 years. However, because cigarette smoking increases the risk for aneurysmal rupture, this is a good opportunity to remind families about the dangers of smoking.

Most brain tumors are sporadic primary tumors or metastatic, not familial, and, therefore, a family history of brain tumors is not an indication for neuroimaging in most cases. In the absence of symptoms and signs of elevated intracranial pressure or meningitis, lumbar puncture is not needed.

Imaging studies (CT scan, MRI, and occasionally magnetic resonance angiography), sometimes followed by lumbar puncture with manometry, are indicated when there is suspicion of intracranial disease (eg, tumor, aneurysm) or other medical processes, particularly processes that increase intracranial pressure. Symptoms that may herald the presence of secondary headache include pain awakening from sleep, pain relieved by vomiting, and pain increased by the Valsalva maneuver. Additional symptoms such as new binocular double vision, any focal numbness or weakness, or loss of coordination should prompt an investigation. Secondary headaches are more likely in the presence of abnormal signs such as papilledema, acquired (new) ocular malalignment with double vision, stiff neck, limb weakness, or ataxia.

2. A 16-year-old girl who is new to your practice complains of a nearly constant headache for the past year. She describes the pain as a band around her head that often is throbbing and is worse during the middle of the day. She denies nausea or vomiting but reports occasional fatigue. There is no family history of headaches. She has missed more than 20 days of school this year because of the headache, and she is struggling to maintain a C average. She admits to hating school and does not participate in

extracurricular activities because she "doesn't like anything." Findings on her physical examination, including complete neurologic and fundoscopic evaluation, are normal.

Of the following, the BEST next step in the management of this girl's headaches is to
A. advise her to keep a headache diary and return in 2 months
B. obtain a lumbar puncture
C. obtain computed tomography scan of the brain
D. prescribe oral sumatriptan
E. refer her for psychosocial evaluation and counseling

Chronic headache is a common complaint in children and adolescents. A careful history and complete neurologic examination are indicated in the evaluation of headache. The most important initial consideration is to identify characteristics of the headache that suggest serious diagnoses, such as brain tumors or other diseases causing increased intracranial pressure.

Such characteristics include worsening pain at night or immediately upon awakening, association with vomiting, and worsening pain with coughing or straining. Papilledema or focal neurologic findings may be found in patients who have increased intracranial pressure or the examination results may be normal. Migraine headaches are periodic, may be accompanied by an aura, and typically are relieved by sleep. A family history of migraines usually can be elicited. The neurologic examination typically yields normal results, although complicated migraines can be accompanied by focal neurologic deficits such as hemiparesis, cranial nerve palsies, and visual disturbances.

Pain from stress-related or tension headache generally is diffuse and may be described as "bandlike" or throbbing, as reported for the girl in the vignette. Pain usually occurs on most days, and school absence is frequent. The neurologic examination yields normal results.

It is also very important for the clinician to obtain further information regarding any emotional, social, or academic difficulties the patient may be experiencing. Such data can help to determine both an underlying cause for the headache and the effect the headache is having on the child's quality of life. Family stressors and depression are known causes of headache, and questions regarding sleep patterns, anhedonia, school performance, and relationships with family and friends can help to screen for these conditions. Studies have shown that children and adolescents who have frequent or severe headaches have greater impairment in academic and social functioning than those who do not have headaches. A thorough psychosocial evaluation can aid in evaluating patients for depression and assessing the effect of headaches on their daily functioning. Nonpharmacologic therapies, such as rest, relaxation techniques, and removal of stress from the environment, can be effective once the stress is identified.

Advising the girl in the vignette to keep a diary for 2 months likely would prolong her difficulties and not address the underlying cause of her headaches. Lumbar puncture and computed tomography scan of the brain may play some role in the evaluation of an acute headache, especially if meningitis or a mass lesion of the brain is suspected, but these diagnoses are very unlikely in a patient who has had a headache for a year and normal results on neurologic examination. Oral sumatriptan is used in the treatment of migraine, but this girl's history points to depression or another psychological cause for her headache, and prescribing medications without a psychosocial evaluation probably would not be effective.

3. A 14-year-old girl who has a 1-year history of migraine headaches presents to the emergency department with a severe headache that she calls "the worst headache of my life." The headache occurred suddenly after she lifted a heavy box. Her mother says that the girl has been holding her head stiffly. On physical examination, she appears in severe pain and has meningismus. Other findings on the physical examination are normal.

Of the following, the MOST appropriate initial course of action is
A. emergent noncontrast head computed tomography scan
B. intravenous administration of ceftriaxone
C. intravenous administration of dihydroergotamine
D. lumbar puncture
E. oral administration of sumatriptan

Although severe headaches in adolescents are often due to migraine, four key findings from the history provided by the girl described in the vignette indicate that she is experiencing a "symptomatic" headache (ie, headache due to an underlying disease) instead of a migraine headache. These findings are: 1) her description of this headache as “the worst ever,” 2) its abrupt onset, 3) the onset during a “Valsalva maneuver” (heavy lifting), and 4) the stiff head/neck position. These features are characteristic of a subarachnoid hemorrhage (SAH), likely a small hemorrhage at this point, because the girl is still conscious.

In contrast, migraine headaches, which are common in children and adolescents, are recurrent headaches often associated with nausea, dizziness, and photo- or phonophobia. They represent an “idiopathic” chronic recurrent headache disorder, meaning that no space-occupying lesions (tumors, vascular malformations) are causing the pain. In “symptomatic” headaches, the pain is a symptom of an underlying disease process.

Head computed tomography (CT) scan is the preferred diagnostic modality for the girl in the vignette because it is fast, noninvasive, and highly sensitive to blood and structural lesions causing pain. Of note, CT findings are normal in patients whose headaches are caused by pseudotumor cerebri.

Although this girl has nuchal rigidity, which occurs in meningitis, she is afebrile, and her symptoms began abruptly while lifting, which should not be related to central nervous system infection. Accordingly, ceftriaxone treatment is not appropriate at this point. Intravenous administration of dihydroergotamine might be appropriate treatment for a severe migraine headache, not for the symptomatic headache described for the girl in the vignette. For the same reason, oral sumatriptan is not the appropriate initial therapy. Although a lumbar puncture eventually may be necessary, it should not be the initial diagnostic test because it is invasive and may be unsafe in the presence of a focal lesion. Because the history suggests SAH and the sensitivity of head CT in diagnosing this condition is at least 95%, CT should be the initial diagnostic test. If the suspicion for SAH is high and results of the CT are normal, lumbar puncture should be obtained to look for red blood cells.

4. A 15-year-old girl presents to the emergency department with a 4-week history of nasal drainage and face pain and a 2-week history of frontal headaches and fatigue. Her mother complains that her daughter has an "attitude" and has not been respectful or seemed to care about anything for the past 2 weeks. The daughter awoke this morning with a headache and vomited. On physical examination, the adolescent is afebrile and has normal vital signs. She responds slowly to questions and is not oriented to the date. She complains of pain to palpation of her cheeks and forehead. She has no nuchal rigidity and no focal weakness. The remainder of the physical examination findings are normal.

Of the following, the BEST initial diagnostic procedure is
A. computed tomography scan of the head with intravenous contrast
B. emergent electroencephalography to rule out nonconvulsive status epilepticus
C. lumbar puncture to rule out meningitis
D. nasal swab for bacterial culture
E. urine drug screen for barbiturates, amphetamines, and cocaine

The subacute onset of mental status changes described for the adolescent in the vignette warrants an emergency evaluation. In most cases, neuroimaging is indicated, along with appropriate laboratory testing.

The relatively nonspecific pain and what her mother perceives as common emotional problems (apathy in a teenager) probably represent early frontal lobe symptoms. The headache on awakening and vomiting are concerning for increased intracranial pressure (ICP). Confusion and psychomotor retardation on the mental status examination indicate involvement of the central nervous system. A focal, ischemic, ictal, infectious/inflammatory, or toxic/metabolic process must be identified urgently. A brain abscess is suggested by the prominent facial pain in this setting; the sinuses are a common source of brain abscesses. Brain abscesses often present only with nonspecific pain and not with fever.

Head computed tomography (CT) scan is preferred for this patient because the constellation of pain, confusion, and morning vomiting makes a focal intracranial mass a possibility. Increased ICP is associated with morning vomiting because ICP is highest in the morning. Contrast is recommended because of the insidious onset, which could indicate either a neoplasm or infectious process. Intravenous contrast is not needed for all neuroimaging procedures. However, it increases the diagnostic yield of imaging studies where either neoplasm or infection is suspected because both typically involve some degradation of the blood-brain barrier or hypervascularity, resulting in contrast enhancement at the site of the lesion.

Magnetic resonance imaging (MRI) with contrast also is a good choice. The advantage of MRI is higher spatial and soft-tissue resolution. Disadvantages of MRI compared with CT include: 1) less availability for emergency department studies; 2) need for pharmacologic sedation in agitated patients because sedation affects mental status, thereby masking disease-related mental status; 3) longer time in the scanner, which could delay treatment decisions; and 4) cost. Thus, in most cases, a head CT scan with contrast is preferred as the initial study in the emergency department.

Electroencephalography (EEG) is an important test for assessment of a patient who has encephalopathy of unclear cause to rule out nonconvulsive status epilepticus (NCSE), particularly if the patient is known to have epilepsy. If an EEG cannot be obtained rapidly, intravenous administration of 0.1 mg/kg lorazepam can treat NCSE immediately, although this would not clear confusion about other causes. For this adolescent, the facial pain makes the diagnosis of NCSE less likely than a brain abscess.

A lumbar puncture may be needed to rule out meningitis or encephalitis, but the pain and morning vomiting more strongly suggest the possibility of an intracranial mass. Lumbar puncture prior to head CT is not advised in this case because it could reduce pressure below the foramen magnum and result in herniation from the supratentorial mass. Toxicology screening and nasal swabs are reasonable but not the preferred initial diagnostic tests because they will not affect emergency management of the increased intracranial pressure.

5. A 10-year-old boy presents after falling from a second floor window onto the pavement 30 minutes ago. There was a 3-minute loss of consciousness initially, but he has been alert and talking to his mother during the ambulance ride to the hospital. On physical examination, the child has tenderness and a hematoma over the right parietal region of the head. Results of an initial complete neurologic examination are normal, but on subsequent examination 15 minutes later, the boy exhibits marked lethargy and slurred speech.

Of the following, the MOST likely explanation for his current symptoms is
A. Cerebral contusion
B. Concussion
C. Epidural hematoma
D. Subarachnoid hematoma
E. Subdural hematoma

The sequence of events described for the boy in the vignette after sustaining the blow to the head is an initial loss of consciousness, followed by a lucid interval, followed once again by an alteration in the level of consciousness. This "waxing and waning" the level of consciousness is typical of an epidural hematoma. The rapid increase in intracranial pressure that results when the origin of the bleeding is a damaged artery can cause acute deterioration of the patient. Prompt recognition of the injury is critical to providing appropriate medical or surgical intervention.

A concussion is a head injury that causes at least temporary neurologic dysfunction, often with loss of consciousness of 1 minute or less. These injuries may be associated with abnormal findings on computed tomography (CT) of the head, but often the findings are normal. A cerebral contusion represents direct injury to the brain parenchyma and can be seen with CT. A subdural hematoma results from bleeding from bridging veins or dura and can lead to increased intracranial pressure, as seen with epidural hematomas. Deterioration generally is not as rapid as with an epidural hematoma and may occur hours to days after the initial injury. Subarachnoid hemorrhage is common with severe brain injury and leads to blood in the cerebrospinal fluid. This type of bleeding can cause vasospasm and ischemic brain injury. All of these injuries can be associated with an initial loss of consciousness and later deterioration, but the rapid progression of the symptoms in the patient in the vignette makes these alternative diagnoses less likely.

6. A 13-year-old girl has had 5 days of unremitting headache that is relieved by vomiting but not sleep and 1 day of double vision. She was previously healthy and has no history of migraine headaches, but she was treated for otitis media 6 weeks ago. Findings on physical examination are normal except for some tenderness over her left mastoid. On neurologic examination, you note normal mental status and normally reactive pupils and vision but florid papilledema. She cannot abduct her right eye fully and has subjective double vision with both eyes open looking to the right but not looking to the left or with either eye covered. Facial sensation and movements are normally symmetric, and the rest of the findings are normal. Head computed tomography scan yields normal results.

Of the following, the diagnostic test or procedure that is MOST likely to be helpful is:
A. brain magnetic resonance imaging
B. cerebral angiography
C. lumbar puncture with manometry
D. ocular nerve sheath fenestration

The girl described in the vignette has unremitting head pain that improves transiently after vomiting but not sleep. In addition, she has a new symptom of double vision when looking to the right, not left, an acquired ocular malalignment consistent with a right 6th nerve palsy. The lack of facial weakness or facial sensory loss suggests that this symptom comes from outside of the brainstem. Funduscopic examination reveals bilateral papilledema. This complex of symptoms is characteristic of raised intracranial pressure due to pseudotumor cerebri. Diagnosis and treatment are needed to reduce pain and prevent visual loss.

An urgent head computed tomography (CT) scan in the emergency department showed normal findings. This rules out hydrocephalus or a mass lesion but does not rule out elevated intracranial pressure. The

most helpful procedure to determine this finding is a lumbar puncture with manometry. Manometry pressure measurement should be obtained with the child in the lateral decubitus position, with legs relaxed. A pressure greater than 20 cm H2O confirms the clinical impression of elevated intracranial pressure and relieves the pressure. The pressure often remains low for several days because cerebrospinal fluid drains into the soft tissues around the lumbar puncture site. Cerebrospinal fluid studies should include assessment of protein, glucose, and cell count. Bacterial, fungal, and Mycobacterium tuberculosis studies as well as cytology for malignancy may be indicated in some cases.

The differential diagnosis of pseudotumor cerebri includes complications of obesity; adverse effects of medications such as minocycline, isotretinoin, or steroids; hypervitaminosis A; venous sinus thrombosis; anemia; renal failure; and hypercalcemia.

The recent history of otitis media and current pain over the mastoid described for the girl are consistent with mastoiditis. The cause for her pseudotumor was venous sinus thrombosis. This may be apparent on head CT scan, but magnetic resonance imaging (MRI) with contrast and with venography is more sensitive for detection than head CT or routine MRI.

Cerebral angiography typically is used to characterize arterial vascular pathology. However, this invasive procedure is undertaken infrequently because of improvements in magnetic resonance angiography. Ocular nerve sheath fenestration is performed occasionally as a longer term treatment for refractory pseudotumor cerebri to reduce pressure on the eyes and preserve vision. Serum vitamin A measurement is reasonable after lumbar puncture as part of the evaluation for causes of intracranial hypertension.

7. A 14-year-old boy who was diagnosed with migraines at age 11 presents to the emergency department with a severe migraine. For the past 2 months, he has had two to three such headaches per week. His mother asks about using stronger pain medications. You are concerned about the possible complications of medication overuse.

Of the following, the class of abortive medications MOST likely to induce chronic headaches is:
A. caffeine-containing medications
B. isometheptene compounds
C. nonsteroidal anti-inflammatory drugs
D. opiates
E. triptans

Opiates and barbiturates are more likely than caffeine-containing medications, isometheptene compounds, nonsteroidal anti-inflammatory drugs (NSAIDs), or triptans to cause chronic headaches due to overuse of medications. Medication overuse headache is the third most common type of chronic headache after migraine and tension headache. Most often, it results from NSAID use because NSAIDs are the most widely used agents for headaches. However, the probability of medication overuse headache is higher with opiates.

Medication withdrawal headache is a huge public health problem and a factor involved in chronic daily headache for many adolescents. The only effective treatment is withdrawal of the medication. Although less common than with opiates, medication overuse headache may occur with over-the-counter analgesics, triptans, ergotamines, and combination analgesics with caffeine.

Other well-known complications of medications used to treat headache include constipation with opiates, tolerance with benzodiazepines, and gastrointestinal distress with NSAIDs.