Headache in Children

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Practice Gap

Headache is a common complaint in children and adolescents. Although an efficient, organized, and methodical approach to the patient's history and physical examination is essential, many practitioners are not familiar with a best practices approach to headache. This can result in difficulty with decision making regarding further testing, such as brain imaging, as well as treatment options.

Objectives

After completing this article, readers should be able to:

1. Recognize key elements of the history and physical examination associated with headaches of various etiologies.
2. Understand the role of neuroimaging in the evaluation of headache in children.
3. Describe the appropriate management of headaches and the roles of abortive therapy and preventive therapy in patients with recurrent headaches.

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ABBREVIATIONS

ICHD-3	third edition of the International Classification of Headache Disorders
IV	intravenous
MRA	magnetic resonance angiography
MRI	magnetic resonance imaging
MRV	magnetic resonance venography
NSAID	nonsteroidal anti-inflammatory drug
OTC	over-the-counter
PedMIDAS	Pediatric Migraine Disability Assessment

INTRODUCTION

Headache is a common complaint in children and adolescents and many times leads to much anxiety for the practitioner and the parents. Therefore, it is important for providers to understand the approach to evaluation of headache. A thorough headache history and a focused neurologic examination are critical and, in most situations, allow the provider to distinguish between primary headache disorders (eg, migraine, tension, or chronic daily headache) and secondary headache disorders (eg, those seen with brain tumors, pseudotumor cerebri syndrome, chronic meningitis, hydrocephalus, hypertension, or acute febrile illnesses). The performance of ancillary diagnostic testing depends on information obtained during data collection. (1)

HEADACHE HISTORY AND PHYSICAL EXAMINATION

The initial approach to the patient with headache begins with a focused set of headache-based questions (Table 1). (2) The answers to these questions allow the provider to begin to distinguish between features characteristic of a primary

TABLE 1. **Basic Headache Questions**

1. When did you first begin having headache(s)?
2. What is the temporal pattern of your headaches?
- sudden onset of first lifetime headache
- episodic headaches, normal in between
- frequent nonprogressive headaches
- gradually worsening headaches
- a mixture of daily headache with episodic worsening
3. Where does your head hurt with your headaches?
4. What do your headaches feel like (throbbing, pounding, stabbing, squeezing, etc)?
5. What do you do when you get a headache?
6. How long do your headaches typically last?
7. With your headaches do you have:
- nausea
- vomiting
- photophobia
- phonophobia
- dizziness
- numbness
- weakness
- double vision
8. Do you get a warning sign or can you tell a headache is coming on?
9. Has a headache ever awoken you at night or is present first thing on awakening?
10. Have you ever had a seizure?
11. Do any activities, foods, or medications make your headaches worse?

headache disorder and those suggestive of a secondary headache disorder and to determine whether neurodiagnostic testing is indicated.

Establishing how long the headaches have been occurring is crucial. Headaches secondary to pseudotumor cerebri syndrome or brain tumors typically worsen over several weeks and uncommonly persist for more than 6 months without the presence of overt neurologic examination abnormalities. (2) In a patient with 2 years of intermittent headache who is asymptomatic between bouts of headache, increased intracranial pressure is very unlikely. (3)

Next, the temporal pattern of the patient's headaches needs to be considered. An acute onset of headache in a patient with no headache history could be due to a febrile illness, whereas the fulminant severe onset of headache may suggest more ominous events, such as a subarachnoid or intraparenchymal hemorrhage. (3) In the latter instance, urgent brain imaging is recommended. Likewise, a child with progressively worsening headaches also warrants brain imaging. Conversely, recurring episodes of headaches lasting 1 to 4 hours with associated nausea and photophobia and/or phonophobia with periods of interval wellness is characteristic of migraine and usually does not warrant neuroimaging. Daily or near-daily headaches that have been present for longer than 3 months with frequent school absences suggest chronic daily headache, for example, chronic tension-type or chronic migraine headache or, more commonly, a mixture of both. This mixed headache pattern can be seen in up to 22% of children with headaches. (4)

Although the location and quality of migraine pain in adults is typically unilateral temporal and throbbing in nature, in children and young adolescents it is typically bilateral frontal or temporal. Young children frequently have difficulty describing the quality of their pain but may state that it feels like a hammer or their heart beating in their head. Occipital pain warrants careful consideration of the need for neuroimaging because although pain in this location may occur with migraine with brainstem aura, formerly called basilar-type migraine, it also may be seen with posterior fossa neoplasms and Chiari malformations.

A comprehensive headache history involves asking about red flag features because these headache features are associated with a higher rate of brain abnormalities and should raise concern for potential tumors, abscesses, increased intracranial pressure, vascular malformations, or intracranial bleeds. (2) In these cases, further diagnostic testing with neuroimaging is warranted. The type (computed tomography, magnetic resonance imaging [MRI], magnetic resonance angiography [MRA], magnetic resonance venography [MRV]) and timing of neuroimaging would be based on the patient's presentation. This list of red flags includes younger than 3 years of age; recent onset (<6 months) with a steadily worsening pattern (frequency or intensity); early-morning awakening with headache or vomiting; double vision; worsening of headache while straining; explosive onset; presence of seizures; associated mood, mental status, or school performance change; and neurocutaneous stigmata (café-au-lait macules, hypopigmented macules). (2)

Table 2 displays the common features seen with primary and secondary headaches, thus allowing the provider to construct a differential diagnosis for the patient's headaches based on data gathered from the history. After the history, a comprehensive physical examination in a patient with headaches includes careful attention to the blood pressure, a detailed neurologic examination, and funduscopy. The funduscopic examination is critical in the assessment for potential increased intracranial pressure. If a nondilated funduscopic examination is suboptimal, referral for dilated funduscopy is appropriate. The presence or absence of optic nerve edema is of paramount importance in determining whether the patient's headaches have a secondary etiology. Other key features on the neurologic examination include the pupillary response to light and extraocular motility. The presence of diplopia is another important feature seen with many secondary causes of headache. Facial strength and symmetry as well as motor strength and symmetry need to be assessed to exclude a hemiparesis or other motor abnormality suggesting focal pathology. Balance and coordination assessments address concerns for posterior fossa involvement, and symmetry of reflexes and gait complete the assessment for focal features that may suggest a secondary cause for the headaches.

PRIMARY HEADACHE DISORDERS

The third edition of the International Classification of Headache Disorders (ICHD-3) divides headaches into primary and secondary headaches. (5) Primary headaches are idiopathic or genetic disorders with no known secondary cause, in contrast to secondary headaches, which are headaches caused by external factors such as tumors, trauma, increased intracranial pressure, infection, or the effects of substances or medications. In most situations, the history and physical examination findings suggest a pattern compatible with a primary headache disorder. Familiarity with

TABLE 2. **Common Features Seen with Primary and Secondary Headaches**

HISTORICAL FEATURE	PRIMARY HEADACHE	SECONDARY HEADACHE
Length of illness	Chronic, >6 mo	Acute, subacute
Temporal pattern	Recurrent or daily	Progressive
Location	Frontal, temporal	Posterior
Quality	Throbbing, squeezing	Pressure
Time of day	Anytime	Early morning, awakening
Frequency/duration	Varied/hours to days	Constant
Nausea/vomiting	Nausea > vomiting	Vomiting > nausea
Visual aura/diplopia	Aura	Diplopia
Photophobia/phonophobia	+++	---

the spectrum of primary headache disorders that are seen in children and adolescents is important for the primary care provider for appropriate treatment options to be discussed. The diagnosis of primary headache disorders is clinical and based on the ICHD-3 diagnostic criteria (https://www.ichd-3.org/). (5)

Migraine

Migraine is the most common primary headache type seen in children, with an overall prevalence of 9.1% (6) and a range reported of 1.2% (young children) to 23% (adolescents), (1) and is one of the most common reasons for referral to a pediatric neurologist. Migraine is typically divided into migraine without aura and migraine with aura. (5) Approximately 20% of migraines can be associated with a preceding aura, which is typically visual but may include numbness, weakness, dysarthria, coordination difficulties, and confusion. (5) The impact that frequent migraines can have on a child or young adult is significant. Children with migraine, and in particular the subset with chronic daily headache, have lower quality of life scores on the Pediatric Quality of Life Inventory, similar to children with arthritis and cancer. (7)

The ICHD-3 criteria for the diagnosis of migraine without aura are as follows (5):

A. At least 5 attacks fulfilling criteria B through D
B. Headache attack duration of 2 to 72 hours for children younger than 18 years (untreated or unsuccessfully treated)
C. Headache has at least 2 of the following 4 characteristics: 1) unilateral or bilateral location in children younger than 18 years and often frontal, 2) pulsating quality, 3) moderate or severe pain intensity, and 4) aggravation by or causing avoidance of routine physical activity (eg, walking or climbing stairs)
D. During headache at least 1 of the following occurs: 1) nausea and/or vomiting and 2) photophobia and phonophobia
E. Not better accounted for by another ICHD-3 diagnosis

The ICHD-3 criteria for the diagnosis of migraine with aura are as follows (5):

A. At least 2 attacks fulfilling criteria B and C
B. One or more of the following 6 fully reversible aura symptoms: visual, sensory, speech and/or language, motor, brainstem, and retinal
C. At least 3 of the following 6 characteristics: 1) at least 1 aura symptom spreads gradually over 5 minutes or more, 2) 2 or more symptoms occur in succession, 3) each individual aura symptom lasts 5 to 60 minutes, 4) at least 1 aura symptom is unilateral, 5) at least 1 aura symptom is positive, and 6) the aura is accompanied, or followed within 60 minutes, by headache
D. Not better accounted for by another ICHD-3 diagnosis

Tension-Type Headache

Tension-type headaches are common in the pediatric population and, in general, are less severe than migraine headaches. Many patients with tension-type headaches may go unnoticed because often they do not bring it up as a primary concern at health-care visits.

The diagnostic criteria for infrequent episodic tension-type headache are as follows (5):

A. At least 10 episodes of headache occurring on fewer than 1 day per month on average (<12 days per year) and fulfilling criteria B through D
B. Lasting from 30 minutes to 7 days
C. At least 2 of the following 4 characteristics: 1) bilateral location, 2) pressing or tightening (nonpulsating) quality, 3) mild or moderate intensity, and 4) not aggravated by routine physical activity such as walking or climbing stairs
D. Both of the following: no nausea or vomiting and no more than 1 of photophobia or phonophobia
E. Not better accounted for by another ICHD-3 diagnosis

Chronic Daily Headache

Chronic daily headache is typically a combination of chronic migraine and chronic tension-type headaches. "Headache occurring on 15 or more days per month for more than 3 months which has the features of migraine headache on at least 8 days per month" is considered to be chronic migraine. (5)

The diagnostic criteria for chronic daily headache are as follows (5):

A. Headache (migraine-like or tension-type-like) on 15 or more days per month for longer than 3 months and fulfilling criteria B and C
B. Occurring in a patient who has had at least 5 attacks fulfilling criteria B through D for migraine without aura and/or criteria B and C for migraine with aura
C. On at least 8 days per month for more than 3 months, fulfilling any of the following: 1) criteria C and D for migraine without aura, 2) criteria B and C for migraine with aura, and 3) believed by the patient to be migraine at onset and relieved by a triptan or ergot derivative
D. Not better accounted for by another ICHD-3 diagnosis

Medication Overuse Headache

Although medication overuse headache, sometimes termed *rebound headache,* is a secondary headache disorder and as

such is not the focus of this article, it is an important entity to discuss because it can complicate the management of primary headache disorders. Medication overuse headache can be seen in greater than 50% of patients who have 15 or more headache days per month. It is crucial to identify whether medication overuse is contributing to a patient's headache burden because management of this entity is specific to eliminating overuse of acute abortive agents. Effective treatment of medication overuse headache can lead to a reduction in the number of headache days per month that a patient experiences and can also lead to an improved response to daily preventive agents. In patients who are not overusing acute abortive agents, it is important for their provider to counsel them about preventing medication overuse headache. (5)

The diagnostic criteria for medication overuse headache are as follows (5):

A. Headache occurring on at least 15 days per month in a patient with a preexisting headache disorder
B. Regular overuse for more than 3 months of 1 or more drugs that can be taken for acute or symptomatic treatment of headache
C. Not better accounted for by another ICHD-3 diagnosis

Childhood Periodic Syndromes

In addition to the common primary headache syndromes, there are several childhood periodic syndromes in the presence or absence of head pain that should be considered in children presenting with recurrent paroxysmal events. Abdominal migraine is a syndrome of paroxysmal abdominal pain with or without vomiting lasting hours to days. Cyclical vomiting syndrome occurs when patients have hours to days of vomiting occurring at regular predictable intervals. It "is typically a self-limiting episodic condition occurring in childhood, with periods of complete normality between episodes." (5) The predictable and cyclic quality is its trademark. Benign paroxysmal vertigo involves recurrent episodes of vertigo with associated symptoms lasting minutes to hours seen in younger children, and benign paroxysmal torticollis in very young children involves recurrent episodes of torticollis with associated symptoms lasting minutes to days. In all of these syndromes, the patient is symptom-free with normal neurologic examination findings between attacks. (5) Children with these periodic syndromes are at a higher risk for developing migraine in the future.

The diagnostic criteria for abdominal migraine are as follows (5):

A. At least 5 attacks of abdominal pain fulfilling criteria B through D
B. Pain has at least 2 of the following 3 characteristics: midline location, periumbilical or poorly localized; dull or "just sore" quality; and moderate or severe intensity
C. At least 2 of the following 4 associated symptoms or signs: anorexia, nausea, vomiting, and pallor
D. Attacks last 2 to 72 hours when untreated or unsuccessfully treated
E. Complete freedom from symptoms between attacks
F. Not attributed to another disorder

The diagnostic criteria for cyclical vomiting syndrome are as follows (5):

A. At least 5 attacks of intense nausea and vomiting, fulfilling criteria B and C
B. Stereotypical in the individual patient and recurring with predictable periodicity
C. All of criteria D through H
D. Nausea and vomiting occur at least 4 times per hour
E. Attacks last at least 1 hour, up to 10 days
F. Attacks occur at least 1 week apart
G. Complete freedom from symptoms between attacks
H. Not attributed to another disorder

FURTHER TESTING

In general, laboratory testing and electroencephalography are not recommended for the evaluation of recurrent headaches in children. In a child with normal neurologic examination findings who has a stable pattern of recurrent headaches without red flag features, routine neuroimaging is not indicated. (8) Neuroimaging with a computed tomographic scan of the head is appropriate in acute emergent presentations. In some circumstances, a limited (fast) brain MRI may be preferable if available. A limited brain MRI can be particularly helpful in patients who require urgent imaging but would require anesthesia for a full brain MRI due to length of time required for image acquisition. In nonemergent patients in whom it is determined that neuroimaging is required, an MRI brain is the study of choice given the detail it provides and the lack of radiation exposure. (9) Vascular imaging with MRA and MRV may be considered in specific circumstances. For example, if there is concern for an arterial aneurysm an MRA is appropriate. If there is concern for venous sinus thrombosis or venous sinus stenosis (which can be seen in pseudotumor cerebri syndrome), MRV is appropriate. A lumbar puncture should be considered in patients with acute isolated headache or chronic progressive headache after neuroimaging has been obtained. Documentation of the cerebrospinal fluid opening pressure is crucial for the establishment of increased intracranial pressure, and

cerebrospinal fluid analysis is aimed at evaluating for infection, inflammation, and hemorrhage.

TREATMENT

The treatment of headaches and migraines in children consists of a multifaceted approach including lifestyle modifications, abortive agents, preventive agents, complementary therapies, and procedural interventions.

Lifestyle Modifications

Lifestyle modifications are an imperative base on which to build a treatment plan. Optimizing these factors can improve the chances of successful treatment. Use of late-night electronics, poor sleep hygiene, poor hydration, erratic meals, caffeine consumption, a lack of routine exercise, stress and depression, and medication overuse can all contribute to poor headache control.

All patients should be asked about their sleep pattern and sleep hygiene. Sleep issues that are important to address include the amount of sleep appropriate for age, when are they getting their sleep (all at night or napping during the day), screening for sleep apnea, and counseling against use of screens (smartphones, computers, television) close to bedtime.

Hydration status needs to be assessed, and the patients should be asked what types of liquids they consume, stressing the need for improved water and electrolyte intake. Often setting a goal for the number of urinations per day can be useful rather than a set amount of water consumption because this better accounts for physical activity or exertion variations. We suggest drinking enough water to have 6 or more urinations per day.

Screening patients' dietary and exercise habits is also important. Patients should be counseled about healthy eating, reaching a healthy weight, and not skipping meals. Diet can significantly affect headache management. Patients may find that their headaches are affected by particular beverages, foods, or additives. We routinely provide an information sheet regarding foods to consider limiting or avoiding in patients with headache (Table 3). Caffeine use should always be assessed, and routine caffeine use should be discouraged. Regular cardiovascular exercise is important for patients with headaches and should be strongly encouraged.

In addition, patients should be screened for stress, anxiety, and depression. These issues can greatly affect the headache burden and, if discovered, should be addressed by stress management techniques, psychological therapy, or psychiatry referral when needed.

Finally, screening for medication overuse is an important part of obtaining a complete headache history. If medication overuse is ruled out, counseling the patient and family about how to prevent medication overuse is imperative. If medication overuse is a factor, treatment consists of stopping overuse of acute abortive medications. Often it is recommended to stop them altogether for a period such as 2 weeks, followed by reintroduction of their use at an appropriate frequency. The child's headaches may worsen during this washout period. Should this occur, bridging with a methylprednisolone taper dose pack can be considered if appropriate for the individual patient.

Having the family keep a headache log or calendar may help assess headache burden and identify avoidable triggers. It may also bring to light some of the lifestyle issues reviewed herein.

Medication Options

Medication options are divided into abortive (or immediate) treatment for headache pain and associated discomfort and preventive treatment for patients who have a significant monthly headache burden. The headache burden is a composite of headache frequency, usually evaluated over a month, and headache severity and duration. Although there is no standardized burden assessment tool, the amount of disability a child experiences from headaches may be assessed using the Pediatric Migraine Disability Assessment (PedMIDAS) score. This 6-question scoring tool provides a standardized and trackable assessment of the impact of the patient's headaches on his or her school and home life as well as on participation in extracurricular activities. (10) Based on the headache burden, the patient, family, and provider can together develop a treatment strategy. It is typically at the point of considering a daily preventive agent or if an acute abortive agent or "cocktail" is ineffective that a child is referred to a pediatric neurologist for further recommendations. Having the patient bring his or her headache calendar as well as any lifestyle modifications and medications (with dosage) he or she has tried can be very helpful in formulating a treatment plan going forward.

Abortive Therapy. A combination of rest and hydration are important first steps and need to be reinforced. Most patients and families will usually begin with the use of an over-the-counter (OTC) medication such as a nonsteroidal anti-inflammatory drug (NSAID) or acetaminophen. Ibuprofen and acetaminophen both have been found to be effective and safe in children with migraine in double-blind placebo-controlled trials. (11) To optimize the efficacy of OTC medications, it should be emphasized that they should be taken as soon as the patient feels the headache coming

TABLE 3. **Diet and Headaches**

Dietary triggers for headaches:
1. Caffeine (soda, coffee, tea)
2. MSG and soy products
3. Chocolate
4. Nitrite-containing foods (hot dogs, lunch meats, sausage)
5. Artificial sweeteners (saccharin, aspartame)
6. Some cheeses/dairy (aged cheeses, sour cream, yogurt, whole milk, buttermilk, ice cream)
7. Nuts and nut butter (peanut butter, peanuts)
8. Vinegar and vinegar-containing condiments (ketchup, mustard, mayonnaise)
9. Certain fruits/juices (citrus fruit, raisins, raspberries, red plums, papayas, passion fruit, dates, avocados)
10. Certain vegetables (lima beans, fava beans, navy beans, sauerkraut, pea pods, lentils)
11. Fresh yeast in baked goods (bagels, doughnuts, sourdough, pizza dough, soft pretzels, coffee cake)
12. Snack foods (TV dinners, chips)
13. Beer and wine
Safe alternative foods:
1. American or cottage cheese, low-fat milk
2. Pasta, potatoes, rice cereal
3. Lamb, chicken
4. Broccoli, cauliflower, cabbage
5. Apples
6. Jelly, jam, hard candy, honey
7. Gelatin, sherbet, cookies

on. When possible, patients with migraine with aura should take their abortive therapy as soon as the aura is detected. This simple approach may be beneficial as long as the patient and family are cautioned about the risk of overuse and rebound headaches if OTCs are chronically used more than 10 to 15 days per month. Combination OTC medication options containing acetaminophen, aspirin, caffeine, or butalbital are at a higher risk for causing medication overuse headache. (12)

A "migraine cocktail" approach is frequently used as acute abortive therapy at home and typically consists of an NSAID, an antiemetic agent, oral fluids, and sometimes an antihistamine. Some patients also find benefit from the addition of a caffeine drink if the headache occurs in the morning. If this is ineffective, a triptan can be added to the migraine cocktail.

The use of triptan medications can be useful for abortive therapy, especially in older children and adolescents, although other than rizatriptan and almotriptan their use is largely off-label. (13) In studies, both nasal sumatriptan and nasal zolmitriptan have the best efficacy data in pediatrics. However, most providers initiate treatment with an oral triptan. In addition to the option of nasal administration with sumatriptan and zolmitriptan, both rizatriptan and zolmitriptan are available in disintegrating oral tablets, which allow for easier administration to younger children.

Sometimes a patient will not get adequate relief from his or her home migraine cocktail and will then present to the emergency department for further treatment. In this setting, an intravenous (IV) migraine cocktail is often used and typically consists of a pain medication such as IV ketorolac combined with an antinausea medication, IV fluids, and sometimes an antihistamine. If ineffective, other abortive medications may be tried, such as IV magnesium, IV valproic acid, IV methylprednisolone, and IV dihydroergotamine. Occasionally a patient may be admitted to the

TABLE 4. Common Abortive Therapy Options

MEDICATION[a]	DOSING RANGE	ADVERSE EFFECTS; WARNINGS	INDICATIONS FOR USE/OTHER INFORMATION
Ibuprofen	10 mg/kg – max 800 mg Q6h	GI upset, bleeding, kidney dysfunction	First line
Naproxen	10–20 mg/kg – max 500 mg Q12h	GI upset, bleeding, kidney dysfunction	First line, longer period of action
Acetaminophen	15 mg/kg – max 1,000 mg Q8h or 3,000 total mg/day	Liver dysfunction	First line, especially in patients with contraindication or sensitivity to nonsteroidal anti-inflammatory drugs
Ketorolac	0.5 mg/kg PO or IV – max 10 mg PO Q6h or 30 mg IV Q6h	GI upset, bleeding, kidney dysfunction	Often used first line in ED as part of a "migraine cocktail" with fluids and antiemetic agent
Metoclopramide	0.2 mg/kg PO or IV – max 10 mg Q6h	Somnolence, extrapyramidal adverse effects	Diphenhydramine can be used for pretreatment to prevent extrapyramidal effects
Prochlorperazine	0.15 mg/kg PO or IV – max 10 mg Q6h	Somnolence, extrapyramidal adverse effects, dizziness	Diphenhydramine can be used for pretreatment to prevent extrapyramidal effects
Diphenhydramine	1 mg/kg IV or PO – max 50 mg Q4h	Somnolence, paradoxical activation	
Valproic acid	15 mg/kg IV – max 1,000 mg Q12h	Somnolence, GI upset; avoid in patients with hepatic dysfunction and pregnant patients	Typically used second line in ED if initial cocktail ineffective
Triptans			
Almotriptan	6.25 or 12.5 mg – max 25 mg/day	Fatigue, somnolence, flushing, chest pain, paresthesia; do not use in patients with arrhythmia, coronary artery disease, stroke, hemiplegic migraine, migraine with brainstem aura, poorly controlled hypertension, use of ergot derivative within previous 24 h; serotonin syndrome risk when using in patients taking SSRIs	Use after or in conjunction with analgesic agents; do not use >2 days per week
Rizatriptan	5 or 10 mg ODT – max 20 mg/day	Same as above	Same as above
Frovatriptan	2.5 mg – max 5 mg/day	Same as above	Same as above
Naratriptan	1 or 2.5 mg – max 5 mg/day	Same as above	Same as above
Zolmitriptan	Nasal 5 mg, 2.5 or 5 mg ODT – max 10 mg/day	Same as above	Same as above
Eletriptan	20 or 40 mg – max 80 mg/day	Same as above	Same as above
Sumatriptan	Nasal 5 or 20 mg – max 40 mg/day Oral 25, 50, 100 mg – max 200 mg/day	Same as above	Same as above

ED=emergency department, GI=gastrointestinal, IV=intravenous, max=maximum, ODT=orally disintegrating tablet, PO=orally, Q4/6/8/12h=every 4/6/8/12 hours, SSRI=selective serotonin reuptake inhibitor.

[a]*Providers should be aware that many of these medications are not Food and Drug Administration (FDA) approved for migraine or headache treatment in the pediatric age group.*

Adapted from Klein J, Oakley C. Migraine and headaches in children. In: Johnston MV, Adams HP, Fatemi A, eds. Neurobiology of Disease. *2nd ed. Oxford, NY: Oxford University Press; 2016:540–546. (14)*

TABLE 5. **Common Preventive Therapy Options**

MEDICATION[a]	DOSING RANGE	ADVERSE EFFECTS; WARNINGS	FAVORABLE QUALITIES
Antihistamines			
Cyproheptadine	2–4 mg PO QHS – max 8 mg Q8-12h	Increased appetite, weight gain, somnolence	In general, is well tolerated
Antidepressants/ anxiolytics			
Amitriptyline	10 mg PO QHS – max 50 mg BID	Somnolence, dizziness, overdose may cause cardiotoxicity, risk of suicidal ideation, must be weaned	Can help sleep initiation; may stabilize mood at a high dose
Nortriptyline	25 mg PO QHS – max 50 mg BID	Same as above	Same as above; may be helpful for chronic widespread pain
Duloxetine	20 mg PO QHS – max 80 mg daily	GI upset, risk of suicidal ideation; can lead to serotonin syndrome or dystonia if used with metoclopramide; can lead to hyponatremia, SIADH, hypotension, serotonin syndrome if used with prochlorperazine; must be weaned	May be helpful for chronic widespread pain; may improve anxiety
Venlafaxine extended release	37.5 mg PO daily – max 150 mg daily	Constipation, dry mouth, risk of suicidal ideation, can lead to serotonin syndrome or dystonia if used with metoclopramide, must be weaned	Same as above; can be helpful for dizziness
Antiepileptics			
Topiramate	15 mg PO QHS – max 100 mg BID but typical max dose used for headache is 50 mg BID	Cognitive dysfunction, paresthesia, weight loss, kidney stones, decreased perspiration, metabolic acidosis	Especially useful in overweight/ obese patients; can be used for dual purposes in patients who also have epilepsy
Zonisamide	25 mg PO QHS – max 50 mg BID	Contraindicated in patients with a sulfa allergy	In general adverse effects are similar to but less severe than those for topiramate
Acetazolamide	10 mg/kg per day divided BID-TID or 250 mg BID – max 4,000 mg/day	Paresthesia, urinary frequency, metabolic acidosis, electrolyte derangement (hyponatremia, hypokalemia)	Useful in some patients with hemiplegic migraine
Divalproex	10 mg/kg per day PO (usually divided BID) – max 40 mg/kg per day divided BID or 750 mg BID	Teratogenicity, weight gain, hair and skin changes, tremor, liver dysfunction, requires laboratory monitoring (particularly liver function tests and platelets)	Can be used for dual purposes in patients who also have epilepsy, mood stabilizer
Gabapentin	10 mg/kg per day divided TID – max 35 mg/kg per day divided TID or 900 mg TID	Weight gain, somnolence, easy bruising, caution if renal impairment	May help other neuropathic pain, helps with sleep initiation; can be used for dual purposes in patients who also have epilepsy
Antihypertensives			
Propranolol	1 mg/kg per day PO (daily or divided BID) – max 4 mg/kg per day	Bradycardia, hypotension, decreased exercise tolerance, erectile dysfunction; contraindicated in patients with poorly controlled asthma, diabetes; caution in depression as can worsen mood	In general, is well tolerated
Nadolol	20 mg PO daily – max 120 mg daily	Same as above	

Continued

TABLE 5. (Continued)

MEDICATION[a]	DOSING RANGE	ADVERSE EFFECTS; WARNINGS	FAVORABLE QUALITIES
Verapamil extended release	4 mg/kg per day PO daily – max 8 mg/kg per day or 480 mg daily	Hypotension, constipation, leg edema	Useful in some patients with hemiplegic migraine

BID=twice daily, GI=gastrointestinal, IV=intravenous, max=maximum, ODT=orally disintegrating tablet, PO=orally, QHS=every night at bedtime, Q8-12h=every 8 to 12 hours, SIADH=syndrome of inappropriate antidiuretic hormone secretion, TID=3 times daily.

[a]*Providers should be aware that not all of these medications are Food and Drug Administration (FDA) approved for migraine or headache treatment in the pediatric age group.*

Adapted from Klein J, Oakley C. Migraine and headaches in children. In: Johnston MV, Adams HP, Fatemi A, eds. Neurobiology of Disease. *2nd ed. Oxford, NY: Oxford University Press; 2016:540–546. (14)*

hospital for ongoing pain management. Table 4 lists the commonly used abortive treatment options, including the triptans.

Preventive Therapy. Preventive therapy involves medications that the patient takes every day to eventually reduce the frequency and severity of his or her headaches. When initiating preventive therapy, one needs to carefully consider the risk of a daily medication versus the effect on quality of life due to the child's headache burden. Frequent and incapacitating headaches can lead to severe disability, with children missing excessive time from school and compromising normal home and social activities. The headache burden can lead to feelings of hopelessness and depression. In addition, the child's headache burden can have a significant effect on the family and parental work time and financial stability. It is important to counsel the patient and family that these medications are typically started at a low dose and increased gradually and as such take some time to begin working.

There are 4 main classes of medication used for preventive therapy: antihistamines, antiepileptics, antidepressants/anxiolytics, and antihypertensives. In 2017, the *New England Journal of Medicine* published the Childhood and Adolescent Migraine Prevention (CHAMP) trial. This trial looked at efficacy and adverse event differences between topiramate (goal dose of 2 mg/kg per day), amitriptyline (goal dose of 1 mg/kg per day), and placebo. They found no statistically significant differences in reduction in headache frequency or disability (measured by PedMIDAS scores) among the 3 groups and found higher rates of adverse effects in the active drug groups. Specifically, they found that "the percentage of patients with a relative reduction of 50% or more in the number of headache days was 66% with amitriptyline, 71% with topiramate, and 68% with placebo." (15) They comment on the high placebo response rate, which is typical of previous headache trials, and note that this may benefit children with migraine. (15) Despite the results of this trial, topiramate and amitriptyline are still commonly used as first-line preventive choices, as is cyproheptadine. The selection of which agent to begin with and the duration of treatment needs to be individualized by matching the specific needs and comorbidities of the patient with the medication efficacy and adverse effect profile. For example, a patient with migraine and obesity may benefit from topiramate given the possible weight loss that can occur with this medication. On the other hand, in a child with uncontrolled asthma, β-blockers should be avoided. See Table 5 for preventive medications and dosing guidelines.

Complementary Therapies. Complementary therapies can be very useful for headache treatment and are particularly helpful in patients with chronic daily headache. Common therapies include vitamin supplementation (riboflavin, magnesium, melatonin, CoQ10), and herbals (Petadolex® [Linpharma Inc, Oldsmar, FL], feverfew). Psychological therapies with biofeedback, cognitive behavioral therapy, and relaxation therapy, as well as physical therapies with acupuncture, massage, and craniosacral therapy, can all be important tools to treat migraine and chronic headaches. (16)

Riboflavin, magnesium oxide, and melatonin are common choices from the class of complementary preventive agents. These are sometimes used in lieu of starting a daily preventive medication or as adjunctive therapies in a patient already taking a daily preventive medication. Dosing is individualized to the patient and depends on the age and weight of the child. The dosing range of riboflavin is 25 mg daily for a young or small child to the maximum recommended dose of 400 mg daily for an adolescent who is near or at adult weight. Similarly, the dosing range of magnesium oxide is wide and can range from 125 mg daily for a young or small child up to the maximum recommended dose of 400 mg twice a day for an adolescent near or at adult weight. Melatonin therapy can be helpful for patients with migraine who have sleep initiation dysfunction that is not adequately treated with improved sleep hygiene. Doses typically range from 1 to 5 mg before bed.

Procedural Interventions

Procedural interventions are typically used when other therapies have not yielded relief. These include nerve blocks (occipital, sphenopalatine, trigeminal, etc), botulinum toxin, transcutaneous electrical nerve stimulation, and migraine surgery. There is limited experience with these procedural interventions in children and adolescents. Migraine surgery is considered by many as still experimental, and the American Headache Society cautions general use.

Summary

- Headache is a common complaint in children and adolescents and many times leads to much anxiety for the practitioner and the parents.
- Based on research evidence and consensus, (1)(2)(5)(6)(9) a thorough headache history and focused neurologic examination remain critical steps in the evaluation of the child with headache. In most situations these steps will allow the provider to distinguish between primary headache disorders, including migraine, tension, or chronic daily headache, and secondary headache disorders, such as those seen with hydrocephalus, acute febrile illnesses, hypertension, chronic meningitis, brain tumors, or pseudotumor cerebri syndrome. (2) Whether to perform ancillary diagnostic tests depends on details revealed during data collection. (1)
- Based on research evidence, neuroimaging is not routinely indicated in children with normal neurologic examination findings who have recurrent headaches but should be considered in patients with abnormal neurologic examination findings, seizures, new severe headaches, change in headache type, or symptoms of neurologic dysfunction occurring with their headaches. (8)
- Based on some research evidence and expert consensus, treatment of headache and migraine in children (13)(14)(16) consists of a multifaceted approach including lifestyle modifications, abortive agents, preventive agents, complementary therapies, and, rarely, procedural interventions. (13)(14)(16)

References for this article are at http://pedsinreview.aappublications.org/content/41/4/159.

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1. A 15-year-old boy presents to the clinic with a 2-month history of headaches. The headaches are right-sided and pulsating. There is associated nausea, phonophobia and photophobia, and dizziness. He occasionally gets double vision. He denies dysesthesia and limb or facial weakness. There is no vomiting. At onset, the headaches occurred once every few days but now he always has a headache. He is taking ibuprofen every other day but it is not helping. His only other medication is isotretinoin for acne. He is otherwise healthy. His blood pressure is normal. His physical and neurologic examination findings are normal. On funduscopic examination, the examiner was unable to visualize his fundi due to photophobia. Which of the following is the most appropriate next step in management?
   A. Increase ibuprofen dose and frequency.
   B. Refer to ophthalmology to evaluate for optic nerve edema.
   C. Refer to otolaryngology to evaluate for vestibulitis.
   D. Start him on migraine prophylaxis for migraine headaches.
   E. Treat him for tension headaches.
2. A 10-year-old girl presents to the emergency department with headaches and vomiting for the past several hours. The headache is frontal and "like a heartbeat." She has to have the lights out and no noise in the room to feel some relief. She has had headaches like this every few months for the past 3 years. This headache was different in that it started with numbness and tingling that spread up her right arm, and then she had garbled speech and confusion. Her vision was normal. These symptoms resolved after 45 minutes, but the headache continued. Her blood pressure is normal, and her general physical and neurologic examination findings are normal. Which of the following is the most likely diagnosis in this patient?
   A. Intracranial hemorrhage.
   B. Migraine with aura.
   C. Migraine without aura.
   D. Pseudotumor cerebri.
   E. Tension headache.
3. A 9-year-old girl presents to the clinic with a 1-year-history of headaches. The headaches are frontal and associated with photophobia, phonophobia, nausea, and vomiting. She denies double vision, vision loss, numbness and tingling, or weakness. These headaches occur 1 to 2 times a month, usually after school. In between headaches she is normal. She continues to do well in school. Her physical and neurologic examination findings are normal. Which of the following diagnostic tests is the most appropriate to obtain for further evaluation of this patient?
   A. Complete blood cell count and serum electrolytes.
   B. Computed tomography of the head.
   C. Lumbar puncture
   D. Magnetic resonance imaging of the brain.
   E. No further evaluation is needed.
4. A 17-year-old boy presents to the clinic with 2 to 3 episodes of migraine headache per month. He reports that he plays sports and does his homework after school, and often cannot go to bed until 11 pm. He watches videos on his phone and sometimes does not fall asleep until 1 am. He has to wake up at 6 am for school. He denies anxiety or depression. He takes ibuprofen about once a week for the most severe migraines, but ibuprofen does not usually relieve the headache. He drinks a lot of water and sports drinks, and he denies drinking any caffeinated beverages. Which of the following is the most appropriate next step in the management of this patient?

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A. Decrease his use of ibuprofen.
B. Improve sleep hygiene.
C. Increase hydration.
D. Start a daily medication for preventive therapy.
E. Start melatonin therapy.

5. A 16-year-old girl with migraines presents to the clinic reporting that her abortive medications do not help. She gets migraine with aura 2 times a month. The aura is a "hole in my vision" that gets progressively bigger, then she gets numbness and tingling in one arm. This lasts approximately 20 minutes and then she gets a severe right-sided headache with nausea, vomiting, phonophobia, and photophobia. There is no hemiparesis. As soon as the headache starts, she takes ibuprofen with a caffeinated soda. She reports that the headache improves a little but she still cannot function and has to go to sleep. Which of the following is the most appropriate advice to give her in aborting her headache episodes?

A. Decrease her use of abortive medications to avoid medication overuse headache.
B. Go to an emergency department for a "migraine cocktail."
C. Start a combination medication with butalbital.
D. Start a daily medication for preventive therapy.
E. Take the abortive medications at the onset of the aura symptoms.