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Diagnosis and management of the primary headache disorders in the emergency department setting

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Abstract

Headache continues to be a frequent cause of emergency department (ED) use, accounting for 2% of all visits. The majority of these headaches prove to be benign but painful exacerbations of chronic headache disorders, such as migraine, tension-type, and cluster. The goal of ED management is to provide rapid and quick relief of benign headache, without causing undue side effects, as well as recognizing headaches with malignant course. Though these headaches have distinct epidemiologies and clinical phenotypes, there is overlapping response to therapy: non-steroidals, triptans, dihydroergotamine, and the anti-emetic dopamine-antagonists may play a therapeutic role for each of these acute headaches. Because these headaches often recur over the days and months following ED discharge, the responsibility of the emergency physician includes identifying as yet unmet treatment needs and ensuring successful transition of care of these patients to an outpatient healthcare provider. Herein, we review the diagnostic criteria and management strategies for the primary headache disorders.

Keywords

headache; migraine; emergency department

Overview

Headache continues to be a frequent cause of emergency department (ED) use, accounting for 2% of all visits to U.S. EDs[1]. In these visits, the most commonly diagnosed are the primary headache disorders, most often migraine or tension-type headache[2-4]. The primary headache disorders are a collection of chronic illnesses characterized by repeated acute exacerbations, sometimes warranting an ED visit. The cornerstones of ED management are: 1) to determine the correct headache diagnosis, 2) to exclude secondary causes of headache, such as infection, mass-lesion, or hemorrhage, 3) initiate headache abortive therapy in appropriate cases, 4) provide the patient with an appropriate discharge plan that includes a diagnosis, patient education, prescriptions, and 5) prompt referral to an appropriate health care provider for definitive management. In this chapter, we review the diagnosis and management of the

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primary headache disorders, including migraine, tension-type headache, and cluster. In addition, less common primary headache disorders are reviewed.

Diagnosing or classifying the individual headache can be challenging, but allows appropriate treatment to be targeted to the patient. Time constraints and heterogeneity of presentation complicate this process. Based on earlier consensus statements, a standardized classification scheme has been promulgated by the International Headache Society to diagnose the underlying recurrent headache disorder; the 2nd edition of the International Classification of Headache Disorders is now several years old[5]. These classification criteria are most applicable to a between-attack assessment of a patient's typical headache but are often applied to the acute attack.

Providing a diagnosis for every patient is easier said than done. Up to one-third of patients who present to an ED with headache cannot be assigned a specific diagnosis, despite a thorough questionnaire-based assessment[3]. When considering an acute headache attack in isolation, rather than as representative of an underlying headache disorder, assigning a diagnosis becomes more difficult because there is often something different about the acute headache that caused a patient to present to an ED. Given the limitations of conducting a thorough history and physical exam on a patient in the throes of an acute headache, it is less likely that a complete assessment can be obtained prior to treatment. Once the acute headache has been controlled, taking the time to make an accurate diagnosis may facilitate the outpatient care of the patient.

Migraine

Migraine is common, under-diagnosed, and treatable[6]. It affects more than one in four women, less frequently in men, and is a leading cause of workplace absenteeism[7,8]. Migraine has a peak incidence in the third decade of life, and declines with age. It can be present at the extremes of age[8]. Patients with lesser socio-economic resources are more likely to be under-diagnosed and under-treated[9]. Despite widespread under-diagnosis and under-treatment, the vast majority of patients with migraine do not use an ED over the course of a year[10]. A very small subset of U.S. migraineurs account for all ED visits, and the minority of ED users account for the majority of ED visits, because these patients make multiple visits over the course of the year[11].

A theoretical model of ED use for migraine has been proposed: patients present to an ED with their "first or worst" headache or their "last straw" headache[12]. The severe "first or worst" headache is generally believed to require a thorough diagnostic evaluation in the ED[13]. The "last straw" syndrome refers to an unbearable or unremitting exacerbation of a chronic episodic headache disorder. However, there is some variability in what constitutes the last straw—a consistent and substantial minority of urban ED headache users present to the ED without taking any analgesic, not even acetaminophen, before presenting to the ED[14,15]. In general, ED use for headache is most closely associated with ED use for other chief complaints; thus patients who rely on the ED as a source of medical care will use it for management of their headache as well [11,16]. Other important predictors of ED use are lower socio-economic status and increased severity of the underlying recurrent headache disorder[11,16].

Patients with migraine typically give a history of a recurring, unilateral headache manifesting in attacks lasting 4 to 72 hours if not treated. Typical attacks reach moderate or severe intensity, are throbbing, are aggravated by routine physical activity, and are associated with nausea, vomiting, photophobia, phonophobia, and olfactophobia [5]. Because the standard criteria require ten questions to diagnose migraine, various screening instruments have been developed to help clinicians identify migraine. Migraine is the headache type with a many of evidence-based treatment options. Using a headache expert's clinical gestalt as the gold standard, brief instruments such as IDMigraine can help identify migraine with a high degree of sensitivity

[17]. IDMigraine incorporates three questions (nausea, photophobia, and headache-related functional disability), requires two to be positive, and is focused on typical attacks, rather than the acute attack. A systematic review identified the following clinical features to be most useful for discriminating migraine from non-migraine recurrent headaches: pounding headache, duration of headache lasting four to 72 hours, unilateral pain, nausea, and headache-related functional disability; the presence of any four made it highly likely that the headache was indeed a migraine; fewer than three decreased the odds of migraine[18]. These instruments have yet to be validated in the ED setting, but may provide a useful frame of reference for the emergency physician.

An ED history and physical exam should focus on excluding secondary causes of headache, then determining which therapeutic agent is most appropriate. Physicians should be vigilant not to dismiss a diagnosis of migraine because of the presence of a coexisting illness such as sinusitis [19,20]. This condition, amongst others, may exacerbate an acute attack of migraine. It is well recognized that acute sinusitis can indeed cause headache, though it is less clear that chronic sinusitis does the same[19]. The role of imaging in sinus headache, and how to interpret the findings is not clear because findings on CT imaging of the sinuses may not correlate with a patient's symptomatology [21,22]. Surprisingly, a sizable number of patients who are either self-diagnosed with sinus headache or referred to an otolaryngology practice with this working diagnosis actually meet criteria for migraine and respond appropriately to migraine-specific medications [23-25].

Similarly, the pain associated with a migraine headache may cause an elevation in blood pressure. Care should be taken not to mistakenly diagnose this occurrence as a "hypertensive" headache. Whether and how often hypertension causes headache is uncertain- even more so at levels of hypertension that are considered moderate. We believe that known migraineurs who present with an acute migraine attack and associated moderate hypertension should be treated with an analgesic medication prior to an antihypertensive agent if there is no evidence of end-organ damage. Physicians should be careful not to cause an unnecessary precipitous drop in blood pressure. Once the headache has been controlled the blood pressure can be re-assessed and a more thorough history obtained and examination undertaken.

Diagnostic testing is of limited value in patients with a well-established diagnosis of migraine. Concomitant infection or associated dehydration can be diagnosed clinically. Depending on the choice of therapeutic agent, pregnancy may need to be excluded before initiating therapy. In the absence of a concerning alteration in a patient's typical chronic headache pattern, emergent neuroimaging is unlikely to be helpful.

Treatment

A large variety of treatment options are available for acute migraine, many with FDA approval and many that are used off-label. The array of options is wide. Many emergency practitioners settle on a favorite, which they rely on for most cases. The ideal migraine agent would relieve the pain and associated symptoms of migraine headache rapidly and completely, without causing severe, debilitating, or frequent side effects. It would minimize the recurrence of headache after ED discharge, the likelihood of ED recidivism and the risk of development of chronic headache. With these therapeutic goals in mind, we will review the available classes of medication, all of which are commonly used to treat acute migraine.

Routine intravenous fluids may be of benefit to patients with acute migraine, though this has not been well-established. For patients with persistent gastro-intestinal symptoms intravenous rehydration is unlikely to be harmful. In general, parenteral treatment is preferred because gastric stasis and delayed absorption of medication occur during an acute migraine attack [26].

Triptans—Despite twenty years of clinical experience with the serotonin 1B/1D receptor agonists, this class of medication still has not enjoyed widespread use in the ED setting[27]. One explanation for this is the lack of parenteral options—to this day, sumatriptan remains the only injectable triptan available in the US. Another likely cause of its infrequent use is the perception of cardiovascular risk. Though cardiac events have been infrequent, the difficulty of risk stratifying migraine patients in acute pain may cause practitioners to choose alternates [28]. Side effects, which are often short-lived, occurred in 50% of patients receiving subcutaneous sumatriptan in the ED setting. This rate is twice that of placebo treated patients [29]. Cheaper alternatives are available, as sumatriptan will soon be available as a generic medication. Nevertheless, when it is effective, subcutaneous sumatriptan can rapidly and completely relieve migraine headache, allowing patients to return promptly to their usual daily activities.

Data from a meta-analysis demonstrate that subcutaneous sumatriptan was almost three times as likely to relieve headache as placebo[30]. By two hours, 60% of sumatriptan subjects were pain free, versus 12% of placebo subjects. Sustained headache response (attaining headache relief and maintaining it for 24 hours) was achieved in 49% of sumatriptan subjects, almost three times as many as placebo. In the ED setting, the median time to headache relief with subcutaneous sumatriptan was 34 minutes[29]. However, a large proportion of those who respond to sumatriptan will suffer a headache recurrence within 24 hours of ED discharge [29].

When choosing a suitable population for subcutaneous sumatriptan, the most reasonable candidates include those who report previous response to sumatriptan. Recent literature describes a phenomenon referred to as cutaneous allodynia which may be associated with migraine headaches[31]. Cutaneous allodynia is defined as the sensation of pain in response to normally non-noxious touch stimuli, such as brushing one's hair, taking a hot shower, or putting one's hair back in a ponytail. This phenomenon, hypothetically, is a manifestation of involvement of ascending pain pathways within the central nervous system[32]. The presence of cutaneous allodynia has been associated with decreased responsiveness to subcutaneous sumatriptan [33]. This phenomenon has not been well studied outside of headache sub-specialty populations and may be confounded by chronicity of the underlying headache disorder. Inadvertent administration of sumatriptan during pregnancy has not resulted in a marked increase in birth defects, though safety cannot yet be assured[34]. Therefore, in pregnant patients, alternate therapies should be used. Triptan nasal sprays are available but do not yet have a well-defined role in the ED.

In summary, subcutaneous sumatriptan may be considered for the treatment of acute migraine, dosed as a one-time 6mg dose. Additional doses are unlikely to be more effective[35]. For patients with a history of good response to triptans, subcutaneous sumatriptan should be considered a first-line therapy. For patients who are triptan naïve, the ED setting may not be the most appropriate location for a first dose.

Dihydroergotamine—Ergotamine has been used for the treatment of migraine for more than 100 years. Its hydrogenated derivative, dihydroerogtamine has been available for over 50 years as a parenteral option and is better tolerated than its precursor [36]. Though largely replaced by the triptans because of the latter's greater selectivity for serotonin receptors, dihdryoergotamine may still play a useful second-line role for some ED patients. When compared head-to-head, sumatriptan has greater initial efficacy, though dihydroergotamine is less likely to allow recurrence of headache, and so it may be useful in patients with a history of recurrence after treatment[37]. Dihydroergotamine is often administered with an anti-emetic, because it commonly induces nausea. When choosing an anti-emetic, one of the anti-migraine anti-emetics, discussed below, would be preferred.

Dihydroergotamine, when administered as monotherapy, is less likely than sumatriptan to relieve the pain or the functional disability associated with an acute migraine attack[38]. Both medications are associated with an assortment of adverse events, including chest pain (more common with sumatriptan), nausea (more common with dihydroergotamine), drowsiness, flushing, neck stiffness, vertigo, weakness, and injection site reactions[38]. When compared to chlorpromazine, dihydroergotamine alone was more likely to result in use of rescue medication[38].

Dihydroergotamine can be administered in doses of 0.5 to 1mg, infused as a slow intravenous drip. It is commonly co-administered with intravenous metoclopramide 10mg. It should be avoided in patients with uncontrolled hypertension, risk of atherosclerotic vascular disease, and pregnancy.

The anti-emetic dopamine-antagonists—An increasing evidence base demonstrates that this diverse class of medications is the most appropriate first-line treatment of acute migraine in the ED setting, though mechanistic data for this class's efficacy is still lacking. Anti-migraine action is probably mediated through dopamine-receptor blockade, albeit this has not yet been demonstrated.

Anti-migraine efficacy has been well-demonstrated in multiple high quality clinical trials for chlorpromazine[39], metoclopramide[14,40], prochlorperazine[41], and droperidol[42]. In general, these medications are inexpensive, well-tolerated and at least as efficacious, if not more so, than any agent to which they have been compared. Therefore, these medications should be considered first-line therapy for acute migraine in the ED setting.

Of the four agents mentioned above, chlorpromazine has fallen out of favor because of profound orthostasis that may accompany administration of this medication. Of the remaining three agents, droperidol is probably the most effective, with two hour headache relief rates approaching 100%. The ideal dose, as determined by a high quality dose finding study is 2.5mg [42]. This medication is commonly used and exceedingly safe, but a recent FDA warning about QT prolongation has caused some clinicians to perform an EKG prior to medication administration.

Prochlorperazine administered in doses of 10mg is also highly effective, though not quite as effective as droperidol [43,44]. Metoclopramide is typically administered as a 10mg intravenous dose but has been well-tolerated and efficacious when administered as repeated successive doses of 20mg[14,45].

Metoclopramide, prochlorperazine, and droperidol can all be accompanied by extra-pyramidal symptoms, particularly akathisia, which often goes unrecognized. Prophylactic administration of diphenhydramine is a reasonable course of action, as is slower intravenous drip rates [46, 47].

The anti-emetic trimethobenzamide[48] and the anti-psychotic haloperidol[49] have also demonstrated efficacy and tolerability for acute migraine attacks, though as of this writing, fewer data are available to determine the relative efficacy of these two agents.

Metoclopramide has a favorable pregnancy rating and a long history of use for treatment of hyperemesis gravidarum. It is the most appropriate parenteral agent for treatment of acute migraine in pregnancy.

Non-steroidal anti inflammatory drugs—Non-steroidal anti-inflammatory drugs are a main-stay of outpatient migraine therapy, particularly for less severe migraine attacks. The parenteral non-steroidal ketorolac has demonstrated efficacy for the acute treatment of

migraine. Its overall efficacy is comparable to meperidine [50-52], though less than the anti-emetics[53-55]. In patients without contra-indications to non-steroidals, such as peptic ulcer disease or chronic kidney disease, this medication dosed at 30mg IV or 60mg IM is a reasonable treatment option, either as primary treatment or as adjuvant therapy for acute migraine.

Opioids—Opioids, particularly meperidine, are still the most widely used medications for the treatment of acute migraine in North American EDs [27,56]. Standard critiques of opioid use for migraine include the following: decreased efficacy, high rate of adverse effects, increased rate of recurrence of migraine within the short term, increased rate of ED recidivism, and association with chronic migraine, though specific data for all of these is underwhelming. A recent meta-analysis demonstrated that meperidine is less efficacious for the treatment of acute migraine and burdened by more side effects than regimens containing DHE [57]. Additionally, meperidine is probably less efficacious than the anti-emetics while allowing a higher rate of return visits to the ED, though a lower rate of extra-pyramidal side effects. Finally meperidine is no better than ketorolac, with a similar side effect profile[57]. Some data suggest that meperidine is associated with an increased rate of return visit to the ED [56,58] and may be associated with decreased responsiveness to triptans [59]. In short, there are ample reasons to recommend avoidance of meperidine as a first-line treatment of migraine. In patients with infrequent episodic migraine and a history of excellent response to this medication, it still may be a reasonable option.

When choosing among opioids, scant data are available to help guide a clinician. Parenteral morphine and hydromorphone have not been subjected to comparative clinical trials. Intramuscular butorphanol is more efficacious than meperidine and is as efficacious and well-tolerated as DHE + metoclopramide[60]. Opioids should not be withheld on principle--in general, this class of medication is highly effective, safe, and well-tolerated for the management of acute pain. However, for this one ailment, better agents are available.

Valproic acid—A more recent addition to the anti-migraine armamentarium, this anti-epileptic medication has seemed beneficial in open-label studies[61-63], though it has performed less well in randomized trials[64]. It is not an unreasonable choice as a final treatment prior to admission, and should not be considered a first line medication. Valproic acid is often administered in doses between 500mg and 1gm as a slow intravenous drip over thirty minutes.

Recurrence of migraine after ED discharge—No matter the treatment used, migraines frequently recur after ED discharge. Two-thirds of patients report headache within 24 hours of ED discharge; half of these are moderate or severe in intensity. Fifty percent of patients report functional disability within 24 hours of ED discharge[65,66]. It is difficult to predict who will suffer headache after discharge. Risk factors include a history of headache recurrence, longer duration of headache, more severe pain at baseline or persistent pain at discharge. It is a reasonable to educate all patients as to the likelihood of recurrence.

A recent meta-analysis demonstrated that one dose of parenteral dexamethasone administered in the ED can decrease the rate of recurrence of headache after ED discharge, with a number needed to treat of nine[67]. Dexamethasone may begin to be effective within several hours.

Doses of dexamethasone demonstrating efficacy have ranged from 10mg to 24mg, without a clear dose-response curve. In general, one dose of dexamethasone was very well-tolerated, and may now be considered first-line therapy to decrease the recurrence of headache after ED discharge.

It is less clear what additional medications should be offered to treat the recurrence of headache after ED discharge. Non-steroidals, such as naproxen, or triptans, such as sumatriptan, are reasonable options, though data are not available.

A substantial proportion of migraine patients who use the ED continue to suffer from their underlying headache disorder over the months after ED discharge[66]. It is reasonable practice to start patients who suffer from episodic migraines on an oral medication for use during their next migraine attack, particularly if neurology or headache specialty appointments will be difficult to obtain. If non-steroidals, acetaminophen, or aspirin have not proved sufficient for the patient previously, consider starting the patient on a triptan medication, assuming low cardiovascular risk, or a combination of metoclopramide taken with a non-steroidal drug or salicylate. An evidence-based approach to outpatient care stratifies patients based on headache-related disability at baseline[68]. Thus patients with substantial headache-related functional disability at baseline (i.e., frequently miss work or social activities) benefit from a triptan and patients without as much functional disability can be started on cheaper alternatives such as a prescription non-steroidal with or without metoclopramide. Though baseline headache-related functional disability scores are less useful in the ED setting, this model is a useful framework to approach migraine care at the time of discharge.

Frequent ED migraine visitors—Although they represent fewer than 10% of all ED headache patients, frequent ED users account for 50% of visits in some institutions[69]. The reasons why patients frequent the ED are not well understood. Although it could represent “drug-seeking” behavior, it may also be a marker for poorly treated migraine. Headache patients who frequent the ED tend to know their disease well and request specific medications, often opioids. Although effective ED-based approaches to the frequent visitor have not been reported in the headache literature, individual EDs should develop a uniform departmental approach to the chronic pain patient, so that the pain and social needs of the patient can be addressed appropriately. Physician to physician variability in management leads to unpleasant confrontations for the physician and uncomfortable situations for the patients, who at times are forced to beg for analgesia within the throes of an acute migraine.

Some data demonstrate a decrease in the frequency of ED visits for chronic headache patients who participated in a comprehensive headache management program, which offered headache education and multidisciplinary care [70-72]. These programs were effective at decreasing the burden of illness and healthcare costs in patients with chronic headaches, though only select patients were able to benefit from these programs.

We could not find any evidence-based ED-appropriate strategies for addressing a patient’s opioid for migraine requirements from the perspective of the individual clinician. This is a difficult problem for an emergency clinician in the middle of a busy shift. Potential strategies include offering a non-opioid therapy in conjunction with a lower opioid dose, referring to an appropriate outpatient clinician, and initiating a preventative therapy at the time of discharge. It is not clear how best to handle infrequent ED users who report complete and persistent relief after one dose of opioid. On the one hand, one should not deny effective analgesics to patients who respond well to a particular therapy. On the other hand, there is an association between this particular class of therapy, chronic migraine, and ED recidivism.

Special concerns for a pediatric population—Migraine incidence begins to peak in early adolescence[6] and may be a concern for children as young as five or six years. In general, the presentation of pediatric migraine is more atypical, as children may present with bilateral headache of shorter duration and without the combination of photo- and phonophobia[73]. There is a smaller evidence base for the treatment of pediatric migraine, partly because of a very high placebo-response rate in this population. Management of pediatric migraine often

consists of simple analgesics, such as ibuprofen or acetaminophen, which seem to be as efficacious in this population as oral triptans[74,75]. The anti-emetic dopamine antagonists are commonly used [76], though efficacy data is inferential and to date, limited to prochlorperazine [53]. The pediatric population also suffers several variants of cyclical pediatric pain and vomiting syndromes linked to migraine. These are particularly difficult to diagnose because they lack associated headache. Cyclical vomiting, benign paroxysmal vertigo of childhood, and abdominal migraine are associated with development of migraine in adulthood[5].

Tension-type headache

Though very common in the general population, tension-type headache is rarely severe and only infrequently causes an ED visit[77]. This headache is defined by the absence of migraine's characteristic features, such as nausea, vomiting, severe intensity, or causing functional disability[5]. The pain is typically bilateral, pressing or tightening in quality and of mild to moderate intensity. Generally, the pain does not worsen with routine physical activity. There is some controversy as to whether this headache is indeed a distinct illness, or merely a milder form of migraine. Speaking against this shared pathophysiology argument is distinct epidemiological data--in contrast to migraine, tension-type headache is a disease of higher socio-economic demographics [8,77]. Speaking for a unified pathophysiology is a shared response to many of the same medications that are effective against migraine, such as triptans, anti-emetics, and non-steroidals[78-80].

Traditional management of tension-type headache calls for non-steroidals, which have a solid background of efficacy in this illness. Limited though methodologically sound data demonstrate efficacy of chlorpromazine and metoclopramide for the treatment of tension-type headache as well [78,81]. Sumatriptan, too, has demonstrated efficacy in ED patients with tension-type headache and in outpatients with severe episodic tension-type headache, if they have an underlying migraine disorder [79,80]. In general, once the emergency physician has excluded secondary headache from the differential diagnosis, it would be appropriate to treat the acute headache with an anti-emetic such as metoclopramide.

Like migraine, tension-type headache remains a problem after ED discharge. Nineteen percent of patients with tension-type headache treated in an ED reported moderate or severe headache within 24 hours of discharge; 23% report headache-related functional impairment[66]. The emergency physician should ensure that the initial headache is well-treated and that the patient has adequate resources to treat the recurrence of headache after ED discharge.

Cluster

Cluster is a rare headache[82] and an infrequent cause of ED presentation, particularly when compared to migraine or tension-type headache. However, an accurate diagnosis allows for effective treatment and helps avoid unnecessary diagnostic and therapeutic interventions. Barriers to accurate diagnosis include the brevity of the attacks, which may have ended before ED evaluation, the rarity of the disorder and consequent lack of physician familiarity with its presentation, and the lack of specificity of the autonomic features, which may cause physicians to think of other illnesses[83].

Classically a disease of men[83], this illness usually begins between the ages of 20 and 40 years[84]. The most common type is episodic cluster, in which headaches occur in groups or clusters, lasting weeks to months and are followed by headache-free periods or remissions lasting one month or longer. Approximately 10% of patients with cluster headache either do not experience remissions or have remissions lasting less than 1 month. In these cases, the term "chronic cluster headache" is applied.

The pain of cluster headache is invariably unilateral and the side affected generally is consistent for every attack and every cluster period (the interval of time containing sequential attacks). Predominantly situated in and around the eye and temporal locations, the pain may radiate into the ipsilateral neck, ear, cheek, jaw, upper and lower teeth, and nose[85]. The latter areas, if involved, may account for unnecessary dental and sinus investigations and treatments.

The pain is excruciating in intensity and is typically described as a stabbing or boring sensation, similar to a hot poker being thrust into the eye. An attack begins abruptly and rapidly intensifies, reaching a climax of pain within 5 to 15 minutes. The attack also ceases suddenly and the patient often is left feeling exhausted. The presence of at least one accompanying cranial autonomic symptom is a criterion for the diagnosis of cluster headache[5]. Autonomic features include conjunctival injection, lacrimation, nasal congestion, rhinorrhea, eyelid edema, forehead and facial sweating, ptosis, and miosis. These signs are invariably ipsilateral to the side of the pain.

Another notable feature of cluster headache is its short duration. Each untreated attack typically lasts from 15 to 180 minutes, with more than 75% of attacks reported lasting less than 60 minutes. Because of the brevity of each attack, a partial or complete recovery may have occurred by the time of evaluation in the ED; this can obscure the correct diagnosis. Attacks rarely may last longer than 3 hours. Attacks commonly occur one to three times daily, although they may be as variable as one every other day to up to eight daily. The daily attacks usually last for 2 to 3 months (the cluster period). The headaches then remit spontaneously, only to recur again as another cluster of daily headaches months to years later[86].

There is usually a remarkable predictability to the timing of the individual attack and the cluster period, a phenomenon that distinguishes cluster headache from other primary headache disorders. Specific questioning often will reveal its circadian and circannual periodicity, when daily attacks recur at the same time each day and cluster periods occur at the same time each year. Furthermore, there is a predilection for headaches to occur at night; the attacks often will awaken the sufferer 90 minutes after falling asleep, corresponding to the onset of the first period of rapid eye movement (REM) sleep. Sleep deprivation often is a result of these repeated nightly attacks and may trigger additional attacks. Alcoholic beverages and vasodilator medications such as nitroglycerin also may trigger an attack during the cluster period[84]. Seasonal periodicity is observed frequently, with the highest incidence of cluster periods occurring in the spring and autumn.

In contrast to migraineurs, sufferers of cluster headache are agitated and restless and prefer to be erect and to move about; sufferers of migraine prefer to lie quietly in a dark room. The intensity of the pain may cause some patients to wail loudly and others may engage in destructive activities, such as banging their heads against the wall. The pain is so excruciating that it may drive cluster headache sufferers to suicide[86].

ED-based treatment should be directed at relieving the acute attack and aborting the entire cluster of headaches. Abortive agents for cluster headache must work quickly and effectively. For most patients suffering from an acute cluster attack, the use of oxygen inhalation is the treatment of choice since it is easily administered, has an excellent safety profile, and works rapidly[87,88]. In our experience, oxygen is most effective when administered with the patient bent forward in a seated position through a loose-fitting, non-rebreathing facial mask at a flow rate of 7-10 L/min for 15 minutes. The response usually is rapid and appreciable, benefiting roughly 70% of patients within 15 minutes. Although it is unclear why flow rate should matter when breathing 100% oxygen from a non-rebreather device, increasing the flow rate of oxygen to 15 L/ minute has been reported to help those refractory to the initial intervention[89]. Administering oxygen at the pinnacle of the attack may reduce the pain significantly; delivering

it close to the onset of the attack may abort the pain completely. Subcutaneous sumatriptan in doses up to 12mg SQ is highly effective at relieving cluster headache, though because of increased adverse effects, 6 mg is a more appropriate dose[90]. Subcutaneous sumatriptan has a rapid onset and is considered to be the most effective abortive agent for acute cluster attacks, often producing a benefit in 5-7 minutes after administration. A 6-mg subcutaneous dose may be repeated at least 1 hour later but not more than twice daily. Dihydroergotamine (DHE) at doses of 0.5-1.0 mg given intravenously or intramuscularly is also useful as an abortive agent for cluster headache, though evidence supporting this medication is lacking. Anti-emetic dopamine receptor antagonists may be useful for acute attacks [91,92]. Subcutaneous octreotide (somatostatin) dosed at 100 micrograms can abort the acute attack, with a number needed to treat of five for complete relief of headache by 30 minutes[93].

After successful management of the individual episode of cluster headache, patients should be given treatment recommendations and referred to a qualified specialist. Because cluster headache is a condition of relatively long duration, follow-up care and prophylaxis are essential to avoid repeat visits to the ED for each attack of cluster. The patient should be reassured that there is no underlying organic pathology responsible for their headache.

Avoidance of potential triggers of cluster headache is recommended. During the active cluster period, patients should be advised to refrain from taking daytime naps, drinking alcoholic beverages, and using medications such as nitroglycerin that are vasodilators and can trigger attacks. Recurrence of symptoms is common within 24 hours of the ED visit; therefore, consideration should be given to starting the patient on transitional and maintenance therapy.

Prescriptions may also be written for subcutaneous sumatriptan, oxygen, or both so that the patient is able to treat acute attacks at home. Corticosteroids are often recommended as transitional treatment for cluster headache, though the evidence base for this treatment is underwhelming[94,95]. Verapamil has been shown to be an effective prophylactic agent for cluster headache[96]. If rapid follow-up with a headache specialist cannot be ensured, these medications should be initiated in the ED.

Other primary headaches

Less common, and more difficult to diagnosis, are a variety of benign recurrent headache disorders, whose initial presentation can be quite concerning. Secondary mimics of these disorders must be excluded.

Primary cough headache

This headache is brought on suddenly by coughing, straining, or other Valsalva maneuvers [5]. The pain has been described as sharp, stabbing, or splitting in nature, moderate to severe in intensity and maximal in the vertex, frontal, occipital, or temporal regions. The headache lasts from 1 second to 30 minutes. Approximately one-half of all cases of cough headache are due to secondary causes. Therefore, diagnostic neuroimaging, with special attention to the posterior fossa and base of the skull, is mandatory to differentiate secondary and primary forms of cough headache. Indomethacin may help patients who frequently experience cough headache[97].

Primary exertional headache

This headache begins shortly after exertion[5]. In one ED case series, four cases were identified over a six month period, all in men, and all provoked by lifting weights[98]. Headache typically last up to one day. Treatment is avoidance of the instigating activity, though non-steroidals taken prior to exertion may be of benefit.

Post-coital headache or headache associated with sexual activity

Usually this headache is described as severe and explosive. Due to this presentation, other types of headache with a potential for malignant course need to be excluded [5]. Headache provoked by sexual activity usually begins as a dull bilateral ache as sexual excitement increases, and suddenly becomes intense at orgasm. Two sub-types are classified: pre-orgasmic headache, a dull ache in the head and neck, and orgasmic headache, an explosive and severe headache occurring with orgasm[99]. The mainstay of treatment for this headache disorder is usually reassurance, although preemptive treatment with indomethacin or prophylaxis with a beta-blocker may prevent attacks.

Primary thunderclap headache

This disorder is characterized by a severe headache that begins abruptly and rapidly intensifies, reaching a climax of pain within 1 minute[100]. The pain is most commonly occipital in location, but may involve any region of the head and neck. Associated symptoms may include migrainous features. The pain lasts from 1 hour to 10 days and may recur within the first week after onset but not regularly over subsequent weeks or months. This diagnosis can be established only after excluding secondary headache disorders.

Hemicrania continua

Hemicrania continua is characterized as a continuous, strictly unilateral headache of mild to moderate intensity with superimposed exacerbations of more severe pain. During these exacerbations, one or more autonomic symptoms (ptosis, conjunctival injection, lacrimation, and nasal congestion) occur ipsilateral to the pain. Many patients report a foreign body sensation, like an eyelash or a piece of sand, in the eye ipsilateral to the pain. This headache is defined by its absolute response to therapeutic doses of indomethacin.

New daily persistent headache (NDPH)

This disorder is characterized by a daily and unremitting headache that becomes continuous shortly (<3 days) after onset, without a precipitating factor or a prior headache history. A clear recall of such an onset is necessary to establish the diagnosis of NDPH. It has features of both migraine and tension-type headache. It appears that there may be subtypes of NDPH: a self-limited form, which typically resolves spontaneously without treatment, and a refractory form, which is associated with an inconsistent and suboptimal response regardless of the therapeutic modality employed. Two of the most common identifiable secondary causes of NDPH are spontaneous CSF leaks and cerebral venous sinus thrombosis.

Medication overuse headache

Frequent analgesic use is now well-recognized as an independent cause of chronic daily headache[5]. The cycle begins when over-the-counter or prescription medication is used with increasing frequency to treat a primary headache disorder, ultimately causing a dependence on the medication and a lack of response to acute therapies that formerly were effective. This syndrome has been reported with a wide variety of anti-headache medications including acetaminophen, ergotamine, opioids, and triptans[101]. Though these patients may have to be admitted for detoxification, an outpatient regimen consisting of a novel acute therapy and a migraine preventative may be appropriate. This headache is difficult to diagnose and requires a detailed assessment of the patient's headache history and medication use. It has a high relapse rate; if outpatient therapy is considered, the care should be coordinated with the outpatient physician.

When to consider admission: the intractable headache

Despite aggressive ED management, some headaches will not remit, or will rapidly return after initial therapy. Admission to an inpatient unit for comprehensive headache management and control of external stressors may be needed to abort the headache successfully. Various inpatient regimens are utilized, all of which incorporate classes of medication discussed above. The Raskin protocol, consisting of around-the-clock administration of parenteral anti-emetics and dihydroergotamine has been used successfully for almost two decades[102].

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