Chapter 49

A Young Man with New Headache after Mild Head Trauma

Miguel J. A. Láinez, MD, PhD

Ana M. Pascual-Lozano, MD

Case History

A 20-year-old man, without past history of significant headache, suffered a left frontoparietal head trauma 1 month before he developed a throbbing pain on the left side of his head. The pain built in intensity over 45 minutes and was accompanied by nausea, photophobia, and phonophobia. This first episode of pain lasted approximately 6 hours. Pain resolved with nonsteroidal anti-inflammatory drugs (NSAIDs).

When head trauma occurred, the patient was examined in the emergency department. Head trauma had been slight and did not cause alteration of consciousness, post-traumatic amnesia (PTA), or positive neurologic findings. After 6 hours of observation, the patient went home. When we saw him in follow-up several days later, he was completely recovered.

Initially, headache recurred with similar clinical characteristics twice or three times in the same month. After several weeks, this new headache repeated several days a week. The patient could not function for a period of 2 to 3 hours, when pain was more intense, and he found that any movement of his head or almost any activity increased the pain. Pain usually lasted 4 to 12 hours. Neuroimaging studies (magnetic resonance imaging [MRI], computed tomography [CT] scan) were normal. Symptomatic treatments (analgesics, NSAIDs, triptans, and oral corticosteriods) were partially or completely effective. In the last months, the patient complained of a daily severe to moderate, constant left-sided headache, more severe later in the evening, with some nausea. Then, headache lasted 12 to 18 hours a day. Preventive treatments (beta-blockers, calcium antagonists, antidepressants, valproate, and topiramate) were ineffective.

Following the head injury, the patient had noted, over an area of skull contusion in the parietal bone, a small growing mass. MRI study showed a mass in subcutaneous tissue. Touch of this mass was the only triggering factor for headache, and pain disappeared for days when we infiltrated the mass with local injection of corticosteroids and anesthetic agents. Sometimes, if we infiltrated the mass with a placebo substance, the headache was not relieved. Surgery of the mass, 2 years later, resolved the headache completely. Pathologic examination showed a fibrotic tissue that involved one small regional nerve (neurofibroma).

Questions on the Case

Please read the questions, try to answer them, and reflect on your answers before reading the authors' discussion.

- What are your diagnostic considerations in this case?
- Do you agree with the diagnosis proposed?
- Do you need more pertinent information about this particular case?
- If you agree with our diagnosis, do you think more investigational procedures should be done?

- How would you manage this patient's headache? If initial therapies are not successful, what would you consider?
- What is, in your opinion, the role of the growing mass in the headache of this patient? Why?

Case Discussion

Diagnosis

The most likely initial diagnosis for this patient would be migraine without aura, a disorder manifesting with attacks of throbbing headache, nausea, photophobia, and phonophobia. The headache usually lasts 4 to 72 hours. To differentiate between a primary and a posttraumatic migraine in some cases can be difficult. Patients who develop a new form of headache in close temporal relation to head and/or neck trauma will be coded as a secondary headache. In patients whose preexisting headache significantly worsens in close temporal relation to trauma, without evidence of a causal relationship between the primary headache and the other disorder, only the primary headache diagnosis will be made. However, if there is both a close temporal relation and other evidence of a causal relationship (ie, if trauma in scientific studies of good quality has been shown to aggravate the primary headache disorder), then the patient receives both the primary headache diagnosis and a secondary headache diagnosis.

In this case, without history of previous headache, the new pain in the head seems to be significantly related to the previous head trauma. The uniformity of clinical presentation, the localization of the pain, the triggering mechanism, and the last response to the surgery make us suspect this type of relationship. The migraine began 4 weeks after head injury. In accordance with IHS classification, this period of time is longer than temporal criteria accepted for "posttraumatic headache" (PTHA), but we think criteria may be less strictly considered when a casual relation between the headache and the trauma is highly suggestive. In our opinion, this patient suffered a "posttraumatic migraine" (PTM; category 5.1.2.1). Consistent with our diagnosis, migrainous headache recurred, often with similar characteristics.

PTHA is one of several symptoms of the postconcussive syndrome, and therefore may be accompanied by additional cognitive, behavioral, or somatic problems (Table 49-1). The etiology of these symptoms in individuals with mild traumatic brain injuries has been a subject of some controversy, ranging from neural damage to malingering.

"Acute posttraumatic headaches" must begin within 7 days after head or neck trauma and continue for no longer than 3 months post-injury (Table 49-2). Although onset proximate to the time of injury is most common, any new headache type occurring within this period of time is referred to as an acute posttraumatic headache, as long as the injury was moderate or severe (code 5.1.1). After mild head injury, it is 5.1.2 headache caused by whiplash; that which develops in less than 7 days after head injury and lasts no more than 3 months has been termed acute headache related to whiplash injury (code 5.3). If the headaches do last longer than 3 months post-injury, then they are referred to as chronic headache attributed to whiplash injury. This is all documented in the new International Headache Society classification, *International Classification of Headache Disorders-II*, published in *Cephalalgia* in 2004.

Tension-type is the most common variety of PTHA followed by cervicogenic headache, but exacerbations of migraine-like headaches often occur. PTM represents approximately 8 to 10% of PTHA. This is usually a migraine without aura, often for children, adolescents, and young adults with familiar history of migraine. The exact pathophysiology of headaches after trauma is still unknown in many cases. Similar neurochemical changes have been implicated in both migraine and traumatic brain injury (excessive release of excitatory amino acids; alterations of serotonin; abnormalities in catecholamines and endogenous opioids; decline in magnesium levels; abnormalities in nitric oxide formation and alterations in neuropeptides). Whether these changes are determining, contributing, or precipitating factors for headache in each patient is still unknown. Psychological and legal factors are also considered by different authors.

Clinical quantification of mild traumatic brain injury patients should be based on Glasgow Coma Scale (GCS)

Table 49-1. International Headache Society Classification Criteria for Headache Attributed to Head and/or Neck Trauma

5.1	Acute posttraumatic headache
5.1.1	Acute posttraumatic headache with moderate or severe head injury
5.1.2	Acute posttraumatic headache with mild head injury
5.2	Chronic posttraumatic headache
5.2.1	Chronic posttraumatic headache with moderate or severe head injury
5.2.2	Chronic posttraumatic headache with mild head injury
5.3	Acute post-whiplash injury headache
5.4	Chronic post-whiplash injury headache
5.5	Headache attributed to traumatic intracranial hematoma
5.5.1	Epidural hematoma
5.5.2	Chronic subdural hematoma
5.6	Headache attributed to other head and neck trauma
5.7	Postcraniotomy headache
5.7.1	Acute postcraniotomy headache
5.7.2	Chronic postcraniotomy headache

Adapted from the Headache Classification Subcommittee of the International Headache Society, 2004.

Table 49-2. New Diagnostic Criteria for Acute Posttraumatic Headache

5.1.1 Acute Posttraumatic Headache with Moderate or Severe Head Injury
Diagnostic criteria:
A. New headache appearing after head trauma and fulfilling criteria B to D
B. Head trauma with at least one of the following:
1. Loss of consciousness > 30 min
2. Glasgow Coma Scale (GCS) < 13
3. Posttraumatic amnesia > 48 h
4. Imaging demonstration of a traumatic brain lesion (cerebral hematoma, brain contusion, or skull fracture)
C. Headache occurs less than 7 days after head trauma or after regaining consciousness or memory
D. Headache lasts < 3 months after regaining consciousness or memory
5.1.2 Acute Posttraumatic Headache with Mild Head Injury
Diagnostic criteria:
A. New headache appearing after head trauma and fulfilling criteria B to D
B. Head trauma with all the following:
1. No loss of consciousness, or loss of consciousness of < 30 min duration
2. GCS ≥ 13
3. Symptoms or signs diagnostic of concussion
C. Headache occurs less than 7 days after head trauma or after regaining consciousness or memory
D. Headache lasts < 3 months after regaining consciousness or memory

score, duration of loss of consciousness (LOC), and PTA. In addition, a short practicable neuropsychological test might be useful in detecting minor memory and attentional deficits. Laboratory and neuroimaging investigations in PTM after mild head trauma or whiplash are not needed. When mild head injury does not cause alteration in consciousness (GCS score of 14 to 15) or positive neurologic findings, only home observation is indicated. When the GCS score is less than 13 in the emergency room after head trauma, the LOC is longer than 30 minutes, and there is PTA, neurologic deficits, or personality disturbances, then neuroimaging studies (CT scan, MRI) are indicated.

MRI (using at least T1-weighted, T2-weighted, proton density, and gradient-echo sequence images) is much more sensitive than CT for detecting and classifying brain lesions. Within 1 week of a head injury, MRI can identify cortical contusions and lesions in the deep white matter of the cerebral hemispheres, which are usually underdiagnosed by CT. MRI thus provides a more sound basis for diagnosis and treatment in patients suffering from late sequelae of cranial injuries.

Complementary studies (neuroimaging, electroencephalogram, evoked potentials, cerebral spinal fluid examination, vestibular function testing) should also be considered for patients with ongoing posttraumatic headaches. There is no evidence that an abnormality of these studies changes the prognosis or contributes to treatment.

Differential diagnosis would include late primary migraine, symptomatic migraine secondary to structural lesion in the left hemisphere (epidural hematoma, subdural hematoma, subarachnoid hemorrhage, intraparenchymal contusion, vascular dissections, occluded vein or sinus, low spinal fluid pressure, hydrocephalus, epilepsy) or other disorders. Family history of migraine would be relevant for a diagnosis of primary headache while the patient's family history of vascular diseases would be relevant for secondary headache.

After several months, our patient developed a daily migraine. In the majority of patients with episodic headaches after head injury, this condition is self-limited, but a minority of individuals may develop persistent headaches. The features of posttraumatic headache will vary, but the most distressing type is the chronic daily headache. Neurologic factors have been implicated in the initial phase, and psychological and legal factors (litigation and expectations for compensation) in the maintenance of them. This patient developed a chronic PTM (Table 49-3). Paradoxically, the risk of developing chronic PTM is greater for mild to moderate head injury. Permanent PTM can be present several years after a legal settlement.

Age, gender, certain mechanical factors, long duration of unconsciousness after the trauma, neurologic deficits, and course length are risks for a poor outcome after head injury or whiplash injury. Women have higher risk for PTHA, and increasing age is associated with a less rapid and less complete recovery. Mechanical impact factors such as the position of head (rotation or inclined) increase the risk of PTHA. Other predictor factors include presence of skull fracture, reduced value of GCS score, elevated serum protein S-100B and dizziness, previous headache, and nausea in the emergency room. Unfavorable prognostic factors for PTM transformation into a chronic form include age greater than 40 years; a low intellectual, educational, and socioeconomic level; previous history of headache; previous history of alcohol abuse; and pending litigation or compensation. Medicolegal issues should be solved as soon as possible.

Investigation

During typical migraine, the activation of the brainstem monoaminergic nuclei has been demonstrated with functional imaging studies. Disturbed neuronal calcium influx and/or hemostasis has also been involved. These events have not been confirmed for PTM.

Pathophysiology of posttraumatic headaches is still not well understood, and biologic, psychological, and social factors have been included. In patients with late PTM, a sensitization phenomenon is discussed. In relation to this case, we propose the possibility of no central cause for trigeminal neuron sensitization in our patient without previous migraine and history of recent mild head injury. After head trauma, fibers arising from the trigeminal ganglion or from upper cervical dorsal roots could be irri-

Table 49-3 New Diagnostic Criteria for Chronic Posttraumatic Headache

5.2.1 Chronic Posttraumatic Headache with Moderate or Severe Head Injury
Diagnostic criteria:
A. New headache appearing after head trauma and fulfilling B to D
B. Head trauma with at least one of the following:
1. Loss of consciousness > 30 min
2. Glasgow Coma Scale (GCS) < 13
3. Posttraumatic amnesia > 48 h
4. Imaging demonstration of a traumatic brain lesion (cerebral hematoma, brain contusion, or skull fracture)
C. Headache occurs less than 7 days after head trauma or after regaining consciousness or memory
D. Headache lasts > 3 months after regaining consciousness or memory
5.2.2 Chronic Posttraumatic Headache with Mild Head Injury
Diagnostic criteria:
A. New headache appearing after head trauma and fulfilling B to D
B. Head trauma with all the following:
1. No loss of consciousness, or loss of consciousness of < 30 min duration
2. GCS ≥ 13
3. Symptoms or signs diagnostic of concussion
C. Headache occurs less than 7 days after head trauma or after regaining consciousness or memory
D. Headache lasts > 3 months after regaining consciousness or memory

tated and cause interaction of nociceptors of the trigeminocervical complex (upper cervical and occipital nerves) and trigeminovascular pathways. Peripheral sensitization during migraine had been proposed by other authors before. PTM associated with mild head injury and primary migraine may share a common headache pathway.

In our opinion, in this patient, an abnormal stimulation of a regional nerve by a small neurofibroma could sensitize these deeply located neurons and trigger headache. For us, the evidence for a peripheral trigger was fully demonstrated when the surgical removal of the neural lesion resolved the migraine attacks.

Further research is still necessary to clarify the relationship between chronic symptoms after mild head trauma and neuroimaging abnormalities. These abnormalities could provide a pathologic basis for long-term neurologic disability in patients with postconcussive syndrome. New techniques of MRI are useful for detecting small parenchymal brain lesions, diffuse axonal injury secondary to disruption of axonal membranes or delayed cerebral atrophy (diffusion tensor imaging, magnetization transfer ratio). In normal-appearing white matter, MR spectroscopy studies detect metabolic brain changes (an early reduction in *N*-acetyl aspartate and an increase in choline compounds), which correlate with head injury severity. Positron-emission tomography and single-photon emission computed tomography may evidence brain perfusion abnormalities after mild head trauma and chronic posttraumatic symptoms.

Case Summary

- The patient was a 20-year-old man who had a history of mild left-side head trauma followed by PTM.
- Symptomatic and preventive treatments were inefficient, and finally, the headache transformed into a chronic posttraumatic headache.
- The pathophysiology of this type of pain is not well understood.
- Minor head lesions after mild head trauma seem to act as a triggering factor, leading to migraine attacks in a person without history of migraine.
- In this patient, a neuroma over the site of the trauma could have sensitized the trigeminovascular nociceptive system through the trigeminocervical complex.
- Evidence for this peripheral trigger appeared when the posttraumatic migraine resolved after surgical removal of the neuroma.
- With this case, we also review diagnostic criteria and treatment of PTHA.

Management Strategies

Trauma-induced headaches are usually heterogeneous in nature, including both tension-type and intermittent migraine attacks. Over time, PTHA may take on a pattern of daily occurrence. If aggressive treatment is initiated early, PTHA is less likely to become a permanent problem. Adequate treatment typically requires both "peripheral" and "central" measures. Delayed recovery from PTHA may be a result of inadequately aggressive or ineffective treatment, overuse of analgesic medications resulting in analgesia rebound phenomena, or comorbid psychiatric disorders (posttraumatic stress disorder, insomnia, substance abuse, depression, or anxiety).

In general, treatment strategies are based upon studies of nontraumatic headache types. Acute PTM may be treated with analgesics, anti-inflammatory agents, ergotamine, or triptans. Chronic PTM needs prophylactic antimigraine medication. Previously, amitriptyline or propranolol, used alone or in combination, and verapamil have demonstrated to improve all symptoms of postconcussive syndrome, especially the migraine. Recently, R. C. Packard has published very good results with divalproex sodium as preventive option in the treatment of migraine. Additional physical therapy, behavioral therapy (biofeedback), and educational support can be performed. The explication of the headache's nature could also improve the patient's evolution. PTM, poorly treated, often affects family life, recreation, and employment.

Moreover, in some cases, when a posttraumatic lesion is a peripheral triggering factor for headache, then surgical treatment of the lesion can resolve the pain.

Overview of Posttraumatic Headache

Headache is usually the most prominent symptom of posttraumatic syndrome. In accordance with new IHS classification criteria, when a new headache occurs less than 7 days after a head or neck trauma, it is coded as acute PTHA. However, in some cases, when a strong relationship exists between the headache and the head trauma, then these temporal criteria can be less strictly considered.

Mild, moderate, and severe head injuries can be associated with a PTHA. When head injury does not cause a GCS score < 13, LOC longer than 30 minutes, PTA, or imaging demonstration of a traumatic brain lesion (cerebral hematoma, brain contusion, or skull fracture), then it is defined as mild head trauma and is frequently accompanied by additional cognitive, behavioral, or somatic problems. Acute PTHA, associated with mild head injury, can resemble a tension-type headache (80% of patients), a migraine-like headache, a cluster, or cervicogenic headache. If PTHA lasts more than 3 months after head injury, then it is defined as chronic PTHA. For the transformation of acute PTHA into a chronic daily headache, neurologic, psychological, and legal factors (litigation and expectations for compensation) have been implicated. Further research is still necessary to clarify the nature of chronic symptoms after mild head trauma.

The pathogenesis of PTM is still unknown, but it might share a common headache pathway with primary headache. We propose the cause to be a peripheral sensitization of the trigeminovascular pathway through the trigeminocervical complex.

Recommendations

Trauma-induced headache should be treated early, or associated complications will appear (daily occurrence of headache, overuse of analgesic medications, and comorbid psychiatric disorders). Preventive and symptomatic treatments may be prescribed in relation to the clinical pattern of headache (tension-type, migraine, cluster, or cervicogenic headaches), as in primary headaches. Physiotherapy, psychotherapy, behavioral therapy, and resolution of litigation can be contributing factors for recovering.

In some cases, when a peripheral triggering factor is identified in relation to a posttraumatic lesion, then surgical treatment can be effective.

Selected Readings

Arfanakis K, Haughton WM, Carew JD, et al. Diffusion tensor MR imaging in diffuse axonal injury. AJNR Am J Neuroradiol 2002;23:749–802.

Aumile EM, Sandel ME, Alavi A, et al. Dynamic imaging in mild traumatic brain injury support for the theory of medial temporal vulnerability. Arch Phys Med Rehabil 2002;83:1506–13.

Bahra A, Matharu MS, Buchel C, et al. Brainstem activation specific to migraine headache. Lancet 2001;357:1016–7.

Burstein R, Cutrer MF, Yarnitsky D. The development of cutaneous allodynia during a migraine attack. Clinical evidence for the sequential recruitment of spinal and supraspinal nociceptive neurons in migraine. Brain 2000;123:1703–9.

De Kruijk JR, Leffers P, Menheere PP, et al. Prediction of posttraumatic complaints after mild traumatic brain injury: early symptoms and biochemical markers. J Neurol Neurosurg Psychiatry 2002;73:727–32.

Garnett MR, Blamire AM, Corkill RG, et al. Early proton magnetic resonance spectroscopy in normal-appearing brain correlates with outcome in patients following traumatic brain injury. Brain 2000;123:2046–54.

Garnett MR, Blamire AM, Rajagopalau B, et al. Evidence for cellular damage in normal-appearing white matter correlates with injury severity in patients following traumatic brain injury: a magnetic resonance spectroscopy study. Brain 2000;123:1043–9.

Hachinski W. Posttraumatic headache. Arch Neurol 2000;57:1780.

Headache Classification Subcommittee of the International Headache Society. The international classification of headache disorders: 2nd ed. Cephalgia 2004;1:9–160.

Hofman PA, Verhey FR, Wilmink JT, et al. Brain lesions in patients visiting a memory clinic with postconcussional sequelae after mild to moderate brain injury. J Neuropsychiatry Clin Neurosci 2002;14:176–8.

Keidel M, Diener HC. Posttraumatic headache. Nervenarzt 1997:68:769–7.

Kors E, van der Maagdenberg AM, Plomp JJ, et al. Calcium channel mutations and migraine. Curr Opin Neurol 2002;15:311–6.

Lane J, Arciniegas DB. Post-traumatic headache. Curr Treat Options Neurol 2002;4:89–104.

Malick A, Burstein R. Peripheral and central sensitization during migraine. Funct Neurol 2000;15 Suppl 3:28–35.

Margulies S. The postconcussion syndrome after mild head trauma, part II: is migraine underdiagnosed? Clin Neurosci 2000;7:495–9.

Packard RC. Epidemiology and pathogenesis of posttraumatic headache. J Head Trauma Rehabil 1999;14:9–21.

Packard RC. The relationship of neck injury and posttraumatic headache. Curr Pain Headache Rep 2002;6:301–7.

Packard RC. Treatment of chronic daily posttraumatic headache with divalproex sodium. Headache 2000;40:736–9.

Packard RC, Haw CP. Pathogenesis of PTH and migraine: a common headache pathway? Headache 1997;37:142–52.

Son BC, Park CK, Chron BG, et al. Metabolic changes in periconcussional oedematous areas in mild head injury evaluated by 1H-MRS. Acta Neurochir Suppl 2000;76:13–6.

Titus F, Targa C, Láinez MJA. Cefaleas secundarias. Ergón SA, edi-

tores. Madrid; 1995.

Voller B, Auff E, Schnider P, Aichner F. To do or not to do MRI in mild traumatic brain injury? Brain Inj 2001;15:107–15.

Weiss HD, Stern BJ, Goldbert J. Post-traumatic migraine: chronic migraine precipitated by minor head or neck trauma. Headache 1991;31:451–6.

Editorial Comments

No clinical situation can be as difficult and trying for headache physicians and their patients as the accurate diagnosis and management of PTHAs. This is one time when a detailed history is paramount, including of course any history whatsoever of a premorbid history of headache, especially migraine, which by nature is episodic. The patient and the clinician initially may not realize that headaches in the remote past are relevant until this aspect of the history is clarified. This case is remarkable for the detailed discussion of the case and nosology of PTHA, but even more remarkable for the fact that a putative cause was found and corrected, leading to a good outcome for the patient. Such is not always the case; however, Drs. Láinez and Pascual-Lozano have dissected this case in great detail, and this provides us with an entirely reasonable approach to these entities.

Final diagnosis:

Posttraumatic headache