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Brain Injury

# **INVITED REVIEW**

# Characteristics and Treatment of Headache After Traumatic Brain Injury

A Focused Review

# ABSTRACT

Lew HL, Lin P-H, Fuh J-L, Wang S-J, Clark DJ, Walker WC: Characteristics and treatment of headache after traumatic brain injury: A focused review. Am J Phys Med Rehabil 2006;85:619-627.

Headache is one of the most common complaints in patients with traumatic brain injury. By definition, headache that develops within 1 wk after head trauma (or within 1 wk after regaining consciousness) is referred to as posttraumatic headache (PTH). Although most PTH resolves within 6-12 mos after injury, approximately 18-33% of PTH persists beyond 1 yr. We performed a systematic literature review on this topic and found that many patients with PTH had clinical presentations very similar to tension-type headache (37% of all PTH) and migraine (29% of all PTH). Although there is no universally accepted protocol for treating PTH, many clinicians treat PTH as if they were managing primary headache. As a result of the heterogeneity in the terminology and paucity in prospective, well-controlled studies in this field, there is a definite need for conducting double-blind, placebo-controlled treatment trials in patients with PTH.

Key Words: Brain Injuries, Headache, Posttraumatic Headache, Traumatic Brain Injury

eadache is one of the most common complaints in patients after traumatic brain injury (TBI).<sup>1</sup> Anywhere from 30 to 90% of patients with TBI may develop some form of headache.<sup>2-4</sup> In 2004, the International Classification of Headache Disorders, 2nd Edition (ICHD-2) defined posttraumatic headache (PTH) as a secondary headache that develops within 7 days after head trauma (or after regaining consciousness after head trauma) (Table 1).<sup>5</sup> If the headache persists for more than 3 mos after head trauma, it falls into the category of chronic PTH. Chronic PTH that persists beyond 6 mos after injury commonly becomes permanent and may be very disabling.<sup>4,6–9</sup> PTH can occur in patients with any severity of TBI. Some studies have reported an inverse correlation between the incidence of PTH and the severity of brain injury.<sup>10,11</sup> However, this observation has not been substantiated by others.<sup>4,12</sup> Differences in research design and the protean nature of PTH may have contributed to the inconsistent results.

#### **TABLE 1** Diagnostic criteria for posttraumatic headache<sup>5</sup>

5.1.1 Acute posttraumatic headache attributed to moderate or severe head injury

A. Headache, no typical characteristics known, fulfilling criteria C and D

B. Head trauma with at least one of the following:

- 1. Loss of consciousness for >30 mins
- 2. Glasgow Coma Scale (GCS) <13
- 3. Posttraumatic amnesia for >48 hrs
- 4. Imaging demonstration of a traumatic brain lesion (cerebral hematoma, intracerebral and/or
- subarachnoid hemorrhage, brain contusion, and/or skull fracture)

C. Headache develops within 7 days after head trauma or after regaining consciousness after head trauma

D. One or other of the following:

1. Headache resolves within 3 mos after head trauma

2. Headache persists but 3 mos have not yet passed since head trauma

5.1.2 Acute posttraumatic headache attributed to mild head injury

A. Headache, no typical characteristics known, fulfilling criteria C and D

B. Head trauma with at least one of the following:

- C. Headache develops within 7 days after head trauma
- 1. Either no loss of consciousness or loss of consciousness for <30 mins duration 2. GCS  $\ge 13$
- 3. Symptoms and/or signs diagnostic of concussion

D. One or other of the following:

- 1. Headache resolves within 3 mos after head trauma
- 2. Headache persists but 3 mos have not yet passed since head trauma

5.2.1 Chronic posttraumatic headache attributed to moderate or severe head injury

A. Headache, no typical characteristics known, fulfilling criteria C and D

B. Head trauma with at least one of the following:

- 1. Loss of consciousness for >30 mins
- $2.~\mathrm{GCS}<\!\!13$
- 3. Posttraumatic amnesia for >48 hrs
- 4. Imaging demonstration of a traumatic brain lesion (cerebral hematoma, intracerebral and/or
- subarachnoid hemorrhage, brain contusion, and/or skull fracture)
- C. Headache develops within 7 days after head trauma or after regaining consciousness after head trauma
- D. Headache persists for >3 mos after head trauma

5.2.2 Chronic posttraumatic headache attributed to mild head injury

- A. Headache, no typical characteristics known, fulfilling criteria C and D
- B. Head trauma with at least one of the following:
- 1. Either no loss of consciousness or loss of consciousness for >30 mins duration
- 2. GCS ≧13
- 3. Symptoms and/or signs diagnostic of concussion
- C. Headache develops within 7 days after head trauma or after regaining consciousness after head trauma
- D. Headache persists for >3 mos after head trauma

In an attempt to synthesize recent medical literature on PTH, we reviewed both prospective and retrospective studies related to PTH published in the last 15 yrs. The method and results of our literature review are elaborated in the following sections.

# SEARCH METHOD

We performed a systematic review of published medical literature indexed between January 1990 and February 2005 through the MEDLINE database. The literature search was limited to the English language and human studies. The key words used and search strategy are shown in Figure 1. To focus on adult patients, articles related to pediatric populations were excluded. Our search yielded 145 articles. We retrieved the full text of these publications and reviewed each article in detail.

# RESULTS

Five articles that specifically addressed patient characteristics and types of headache were identified.<sup>6,13–16</sup> These studies had a total of 423 patients, as shown in Table 2. Four articles used the old ICHD-1 diagnostic criteria and only one article used the most current ICHD-2 criteria.<sup>6</sup> Details in headache characteristics were described in four of these five articles, as shown in Table 3. We identified ten articles that specifically addressed the treatment of headache after TBI.<sup>17–26</sup> Among these ten studies, two were single case reports, three were case series, and the remaining five were either

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FIGURE 1 The literature search strategy, key words used, and number of articles retrieved in this review article. The search was limited to English language and human studies.

retrospective or prospective studies without controls. Details regarding the type and the design of these studies are described in Table 4.

During the traumatic event, patients with TBI may also sustain whiplash injury, which often causes headache. Therefore, studies on headache resulting from whiplash injury were also included. Our review found four articles,<sup>27–30</sup> which studied the characteristics of headache attributed to whiplash injury. These articles are summarized in Table 5. Three of these studies used the ICHD-1,<sup>27–29</sup> and the other one did not specify its diagnostic criteria.

# Headache Profiles in Posttraumatic Headache

Although PTH is defined as secondary headache, it often shows many clinical features that characterize primary headache. From 1990 to 2005, only five articles specifically delineating the clinical presentations of PTH were identified through our MEDLINE search. Two of these five studies that compared PTH with primary headache revealed marked similarity of headache profiles between these two groups.<sup>6</sup> Our review showed that most PTH had tension-type (ranging from 6.9 to 85.7%, mean = 33.6%) and migraine-like characteristics (ranging from 1.9 to 40.7%, mean = 28.6%). A large proportion of these patients presented with tension-type headache characteristics such as bilateral (72.5%) and nonthrobbing (83.0%) headache. Approximately 60% of these patients have headache with mild to moderate intensity, which is also an important characteristic of tension-type headache. The associated symptoms of migraine were also very common in PTH. For example, approximately one third of patients presented with sensitivity to light or noise (35.8 and 29.1%, respectively).<sup>6,13</sup> Headache aggravated by routine physical activities was reported in 71.1% of these patients. Our review also showed that the percentage of mixed or unclassified headaches ranged widely, from 4.2 to 36.5%.<sup>6,13–15,31</sup>

#### Patient Demographics in Posttraumatic Headache

Mean age ranged from 31.7 to 39.5 yrs. The male to female ratio in these studies varied widely from 0.17 to 1.03:1 (mean ratio n = 0.7:1). All studies except one showed a female preponderance in headache after TBI.

#### **Treatment for Posttraumatic Headache**

*Pharmacologic Treatment*. Our search found no randomized, double-blind, placebo-controlled clinical trials in PTH or headache after whiplash injury. There were five uncontrolled studies addressing the effectiveness of treating PTH. One study retrospectively

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M/F Ratio	Mean Age	Study Period	Tension- Type	Migraine	Other	Mixed	Unclassified
27/26 (1.03:1)	35	2001-2003	33 (62.2%)	1 (1.9%)		14 (26.4%)	5 (9.4%)
NA	NA	1996-1998	13 (6.9%)	77 (40.7%)	$30^a$ (15.9%)	24 (12.7%)	45 (23.8%)
46/66 (0.70:1)	$39.5\pm10.5$	NA	42 (37.5%)	30 (26.8%)	$20^{b}$ (17.8%)		20 (17.8%)
3/18 (0.17:1)	31.7	NA	18 (85.7%)	3 (14.3%)			
NA	NA	1991-1995	36 (75.0%)	10 (20.8%)			2(4.2%)
0.69:1			33.6%	28.6%	11.8%	9.0%	17.0%
	M/F Ratio 27/26 (1.03:1) NA 46/66 (0.70:1) 3/18 (0.17:1) NA 0.69:1 to dicorder	M/F Ratio Mean Age   27/26 (1.03:1) 35   NA NA   46/66 (0.70:1) 39.5 ± 10.5   3/18 (0.17:1) 31.7   NA NA   0.69:1 0.69:1	M/F Ratio Mean Age Study Period   27/26 (1.03:1) 35 2001–2003   NA NA 1996–1998   46/66 (0.70:1) 39.5 ± 10.5 NA   3/18 (0.71:1) 31.7 NA   NA NA 1991–1995   0.69:1 0.69:1 0.69:1	M/F Ratio Mean Age Study Period Type   27/26 (1.03:1) 35 2001–2003 33 (62.2%)   NA NA 1996–1998 13 (6.9%)   46/66 (0.70:1) 39.5 ± 10.5 NA 42 (37.5%)   3/18 (0.17:1) 31.7 NA 18 (85.7%)   NA NA 1991–1995 36 (75.0%)   0.69:1 33.6% 33.6%	M/F Ratio Mean Age Study Period Type Migraine   27/26 (1.03:1) 35 2001–2003 33 (62.2%) 1 (1.9%)   NA NA 1996–1998 13 (6.9%) 77 (40.7%)   46/66 (0.70:1) 39.5 ± 10.5 NA 42 (37.5%) 30 (26.8%)   3/18 (0.17:1) 31.7 NA 18 (85.7%) 3 (14.3%)   NA 1991–1995 36 (75.0%) 10 (20.8%)   0.69:1 33.6% 28.6%	M/F Ratio Mean Age Study Period Type Migraine Other   27/26 (1.03:1) 35 2001–2003 33 (62.2%) 1 (1.9%)   NA NA 1996–1998 13 (6.9%) 77 (40.7%) 30" (15.9%)   46/66 (0.70:1) 39.5 ± 10.5 NA 42 (37.5%) 30 (26.8%) 20 <sup>b</sup> (17.8%)   3/18 (0.17:1) 31.7 NA 18 (85.7%) 3 (14.3%) NA   NA NA 1991–1995 36 (75.0%) 10 (20.8%) 0.69:1 33.6% 28.6% 11.8%	M/F Ratio Mean Age Study Period Type Migraine Other Mixed   27/26 (1.03:1) 35 2001–2003 33 (62.2%) 1 (1.9%) 14 (26.4%)   NA NA 1996–1998 13 (6.9%) 77 (40.7%) 30 <sup>a</sup> (15.9%) 24 (12.7%)   46/66 (0.70:1) 39.5 ± 10.5 NA 42 (37.5%) 30 (26.8%) 20 <sup>b</sup> (17.8%)   3/18 (0.17:1) 31.7 NA 18 (85.7%) 3 (14.3%) 0.69:1   NA NA 1991–1995 36 (75.0%) 10 (20.8%) 0.0%   0.69:1 33.6% 28.6% 11.8% 9.0%

reviewed the efficacy of divalproex sodium, which is U.S. Food and Drug Administration-approved for migraine prevention, and it showed mild to moderate improvement in 60 of 100 patients.<sup>17</sup> Another prospective, nonrandomized, uncontrolled study using prophylactic medications for severe posttraumatic migraine (propranolol and amitriptyline) revealed satisfactory results in 21 of 30 patients.<sup>26</sup> The effectiveness of treating acute migraine by intravenous chlorpromazine and subcutaneous sumatriptan has also been reported in a few select cases.<sup>18,19,25</sup>

*Nonpharmacologic Treatment.* In patients with chronic PTH, no studies were identified that specifically assessed the efficacy of interventional techniques except one case report that described complete relief for at least 19 mos by sphenopalatine ganglion pulsed radiofrequency lesioning.<sup>20</sup> Two uncontrolled studies investigated the effectiveness of relaxation and biofeedback in PTH.<sup>22,23</sup> They both showed favorable results. In a prospective, nonrandomized, uncontrolled study, a combined therapy of medication, relaxation, and biofeedback showed the most dramatic improvement.<sup>24</sup> Fourteen of 20 patients reported marked improvement.

### Headache Attributed to Whiplash Injuries

Three studies described the characteristics of headache attributed to whiplash injuries.<sup>27–29</sup> They showed notable discrepancies in the type and quality of headache from that of PTH. One study showed that 81% of patients with headache that could not be classified as tension-type headache or migraine.<sup>27</sup> Female predominance was noted in three studies (mean male to female ratio = 0.54:1). Our search results also found that patients with headache after whiplash injuries had a much higher percentage of light and sound hypersensitivity or aggravation of symptoms by physical activities than those with PTH. The relative frequencies of nausea and vomiting were reported in one study (32.4 and 8.1%, respectively), but analgesic overuse or headache severity was not reported.

#### DISCUSSION

The majority of studies reported that patients with PTH presented with tension-type or migrainelike headache. It is possible that many patients with TBI might have two or more types of headache. The occurrence of each component of headache may

		Bilateral		Aggravated by	Sensitivity	Sensitivity		Analgesic	Severity:
Author	No.	Location	Nonthrobbing	Physical Activity	to Light	to Noise	Nausea/Vomiting	Overuse	Mild/moderate
Posttraumatic heada	che								
Baandrup, 2004	$48^{b}$	44 (91.7%)	40 (83.3%)	40 (83.3%)	16 (30.2%)	19 (35.8%)	14	22 (45.8%)	27 (56.25%)
Radanov, 2001	112	66 (58.9%)	91 (81.25%)	101 (90.2%)	43 (38.4%)	29 (25.9%)	35/16		
Bettucci, 1998	21	18 (85.7%)	18 (85.7%)						10 (47.6%)
Hass, 1996	$37^a$	30 (81.1%)	32 (86.5%)	14 (37.8%)			6/NA	$9^a$ (18.8%)	27 (73.0%)
Total	218	158 (72.5%)	181 (83.0%)	155 (71.1%)	59 (35.8%)	48 (29.1%)		31 (32.3%)	64 (60.4%)

<sup>*a*</sup> A total of 48 patients were included in this study, but nine patients with heavy analgesic use were not included in reviewing their characteristics of headache. The percentage of analgesic overuse was calculated with total number of 48 patients.

<sup>b</sup> Five patients with unclassified headache were not included in reviewing the characteristics of headache.

NA, not available.

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Author	Patient No.		Treatment	Outcomes
Pharmacologic treatment Packard, 2000	100	Retrospective study	divalproex sodium	Mild to moderate improvement: 60%; no response: 26%; discontinued resulting from side effects: 14%
Herd, 1994	1	Case report	Intravenous chlorpromazine	The headache resolved completely without recurrence
Sheftell, 1993	4	Prospective study	Subcutaneous sumatriptan	Of 32 treated attacks, there was adequate symptom relief in 95% of them with average time to relief of 51 mins
Gawel, 1993	7	Prospective case series	Subcutaneous sumatriptan	All seven patients reported that the frontal throbbing component of the headaches had been entirely or almost entirely abolished by 20 mins after the sumatriptan injection
Weiss, 1991	30	Prospective study	Propranolol and/or amitriptyline	Twenty-one patients (70%) showed dramatic reduction of frequency and severity of headache
Nonpharmacologic treatment				
Shah, 2004	1	Case report	Sphenopalatine ganglion pulsed radiofrequency lesioning	The patient became headache-free for $>19\ {\rm mos}$
Ahmed, 2000	5	Prospective study	Percutaneous electrical nerve stimulation	Improvement in physical activity: 41 to 58%; improvement in quality of sleep: 41 to 48%
Behavioral therapy Tatrow, 2003	14	Prospective study	Relaxation and biofeedback	Improvement of 50% or greater: 4 between 25 and 49%: 6; from 10 to 24%: 2: worsening: 2
Ham, 1996	40	Retrospective study	Relaxation and biofeedback	Improvement in headache: 53%; improvement in ability to relax and cope with headache: 80%
Mixed therapy Medina, 1992	20	Prospective study	Medication, relaxation, and biofeedback	Improvement: marked: 14; moderately: 4; slightly: 2

happen simultaneously or alternatively with various degrees of severity.

# **Psychologic Issues**

Patients with TBI may also have posttraumatic stress disorder. Although a causal relation has not yet been established, a large proportion of patients with chronic PTH demonstrated psychologic issues such as anxiety, depression, anger, and personality change.<sup>4,32</sup> Psychologic problems may trigger headache or may contribute to a vicious cycle of pain and emotional problems. Alternatively, persistent headaches may perpetuate emotional problems. In addition, mental fatigue and cognitive deficits such as slowed information processing, impaired memory, and problem-solving ability have also been reported in patients with PTH.<sup>33</sup>

#### **Treatment for Posttraumatic Headache**

Management of headache in TBI may be difficult and complex because there are many possible underlying factors, including musculoskeletal, vascular, visceral, neural, and iatrogenic causes.<sup>9</sup> In brief, there are peripheral and central mechanisms that might trigger headache independently or simultaneously. Peripheral mechanisms (musculoskeletal and biomechanical dysfunctions) may cause acute PTH, which can be treated with simple analgesics or physical therapy. A comprehensive psychologic evaluation, including cognitive assessments and management, is also very important because psychologic factors may aggravate the condition. The mainstay of treatment is to prevent chronicity by using prophylactic medications, to adequately control the use of multiple medications in the acute stage, and to diminish the risk of the

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	TABLE 5	5	Patients	characteristics	and	types of	of	headache	after	whit	olash	iniu	ırv
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							Type of Headache		
	No.	M/F Ratio	Mean Age	Study Period	Tension	Migraine	Other	Mixed	Unclassified
Pearce, 2001	48	17/ 31 (0.6:1)	NA	NA	6 (12.5%)	3 (6.25%)			39 (81.25%)
Obelieniene, 1998	101	NA	NA	1992-1995	53 (52.5%)	13 (12.9%)	$6^{b}$ (5.9%)		29 (28.7%)
Magnusson, 1994	38 <sup>a</sup>	13/ 25 (0.52:1)	33 (17 to 52)	1991					
Bring, 1991	$22^a$	8/14 (0.57:1)	38	1986		18 (85.7%)			

 $^{a}$  These two articles studied posttraumatic syndrome and included 38 and 22 patients, respectively, as shown on the lower part of Table 2. Only 37 of 38 and 21 of 22 patients from these two studies reported headache.

<sup>b</sup> Cervicogenic headache.

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NA, not available.

rebound phenomenon induced by medication overuse. Caution is recommended in long-term medication use such as ergotamine, triptan, or analgesics as a result of the potential for rebound headache, dose tolerance, and dependency.

Pharmacologic Treatment. A widely accepted guideline for treatment of primary headache already exists.<sup>34,35</sup> For acute attacks of tension-type headache and migraine, simple analgesics and nonsteroidal antiinflammatory drugs are commonly used. Prophylactic therapies for migraine include calcium channel blockers, anticonvulsants, antidepressants, and beta-blockers. Acute migraine-specific treatments such as ergotamine, dihydroergotamine, and the triptans may also be given. For tension-type headache, antidepressant and muscle relaxants are commonly used. Published studies on pharmacologic treatment specific to patients with PTH are very scarce. Only five investigators studied the treatment outcome of headache after TBI with migraine medication. There were no randomized, double-blind, controlled trials. Neither have there been any case-control studies comparing the outcomes of medical treatment for headache in TBI and primary headache.

Medication overuse headache is not uncommon among patients who present to headache clinics.<sup>36</sup> Patients with chronic daily headache may overuse various kinds of medications such as ergotamine, triptan, analgesics, or opioids.<sup>5</sup> It may actually result in an increase in frequency of headache, which may become refractory. This phenomenon has been recognized for years and its prevalence was estimated at 1-2% in the general population.<sup>37–39</sup> In our review, two articles reported analgesic overuse in 18.8 and 45.8% of patients with chronic PTH, respectively.<sup>6,11</sup> These studies also demonstrated that similar to the primary headache, the severity and the frequency of PTH declined after withdrawal or reduction of the offended medications. Therefore, it was postulated that medication overuse may be a factor in the development or prolongation of chronic PTH.<sup>36</sup>

*Nonpharmacologic Treatment*. Many alternative nonpharmacologic treatments that have been used to treat primary headache were also extrapolated to treat PTH. Specific alternative therapies included physical therapy, manipulation, as well as psychologic and behavioral managements. Our review showed no published studies on their use in patients with PTH except three studies investigating the effectiveness of behavioral management. None of them were randomized, controlled studies.

*Physical Therapy and Manipulation.* The extent of peripheral involvement of headache probably determines the prognosis of physical therapy on treating headache.<sup>40</sup> Headache resulting purely from musculoskeletal and biomechanical dysfunction may be relieved with appropriate physical therapy intervention. Because the peripheral contribution is variable in each patient, there is still insufficient evidence to either support or refute the effectiveness of physical therapy and spinal manipulation on treatment for primary headache.<sup>41</sup> Neither did we find any study regarding the effect of physical therapy and manipulation on PTH.

Anesthetic Blockade and Botulinum Toxins. Nerve block by local anesthetics has been advocated to relieve various kinds of primary headache. Although favorable outcome has been reported,<sup>42</sup> the mechanism remains unclear. Studies on therapeutic blocks have not been well-controlled, and the placebo effects have not been excluded.<sup>42</sup> The effects of botulinum toxins on treating primary headache have been widely studied but with conflicting

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**FIGURE 2** A proposed algorithm for diagnosis and treatment of posttraumatic headache is demonstrated in this flowchart.

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results. Although initial open-label studies reported satisfactory results, some randomized, double-blind, and placebo-controlled studies did not demonstrate strong evidence for the efficacy of botulinum toxin in reduction of headache frequency for tension-type headache or migraine headache.<sup>43,44</sup> In addition, different dosages and injection sites in each study have made direct comparisons impossible. Our review did not find articles studying the therapeutic effect of botulinum toxin in PTH.

*Biofeedback, Relaxation Technique, and Behavior Therapy.* Psychologic and behavioral management had been suggested to be an important adjunctive therapy for primary headache disorders. Previous studies in primary headache also demonstrated better outcome by combining medications and behavioral therapy to treat chronic tension headache despite the fact that each individual treatment strategy was modestly effective.<sup>45</sup>

#### Limitations

Several limitations in our review should be taken into account. First, we limited our literature search to articles in the English language from 1990 to 2005. In addition, there is no universally accepted terminology regarding headache after brain injuries. For example, some articles used "post-traumatic headache," whereas others used "posttraumatic headache." Neither of them is an official key word in Index Medicus. The ICHD-2 used the term: "headache attributed to head and/or neck trauma," which encompasses a much wider spectrum including acute and chronic PTH, acute and chronic headache attributed to whiplash injury, headache attributed to traumatic intracranial hematoma or other head and/or neck trauma, and postcraniotomy headache. Also, the term "head trauma" could potentially be confusing because it may mean bone or soft tissue trauma near the skull instead of brain injury per se.

There is still much controversy over diagnostic criteria for cervicogenic headache. Many clinicians have classified headache after whiplash injuries as cervicogenic headache. However, ICHD-2 claimed that history of neck trauma is not necessary to establish the diagnosis of cervicogenic headache. It also suggests that when myofascial tender points are identified as the source of pain, the headache should be coded under tension-type headache.<sup>5</sup>

The temporal relationship between the head injury and onset of headache may be another source of confusion. Although the pain research literature defined 6 mos (or more) as chronic, ICHD-2 defined chronic PTH as headache that persists for 3 mos or longer. A main purpose for establishing the ICHD was to assure that the same diagnostic approach and appropriate treatment are applied to all patients with headaches. Hopefully, its use will provide the basis for class 1 evidence for universally accepted therapeutic guidelines.

Finally, although our review found satisfactory response to several pharmacologic and/or nonpharmacologic treatments for PTH, it is possible that negative results were not published.

#### CONCLUSION

Most headaches are multifactorial and involve a combination of central and peripheral mechanisms. Therefore, clinicians should be careful in classifying PTH before administration of therapy. Unfortunately, there is a shortage of published articles on headache interventions specific to patients with PTH. In the interim, guidelines for treatment have been extrapolated from the primary headache medical literature. A tentative diagnostic and therapeutic flowchart is proposed by the current authors (consisting of three PM&R physicians, two neurologists, and one anesthesiologist) and illustrated in Figure 2. Finally, psychologic evaluation and behavior therapy, as well as lifestyle change and avoidance of medication overuse, are also important in the management of PTH.

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#### REFERENCES

- Nicholson K, Martelli MF: The problem of pain. J Head Trauma Rehabil 2004;19:2–9
- Gfeller JD, Chibnall JT, Duckro PN: Postconcussion symptoms and cognitive functioning in posttraumatic headache patients. *Headache* 1994;34:503–7
- Solomon S: Posttraumatic headache. Med Clin North Am 2001;85:987–96, vii–viii
- Walker WC, Seel RT, Curtiss G, Warden DL: Headache after moderate and severe traumatic brain injury: a longitudinal analysis. Arch Phys Med Rehabil 2005;86:1793–1800
- Headache Classification Committee of the International Headache Society: The International Classification of Headache Disorders 2nd Edition. *Cephalalgia* 2004;24 (suppl 1): 9–160
- Baandrup L, Jensen R: Chronic post-traumatic headache—a clinical analysis in relation to the International Headache Classification 2nd Edition. *Cephalalgia* 2005;25:132–8
- Packard RC, Ham LP: Posttraumatic headache: determining chronicity. *Headache* 1993;33:133–4
- Packard RC: Posttraumatic headache: permanency and relationship to legal settlement. *Headache* 1992;32:496–500
- Walker WC: Pain pathoetiology after TBI: neural and nonneural mechanisms. J Head Trauma Rehabil 2004;19:72–81
- Couch JR, Bearss C: Chronic daily headache in the posttrauma syndrome: relation to extent of head injury. *Headache* 2001;41:559–64

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- Haas DC: Chronic post-traumatic headaches classified and compared with natural headaches. *Cephalalgia* 1996;16: 486–93
- De Benedittis G, De Santis A: Chronic post-traumatic headache: clinical, psychopathological features and outcome determinants. *Neurosurg Sci* 1983;3:177–86
- Radanov BP, Di Stefano G, Augustiny KF: Symptomatic approach to posttraumatic headache and its possible implications for treatment. *Eur Spine J* 2001;10:403–7
- Bekkelund SI, Salvesen R: Prevalence of head trauma in patients with difficult headache: the North Norway Headache Study. *Headache* 2003;43:59–62
- Bettucci D, Aguggia M, Bolamperti L, et al: Chronic posttraumatic headache associated with minor cranial trauma: a description of cephalalgic patterns. *Ital J Neurol Sci* 1998;19:20–4
- Haas DC: Characteristics of chronic posttraumatic headache. *Headache* 2002;42:162–3
- 17. Packard RC: Treatment of chronic daily posttraumatic headache with divalproex sodium. *Headache* 2000;40: 736–9
- Herd A, Ludwig L: Relief of posttraumatic headache by intravenous chlorpromazine. J Emerg Med 1994;12:849–51
- Gawel MJ, Rothbart P, Jacobs H: Subcutaneous sumatriptan in the treatment of acute episodes of posttraumatic headache. *Headache* 1993;33:96–7
- Shah RV, Racz GB: Long-term relief of posttraumatic headache by sphenopalatine ganglion pulsed radiofrequency lesioning: a case report. Arch Phys Med Rehabil 2004;85: 1013–6
- 21. Ahmed HE, White PF, Craig WF, et al: Use of percutaneous electrical nerve stimulation (PENS) in the short-term management of headache. *Headache* 2000;40:311–5
- Tatrow K, Blanchard EB, Silverman DJ: Posttraumatic headache: an exploratory treatment study. *Appl Psychophysiol Biofeedback* 2003;28:267–78
- Ham LP, Packard RC: A retrospective, follow-up study of biofeedback-assisted relaxation therapy in patients with posttraumatic headache. *Biofeedback Self Regul* 1996;21: 93–104
- 24. Medina JL: Efficacy of an individualized outpatient program in the treatment of chronic post-traumatic headache. *Headache* 1992;32:180–3
- 25. Sheftell FD, Weeks RE, Rapoport AM, et al: Subcutaneous sumatriptan in a clinical setting: the first 100 consecutive patients with acute migraine in a tertiary care center. *Head-ache* 1994;34:67–72
- Weiss HD, Stern BJ, Goldberg J: Post-traumatic migraine: chronic migraine precipitated by minor head or neck trauma. *Headache* 1991;31:451–6
- 27. Pearce JM: Headaches in the whiplash syndrome. Spinal Cord 2001;39:228–33

- Magnusson T: Extracervical symptoms after whiplash trauma. *Cephalalgia* 1994;14:223–7; discussion 181–2
- Bring G, Westman G: Chronic posttraumatic syndrome after whiplash injury. A pilot study of 22 patients. Scand J Prim Health Care 1991;9:135–41
- Obelieniene D: Headache after whiplash: a historical cohort study outside the medico-legal context. *Cephalalgia* 1998; 18:559–64
- Haas DC: Chronic post-traumatic headaches classified and compared with natural headaches. *Cephalalgia* 1996;16: 486–93
- Packard RC: Current concepts in chronic post-traumatic headache. Curr Pain Headache Rep 2005;9:59–64
- Packard RC, Weaver R, Ham LP: Cognitive symptoms in patients with posttraumatic headache. *Headache* 1993;33: 365–8
- Stillman MJ: Pharmacotherapy of tension-type headaches. Curr Pain Headache Rep 2002;6:408–13
- Goadsby PJ, Lipton RB, Ferrari MD: Migraine—current understanding and treatment. N Engl J Med 2002;346: 257–70
- Colas R: Chronic daily headache with analgesic overuse: epidemiology and impact on quality of life. *Neurology* 2004; 62:1338–42
- Lu SR, Fuh JL, Chen WT, et al: Chronic daily headache in Taipei, Taiwan: prevalence, follow-up and outcome predictors. *Cephalalgia* 2001;21:980–6
- Wang SJ, Fuh JL, Lu SR, et al: Chronic daily headache in Chinese elderly: prevalence, risk factors, and biannual follow-up. *Neurology* 2000;54:314–9
- Castillo J, Munoz P, Guitera V, Pascual J: Epidemiology of chronic daily headache in the general population. *Headache* 1999;39:190–6
- Mills Roth J: Physical therapy in the treatment of chronic headache. Curr Pain Headache Rep 2003;7:482–9
- Lenssinck ML, Damen L, Verhagen AP et al: The effectiveness of physiotherapy and manipulation in patients with tension-type headache: a systematic review. *Pain* 2004;112: 381–8
- Bogduk N: Role of anesthesiologic blockade in headache management. Curr Pain Headache Rep 2004;8:399–403
- Lenaerts ME: Alternative therapies for tension-type headache. Curr Pain Headache Rep 2004;8:484–8
- 44. Gobel H, Heinze A, Heinze-Kuhn K, Austermann K et al: Botulinum toxin A in the treatment of headache syndromes and pericranial pain syndromes. *Pain* 2001;91:195–9
- Holroyd KA, O'Donnell FJ, Stensland M et al : Management of chronic tension-type headache with tricyclic antidepressant medication, stress management therapy, and their combination: a randomized controlled trial. *JAMA* 2001; 285:2208–15