Posttraumatic Headache

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1. Definition

- Headache attributed to trauma or traumatic injury to the head and/or neck (ICHD-3)

- Depend on a close temporal relationship between traumatic injury and headache onset (within 7 days after injury or within 7days after regaining consciousness or the ability to sense and report headache)

- Outside of this 7-day window ⟹ delayed onset headaches attributed to traumatic injury to the head

2. Classification

- Classified by mechanisms

(1) Headaches that are attributed to traumatic injury to head

(2) Whiplash

(3) Craniotomy

- Broken down into
  - Acute - during the first 3 months
  - Persistent - beyond (3) months

❖ Headaches that are attributed to traumatic injury to the head

- **Mild Traumatic Injury** (one or more of the following)

  (1) transient confusion, disorientation, or impaired consciousness

  (2) loss of memory for events immediately before or after the head injury and/or

  (3) two or more symptoms of nausea, vomiting, visual disturbances, dizziness, and/or vertigo, gait and /or postural imbalance, and impaired memory and/or concentration

- **Moderate or Severe Injury**

(one or more of the following inclusion criteria)

(1) Loss of consciousness for > 30 minutes
(2) GCS score < 13
(3) Post traumatic amnesia lasting > 24 hours
(4) Altered level of awareness for >24 hours, and
(5) Imaging evidence of a traumatic head injury such as skull fracture, intracranial hemorrhage, and/or brain contusion

3. Epidemiology

- Most common secondary headache disorder (4% of all headache disorder)
- Incidence of acute PTH -25% to 78%
- Lifetime prevalence 4.7% in men and 2.4% in women

3.1 Risk factor for developing PTH after TBI

- Three articles that assessed risk factors for acute PTH

- age
- sex
- "number of post concussion symptoms" (only significant)
- loss of consciousness
- type of injury
- previous TBI
- current treatment for anxiety/depression
- history of preexisting conditions (primary headache disorders, chronic pain , ADHD, learning disorder)
- BMI
- other disease (not further specified)

(Seemingly paradoxically, PTH more frequent after mild than after moderate to severe TBI)

Two special populations

(1) Athletes

- Sports - related TBI – 300,000 in US each year
- PTH ➡ occur immediately after head or neck injury, as a component of persistent post concussion symptoms (symptoms that persist beyond expected time frames i.e.>10-14 days)

  ➡ as a symptom of chronic traumatic encephalopathy (CTE), a progressive neurodegenerative tauopathy
- PTH ➡ 86% of athletes (most commonly associated post concussive symptoms)

(2) Military Personnel

- a sample of military personnel returning from combat in Afghanistan and Iraq – 37% had PTH
- interfered with duty performance in 37% of cases
- associated with comorbidities such as anxiety, depression, posttraumatic stress disorder, and sleep disturbances

4. Pathophysiology

- Poorly understood
- Multifactorial
- TBI - associated with “primary injury” caused by mechanical forces during initial insult
  - “secondary injury” related to a subsequent cascade of cellular changes

Structural level

- Changes in fractional anisotropy in various white matter regions after mild TBI
- Decreased thickness of both cortical and subcortical regions of brain associated with pain in persistent PTH
- Disruption of descending pain neuromodulation pathways which send inhibitory projections to trigeminocervical complex

Functional level

(during secondary injury: occurring before recovery of normal cellular function after a primary injury)

- Loss of cell membrane integrity causing upregulated neurotransmitter release and ion flux
- ATP-driven pumps work to restore homeostasis, but energy stores are rapidly depleted ultimately leading to oxidative stress from lactate and free radicals

- ATP release also occurs in cortical spreading depression

  (observed in regions near damaged cortical tissue) ⟹ play a role in PTH
- Neuroinflammation related to activation of glial cell after TBI ⟹ linked to cortical spreading depression and activation of trigeminovascular system
- Calcitonin gene-related peptide (CGRP) mediated mechanisms ⟹ potentially shared mechanism in PTH
- Activation of extracellular dual afferents and nociceptive drive from cervical afferents and autonomic dysfunction leading to hyper adrenergic state

5. Diagnosis

5.1 History and Physical Exam

- mechanism of injury
- timeline of symptom-onset postinjury
- duration of headache
- known history of a preexisting headache disorder
- comorbidities - sleep disorders
  - prior chronic pain conditions
  - pretrauma psychiatric conditions
    (e.g. depression, anxiety, posttraumatic stress disorders , learning disorders)
- prior head traumas

- **Complete physical and neurological exam:**
  (including spine evaluation)

Phenotype of PTH

- Migraine-type - migraine prodrome and aura are not as commonly described in PTH
- Tension-type - unlikely to be exacerbated by physical activity
- TAC-type - arise from focal irritation and change at the site of injury along trigeminal pathway , leading to localized nociceptive activation

6. Neuroimaging

- No standardized, evidence-based, guidelines for assessing utility of neuroimaging in persistent PTH
- Underlying vascular cause of PTH is suspected (e.g. vertebral or carotid artery dissection)⟹CTA or MRA
- Suspected CSF lack⟹MRI brain with gadolinium contrast
- For assessment of CVT or intracranial hypertension⟹MRI + MRV

Table 2 Comparison of New Orleans Criteria (NOC) and Canadian CT Head Rule (CCTHR)

	NOC (GCS: 15)	CCTHR (GCS: 13–15)
Symptoms	Headache, emesis, persistent short-term memory deficit	≥ 2 episodes of emesis, amnesia before impact of ≥30 min
Structural	Visible trauma above clavicle	Suspected open or depressed skull fracture, or any sign of basal skull fracture
Age	Greater than 60 y	65 y or older
Other	Seizure	Dangerous mechanism of injury

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7. Differential Diagnoses and Contributors

7.1 Non-emergent

7.1.1 Preexisting Primary Headache Disorder (PHD)

- May have a history of PHD that predates traumatic injury (Preexisting migraine & tension headache)
- May be exacerbated in severity and frequency in temporal relation to trauma
- Both preexisting diagnosis of PHD and new diagnosis of PTH are made per ICHD -3 criteria

7.1.2 Cervicogenic Headache

- Secondary headache disorder caused by pathology of cervical spine, vertebrae, and/or soft tissue
- Clinical and/or imaging evidence of disorder or lesion within cervical spine or soft tissue of neck to make this diagnosis
- Neck injuries can occur simultaneously with TBI but can also be the sole injury producing headache in a scenario where TBI is suspected but not confirmed

7.1.2 Cervicogenic Headache (Cont'd)

At least (2) of the following should be demonstrated:

(1) Development of headache in temporal relation to onset of cervical disorder or lesion
(2) Headache improvement or resolution in parallel with improvement or resolution of cervical disorder or lesion
(3) Reduction in cervical range of motion and headache exacerbation with provocative maneuvers, and
(4) Headache resolution after nerve block

7.1.3 Neuralgias (Head trauma may lead to neuralgias in various nerve distributions)

- Occipital neuralgia
  - Caused by irritation of lesser and/or greater occipital nerve
  - Pain is sever, paroxysmal, and lancinating in quality
  - Associated with tenderness to palpation and sensory changes in the distribution of the nerves
- Supraorbital nerve
- Supratrochlear nerve

7.1.4 Low pressure Headache

- Mechanisms of injury that can cause TBI can also cause spinal trauma resulting in a Dural tear and leading to CSF leak, intracranial hypotension and subsequent low pressure headache
- Classically positional or orthostatic in nature
- Significant improvement with lying down

7.1.5 Intracranial Hypertension

- Common symptoms and signs – headache, peripheral vision loss, tinnitus, papilledema and VI CN palsy
- Imaging findings – empty sella, flattening of posterior aspect of globe, distention of perioptic subarachnoid space with or without tortuosity of optic nerve, and transverse sinus stenosis
- Associated with TBI in 6.6% of patients in pediatric intracranial Hypertension Registry

7.1.6 Temporomandibular Disorder

- If involves trauma to structures of face or neck ➡ consider headache related to TM disorder
- Moderate, continuous, and dull/achy in quality , affecting jaw, temporal, forehead, and/or cervical regions
- Aggravated by jaw motion and function, and may be provoked on exam by temporal muscle palpation

7.1.7 Medication Overuse Headache

- New headache type or worsening of preexisting primary headache disorder in setting of medication overuse (i.e., 10-15 days per month depending on the medication) for more than 3 months

- Excessive analgesic use after TBI due to development of PTH or for worsening of preexisting primary headache (ergotamine, triptans, nonopioids or combination of analgesic)

7.1.8 Dysautonomia

- Orthostatic, vasomotor, secretomotor, gastrointestinal, bladder and pupillometry changes ⟹ important contributor to PTH
- Positive correlation between severity of PTH and autonomic dysfunction

7.2 Emergent

7.2.1 Skull Fracture

- Suggestive clinical symptoms & signs-Headache, depressed mental status, nausea and vomiting, focal neurologic deficits, ecchymoses, scalp laceration, contusions, and bony step-offs of the skull
- Associated with underlying vascular and parenchymal intracranial injuries that can cause headache
- E.g., parietal skull fractures – associated with ICH

  basal skull fractures – associated with CSF leaks that can cause low- pressure headache

7.2.2 Intracranial Haemorrhage

- Traumatic injury to brain parenchyma ⟹ various haemorrhagic consequences (EDH, SDH, SAH, and cerebral contusion)
- Epidural haematomas
  - Arterial injury to middle meningeal artery (85% of cases)
  - Transient LOC followed by 'lucid interval'
  - Ultimately clinical deterioration with associated headache
- Subdural haematomas
  - Associated with injury to bridging veins
  - Headache(common symptoms in both acute and chronic SDH)
- Subarachnoid haemorrhage
  - Trauma (most common cause of SAH)

(Each of three types present with headache, nausea/vomiting, altered mentation, focal neurologic deficits, and/or seizures)

7.2.3 Neurovascular Injury

- Head or neck trauma can cause extra cranial arterial dissections – head and/or neck pain
- Carotid artery dissection
  - Ipsilateral and frontal
- Vertebral artery dissection
  - Occipital and associated with neck pain
- Horner's syndrome, TIA and/or ischaemic stroke in setting of neurovascular injury

8.Treatment

8.1 Pharmacologic

8.1.1 Acute Treatment

- No FDA-approved pharmacologic treatment for PTH
- Treatment strategies mirror those of primary headache disorder
- Depending on several factors (severity, duration, and frequency of headache – acute and/or preventive pharmacologic agent should be considered)
- Medications : NSAIDs, acetaminophen, opioids , combination drugs,
  : IV ketorolac, prochloperazine, metochlopramide and/or ondensetron, metochlopramide+diphenhyramine

8.1.2 Preventive Treatment

- Severe, prolonged, disabling, and/or frequent headaches consider preventive pharmacologic agent
- Frequency threshold for PTH – four or more attacks per month
- Selecting preventive agent – based on primary phenotype of PTH
- Medications : Propranolol, amitriptyline, topiramate, valproate, flunarizine, and melatonin
  : CGRP inhibitor (erenumab) – lower frequency of headache days per month

8.2 Nonpharmacologic

- Oral hydration
- Good nutrition
- Optimisation of sleep hygiene
- Avoidance of/ graded exposure to known trigger
- Reduction in polypharmacy
- Stress reduction like behavioral interventions
- Biofeedback – self regulation technique used to reduce sympathetic activation
- Aerobic exercise – beneficial for persistent PTH
- Physiotherapy (i.e., heat, ice, therapeutic exercise, massage, myofascial release, traction, ultrasound, and electrical stimulation)
- Acupuncture – decrease headache burden
- Onabotulinum toxin A injection may be helpful for persistent PTH

9.Prognosis

- On Individual Level

(typical course of recovery is important for)

  - Educating patients about their condition
  - Guiding treatment
  - Handling pertinent medicolegal implications

- On Large Scale

(significant public health issue due to)

  - Burden of their injury-related disability

- In general, a systemic review suggests that post-concussion symptoms, including headache resolve within (3) months to (1) year
- Persistent PTH - 47 to 78% at (3) months
  - 8.4 to 35% at (1) year

Take Home Messages

- PTH is frequently multifactorial & heterogenous in its presentation & the mechanisms of injury.
- Patients with PTH also have an increased risk of psychiatric comorbidies including anxiety, depression, & posttraumatic stress disorder which can complicate diagnosi & treatment.
- The pathophysiology of PTH offers a unique challenge

(cortical spreading depression, CGRP signaling, neuroinflammatory processes, changes in neurometabolism & neuromodulation of pain signaling)

- Current treatment model is based mainly on treating the headache phenotype, relying on expert opinion, as there is a lack of rigorous acute & prophylactic treatment in PTH.

- Wide range of incidence of persistent PTH may be the result of
  - Researchers not strictly adhering to ICHD criteria for PTH, and
  - Studies have employed different methodologies
  - Renders interpretation of findings difficult

- There is still much that we need to better understand regarding PTH.

Reference

Heinzelmann, M., Woods, C., Vargas, B. B., & Stokes, M. (2022). Posttraumatic headache. *Seminars in Neurology*, *42*(04), 428–440. https://doi.org/10.1055/a-1933-4427

Seifert, T. D., & Evans, R. W. (2010). Posttraumatic headache: A Review. *Current Pain and Headache Reports*, *14*(4), 292–298. https://doi.org/10.1007/s11916-010-0117-7

Headache classification committee of the International Headache Society (IHS) the International Classification of Headache Disorders, 3rd Edition. (2018). *Cephalalgia*, *38*(1), 1–211. https://doi.org/10.1177/0333102417738202