Pathophysiology of Neurotrauma

Magnetic Resonance Imaging Differences in Brain Structure: Persistent Posttraumatic Headache and Migraine

A major challenge for the investigation, diagnosis, and treatment of posttraumatic headache (PTH) is the inability to accurately diagnose persistent PTH (PPTH) attributed to mild traumatic brain injury (mTBI) and to reliably differentiate PPTH attributed to mTBI from chronic migraine. It is often impossible to clinically differentiate the patient who had an exacerbation of their underlying migraine pattern following traumatic brain injury (TBI), from the patient who had a new onset of migraine following TBI, from the patient with true PPTH. According to International Classification of Headache Disorders diagnostic criteria, the only evidence for headache being attributable to a preceding head injury is that the headache begins within seven days of the injury. However, a substantial proportion of military PTH starts after a longer interval (up to 60 percent of cases), the majority of PPTH is phenotypically indistinguishable from chronic migraine according to information typically collected in the clinical setting (60-97 percent), and many Service members and civilians with presumed PPTH have a personal history of migraine preceding the mTBI. Thus, it is commonly challenging to differentiate PPTH from chronic migraine in the clinical setting. The inability to accurately diagnose PPTH attributed to mTBI and differentiate it from chronic migraine has substantial negative implications on patient care and the ability to conduct meaningful research on PPTH.

Researchers at the Mayo Clinic and Foundation, Scottsdale (Scottsdale, Arizona) are conducting a study to see if they could identify differences in the pathophysiology of migraine and PTH that would support the notion that migraine and PTH are truly distinct headache types. The objective of this study is to use machine-learning algorithms to construct multivariate models of structural and functional imaging data and patient symptoms that accurately diagnose PPTH attributed to mTBI and differentiate it from chronic migraine. Functional and structural magnetic resonance imaging (MRI) data and patient symptoms will be used to build and test automated diagnostic models that most accurately diagnose PPTH attributed to mTBI and differentiate it from chronic migraine (Figure 1). They are using MRI sequences that can easily be employed during the clinical investigation of patients, without adding risk to the patient, without the need for contrast administration, and with little additional financial burden.

Initial results, published in 2017, show that differences in regional volumes, cortical thickness, surface area, and brain curvature exist when comparing individuals with persistent post-traumatic headache and individuals with migraine. The brain regions affected include the right lateral orbitofrontal lobe, left caudal middle frontal lobe, left superior frontal lobe, left precuneus, and right supramarginal gyrus. These structural differences may be the result of differences in underlying pathophysiology, despite the substantial similarities in symptoms between the two headache types (*Schwedt et al. 2017*).

In conclusion, the inability to accurately diagnose PPTH leads to misdiagnosis and maltreatment. These results could relatively quickly translate into computer-aided diagnostic tools that would assist in diagnosing PPTH and differentiating it from chronic migraine.

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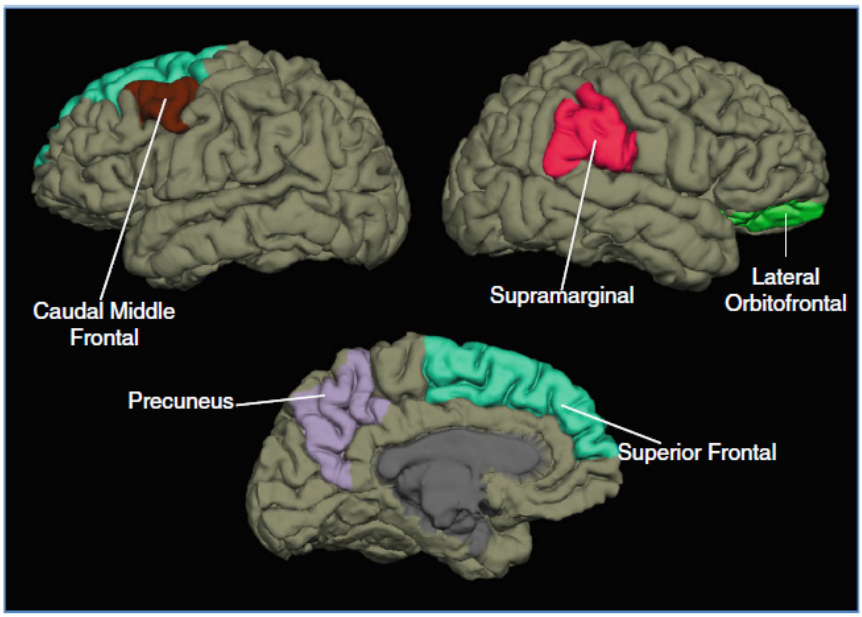

FIGURE 1: Regions with structural differences when comparing individuals with persistent post-traumatic headache (PPTH) to those with migraine. When comparing structural measurements of entire brain regions in patients with PPTH to patients with migraine, the right lateral orbital frontal region differed in area, volume, and curvature. The left caudal middle frontal, precuneus, and superior frontal regions and the right supramarginal gyrus region differed in cortical thickness. (Figure 1 from Schwedt et al. (2017) used with permission from the authors)

REFERENCES:

Schwedt, T. J., Chong, C. D., Peplinski, J., Ross, K., and Berisha, V. 2017. "Persistent Post-Traumatic Headache vs. Migraine: An MRI Study Demonstrating Differences in Brain Structure." J Headache Pain 18 (1):87. doi: 10.1186/s10194-017-0796-0.