

# Cerebral Blood Flow in Chronic Posttraumatic Headache

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**Background and Purpose.**—Headache is the most common neurologic symptom following minor closed head injury. There is often a lack of objective evidence supporting an organic basis of cerebral pathology in these cases. This pilot study considers the possibility of alterations in cerebral blood flow, indicating evidence of an organic disorder in posttraumatic headache.

**Methods.**—Regional cerebral blood flow studies of 35 patients with chronic posttraumatic headache (PTH) (International Headache Society criteria), identified retrospectively from our cerebral blood flow data base, were compared with those of 49 nonheadache controls and 92 migraineurs (Ad Hoc Committee criteria). Regional cerebral blood flow (initial slope index method) was measured using the xenon Xe 133 inhalation technique.

**Results.**—Compared to migraineurs and controls, and after adjusting for differences (analysis of covariance) in baseline variables such as blood pressure, hematocrit, and  $P_{CO_2}$ , patients with PTH had: (1) significantly lower mean initial slope indices ( $P < 0.001$ ,  $P = 0.002$ , respectively); (2) regional interhemispheric flow differences (rIFD), with higher distribution of regional asymmetrical probe pairs (rIFD  $\geq 7\%$ :  $P[\text{PTH versus control}] = 0.006$ ,  $P[\text{PTH versus migraine}] = 0.016$ ; rIFD  $\geq 10\%$ :  $P[\text{PTH versus control}] = 0.011$ ,  $P[\text{PTH versus migraine}] = 0.003$ ); and (3) more hemispheric asymmetries ( $P[\text{PTH versus control}] = 0.023$ ,  $P[\text{PTH versus migraine}] = 0.57$ ). Lower mean initial slope indices and hemispheric asymmetry (mean interhemispheric flow difference  $\geq 3.2\%$ ) predicted PTH over control ( $P = 0.023$  and  $0.002$ , respectively). Lower mean initial slope indices predicted PTH over migraine ( $P = 0.002$ ).

**Conclusions.**—Patients with PTH have reduced regional cerebral blood flow, and regional and hemispheric asymmetries. These cerebral hemodynamic alterations support an organic basis to chronic posttraumatic headache.

**Key words:** headache, closed head injury, cerebral blood flow

**Abbreviations:** mCHI minor closed head injury, PTH posttraumatic headache, CBF cerebral blood flow, rCBF regional cerebral blood flow, ISI initial slope index, rIFD regional interhemispheric flow differences, mIFD mean interhemispheric flow differences

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Minor closed head injury (mCHI) may manifest with a variety of symptoms including headache, dizziness, mood changes, diminished concentration, insomnia, impaired memory, alcohol intolerance, easy fatigability, anxiety, sexual dysfunction, blurred vision, and tinnitus.<sup>1-4</sup> Headache is the most common symptom after head injury.<sup>2</sup> Posttraumatic headache (PTH) has been reported in up to one half of patients following mCHI, and one third of these patients continue with headache after 2 months.<sup>5</sup> Posttraumatic headache may vary considerably in location, severity, characteristics, and temporal profile.<sup>2</sup> Despite persistent and occasionally disabling symptoms, abnormal neurological signs are absent, and evidence of brain damage is usually undetected by present methods of investigation (eg, MRI, EEG).<sup>3</sup>

The pathogenesis of PTH and other symptoms following minor head trauma is a matter of controversy,<sup>2</sup> and the debate of an organic versus psychogenic basis has been ongoing for centuries.<sup>6,7</sup> Posttraumatic symptoms may be related to the mechanisms of concussion,<sup>2</sup> such as axonal injury or excitotoxic amino acid release and subsequent neural injury. Furthermore, altered cerebral hemodynamics and slowed cerebral circulation have been described in the post-concussion syndrome,<sup>7,8</sup> and are likely due to vasomotor instability.<sup>2,9</sup> To investigate cerebral blood flow (CBF) in chronic PTH, defined by the International Headache Society criteria,<sup>10</sup> we compared the regional CBF (rCBF) studies of patients with chronic PTH to those of migraineurs and nonheadache normal controls, using the xenon 133 Xe inhalation rCBF technique.

## SUBJECTS AND METHODS

**Subjects.**—Data from 1546 rCBF studies were entered into the Henry Ford Hospital rCBF database between January 1989 and January 1994. Forty-two studies were coded with the diagnosis of PTH. We reviewed the hospital charts of the 42 patients and selected the 35 which fulfilled the IHS criteria for chronic PTH with minor head injury (IHS 5.2.2).<sup>10</sup> The causes of