Prognostic value of auditory brain-stem responses for late postconcussion symptoms following minor head injury

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Minor head injury is frequently followed by a subjective postconcussion syndrome. Brain-stem auditory evoked responses (BAER's) were found to be pathological in different small series of patients with a postconcussion syndrome who were examined months after sustaining a slight cranial or cervical trauma; abnormal BAER's have also been reported in larger groups of patients examined early after minor head injury. A relationship between these findings and late subjective symptoms has never been demonstrated.

The results of a prospective study into the value of BAER's in the prognosis of a postconcussion syndrome after minor head injury are presented. In 103 patients with minor head injury, BAER's were recorded within 48 hours of the trauma. One year later, the patients were examined for headache, dizziness, depression, anxiety, subjective loss of memory and concentration, and irritability. Eighty percent claimed at least one symptom, most often irritability (54%), memory loss (47%), or depression (39%). Pathological BAER's were found with the same prevalence in patients with and without a postconcussion syndrome.

This study confirms the disturbance of brain-stem function in some head-injured patients. However, the lack of correlation with a postconcussion syndrome limits the prognostic value of BAER recordings for postconcussion syndrome. The data suggest that BAER's not be used for medicolegal evaluation of patients with a postconcussion syndrome.

KEY WORDS • brain-stem auditory responses • evoked potentials • head injury • postconcussion syndrome

About 80% of patients admitted to neurosurgical wards following head injury are discharged with a negative neurological examination after a short period of hospitalization. They generally recover rapidly and soon return to work. Some of them complain for months or years of symptoms such as headache, dizziness, and loss of memory and concentration, causing them social and economic distress. Brain-stem auditory evoked responses (BAER's) were recently found to be pathological in patients with head trauma who complained of postconcussion symptoms in spite of having normal neurological examinations.2,7,9 Evaluation of BAER's has therefore been proposed to show subclinical brain-stem involvement following head injury.

The prevalence of BAER alterations reported in the literature varies from 0% to 27% reflecting the lack of homogeneity of the relatively small groups of patients described thus far. The severity of the head injury was defined by the duration of unconsciousness, which varied from zero to several hours. Moreover, while in some patients BAER recordings were made months or even years after head injury, in others they were recorded a few days after trauma. The value of BAER recordings in identifying a postconcussion syndrome has therefore been questioned.6,10,11

Since the relationship of BAER alterations to the later occurrence of a postconcussion syndrome is still unknown, we decided to study their prognostic value in patients with the late emergence of postconcussion symptoms.

Clinical Material and Methods

This study comprised 103 patients with minor head injury who were referred to the University Hospital of Modena between November, 1982, and September, 1983. Criteria for admission to the study were: 1) loss of consciousness for less than 20 minutes; 2) an initial Glasgow Coma Scale score of 13 to 15; 3) hospitalization for less than 4 days; 4) negative neurological examination upon admission and discharge; and 5) no medical complications. Patients younger than 12 years or older than 75 years were excluded.
In each patient, BAER’s were recorded within 48 hours after trauma. Rarefraction clicks of 0.1-msec duration were delivered monaurally at 70 dB sensation level. The evoked responses were recorded with a band-pass of 3.2 to 3200 Hz on a MEDELEC MS6 system.* The I-III, III-V, and I-V interpeak latencies were calculated and considered abnormal when they exceeded the corresponding mean by 3 standard deviations found in a mixed-gender sample of 73 normal subjects with similar age distribution (range 15 to 70 years). Upper normal limits for I-III, III-V and I-V interpeak latencies were 2.28, 2.45, and 4.70 msec, respectively.

One year later all of our patients received a questionnaire asking if they suffered from headache, dizziness, depression, anxiety, subjective loss of memory and concentration, or irritability, at least 6 months after trauma. The frequency of referred symptoms in patients with and without pathological BAER results was compared using the chi-square test.

**Results**

Based on recordings of all interpeak latencies of both sides, BAER’s revealed brain-stem dysfunction in seven patients. In six patients only one interpeak latency was increased, and in one patient two interpeak latencies were increased; however, 96 patients had normal BAER’s. Twenty patients claimed no long-lasting post-traumatic symptoms, while the remaining 83 reported suffering from one or more symptoms. The most frequently reported symptoms were irritability (54%), memory loss (47%), and depression (39%), followed by headache (36%), concentration difficulties (33%), anxiety (26%), and dizziness (23%).

Pathological BAER’s were found in one of the 20 patients without symptoms and in six of the 83 with at least one symptom. This difference is not statistically significant (chi-square with Yates’ correction = 0.0194, 1 df). Pathological BAER’s were found with the same prevalence in patients with and without any of the reported symptoms (Table 1).

**Discussion**

The results of this study were obtained from a homogeneous group of patients with minor head injuries selected to comply with restrictive criteria. Abnormal BAER’s were found in about 10% of the cases. Alterations in BAER’s reflect a brain-stem dysfunction that has been confirmed by pathological and neurophysiological data reported in the literature. Experimental models have shown recognizable organic lesions following cerebral concussion. An acceleration-deceleration mechanism can provoke axonal tears and degeneration, especially in the brain stem, and altered BAER’s recorded after concussion can be considered indirect evidence of this mechanism.

Axonal degeneration in the brain stem, as suggested by BAER data, could have a disruptive effect on cortical arousal and hence on cognitive performance, causing anxiety and reactive depression. However, postconcussion symptoms occur much more often than do BAER abnormalities. Moreover, failure to demonstrate any relationship between subclinical brain-stem involvement (as shown by BAER’s) and postconcussion syndrome symptoms does not support the hypothesis that there is an organic basis for this frequent late complication of minor head injury. On the other hand, the nonspecific symptoms of a neurasthenic reaction, such as subjective loss of memory, irritability, and depression, are those most frequently reported by these patients. Similiar symptoms are characteristically found in posttraumatic stress disorder, chronic or delayed (DSM-III code 309.81), in which the same reaction is mostly due to psychic stress, usually unrelated to physical lesions. The unanimous agreement that posttraumatic psychic symptoms can be neither proved nor disproved by electroencephalography is valid also for the more quantitative method of BAER’s. The data do not support any attempt to render posttraumatic symptoms objective by means of BAER recordings.

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**References**


* MEDELEC MS6 system manufactured by Medelec Ltd., Woking, Surrey, England.

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