Methods and devices

Serial recordings of auditory brainstem responses in severe head injury: relationship between test timing and prognostic power

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Abstract. ABRs have proved to be very accurate prognostic indicators in severe head injury, even when predictions are based on single ABR recordings. In this study we submitted 30 severely head-injured patients to serial ABR recordings (during the clinical course of posttraumatic coma) in order to verify whether the ABR prognostic power may depend on test timing in relation to the injury. 15 patients (50%) died, 5 (16.7%) remained vegetative, 2 (6.6%) severely disabled and 8 (26.7%) recovered. All recovered patients had normal ABR throughout clinical course, while severely disabled and vegetative patients showed at least transiently ABR abnormalities (namely, an interpeak latency of waves V-I > 4.48 ms).

Among dead patients, 8 showed steady and 3 transient ABR abnormalities during the clinical course, while 2 of 3 patients with normal ABR dead from extracranial complications.

ABRs were significantly related to the outcome at any time, but gave more accurate prognostic indications on days 3–6 after the injury. The use of serial ABR recordings appeared to improve the outcome predictions in comparison with single ABR tests. Finally our results confirm the previously reported existence of a breakpoint between reversible brainstem dysfunction and irreversible brainstem damage defined by an IPL V-I of about 4.50 ms.

Key words: Head injury – Evoked potentials – Brainstem – Outcome

The assessment of brainstem damage is to be considered of paramount importance in the early outcome prediction of severely head-injured patients. CT scan signs of direct brainstem lesions are reliable but not frequent, while the evidence of secondary brainstem damage is quite uncertain [19]. The functional status of the brainstem in head injury may be assessed by the clinical examination as well as by a variety of investigative techniques including blink reflex [14], stapedial reflex [10] and evoked potentials [1, 2, 4, 11–13, 16, 18].

Among clinical signs, the oculocephalic and light reflexes have proved to be powerful prognostic indicators [5, 20] and have shown a close correlation with the auditory brainstem response (ABR) [9, 17]. Among neurophysiological investigations evoked potentials appear to be the best tool for the assessment of post-traumatic coma and outcome prediction.

We have previously reported on the high prognostic power of ABR [4, 9]: although our data were based on a single ABR test, they suggested that the prognostic power of ABR was not significantly affected by test-timing in relation to the injury. As an earlier report by Seales et al. [13] suggested a higher prognostic value of ABR on days 3–6 post-injury, in this study we submitted our patients to serial ABR tests throughout the clinical course of post-traumatic coma in order to evaluate whether, a) the ABR prognostic power may depend on test timing in relation to the injury and, b) serial ABR recordings may improve the outcome prediction in comparison to the use of single ABR tests.

Materials and methods

ABRs were recorded in 30 post-traumatic comatose patients (Glasgow Coma Score of 8 or less) ranging between the age of 15 and 60 years, during a period of two years. According to our previous report [4] patients with monolateral pathology of the ear (e.g. hemotympanum or temporal bone fracture) were included in this study only if the unaffected side showed an interpeak latency of waves V-I (IPL V-I) more than 4.50 ms or absent V wave. In patients showing
different ABR in the two sides only the worst side was taken into account. Patients admitted in terminal conditions were discarded from this study. All the patients were submitted to CT scan examination and to a standard head-injury management protocol including mechanical hyperventilation, 20% mannitol at a dose of 0.25 g/kg body weight [8] every 4 h and prophylactic anticonvulsivant therapy (Phenobarbital 100 mg twice daily). Any increase in body temperature was vigorously treated.

The outcome of the patients was assessed 6 months after the injury and classified according to Jennett and Bond [6]. Our patients were divided into the following 3 groups according to their outcome: group D (death), group PVS (persistent vegetative state) and group R (recovery), including good recovery (GR), mild and severe disability (MD and SD, respectively).

ABRs were recorded at least twice in each patient during the clinical course: the first ABR test was recorded within 3 days after the trauma in 19 cases, between 3 and 6 days in 5 cases, and after 6 days in 6 patients. A total of 107 ABRs tests were performed in this series.

ABRs were recorded from each ear with the following method: click signals (0.1 ms impulses of alternating polarity) were presented monaurally through an electromagnetically shielded TDH 39 earphone at an intensity of 80 dB HL at a rate of 21 s. The ABRs were recorded from vertex using ipsilateral earlobe as reference; a sweep time of 10 msec, a sensitivity of 0.31 μV/div and a filter band pass 160–3000 Hz were used. A total of 2048 responses were averaged per trial and at least two trials were recorded and superimposed in order to define their reproducibility. The ABRs were recorded by means of a BASIS EP equipment (O.T.E. Biomedica, Florence, Italy).

The latency of each wave was measured from the electrical onset of the click at the earphone to the peak of the wave. The waves were recognized according to the criteria of Laguna Beach Conference [15] (for other details, see ref. 3). ABRs were graded as follows: (a) IPL V−I<4.50; (b) IPL V−I>4.50; (c) absent V wave.

The statistical analysis was conducted with Fisher' exact test.

Results

Fifteen patients (50%) died, 5 (16.7%) remained vegetative, 2 (6.6%) showed severe disability and 8 (26.7%) recovery or mild disability.