Title : INTRACRANIAL PRESSURE EFFECTS ON BRAINSTEM POTENTIALS

Authors : P. Raudzens, M.D., R. Scharber, B.A., R. Erspamer, B.S.

Affiliation: Department of Anesthesia, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, 350 West Thomas Road, Phoenix, Arizona 85013

Introduction. Brainstem auditory evoked potentials (BAEPs) are stable, reproducible submicrovolt signals that have been used clinically to test auditory function, to diagnose demyelinating disorders, to localize brainstem lesions and to determine brain death. In order to evaluate the usefulness of BAEPs in monitoring brainstem integrity during neurosurgical procedures, we investigated the effects of intracranial pressure (ICP), systemic blood pressure (BP), temperature, and acid-base status in a series of acute experiments on 16 cats.

Methods. BAEPs were recorded on adult cats (1.7-5.2 kg. body-wt.) after induction with intraperitoneal Pentothal and Gallamine, after cannulation and placement of burr holes and after every reversible change in one of the parameters of the study. A click stimulus was delivered monaurally at 11/sec. for 100^{u}sec. duration with 60 dB intensity and positive polarity through earphones to the cat. Averages of 1024 responses were recorded in a NICOLET CA 1000 with a band-pass of 150-1500 Hz. Intracranial pressure was measured by a ROCHE epidural fiberoptic transducer. Cerebral blood flow was measured by a thermal diffusion flow probe. Intracranial pressure was manipulated with an epidural Fogarty catheter. Temperature was controlled with a heating pad. Arterial blood gases were changed by setting different ventilatory parameters. Systemic blood pressure was changed by both hypertensive (Ephedrine) and hypotensive agents (Nipride).

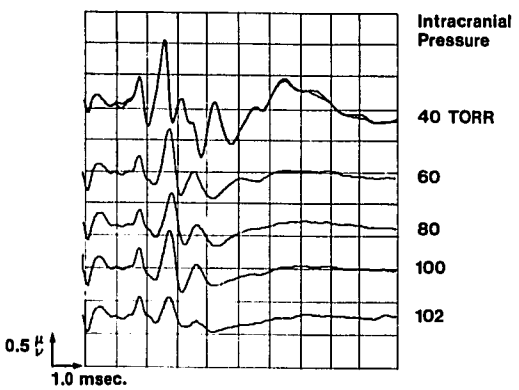
Results. Statistical significance of latency and amplitude values were tested with analysis of variance and the Pearson Product-Moment Correlation. Decreasing temperature in the range of 40.2^{o}C - 28.8^{o}C was identified with prolonged latencies of the BAEP waveform. Surgical manipulation, BP changes and pH changes had no significant effect on the BAEP. Acute reversible increases in ICP resulted in reduced wave latencies and amplitudes. This effect was more evident as a latency change. At levels of ICP exceeding CBF, the waveform was abolished.

Discussion. This experimental model was designed to test the effects of some parameters associated with neurosurgical procedures on the BAEP. We confirmed previously described effects of temperature on this signal. We showed that acute increases in ICP can be detected by BAEP changes. This was a reversible effect unless CBF was compromised. The potential usefulness of the BAEP as a monitor during posterior fossa craniotomy is based on these features: the signal is stable and reproducible, it is derived by low risk, non-invasive techniques, it is quantifiable and resistant to many drugs including anesthetics (ethrane and alcohol may be exceptions). Interpretation of waveform changes depends on controlling variables that effect the BAEP. We have described another factor, ICP, that influences the BAEP. This has to be considered together with the other parameters that affect the waveform: maturation, stimulus intensity, temperature, and species differences.

References.

1. Jewett, D.L.: "Volume Conducted Potentials in Response to Auditory Stimuli as Detected by Averaging in the Cat." Electroencephalography and Clinical Neurophysiology 28 (6):609-618, 1970.

2. Stockard, J.J., Rossiter, V.S.: Clinical and Pathological Correlates of Brain Stem Auditory Response Abnormalities. Neurology 27:316-325, 1977.



Brainstem auditory evoked responses from the cat are recorded at different intracranial pressures. Note the reproducibility of the waveform by superimposition. Ag-AgCl skin electrodes were used so that vertex positivity was recorded with the ipsilateral pinnae electrode. A third electrode was attached to the contralateral pinnae. Electrode impedance was less than 3 KΩ.