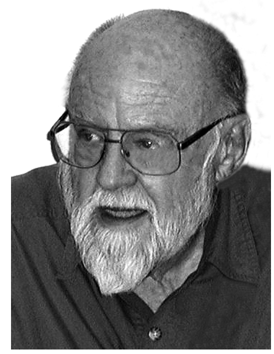
Editorial

Auditory Evoked Potentials in Infants: Thinking out of the Box



Objective audiometry for difficult-to-test persons, especially infants and young children, has been an elusive goal for more than six decades. The advent of auditory evoked potentials (AEPs), in the late 1950s and early 1960s, stimulated a surge of research in this arena in the hope that the brain's electrical responses to acoustic stimuli would reveal the status of auditory sensitivity without the need for the active cooperation of the person being evaluated. The two AEPs receiving the most interest in those early years were the middle latency response (MLR), researched extensively by Robert Goldstein and his associates, and the vertex, or late, response (LVR), thoroughly studied by Hallowell Davis. Neither AEP, however, proved to be clinically viable with infants and small children. Major problems may have been excessive filtering of the EEG signal, nonoptimal stimulus rates, electrode choice, difficulty in controlling state variables like level of alertness, sleep versus wakefulness, stage of sleep, and so forth, and the fact that response waveform, especially in the case of the vertex response, changes substantially over the early months and years of development. The principal focus in almost all of this early work with MLR and LVR was on thresholds: how closely could you predict the behavioral threshold from the lowest level at which you could observe a repeatable electrophysiological response?

With the advent of the auditory brain stem response (ABR) in the 1970s, clinical interest in the MLR and LVR waned. The ABR waveform was relatively independent of state variables and yielded reliable responses close to behavioral thresholds. Moreover, the ABR to tonal stimuli could be used to fit hearing aids to infants and young children based on a prescriptive fitting formula. But one interesting problem arose: the child with auditory neuropathy, also called "auditory dys-synchrony." Such children are defined by the combination of relatively normal otoacoustic emissions and relatively abnormal or absent ABRs. How, then, can degree of loss be estimated in order to fit a hearing aid? Even though the ABR is absent, the child may have relatively normal peripheral sensitivity. In fact, any degree of sensitivity from normal to severe loss may be present. Without ABR, how can degree of sensitivity loss be estimated?

In this issue of *JAAA*, authors Wendy Pearce, Maryanne Golding, and Harvey Dillon, of the National Acoustic Laboratories (NAL), in Chatswood, New South Wales, Australia, and the Cooperative Research Centre for Cochlear Implants and Hearing Aid Innovation, in Melbourne, offer observations on two children with auditory neuropathy in which a novel use of the LVR (herein designated the "cortical auditory evoked potential" or "CAEP"), helped them to a successful amplification solution. In both cases the ABR was either grossly abnormal or absent altogether. One child showed, at age 12 weeks, well-formed and repeatable CAEP responses to three speech stimuli (/m/, /g/, /t/) at 65 dB SPL. The investigators concluded that this result effectively excluded a severe loss but did not exclude a mild or moderate loss. Accordingly, a moderate gain aid was tentatively fitted and subsequent behavior carefully noted. By age two-and-a-half years, behavioral testing revealed that the loss was no greater than 30 dB, and hearing aid use was discontinued.

The second child had already been fitted with a moderate gain aid by the age of five months when CAEP testing was carried out. At 65 dB SPL there were no aided CAEP responses to any of the three speech stimuli. After adjusting the gain upward, the aided testing was redone at 75 dB SPL, but CAEP responses were still absent. After further upward adjustment of the gain, there were still no repeatable CAEP responses. These findings led to the successful fitting of a cochlear implant at age 16 months.

The unique features of the path taken by Pearce et al were (1) testing at one or two moderate levels, then (2) following what might be called an "adaptive fitting strategy" based on the CAEP response at those moderate levels. The important point is that they did not immediately attempt to estimate actual threshold sensitivity in either child. This was always the goal in so much of the earlier work with the auditory evoked potentials, a strategy that may have been a major contributor to the early failures. When testing time is limited, as it always is with infants and small children, it is perhaps a better strategy to focus on a few good responses at moderate intensity levels than to spend excessive time looking for small responses at very low intensity levels. Another example of this "out-of-the-box" thinking is Anu Sharma's use of the latency of the suprathreshold P1 component of the CAEP as a predictor of successful cochlear implant use in very young children.

These novel approaches to old problems remind us that we still have much to learn about the successful clinical implementation of auditory electrophysiological tools.

James Jerger
Editor-in-Chief