INTRODUCTION

It is well-documented that speech-evoked auditory brainstem response (sABR) measurements offer an objective technique for assessment of auditory processing of speech stimuli. Laboratory studies confirm that sABR recording in noise increases sensitivity to auditory processing and related disorders (Johnson et al., 2005). sABR measurements provide an objective analysis of the brainstem electrophysiological response to a complex speech stimulus (d/da) (Russo et al., 2004). Evidence supports the optimal signal-to-noise ratio (SNR) for “auditory comprehension” is +6 dB SNR (Crandell, 1992) with the optimal classroom learning environment SNR for children being +15 dB SNR. The purpose of this study is to objectively examine the effects of noise on a pediatric population.

We examined the effects of noise on the speech-evoked auditory brainstem response (sABR) in a group of normal hearing children with a specially developed custom insert earphone permitting measurement in quiet and noise. The present commercially available system prevents analysis of sABR when noise and speech stimuli are presented through one transducer. The custom insert, designed for this study, allows for this analysis. This study depicts the ease of sABR measurements with noise in the clinical setting. We hypothesized that the sABR composite score in children would decrease with speech stimulation in the presence of ipsilateral noise.

METHODS

Subjects were seven normal hearing (pure tone thresholds ≤ 15 dB HL) children aged 6 to 11 years old (mean age = 8 years). Parental report confirmed good to outstanding school performance, no current medical conditions, and no history of otologic concerns. Comprehensive audiological testing, including Hearing in Noise Test (HINT) and Quick Speech-in-Noise (QuickSN), was completed. Sequential measurements were obtained in three subjects, providing an initial insight into the stability of sABR measurements over time. Data on additional subjects is currently in progress to confirm our findings. An easy to make, custom insert was constructed to allow analysis of sABR data in noise compared to the normative data stored in the commercially available sABR software. Electrophysiological data was obtained for sABR in quiet and in noise (+5 dB SNR). sABR measurements were collected using Biologic® BioMARK™ (Biological Marker of Auditory Processing) sABR system.

RESULTS

Figure 4: Breakdown of sABR results for each subject for quiet and noise conditions. Table depicts various parts of the sABR results. Findings are given in terms of whether they were within normal limits (“Y”) or outside of normal limits (“O”). Components of the sABR waveforms include wave V latency (wave V lat.), wave A latency (wave A lat.), VA slope, Fast Fourier Frequency (FFFF), and High Frequencies (HF). “BioMARK Score” indicates whether a subject’s sABR composite score was within normal limits.

Figure 5: QuickSIN results for all subjects. Results shown for various tracks/recordings. Average SNR loss plotted (3.7 dB = mild, 7.15 dB = moderate, >15 dB = severe). QuickSIN results compared to the sABR measurements suggested a possible correlation between behavioral and electrophysiological measures in this subset of subjects.

SUMMARY

- Preliminary findings indicate a significant difference in sABR measurements in quiet versus noise conditions (t = -2.7; df = 6; p < 0.05).
- Composite scores reported by the sABR BioMARK™ system indicated an increased magnitude of deficit when noise was present.
- All subjects scored within normal limits for HINT conditions (quiet, +15 dB SNR, +5 dB SNR), while QuickSIN scores revealed difficulty among subjects.
- Data analysis permitted quick quantitative information on the effect of noise on a child’s auditory abilities.
- Stability study, with an alpha of 0.05, revealed no significant changes to sABR scores between test periods (t = -0.378; df = 2; p > 0.05).
- The custom insert, designed in this study, offers a novel and clinically feasible approach for sABR recording in quiet and noise conditions.
- These findings are the development of norms indicating that children, even with normal hearing sensitivity, may have increased difficulty in environments with poor SNR.
- The data are consistent with previous subjective studies depicting that children perform better in optimal listening environments. Further data collection and an increased sample size is needed.

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