Comparison Of Auditory Steady- State Response, Auditory Brain Stem Response And Behavioral Test Methods In Evaluation Of Hearing In Infants And Children

Thesis

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بسم الله الرحمن الرحيم

" قالوا سبحانك لا علم لنا الا ما علمتنا انك أنت العليم الحكيم "

صدق الله العظيم

الآيه ٣٢ سورة البقرة

To
My Family

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Abstract

The most widely used auditory evoked potential (AEP), is auditory evoked brain stem response (ABR). Another AEP is the auditory steady state response (ASSR). ASSR allows for frequency specific threshold determination. **Objective:** To study the results of ABR, ASSR and behavioral tests in infants and young children and to determine the best methods for accurate detection of hearing loss in this age group. **Methods:** A total number of 60 infants and children were examined. Their age range was 7 months to 8 years and they were of both sexes. They were all subjected to the following tests; basic audiologic evaluation according to age group, ABR for threshold detection and ASSR with carrier frequencies 250, 500, 1000, 2000 and 4000 Hz. **Results**: There was a significant difference between PTA and ASSR thresholds at all frequencies among the tested groups. The difference decreases in severe and profound hearing losses (HLs). There was a statistically significant correlation between PTA and ASSR at different frequencies. There was a significant difference between ABR thresholds and average threshold of PTA (1000, 2000 and 4000 Hz). Statistical analysis of the correlations between ABR thresholds and average PTA thresholds (1000, 2000, and 4000 Hz) revealed a significant correlation in cases of moderate to profound HLs. There was a significant difference between ABR thresholds and average threshold of ASSR (1000, 2000 and 4000 Hz). Statistical analysis of the correlation between ABR thresholds and ASSR thresholds (1000, 2000 and 4000 Hz) showed a significant correlation in cases of mild, moderately severe, severe and profound HLs. No significant difference was found between young and older children as regards ASSR and ABR thresholds. There was a significant difference in the amplitude of ASSR response between young and older children at 1000 Hz in minimal HL and at 250 Hz in mild and moderately severe HLs. ASSR response amplitude increased with increasing intensity. At severe and profound hearing losses, the amplitude tends to be smaller as compared to normal and other milder degrees of HLs which is obvious at 2000 and 4000 Hz. **Conclusion:** ASSR cannot reliably differentiate between normal ears and those with mild hearing loss and the accuracy of the results improves with severe to profound sensorineural hearing losses. The best ASSR frequencies to correlate with PTA were 1000, 2000 and 4000 Hz. ABR thresholds were best correlated with the average of PTA and ASSR (1000, 2000 and 4000 Hz) in severe and profound hearing losses. At higher

degrees of HL, the slope of ASSR amplitude intensity curves tends to decrease.

Recommendation of this study is to use a test battery which includes behavioral tests, ABR and ASSR for accurate evaluation and management of hearing loss in infants and young children. Further research on the ASSR amplitude intensity relationship for its possible application in suggesting the presence of recruitment and hence its application in hearing aid fitting.

Keywords:

Auditory steady state evoked response, Auditory evoked brain stem response, Pure tone audiometry, Children, Hearing loss.

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Abbreviations

ABR: Auditory brain stem response

AM: Amplitude modulation

AM²: Exponential modulation envelopes

AMFR: Amplitude modulated following response

ASSR: Auditory steady–state evoked response

BOA: Behavioral observation audiometry

CF: Carrier frequency

CM: Cochlear microphonic

CPA: Conditioned play audiometry

dB: Decibel

deg: Degree

EEG: Electro-encephalogram

EFR: Envelope following response

EOAEs: Evoked otoacoustic emission**s**

EPs: Evoked potentials

f: Frequency

FFT: Fast Fourier Transform

FM: Frequency modulation

gr: Group

HL: Hearing level

Hz: Hertz

IAFM: Independent amplitude and frequency modulation

JCIH: Joint Committee on Infant Hearing

KHz: Kilo Hertz

MASTER: Multiple auditory steady–state evoked response

MF: Modulating frequency

min: Minute

MLAEP: Middle latency auditory evoked potential

MM: Mixed modulation amplitude and frequency

ms: Millisecond

nHL: Normal hearing level

NV: Nano volt

PTA: Pure tone audiometry

rms: Root mean square

SAM: Sinusoidally amplitude modulated tone

sec: Second

SIN³: Sinusoidally amplitude modulated tone with exponential envelope

SN-10: Slow negative response after 10 seconds

SPL: Sound pressure level

SSEP: Steady state evoked potential

UV: Micro volt

VRA: Visual reinforcement audiometry

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