An Investigation of the Relationship of ABR Wave V to Na-Pa of the MLR

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This study aimed to investigate the relationship between simultaneously recorded auditory brainstem response (ABR) wave V and middle latency response (MLR) Na-Pa complex, develop normative data, and make quantitative comparisons.

Background

• Auditory Brainstem Response (ABR) provides valuable diagnostic information about the auditory system from the auditory nerve to the level of the pons.
• The middle latency response (MLR) is believed to be generated by the midbrain and the thalamocortical pathway into Heschl’s Gyrus (Kraus, Kiliany, and Agee, 1994).
• The amplitude of the MLR wave Pa is typically larger than that of ABR wave V due to the increased amount of neural substrate at the level of the cortex.
• MLR is often compromised in patients with central auditory lesions or central auditory processing disorders.
• The simultaneous recording of ABR and MLR could allow clinicians to gather information about the central auditory system more efficiently, which could have important implications for the diagnosis of disordered populations (Musiek et al., 1999).

Materials and Methods

Participants

16 adults with:
- normal peripheral hearing bilaterally for the octave frequencies 250 Hz through 8 kHz
- no history of neurological or otological problems
- central auditory processing disorders or learning disability
- normal Type A tympanograms (Jerger, 1970) bilaterally on the day of testing
- present otoacoustic emissions in the test ear

Procedures

• Waveforms were recorded using a Nicolet Spirit 2000 Averages
• Ear of presentation was randomized across participants
• Electrodes at Cz, A1, and A2
• A 100 microphone rate was used
• 1000 accepted sweeps
• Time window of 40 milliseconds
• Stimuli were presented at two repetition rates, 5.7 and 17.7 clicks per second, and two intensities, 35 dB nHL and 70 dB nHL, yielding four recording conditions
• Responses were filtered online at 20-1500Hz

Results

Representative Waveforms of four recording conditions:

5.7 clicks per second, 35 dB

5.7 clicks per second, 70 dB

17.7 clicks per second, 35 dB

17.7 clicks per second, 70 dB

Latency Measures of Wave V and Na-Pa (means and standard deviations)

<table>
<thead>
<tr>
<th>Wave V Latency</th>
<th>No Wave Latency</th>
<th>Pa/Na Latency</th>
<th>Interaural Latencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.60 (1.60)</td>
<td>26.60 (1.40)</td>
<td>25.60 (1.60)</td>
<td>17.70 (1.40)</td>
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Effect of repetition rate on amplitude ratio:

<table>
<thead>
<tr>
<th>Amplitude Ratios at 5.7 clicks per second</th>
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<tbody>
<tr>
<td>0.95 (0.05)</td>
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<tr>
<td>0.90 (0.04)</td>
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<tr>
<td>0.85 (0.03)</td>
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<tr>
<td>0.80 (0.02)</td>
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<table>
<thead>
<tr>
<th>Amplitude Ratios at 17.7 clicks per second</th>
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<tbody>
<tr>
<td>0.70 (0.01)</td>
</tr>
<tr>
<td>0.65 (0.005)</td>
</tr>
<tr>
<td>0.60 (0.002)</td>
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<tr>
<td>0.55 (0.001)</td>
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Discussion and Conclusion

The amplitude ratio between wave V and the Na-Pa complex appeared to be the most sensitive index to changes in stimulus. At 35 and 70 dB in HL, significant effects were noted in the amplitude of wave V, but not in the amplitude of Na-Pa. As expected, the amplitude of Na-Pa was greater than that of ABR wave V at low repetition rates. However, this was not true at high repetition rates, where the amplitude of Na-Pa was significantly reduced while wave V remained relatively stable, creating a marked change in amplitude ratio.

The effects of repetition rate on the amplitude ratios of the ABR and MLR could have important implications for the understanding of refractoriness of the generator sites of the ABR and MLR. Additionally, based on previous reports in the literature (Musiek et al., 1997), findings suggest that with the development of normative data, the amplitude ratios of simultaneously recorded ABR-MLR could be diagnostically useful in patients with neurological impairment. The present data indicates that, at low repetition rates, a Wave V amplitude that exceeds that of the Na-Pa wave could have diagnostic implications.

References


Additional: Based on previous reports in the literature (Musiek et al., 1997), findings suggest that with the development of normative data, the amplitude ratios of simultaneously recorded ABR-MLR could be diagnostically useful in patients with neurological impairment. The present data indicates that, at low repetition rates, a Wave V amplitude that exceeds that of the Na-Pa wave could have diagnostic implications.