PATHNEWS
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Welcome to the new PATH MEDICAL NEWSLETTER. This publication is intended to highlight features of our products, tips on best practices, and how to use PATH MEDICAL devices. We hope that you find the information valuable and would love to have your feedback and suggestions for topics. Please write to us at academy@pathme.de.

Tone Burst ABR

Physiologic tests are of utmost importance for diagnosing disorders of the auditory pathway in young infants (e.g., < 6 months developmental age) and for those who cannot participate for behavioral audiometric measures. The most widely used physiologic tests are the Auditory Brainstem Response (ABR) and/or Auditory Steady State Response (ASSR), otoacoustic emissions and acoustic immittance measures. The focus of this PATHNEWS is the use of the tone-burst for ABR testing to estimate auditory thresholds from physiologic responses.

The use of the ABR to construct an audiogram has some limitations, although the benefits far outweigh the limitations. The major limitation is the choice of stimuli available that can be used to elicit the evoked response. Synchronous neural firing of multiple neurons is essential to record an ABR. The best stimulus to elicit a response is a rapid or abrupt onset stimulus such as a click or chirp that stimulates a broad area of the basilar membrane (the structure within the cochlea that houses the sensory cells for hearing and that when stimulated, activates the auditory nerve) and therefore generates synchronous neural discharge in many neurons.

Typically, those conducting the ABR often start with the click to get an overall estimate of quality of response and secondly, should there not be clear identifiable waveform the click can help to assess whether any cochlear response can be obtained i.e. cochlear microphonic. The ABR to click or chirp stimuli will provide an overall assessment of the integrity of the auditory pathway and provide a basis on which to start investigating thresholds at specific frequencies. The click can be thought of as similar to the speech recognition threshold (SRT). The SRT tells us very little of overall hearing, yet it sets a starting point for us to know what degree of loss (in some frequencies) might be present. So, while a click ABR does not tell us much about thresholds across the frequency range, it allows for us to get a starting point for the tone bursts and allows for assessment of quality of response. This second reason to start with a click is important as the ABR to tonal stimuli does not produce the high quality response that we see with the click and knowing the type of response that an ideal stimulus produces for the ABR helps when

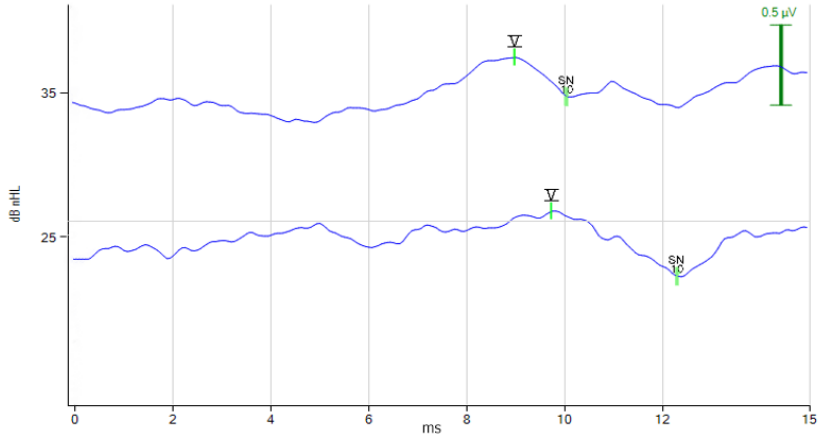
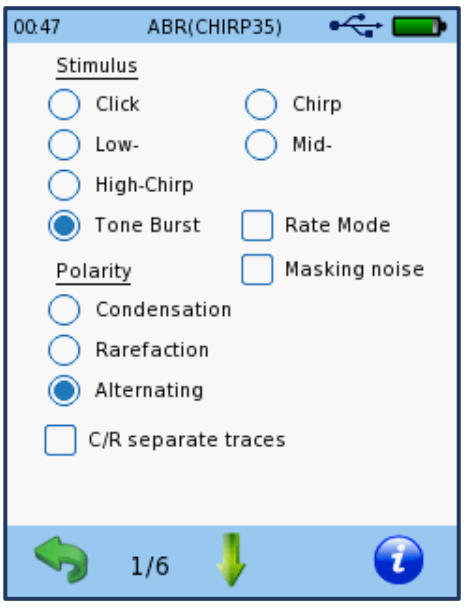


Figure1. Example of 2000 Hz tone burst results at 25 and 35 dBnHL. Note that there is booth a fast and slow response that can be seen such that there is a peak, yet the peak is followed by a slow negative wave (SN10) that is often what is easier to follow when close to threshold.

evaluating the ABR to tone burst. (see Figure 1). The stimulus commonly used to obtain frequency specific information is a brief duration tone burst referred to as a tone pip. With the use of this stimulus, relatively good synchronous neural firing can occur. The trade off in becoming more frequency specific or tonal by increasing the rise time of the stimulus is the reduction of synchronous neural discharge. That is, the more tonal the stimulus the less area of the basilar membrane is stimulated but provides more frequency specific information. Conversely, stimulating more area of the basilar membrane the less frequency specific information is obtained. The aim is to achieve a balance of tonality with enough synchronous neural firing to elicit a response. That is, it is necessary to maintain a fast enough rise time to elicit a response yet reduce the acoustic splatter to frequencies above and below the nominal frequency of the stimulus. Producing a frequency specific stimulus without significant contribution from other frequencies can best be achieved by using gating or stimulus shaping envelopes such as Blackman functions (Gorga & Thornton, 1989). While producing a stimulus that does not have contributions from other frequencies is important, it will not ensure a place specific region of excitation on the basilar membrane. Physiologically there is an upward spread of excitation on the basilar membrane as the intensity level of the stimulus is increased beyond 70 dB SPL. Spread of energy to frequencies with better hearing will result in an underestimation of threshold level.

Methodology

The goal of the ABR is to determine ear and frequency specific information at 500, 1000, 2000 and 4000 Hz to have sufficient information to fit amplification. Therefore, prioritization of the sequence of the frequencies used during testing is necessary to achieve the goal of sufficient frequency information to proceed with amplification. This prioritization improves the efficiency of the testing situation and is needed while testing in natural sleep or in a highly controlled yet costly setting in which the ABR evaluation is conducted in the operating or procedure room. The knowledge and skills to obtain these responses quickly cannot be stressed enough to ensure a full understanding of the nature and extent of the hearing loss. For example, if information from other tests or the latency-intensity function is suggestive of a high frequency loss, then starting with the higher frequencies, that is 4000 and 2000 Hz would make the most sense followed by 500 Hz and 1000 Hz last. If a flat loss is suspected, then a higher frequency would be first, followed by a lower frequency and then repeated until all frequencies have been tested. This sequence will help to start the hearing aid fitting process if only partial information is obtained because the baby woke up during the test. On the PATH MEDICAL Sentiero Advance ABR system, select tone burst, the polarity and the frequency to test. Available tone burst frequencies are 500, 750, 1000, 1500, 2000, 3000, 4000 kHz. After selecting the frequency, you can select the style as either linear or blackman gating functions as shown in Figures 2 and 3.



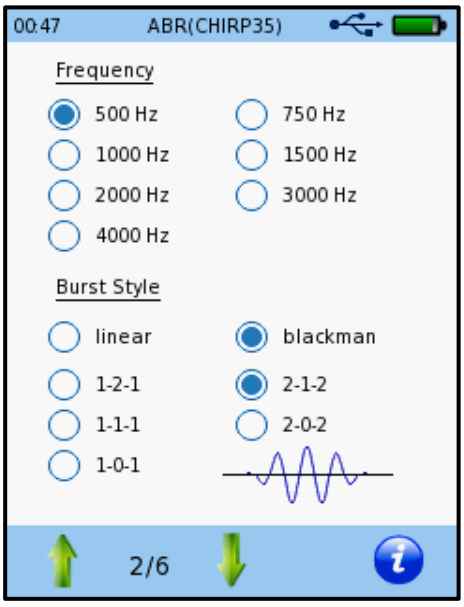


Figure 2 and 3 showing the presets available on the PATH MEDICAL SENTIERO // ADVANCED

References

Gorga MP, Thornton AR. The choice of stimuli for ABR measurements. Ear Hear. 1989 Aug;10(4):217-30. doi: 10.1097/00003446-198908000-00002. PMID: 2673891.