The effect of spatial separation of target signal from distractors on cortical auditory evoked responses parameters utilizing speech stimulus in adults with normal hearing 20-45 years old

Abstract

Introduction: The study aims to determine if cortical auditory evoked responses can be used to investigate the separation of target signals from background noise based on spatial information, as existing assessment methods relying on behavioral tests and questionnaires may be influenced by non-auditory factors.

Materials and methods: This study involved 24 individuals with normal hearing. Screening tests including DDT, SWIN, and SSQ questionnaires were administered to identify potential spatial processing issues. Cortical auditory evoked potentials (CAEP) were then recorded from all participants using seven surface electrodes on the head. The stimulus employed was a speech stimulus ("ba") presented alongside speech background noise. The amplitude and latency of the CAEP waves were measured and compared under two conditions: collocated, where the target signal and background noise originated from the same spatial point, and separated, where they came from different spatial locations.

Results: The results of these studies showed that there was a spatial advantage for differentiating the target signal from the background noise in most recording electrodes. This advantage has been mainly for the latency of the primary waves ($p<0.05$), and the amplitude of the waves only helps in more difficult situations (negative SNR) and strengthens the response. However, the P2 wave did not show such a change ($p>0.05$).

Conclusion: The study found that spatial advantage was observed in the recording of P1 and N1 waves, likely due to the anatomical location of their origin. However, no spatial advantage was observed for the P2 response, which originates from a different location. As the auditory conditions became more challenging with a decrease in signal-to-noise ratio (SNR), the recorded spatial advantage increased. Initially, the advantage was seen in the latency of the waves, but as the conditions became more difficult, a spatial advantage for the amplitude also emerged.

Keywords: Auditory spatial processing, Spatial release from masking, Cortical auditory evoked response, Speech perception.