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Auditory Evoked Responses and the Threshold of Hearing

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An important clinical application of Auditory Evoked Responses is the estimation of frequency-specific electrophysiological thresholds. However, electrophysiological thresholds and pure-tone behavioral thresholds differ in several respects so that comparisons between the two types of thresholds may be similar to comparing apples and oranges (Elberling and Don, 2007). Here, we report three studies that have been done with the goal of learning more about auditory evoked responses at very low sound levels, well below the range considered in routine clinical investigations. In a first study (Lütkenhöner and Klein, 2007), we investigated wave N100m of the auditory evoked field (AEF). The stimulus was a 1-kHz tone with an effective duration of about 110 ms. Up to 10 dB above the behavioral threshold, the level was varied in steps of 2 dB. The N100m amplitude increased roughly linearly with the dB value (thus, as a logarithmic function of intensity). Such a nonlinear behavior is contradictory to the view that the auditory system is linear in the low-intensity limit. Moreover, it implies the existence of a sensory threshold, which would be inconsistent with signal detection theory. This seeming contradiction was resolved in the second, theoretical study, in which the mean firing rate of all fibers in the auditory nerve was simulated. The model suggests a smooth transition between proportionality with intensity (at extremely low intensities) and linear growth with level, as observed in the AEF experiment. First evidence of the predicted proportionality with intensity was obtained in the third study, in which the Auditory Brainstem Response (ABR) to Gaussian-shaped 4-kHz tone pulses was investigated.

Literatur:

Elberling C, Don M (2007) Detecting and assessing synchronous neural activity in the temporal domain (SNR, response detection). In: Auditory Evoked Potentials. Basic Principles and Clinical Applications. (Burkard RF, Eggermont JJ, Don M, eds), pp 102-123. Philadelphia: Lippincott Williams & Wilkins.

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