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ORIGINAL ARTICLE

Analysis of electrically evoked compound action potential of the auditory nerve in children with bilateral cochlear implants☆

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KEYWORDS
Child;
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Abstract
Introduction: The cochlear implant device has the capacity to measure the electrically evoked compound action potential of the auditory nerve. The neural response telemetry is used in order to measure the electrically evoked compound action potential of the auditory nerve.
Objective: To analyze the electrically evoked compound action potential, through the neural response telemetry, in children with bilateral cochlear implants.
Methods: This is an analytical, prospective, longitudinal, historical cohort study. Six children, aged 1–4 years, with bilateral cochlear implant were assessed at five different intervals during their first year of cochlear implant use.
Results: There were significant differences in follow-up time ($p = 0.0082$) and electrode position ($p = 0.0019$) in the T-NRT measure. There was a significant difference in the interaction between time of follow-up and electrode position ($p = 0.0143$) when measuring the N1-P1 wave amplitude between the three electrodes at each time of follow-up.
Conclusion: The electrically evoked compound action potential measurement using neural response telemetry in children with bilateral cochlear implants during the first year of follow-up was effective in demonstrating the synchronized bilateral development of the peripheral auditory pathways in the studied population.

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PALAVRAS-CHAVE
Criança;
Nervo coclear;
Implante coclear;
Potenciais evocados

Análise do potencial de ação composto do nervo auditivo evocado eletricamente em crianças usuárias de implante coclear bilateral

Resumo
Introdução: O implante coclear tem a capacidade de medir o potencial de ação composto eletricamente evocado do nervo auditivo (ECAP). Para esta verificação utiliza-se uma medida chamada telemetria de respostas neurais.
Objetivo: Analisar o potencial de ação composto evocado eletricamente, por meio da neurotelemetria de respostas neurais, em crianças usuárias de implante coclear bilateral.
Método: Trata-se de um estudo analítico, prospectivo, de coorte histórica longitudinal. Foram recrutadas seis crianças, com idades entre de 1-4 anos, usuárias de implante coclear bilateral. Estas crianças foram avaliadas em cinco momentos durante o primeiro ano de uso do implante coclear.
Resultados: Houve diferença significativa no tempo de acompanhamento ($p = 0{,}0082$) e posição do eletrodo ($p = 0{,}0019$) na medida de T-NRT. Houve diferença significativa na interação entre tempo de acompanhamento e posição do eletrodo ($p = 0{,}0143$) na medida da amplitude das ondas N1-P1 entre os três eletrodos a cada tempo de acompanhamento.
Conclusão: A mensuração do ECAP por meio da NRT nas crianças com implante coclear bilateral durante o primeiro ano de acompanhamento foi uma medida importante para apresentar o desenvolvimento bilateral da *via* auditiva periférica de forma sincronizada nesta população estudada.

Introduction

The cochlear implant (CI) device is widely accepted and has been considered one of the most important therapeutic options for patients with severe and/or profound bilateral sensorineural hearing loss, in cases who did not achieve satisfactory auditory perception benefits with the use of individual sound amplification device (ISAD). The CIs have been indicated at progressively younger ages due to advances in early audiological diagnosis and new technologies in the CI devices.[1]

Over the last decades, bilateral CI surgery began to be performed, a procedure that can be performed simultaneously or sequentially. The simultaneous technique is used when the patient receives the two internal components in a single surgical procedure, and the sequential one, when the patient receives the two internal components in different surgical procedures.

Patients who require a CI have been increasingly choosing the bilateral procedure. Some studies have shown that these patients benefit from improved speech in the perception with noise[2] and improved sound location.[3,4]

The process known as ''Programming'' or ''Mapping'' of the CI speech processor is performed at regular intervals postoperatively. The Mapping process aims to determine the appropriate dynamic range of electrical stimulation for each electrode channel. The dynamic range is the difference between the detection perception threshold (T-level) and loudness – maximum comfort (level C).[5]

The measurement of the electrode impedance telemetry can provide an indication of the electrode interface status in the tissues, as well as the appropriate electrode function. Significant changes in these measures can be indicative of changes in the surrounding tissue and/or changes in electrode function. Initial changes in electrode impedance can be expected due to physical changes in the electrode-tissue interface.[6]

The CI has the capacity to measure the electrically evoked compound action potential (ECAP) of the auditory nerve. The system applies an electrical pulse to a specific intracochlear electrode and the evoked neural response is recorded in an adjacent electrode. A measure called Neural Response Telemetry (NRT) is used to assess this potential. The system elicits a valid neural response and robust recordings. These responses are recorded and returned to the programming interface system for clinical analysis.[7,8]

The ECAP provides a relatively direct measurement of the auditory nerve response after electrical stimulation and it is measured in current units (CUs).[9] The ECAP waveform typically consists of an initial negative peak followed by a positive peak, called N1 and P1, respectively.[7,8]

The NRT threshold (T-NRT) is defined as the smallest amount of electric current that can evoke these physiological responses. Studies have shown that the T-NRT measured intraoperatively or at postoperative intervals can be correlated with the psychophysical detection of the threshold (T level) and the maximum level of comfort (C level) in patients with CIs. The amplitude of the response (measured between N1 and P1) varies with increasing stimulus intensity and it is measured in millivolts (μV).[10–12]

Considering the abovementioned facts, this study aims to analyze the ECAP through NRT in children who received bilateral cochlear implants. The ECAP will be analyzed in relation to the T-NRT visual threshold and the amplitude of N1-P1 peak during the first year of CI use.