VOLUME - 11, ISSUE - 09, SEPTEMBER - 2022 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Audiology

NEURAL RESPONSE TELEMETRY (NRT) CHANGES IN COCHLEAR IMPLANT CHILDREN

Pradeep V R — Ph.D. Scholar (Part of Ph.D. work), Dr. M. V. Shetty College of Speech & Hearing, Mangalore University

Dr. T A. Subba Rao — Dr. M. V. Shetty College of Speech & Hearing, Mangalore University

KEYWORDS :

INTRODUCTION

A cochlear implant is one the best option available in the current research world to replace the functions of the damaged sensory hair cells inside the cochlea. Usually, the only option is a cochlear implant for the individual with severe to profound sensorineural hearing loss to whom their hearing aid will not provide satisfactory results. Unlike hearing aids, cochlear implants will provide more sound clarity and enhances the ability to understand the conversation.

The cochlear implant replaces the functions of the cochlea by transforming sound energy into electrical energy. Its function mainly depends on the integrity of the cochlear nerve to conduct the electrical stimuli to the cerebral cortex. Auditory nerve ganglion cells are considered the elements that effectively respond to electrical stimuli emitted by cochlear implants. Thus, these cells' number, distribution, and functional status defer an individual's ability to benefit from a cochlear implant.

Electrically evoked compound action potential (ECAP) is the direct method for assessing the functional status of the ganglion cells and other auditory neural structures. The currently available cochlear implant models will directly record and analyze the electrically evoked compound action potentials by using a bidirectional communication system between the internal and external components, which can stimulate and pick up the response from the auditory nerve fibers. The software that performs these functions is called Neural Response Telemetry (NRT).

The neural response telemetry can be done very quickly and effectively. The main advantage of neural response telemetry is that we will get larger amplitudes and prevent muscle artifacts. Neural response telemetry captures the changes in the electrical potentials of the distal portion of the auditory in a patient with a cochlear implant and records the responses. The way to assess the temporal processing capacity of cochlear implant users is to measure the refractory properties of the auditory nerve.

Electrically evoked compound action potential features are measured in different intracochlear electrodes, expressing the permeability of neural elements to respond to an electrical stimulus. Assessing these features helps monitor the changes in neural response telemetry over time. So, in the current study, we investigate the electrically evoked compound action potential by using neural response telemetry in children with a cochlear implant in different conditions.

Aim of the study

This study aimed to measure the changes in the neural response telemetry values of the cochlear implant children in three different measurements; intraoperative period, during the time of Switch on (Speech Processor), and after one year of the surgery.

Methods and materials used.

In the current study, 25 children with unilateral cochlear implants have been selected. The selection was based on ages between 18 to 60 months & who are operated with CI24RE(ST) with CP802 Speech Processor. All the children successfully completed AVT for one year and have been successful users of cochlear implants for over two years. NRT was carried out in three conditions.

1) Intraoperative time (During surgery)
2) During the time of Switch on (Speech Processor)
3) One year of the surgery

So, in the first condition, Custom Sound EP Software was used to measure the NRT. Second & Third condition Custom Sound Software was used. In both procedures, CP802 Speech Processor was used for measuring the NRT. Successful NRT was measured for electrodes 1, 6, 11, 16, and 22.

RESULTS

The mean average NRT values of all electrodes in interoperative conditions are high compared to the other two conditions. Following 30 days during Switch on of the speech Processor (CP802), the rapid decrease of mean average NRT values is recorded. This is happening because after surgery, one month, the fluid level in the cochlea will be back to normal, and the position of electrodes in the cochlea also will be in stable condition. However, after one year of successful usage of a cochlear implant, not much variation is observed, as shown in Table 1 below. Depending on procedures carried out by surgeons, variation in NRT also can happen. Many researchers support this, and many research studies have also proven this.

Table 1 shows the NRT values of all three conditions for electrodes.

Electrodes	Inter operative	Switch on	One year
22	184.818	176.091	176.273
16	191.364	182.909	181.546
11	192.909	187.273	184.636
6	199.364	186	184.091
1	219.455	197.182	196.818

Table 2 values show huge differences between interoperative & switch on time. The difference in NRT is that during the time of surgery lot of fluid leakage from the cochlea and placement of the electrode may take time to settle down in its position. However, significantly less variation has been recorded when we compare the difference between Switch on & one year. This is maybe because of not much variation in position and fluid levels in the cochlea except the duration of electrical signal transmission to the auditory nerve in these conditions.

Table 2 shows the average mean differences of NRT values in two different conditions.

Electrodes	Difference between Interoperative – Switch on	Difference between Switch on – One year
22	8.7273	-0.1818
16	8.4545	1.3636
11	5.6364	2.6363
6	13.3636	1.9091
1	22.2727	0.3636

CONCLUSION

Analyzing the success of a cochlear implant is based on NRT values. So, variation between interoperative & switch on is very common in all the children. However, NRT plays a significant role in mapping speech processors. The current study was conducted with only a few children, and the duration was only one year. A longitudinal study in a large population is the best way to continue the study. So more relevant changes in NRT can be proven.

REFERENCES

1) Botros A, Psarros C. (2010). Neural response telemetry reconsidered: II. The influence of neural population on the ECAP recovery function and refractoriness. Ear Hear;31(3):380–391.
2) Gantz B. J, Brown C. J, Abbas P. J. (1994). Intraoperative measures of electrically evoked auditory nerve compound action potential. Am J Otol;15(2):137–144.
3) Guedes MC, Brito Neto RV, Gomez MV, et al. (2005). Neural response telemetry measures in patients implanted with Nucleus 24. Braz J Otorhinolaryngol 71(5):660–667.
4) Lai W. (1999). An NRT Cookbook: Guidelines for Making NRT Measurements. 1st ed. Zürich, Switzerland: Cochlear AG.
5) Qiao X, Wang D. (2013). Study of electrode impedance and NRT value characteristics with cochlear implants in children with the malformed inner ear and normal inner ear]. Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi. Nov;27(22):1231-3.