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Case Report Open Access

A Case Report On Compatibility of Electronic Implants: Spinal Cord Stimulator and Cochlear Implant

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Abstract

Objective: We report the case of a patient with a previously implanted spinal cord stimulator (SCS) who presented for a cochlear implant. The patient was successfully implanted with a Nucleus CI422 Slim Straight Electrode from Cochlear Company.

Methods: The authors conducted a case report and literature review.

Results: Successful hookup and mapping of the device was performed 1 month and 6 months after implantation with no evidence of aberrant activity of the spinal cord stimulator.

Conclusion: To our knowledge, this is the first reported case of the successful implantation of a cochlear implant in a recipient already implanted with a spinal cord stimulator.

Keywords: Cochlear implant; Spinal cord stimulator

Introduction

The broadening use of implanted medical devices increases the likelihood that individual patients will require more than 1 device including Cochlear Implant (CI), cardiac pacemakers/defibrillators, spinal cord stimulators, deep brain stimulator and others. So the presence of more devices raised the question of their compatibility and it is therefore important to know if surgical technical adjustments need to be made.

In this report, we describe the successful implantation of a CI in a patient with a previously placed Spinal Cord Stimulator (SCS) for chronic back pain management.

SCS are composed of an implantable stimulator and connected applicator electrodes. Potential application sites are, for example, spinal applications, like in this case, but may also include the head and neck, e.g. supra occipital (in front of ear and over eyebrow) for migraine treatment.

The patient was successfully implanted with a Nucleus CI422 Slim Straight Electrode from Cochlear Company to restore a good level auditory sensation via the electrical stimulation of the auditory nerve.

Materials and Methods

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional guidelines on human experimentation (Decreto Legislativo n.211 24-jun-2003) and with the Helsinki Declaration of 1975, as revised in 2008.

A 61-year-old patient was referred to our institution to be evaluated for cochlear implantation. He had experienced progressive bilateral hearing loss of unknown etiology. After having used a hearing aid for a period of time, the lack of hearing aid benefit made it necessary to assess the application of a cochlear implant.

However, in addition to hearing loss, the patient suffered from chronic back pain, so he underwent laminectomy and foraminotomy at L4 – L5 in April 1993.

In September 1993, the absence of any relief of pain symptoms and the finding of lumbar arachnoiditis resulted in the recommendation to implant a spinal cord stimulation system with a tetrapolar lead Pisces - Quad by Medtronic.

The Trel receiver was positioned in a subcutaneous abdominal wall pocket (code XR0016572N – R315901) (Figure 1).

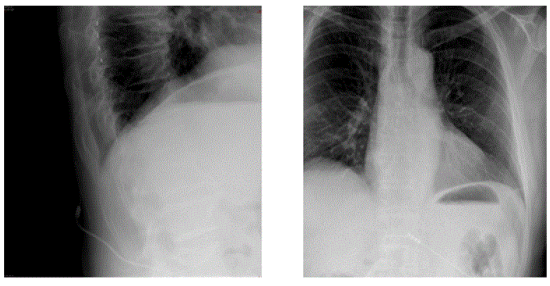

Figure 1: The Trel Receiver

The simulator turned out to be placed too high to provide any neuropathic pain relief in the area of the right lumborsacral nerve roots, and it caused spinal cord stimulation. It was thus deactivated but not removed.

After many years, due to the worsening of the deafness, the patient was considered a good candidate for cochlear ear implantation. Then it was not possible to remove the spinal cord stimulator because so much time had passed since its implant, which increased risk to the spinal cord.

So the presence of "permanent" SCS raised the question of the compatibility of the SCS and the cochlear implant.

The patient was highly motivated and has accepted the risks associated with the procedure by signing the informed consent.

The cochlear implant procedure was performed in the left ear with particular surgical attention. Due to the audiological profile of this recipient, and in the attempt to preserve residual hearing, we decided to implant a Nucleus CI422 Slim Straight Electrode [1].

The procedure plan foresaw the exclusive and reduced use of bipolar electrocautery tweezers, tested on the conscious patient prior to surgery to determine whether there would be any interference with the stimulator.

The surgical procedure was "cold steel" for the most part, with selective tying off of the blood vessels and cutaneous clips to control hemostasis. The electrode was put in place through a cochleostomy at the basal turn following a soft surgery approach.

Results and Analysis

The implant was switched on directly in the operating room once the patient had regained consciousness so as to be able to intervene immediately in the event of any abnormal spinal cord stimulation.

The cochlear implant of the patient was switched on successfully and mapping follow-up was performed 1-3 and 6 month after implantation.

There was a good preservation of residual hearing. The impaired left ear before the implantation had a two frequency PTA of 85 dB HL and then the surgical application of 90 dB HL.

During adjustment of electrode thresholds and comfort levels no interferences were recorded or reported by the patient who presently uses his cochlear implant daily with a good adaptation.

Regarding Speech perception test conducted with no visual contribution, an improvement in perception scores was immediately noted (Table 1).

	Preoperatory	1 month	3 months	6 months
Identification	38,00%	38,00%	52,00%	72,00%
(% Mean)				
Vocal recognition	0.45	0.3	75,00%	100,00%
Word recognition	0	0	0	65,00%
Sentence recognition	11,00%	0	0	80,00%
Syllables	10,00%	0	0	65,00%

Table 1: Comprehension difficulty without support from lip reading

The results are comparable to other ours patients without other devices, with long sound deprivation prior to the procedure. Nevertheless it indicated good adaptation, which is destined to improve with adequate rehabilitation. The positive adaptation was also confirmed by the APHAB (Abbreviated Profile of Hearing Aid Benefit) questionnaire, administered before and after the surgical procedure. (Figure 2).

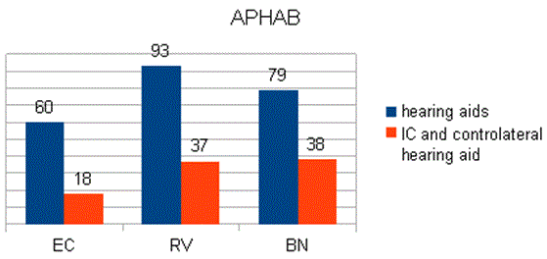

Figure 2: Mean responses (score after APHAB questionnaire) for hearing aid and IC listening groups for each subscale. EC. ease of communication; RV. reverberation; BN. background noise

It reports a significant improvement of everyday life with a quantifiable average benefit of 46%. Further, they led to a new, gradual increase in the patient's social interaction.

Excellent results at QoL questionnaire, the increase of Speech performance results and a good adaptation of the cochlear implant are signs of no sort of interference between the two devices. We found no evidence of aberrant activity of the spinal cord stimulator.

Discussion

With the increasing use of implantable medical devices, a possible interaction between devices is to be evaluated when planning a cochlear implant. There are very few works published on the relationship between cochlear implants and neural stimulators. One work on this topic, published in The Laryngoscope in 2006 by Martin and Hirsch [2], reports the case of a patient who was successfully implanted with a Nucleus Contour cochlear implant after placement of a deep brain stimulator for Parkinson's disease. Another, similar work was published in Neurosurgery in 2010 by Reyes *et al.* [3]. A report, now virtually out of date, was published by Kainz *et al.* [4] on the compatibility between electronic devices, though it did not specifically examine the relationship between cochlear implants and other electric stimulators.

The problem of interference between spinal cord stimulators and implants is particularly delicate given the critical site of the pain management stimulators, whose unusual activation by means of an electric catalyser may lead to repercussions on important neural areas [5]. The distance between the cochlear electrode and the spinal cord stimulator, the intensity of the current used, low in amplitude, and the types of electrical circuits created by the electrode to stimulate the cochlear nerve made it possible to predict that there would be no interference between the cochlear and the spinal cord electrodes, despite the fact that there is no model to confirm this in the literature. For this reason the procedure was often contraindicated in persons with a spinal cord stimulator and the removal of the device is indicated, with subsequent need to reposition it, which increases risk.

In conclusion, we have reported on a man with a spinal cord stimulator who became deaf and subsequently underwent cochlear implantation.

The rapid development of implant surgery, now performed all over the world, along with the high number of implant recipients, will lead to facing conditions analogous to those in this study . It is possible forecast that the number of cases of multi-implantation will increase. The possibility of having a specific model enabled us to perform a procedure which is unique in the literature and to thus state that it is possible to perform cochlear implant surgery in subjects with spinal cord stimulator.

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