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Case Report

Intratympanic Gentamicin Injection for Endolymphatic Hydrops After Cochlear Implantation

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Endolymphatic hydrops has been documented as a possible complication of cochlear implantation; however, few studies have addressed its treatment. We describe the first case ever reported of delayed endolymphatic hydrops after a cochlear implant successfully treated with intratympanic gentamicin injection. A detailed discussion of this case with a focus on its management and outcomes will be provided in comparison with literature data. The intratympanic gentamicin injection has been demonstrated to be an effective treatment for symptomatic endolymphatic hydrops after cochlear implantation. We advocate further studies to validate this strategy as a promising alternative to surgical labyrinthectomy.

KEYWORDS: Endolymphatic hydrops, cochlear implantation, vertigo, gentamicin, hearing fluctuation

INTRODUCTION

The onset of vestibular symptoms is widely reported as a possible sequela of cochlear implantation (CI), although published incidence rates differ considerably. The complaints following CI include temporary, episodic, or permanent vertigo.[1,2,3] Such symptoms can be experienced also in patients without a history of preoperative vestibular disfunction.[4] A remarkable heterogeneity of etiologies has been described: intraoperative loss of perilymph, direct surgical trauma, labyrinthitis secondary to insertional trauma or to foreign body reaction, local infectious contamination, electrical stimulation, vascular lesions, otolith displacement, and endolymphatic hydrops (EH).[5,6,3] With regard to EH, its clinical features are delayed-onset vertiginous symptoms manifesting as recurrent episodic attacks, with some patients experiencing fluctuating hearing loss during the episodes.[7] Although the occurrence of EH after CI has been documented in several studies,[3,8] there is still a limited number of reports about the treatment. We describe the first case ever reported in which intratympanic (IT) gentamicin injections were successfully employed in the treatment of EH after CI.

CASE PRESENTATION

A 72-year-old female presented to our tertiary referral center with complaints of recurrent vertigo episodes associated with neurovegetative symptoms and hearing distortion in the past 2 years, despite having an implant. The patient had successfully undergone left-sided CI 5 years earlier at another institution for a long-standing history of bilateral severe hearing loss with normal vestibular function. The postoperative period was uneventful until the onset of vertigo complaints associated with hearing fluctuations 3 years after surgery. The patient reported the episodes to be spontaneous, lasting about 2 hours and occurring weekly at the time of the visit. She denied apparent causative factors or any reduction in cochlear implant performance in the interictal periods. Physical and otomicroscopic findings were normal. A computed tomography scan of the temporal bone and of the brain with contrast resulted unremarkable. Neither spontaneous nor position nystagmus was observed, the head-shaking test (HST)

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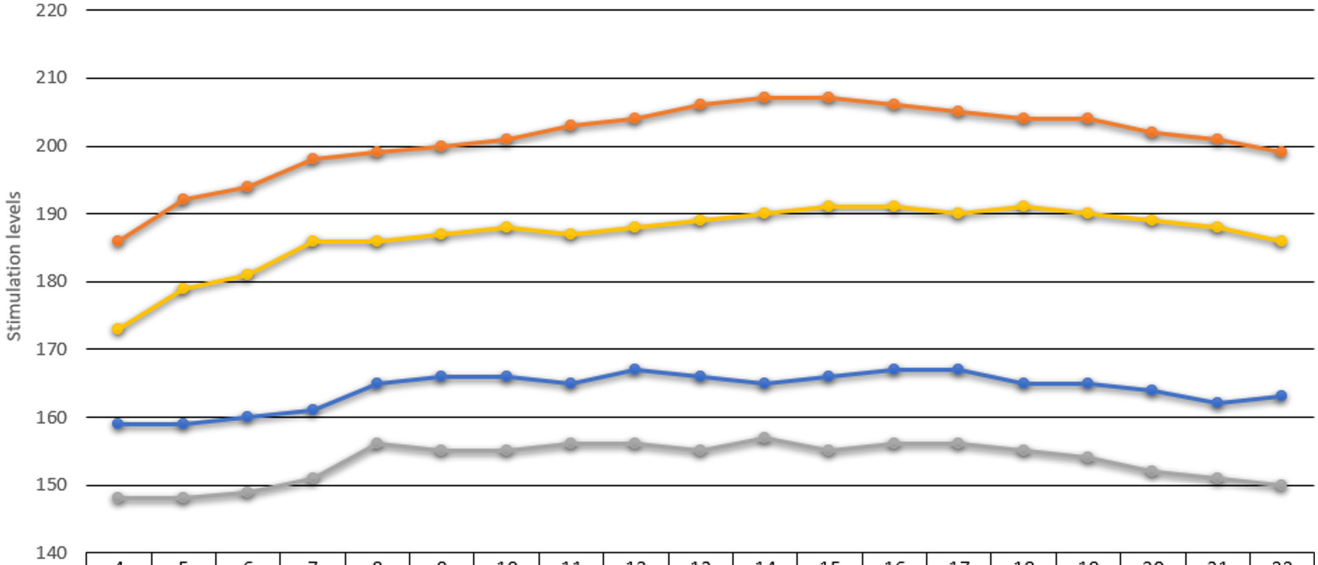
demonstrated a right-beating nystagmus. The caloric electronystagmography suggested left vestibular hypofunction. A second assessment was performed during a severe rotational vertigo attack: vestibular testing under video-oculography goggles revealed a spontaneous, pluripositional, unidirectional, and horizontal ictal right-beating nystagmus with no changes after the HST. Stimulation levels were found to be increased in comparison with the data recorded before the crisis (Figure 1) with a mild rise of electrode impedances. Cochlear implant remapping was sufficient to restore the patient's device performance. Diagnosis of the left EH was postulated. A sodium-restricted diet with high hydration and oral medication with betahistine (48 mg daily in 2 doses) were prescribed to reduce symptoms. However, 6 months later, the assessment of subjective symptoms with the Dizziness Handicap Inventory (DHI) still provided a score of 74, indicating a severe handicap. Since conservative management had failed, left IT gentamicin therapy was indicated. The delivery method was direct injection of a prepared concentration of 26.7 mg/mL gentamicin in the middle ear using a 22-G spinal needle after topical anesthesia. The patient experienced a reduction in the rate of vertigo attacks in the following 4 weeks, reporting two episodes lasting about an hour. Given the partial response, another IT injection was administered after a month, leading to complete control of symptoms. The DHI score was 21 (mild handicap) at 1-month follow-up. The patient reported no further vertigo attacks during the subsequent 36 months. Informed consent was obtained prior to the writing of this case report.

DISCUSSION

The occurrence of vestibular symptoms after CI has been described in a recent meta-analysis with a prevalence of 17.4%,[1] with a wide variability among the published studies.[9] EH is recognized as a possible cause of recurrent episodic vertigo after implantation with delayed onset.[3,8] EH is a pathologic finding of the inner ear in which the structures bounding the endolymphatic space are distended due to an enlargement of endolymphatic volume.[10] It is thought to be the physiopathological basis for Meniere's disease (MD).[11] Handzel and colleagues performed an ex vivo histopathological study on temporal bones of CI recipients, finding cochlear hydrops in 59% of implanted bones.[5] Next, Su-Velez et al. examined 17 temporal bones with a histopathological finding of cochlear hydrops from implanted patients without preoperative diagnosis of MD or vestibular dysfunction. The authors disclosed a fairly high correlation between cochlear hydrops and vestibular EH. In addition to this, they retrospectively reviewed the clinical history of each patient, thus finding post-CI vestibular complaints in 53.3% of their medical reports.[6] In clinical practice, EH is a diagnosis of exclusion, largely based on clinical history.[11] Among a variety of causes, EH can be secondary to traumatic and inflammatory processes resulting from CI[8]. The advocated anatomopathological mechanism is the postoperative change in the inner ear due to fibrosis, which might impede the endolymphatic flow.[5,3] Moreover, EH is reported to be the cause of hearing fluctuation and electrode impedance changes that some patients with MD experience after CI. Alterations in the connection between electrodes and target neurons or physical changes in the spiral ganglion during the attacks have been proposed to be the underlying mechanisms.[12] In the case we present, EH seemed the most likely diagnosis, given the absence of preoperative symptoms, the normal imaging findings, and the clinical and instrumental features during both the crisis and the interictal phases. Although EH after CI is well documented, literature about its management is lacking. The use of labyrinthectomy (LT) to control disabling episodic vertigo after CI has been described in 2 case reports.[13,14] LT associated with CI is a valid option to control vertigo in cases of preexisting MD. Surgical labyrinthine ablation is reported



	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
T during crisis	159	159	160	161	165	166	166	165	167	166	165	166	167	167	165	165	164	162	163
C during crisis	186	192	194	198	199	200	201	203	204	206	207	207	206	205	204	204	202	201	199
T before crisis	148	148	149	151	156	155	155	156	156	155	157	155	156	156	155	154	152	151	150
C before crisis	173	179	181	186	186	187	188	187	188	189	190	191	191	190	191	190	189	188	186

Figure 1. Stimulation levels of the electrodes during and before the crisis: the threshold levels during the crisis (blue), the comfort levels during the crisis (orange), the threshold levels before the crisis (gray), and the comfort levels before the crisis (yellow).

as being performed before, during, or after the CI procedure.[15] However, the innovation introduced by the above-cited articles is the employment of LT in patients not previously diagnosed with MD. Heidenreich and colleagues performed transcanal LT supplemented by filling the vestibule with gentamicin-soaked Gelfoam.[13] While, Tutar et al. implemented a transmastoid procedure because of the blind sac closure of the ear.[14] LT was demonstrated to be effective for vertigo control, but it entailed the potential risks of implant damage or infection spreading. Furthermore, in the current literature, LT is considered the very last option for uncontrolled MD, whereas the IT injection of gentamicin is a far more common treatment.[16] In particular, IT administration of steroids such as dexamethasone and methylprednisolone would have been another viable option; however, IT gentamicin therapy has been documented to provide superior vertigo control,[17] since this vestibulotoxic antibiotic is known to produce chemical ablation of labyrinth, thus reducing vestibular symptoms.[17] In addition to this, in our case, the procedure did not have hearing concerns, thanks to the presence of the CI. Despite the lack of specific protocols for gentamicin dosage, the literature supports its application by injections of 26.7 mg/mL concentration to be administered on "as needed" basis.[17] While the role of IT gentamicin is broadly documented in MD patients, the case we report is, to our knowledge, the first description of its employment in treatment of vertigo after CI. This therapeutic option has been discarded by several authors noting that the round window (RW) obstruction, due to the presence of cochlear implant electrodes, could limit the effectiveness of the IT therapy.[18] Nevertheless, in literature, it has been appreciated that drugs administered via IT injection enter the perilymph through both the RW membrane and the stapes.[19] These findings, in our opinion, suggest that the presence of the electrode array in the RW does not represent an absolute contraindication. Moreover, IT gentamicin has a lower cost and a very low complication risk when compared with surgery. Specifically, the major concern about the administration of gentamicin is the detrimental effect on hearing function, meanwhile there is no such issue in the presence of a cochlear implant. Given all this knowledge, the data derived from a single case seem encouraging, although we strongly believe further studies should be mandatory in order to corroborate our findings.

CONCLUSION

To the best of our knowledge, ours is the first case ever reported in literature of EH after IC managed with IT gentamicin. Our experience seems promising and this procedure, commonly performed in MD, demonstrated to be effective for the treatment of our patient. We advocate further research to develop a standardized treatment protocol, with particular regard to identifying the possible restrictions on use and the suggested doses for this indication.

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