

CASE REPORT

Effects of intratympanic gentamicin treatment on hearing and vestibular functions in a case with symptoms of Meniere's disease

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Competing interest

None declared

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Informed consent form was duly signed by the patient regarding acceptance for investigation and publication

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Abstract

Meniere's disease is an inner ear disorder characterized by vertigo, tinnitus, aural fullness and fluctuating hearing loss. Intra tympanic gentamicin administration is a form of treatment procedure used to alleviate the symptoms of Meniere's disease. It is an aminoglycoside antibiotic which damages the ill functioning labyrinth. Some of the earlier studies have reported that this procedure keeps hearing at risk though it improves vestibular symptoms. However, few studies have reported an improvement in hearing sensitivity as well as symptoms of Meniere's disease in persons administered with intratympanic gentamicin. Present study highlights the detailed audiological evaluations before and after gentamicin therapy and its interpretations in a 50-year old female with symptoms of Meniere's disease in the right ear. Pure tone audiometry, speech audiometry, immittance audiometry and oto-acoustic emissions evaluation were carried out. Pre-treatment evaluations suggested severe sensorineural hearing loss in right ear and mild mixed hearing loss in left ear. Post-treatment re-evaluations were done after three and seven days of treatment. Improvement in vestibular symptoms and bilateral hearing sensitivity were noted in the first re-evaluation and the same effects persisted along the second evaluation. The possible explanations for these findings are discussed in the present paper. The outcome of the study suggests detailed pre and post-treatment audiological evaluations to monitor the benefits and side effects of such treatment procedures.

Key words

Meniere's disease, gentamicin, hearing sensitivity.

Meniere's disease is an inner ear disorder characterized by vertigo, tinnitus, aural fullness and fluctuating hearing loss [1]. Different conservative treatment procedures like administration of diuretics, steroids, calcium channel blockers, vasodilators, low-salt diet etc are applied to alleviate the symptoms of Meniere's disease. Various surgical procedures are also developed for easing the symptoms of Meniere's disease. However, surgical treatment measures are not often used because of the risks involved. In order to minimize the complications and risks involved in the surgical procedures, intratympanic delivery of aminoglycosides or corticosteroids has been introduced recently [2]. Gentamicin is such an aminoglycoside antibiotic administered to alleviate the vestibular tribulations especially related to Meniere's disease. Gentamicin is injected into the intratympanic middle ear space and further absorbed into the inner ear through the semi permeable round window membrane. This method aims to chemically damage the ill functioning labyrinth, thus alleviating the vestibular problems associated. Intratympanic gentamicin injection is a minor surgical procedure performed under local anesthesia consequently reducing the risks of major surgical procedures as in labyrinthectomy, cochleovestibular nerve section etc. This makes it a handy solution for severe vertigo problems even though it keeps hearing sensitivity of the person at risk as it can be toxic to the cochlear structures as well [3]. There have been few studies in the literature on the effect of such treatment procedures on vestibular and hearing systems.

Wu and Minor (2009) [4] studied the effect of intra tympanic gentamicin on vestibular symptoms and hearing in 34 individuals with unilateral Meniere's disease. They reported that the vestibular symptoms were under control in 90% of the subjects after gentamicin therapy. Hearing sensitivity was improved in 5 subjects after the treat-

ment while it remained unchanged in 23 subjects and was worse in 6. El Betalgy et al (2012) [2] compared the effect of intratympanic gentamicin with intratympanic dexamethasone on vertigo, tinnitus, aural fullness and hearing sensitivity. The results suggested that both the treatment procedures helped in controlling all the symptoms of Meniere's disease. However, the gentamicin injection resulted in more deterioration of hearing sensitivity in comparison to intratympanic dexamethasone treatment. Zhai et al (2010) [5] reported that the hearing deterioration was observed in 16% of subjects with Meniere's disease while it improved vertigo symptoms in 89% of the subjects after intratympanic gentamicin administration. Such heterogeneity of results warrants more research on the effect of gentamicin on hearing and vestibular systems.

Case presentation

A 50-year old female was referred to the Department of Audiology, JSS hospital, Mysore for detailed audiological evaluation. Otoscopic evaluation at the Department of ENT revealed that the tympanic membrane in the left ear was dull. No other significant findings were reported. Detailed case history was carried out at the Department of Audiology. The case complained of blocking sensation, fluctuant tinnitus and reduced hearing sensitivity in the right ear along with vertigo since one week. Left ear was reported to be normal. No other significant otological complaints were reported.

Pre-treatment audiological evaluation

On the first visit a detailed pre-treatment audiological evaluation including pure tone audiometry, speech audiometry, immittance evaluation and oto-acoustic emission (OAE) evaluation were carried out.

Table 1. Findings of pre-treatment pure tone audiometry and speech audiometry

Procedure	Right ear	Left ear
PTA (dB)	80	40
SRT (dB)	90	50
SIS (%)	80	80
UCL (dB)	100	100

Pure tone audiometry and speech audiometry was carried out using a calibrated Maico MA53 audiometer. The pure tone average (PTA) was calculated in both the ears as the average of pure tone thresholds at 250 Hz, 500 Hz and 1000 Hz in each ear. Speech audiometry comprised of Speech Recognition Threshold (SRT), Speech Identification Scores (SIS) and Uncomfortable Level (UCL) testing. Interacoustics AT 625 immittance meter was used to perform immittance evaluation and acoustic reflex threshold measurements. Immittance evaluation encompassed static compliance (SC), peak pressure (PP) and ear canal volume (ECV) measurements. Based on these measurements, type of tympanogram was also identified. Ipsilateral and contra lateral acoustic reflex thresholds measurements were carried out as well in both the ears. The audiogram obtained for the subject is given in Figure 1. The results of pure tone audiometry and speech audiometry are given in Table 1 and immittance evaluation findings in Table 2. Distortion product (DP) and transient evoked (TE) OAEs were carried out using interacoustics oto read instrument.

Interpretation of test findings

PTA suggested a hearing loss of severe degree in the right ear and mild degree in the left ear. The SRT scores

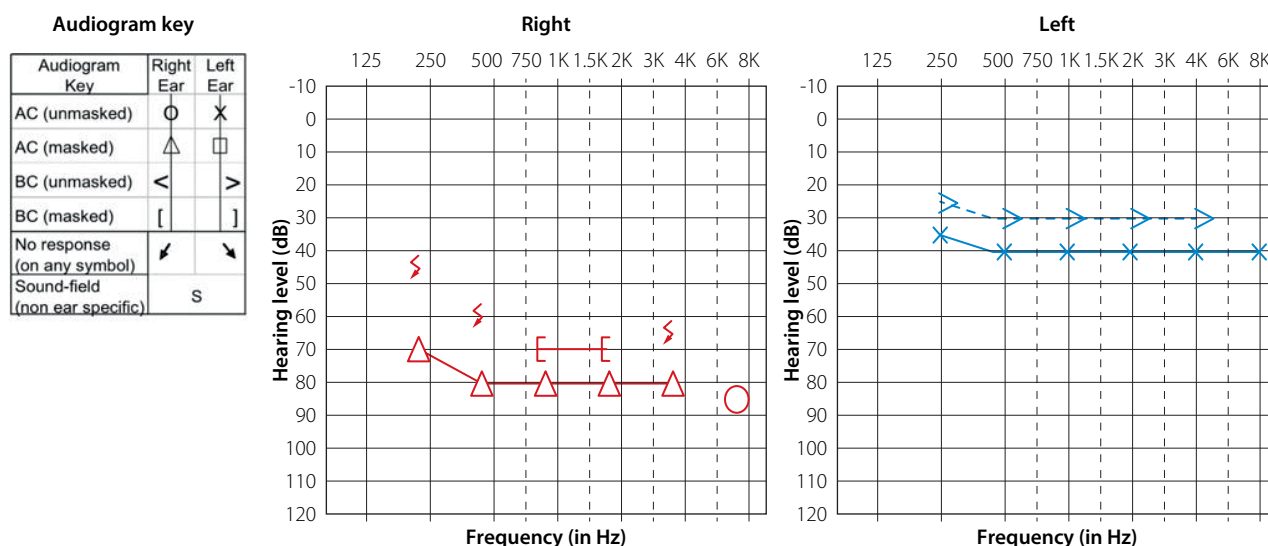


Figure 1. Pre-treatment audiogram showing pure tone thresholds of right and left ears across 250 Hz to 8 kHz.

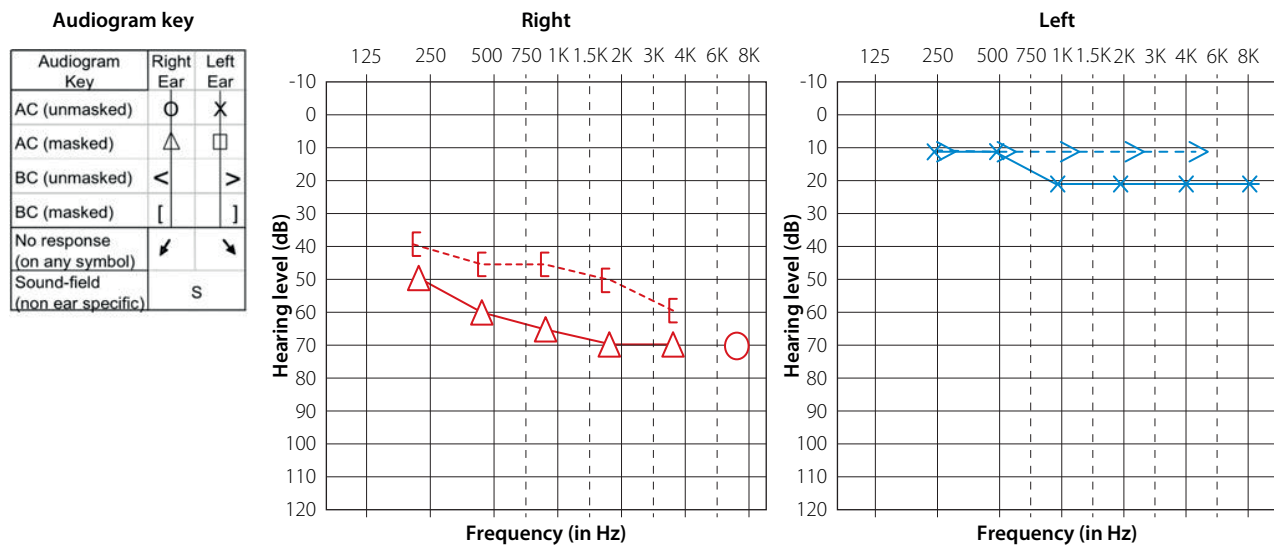
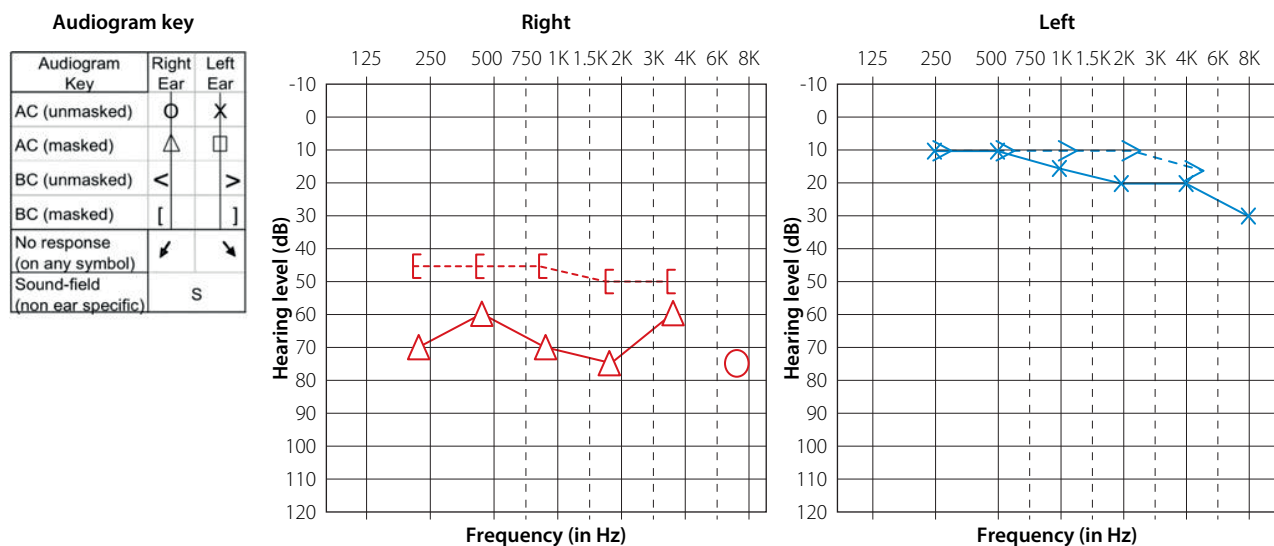
Table 2. Findings of pre-treatment immittance evaluation

Procedure	Right ear	Left ear
Type	A	B
SC	-65	NP
PP	0.6	NP
ECV	1.5	1.9

NP, no peak found.

were in good correlation with PTA and the SIS scores were fair in both the ears. High UCL suggested a probable absence of recruitment in both the ears. Immittance evaluation results indicated middle ear pathology in

the left ear and normal middle ear functioning in the right ear. Ipsilateral and contra lateral acoustic reflexes were found to be absent in both the ears. Absence of acoustic reflex can be attributed to the severe hearing loss in the right ear and middle ear pathology in the left ear. DP and TEOAEs were also found to be absent in both the ears. Absence of oto acoustic emissions in the right ear indicates an outer hair cell (OHC) dysfunction, while similar finding in the left ear cannot be directly attributed to the OHC dysfunction as OAEs are susceptible to middle ear pathologies. The final diagnosis made after the detailed audiological evaluation was severe sensorineural hearing loss in the right ear and mild mixed hearing loss in the left ear.

**Figure 2.** Audiogram obtained after three days of treatment showing pure tone thresholds of right and left ears across 250 Hz to 8 kHz.**Figure 3.** Audiogram obtained after seven days of treatment showing pure tone thresholds of right and left ears across 250 Hz to 8 kHz.

After the pre-treatment audiological evaluation the patient had undergone intra tympanic gentamicin injection (0.5 ml) in the right ear at the Department of ENT, JSS Hospital, Mysore. Gentamicin buffered with sodium bicarbonate was used. Topical anesthesia was applied. The patient was also prescribed antibiotics as the patient was found to have otitis media in the left ear.

Audiological re-evaluations

Two audiological re-evaluations were done on the subject after three days and seven days of gentamicin treatment. Re-evaluation consisted of pure tone audiometry, speech audiometry, immittance evaluation and OAEs. Audiograms obtained after three and seven days of treatment are shown in Figure 2 and 3 respectively (see page 35). The results of audiological evaluations are given in Table 3 and 4.

The subject reported reduction in aural fullness, tinnitus and vertigo symptoms on the first re-evaluation which was carried out three days after the treatment. The frequency of tinnitus and vertigo spells was reported to be reduced. Thresholds at all the frequencies were observed to be improved. The same improvement was hence reflected in the PTA. Improvement was observed in the SRT and SIS scores also. Immittance evaluation revealed a development of middle ear infection in the right ear and persistence of middle ear infection in the left ear. OAEs were found to be absent in both the ears. However, there was no further significant change in the symptoms and pure tone thresholds in the second re-evaluation from the first re-evaluation. Provisional diagnosis made after both the evaluations were moderately severe mixed hearing loss in the right ear and minimal hearing loss in the left ear.

Table 3. Results of pure tone audiometry and speech audiometry in the first and second re-evaluation

Procedure	1 st re-evaluation		2 nd re-evaluation	
	Right ear	Left ear	Right ear	Left ear
PTA (dB)	65	16.6	68.3	15
SRT (dB)	70	20	75	25
SIS (%)	100	100	100	100
UCL (dB)	>100	>100	>100	>100

Table 4. Results of immittance evaluation in the first and second re-evaluation

Procedure	1 st re-evaluation		2 nd re-evaluation	
	Right ear	Left ear	Right ear	Left ear
Type	As	B	B	B
SC	0.2	NP	NP	NP
PP	-21	NP	NP	NP
ECV	1.5	1.7	1.4	1.7

NP, no peak found.

Discussion

It is clear from the audiograms that there was significant improvement in pure tone thresholds in both the ears after treatment. Similar findings though infrequent have been reported in earlier studies. Wu and Minor (2009) [4] reported an improvement of hearing thresholds in 5 out of the 34 subjects with unilateral Meniere's disease who had undergone intra tympanic gentamicin treatment. Kerem et al (2004) [6] reviewed studies carried out in the treatment of Meniere's disease with gentamicin and reported that the procedure is more vestibulotoxic than cochleotoxic. Vanucchi and Pecci (2009) [7] also have reported similar findings in individuals with Meniere's disease. They studied the effect of intratympanic gentamicin on 30 individuals with Meniere's disease and reported control of vertigo in all the subjects and improvement in the hearing thresholds in few. Speech discrimination scores were also reported to be improved in 10 subjects after the treatment. This improvement in hearing thresholds and speech discrimination scores were attributed to the decompression effect of gentamicin on the prolonged contraction of hair cells induced by Meniere's disease. In addition, they also suggested that the partially damaged hair cells can recover the function due to the control of hydrops episodes, thus could improve the hearing thresholds and speech discrimination scores.

Improvement in pure tone thresholds and speech discrimination scores in the present case may also be ascribed to the decompression effect of gentamicin and recovery of hair cell functioning as reported in the earlier studies. It was also observed that there was no significant change in the hearing thresholds and speech discrimination scores in the second re-evaluation from the first re-evaluation. This suggests that in the present case, maximum effect of gentamicin occurred initially and remained stable thereafter. Further, the improvement in hearing thresholds in the left ear may be attributed to the improvement of the middle ear functioning in response to the antibiotic medication prescribed for otitis media in the left ear. However, it was observed that the right ear also developed middle ear dysfunction after the treatment which may be a consequence of the intratympanic procedure adopted to deliver gentamicin to the middle ear.

Improvement in vertigo, tinnitus and aural fullness was also reported by the subject. This is in accordance with various earlier studies [2, 4, 8]. ElBeltagy et al (2012) [2] suggested the vestibulotoxic nature of gentamicin along with the damage to cells responsible for endolymph production as the possible reasons for release from the symptoms of Meniere's disease. In the present case too, a similar effect of gentamicin within the cochlea may have resulted in the reduction of vertigo, aural fullness and tinnitus.

Conclusion

Gentamicin is an aminoglycoside antibiotic administered to alleviate the vestibular problems especially related to Meniere's disease. This method damages the ill functioning labyrinth, thus alleviating the vestibular problems associated. The present case report illustrates the audiological findings before and after the gentamicin therapy in an individual with symptoms of Meniere's disease in the right ear. Detailed audiological evaluations revealed an improvement in hearing threshold and speech discrimination scores in the right ear along with control of symptoms like vertigo, tinnitus and blocking sensation after gentamicin treatment. This improvement may be attributed to the decompression effect of gentamicin and functional recovery of outer hair cells after the treatment. However, the subject developed middle ear dysfunction in the right ear which may be a consequence of the intratympanic procedure followed to deliver gentamicin. The absence of continued improvement in the second re-evaluation from the first suggested a maximum effect of treatment in the initial stages which gets stabilized thereafter. Detailed pre- post-treatment audiological evaluations are hence warranted in such treatment procedures to monitor the benefits and side effects of the procedure. This will help the professional to select the appropriate subsequent rehabilitation options, if required. Studying the effect of gentamicin on the vestibular and hearing functions in more number of subjects and quantifying the amount of improvement using vestibular and tinnitus inventories is required for generalizing the findings.

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