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Collapsed Ear Canal and Sudden Sensorineural Hearing loss

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Abstract 1

Introduction: A collapsed ear canal is defined as the cartilage of the pinna and ear canal close off the opening to the ear canal when earphones (i.e. supra-aural) are placed over the ears during audiological testing; thus, possibly affecting audiological results (2). Case Presentation: A 66-year-old male patient presented with a bilateral collapsed ear canal and a bilateral hearing loss. Discussion: Collapsed ear canals can negatively affect the results from an audiological evaluation, which could result in a false conductive component at higher frequencies and worse thresholds on certain frequencies above 1000 Hz. Conclusion: Audiologists being educated about the signs of a collapsed ear canal can prevent patients from being inappropriately fit with hearing aids. In addition, knowing how to overcome a collapsed ear canal to acquire accurate results is crucial.

Collapsed Ear Canal

Introduction

A collapsed ear canal is relatively uncommon, averaging 10% across all ages (5). The prevalence of collapsed ear canal ranges from 6.3% to 36.6% across all age groups. Those self-identified as white ethnicity having higher prevalence compared to other ethnicities as well. Additionally, it is noted that males, aged 65 year and above, that present with prominent ears are identified as risk factors for the occurrence of collapsed ear canals (2). A collapsed ear canal can present itself when the headphones exert pressure on the auricular pavilion which includes several parts of the ear including the tragus, helix, and concha. This provokes deformation of its natural anatomical position causing the ear canal to close due to constrictions of the ear canal walls (2). During audiological testing, this condition can present itself as a conductive component (greatest effect on frequencies above 1000 Hz) in audiological results when using earphones that are placed over the ears (3). Threshold shifts due to a collapsed ear canal can range from 15 dB or less; however, some shifts can be as large as 30 dB (4). It is essential to cross check with case history, otoscopy, and tympanometry. If a patient presents with case history with no red flags of middle ear conditions, no visualization of conductive component during otoscopy, and normal middle ear function during tympanometry and a conductive component during audiological testing, the audiologist should check for a collapsed ear canal (1). An approach to check for possibility of a collapsed ear canal can consist of depressing the pinna towards the mastoid and observing whether the pinna displacement causing the opening to narrow or close off completely. Switching to insert earphones is recommended in such cases. If insert earphones are not available, having the patient hold the headphone over their ear can allow for testing without collapsing the ear canal. Collapsed ear canals when not identified has the risk of an incorrect

diagnosis of degree and type of hearing loss, incorrect fitting of hearing aids and damaging hearing due to inaccurate targets being met.

Case Presentation 1

A 66 year-old male patient was seen for an audiological evaluation and hearing aid selection. He reported a history of noise exposure while farming with inconsistent use of hearing protection. In addition, he reported difficulties hearing in background noise and occasional, non-bothersome tinnitus. At the appointment, he denied otalgia, aural fullness, imbalance issues, or dizziness.

Prior to testing, an otoscopic examination was completed and revealed partially occluding cerumen in the right ear and a clear ear canal with a healthy appearing tympanic membrane in the left ear. After written consent was obtained, cerumen management was successfully performed without incident in the right ear. Post cerumen removal in the right ear revealed minimal non-occluding cerumen with an intact tympanic membrane. We then proceeded to testing. Tympanometry results revealed an intact tympanic membrane and middle ear function grossly within normal limits, bilaterally (Jerger Type A). Pure tone air and bone conduction was performed to establish type and severity of hearing sensitivity. Results under supra-aural headphones revealed normal hearing sensitivity from 250-1500 Hz, sloping to a mild to severe hearing loss from 2000-6000 Hz, further sloping to a profound hearing loss at 8000 Hz in the right ear. In the left ear revealed normal hearing sensitivity from 250- 1000 Hz, sloping to a mild to profound hearing loss from 1500-8000 Hz. A false conductive component was observed in the high frequencies as this was not consistent with tympanometry results; moreover, pure tone air conduction audiometry results obtained consisted of worse thresholds than anticipated from the patient as indicated by their ability to communicate without hearing aids and their case history.

Due to these concerns, the transducer was then changed to inserts earphones to cross check results. Results under insert earphones revealed normal hearing sensitivity from 250-1500 Hz sloping to a moderate to severe sensorineural hearing loss from 2000-8000 Hz in the right ear and normal hearing sensitivity from 250-2000 Hz sloping to a moderate to moderately-severe sensorineural hearing loss from 3000-8000 Hz in the left ear. It should be noted there was no conductive component with the insert earphones. It was noted that the pure tone average (PTA) with the supra-aural headphones was 25 dB HL for the right ear and 35 dB HL for the left ear. Thresholds were improved with inserts as the PTA for the right ear was 18 dB HL and 20 dB HL for the left ear. The entirety of testing was then completed under insert earphones at this appointment. Speech Recognition Thresholds (SRTs) were obtained as a cross-check for pure tone reliability and to determine speech recognition abilities using monitored live voice presentation of adult spondee words. SRTs were obtained at 25 dB HL in the right ear and 35 dB HL in the left ear. Word Recognition Scores (WRS) were obtained to evaluate speech understanding in quiet, using the recorded NU-6 Ordered By Difficulty word lists, and revealed 100 % correct when presented at 65 dB HL in the right ear and 84% correct at 75 dB HL (with 55 dB EM of contralateral masking) in the left ear. Uncomfortable listening levels (UCLs) were measured in the right ear at 105 dB HL for 750 Hz, 110 dB HL for 1500 Hz and at 115 dB HL for 3000 Hz and in the left ear at 110 dB HL for 750, 1500, and 3000 Hz.

The NAL Client-Oriented Scale of Improvement (COSI) was administered and his amplification goal was to be able to hear his wife better in background noise. All of his options were discussed with him in detail. The final two options the patient was choosing between were binaural Oticon More3 miniRITE R with a size 1-85 receiver (R) and 2-85 receiver (L) with open bass domes or binaural Phonak Audeo P50-RT with size 1M receiver (R) and size 2M

receiver (L) with open domes. It was recommended the patient think about their options and call the clinic when they were ready to pursue amplification.

Discussion

The chances of a collapsed ear canal are greatly increased when using supra-aural headphones especially in the elderly male population (> 65 years) (2). Special attention should be taken when utilizing supra-aural headphones due to the consequences of a collapsed ear canal. The first consequence could be diminishing auditory perception; thus, affecting the threshold results of tonal audiometry. This can result in misdiagnosing a conductive component. Another test it could alter threshold results is during electrophysiological threshold testing (2.) Although conventional audiological testing is fairly simple and standard, these errors can result due to lack of care, clinical reasoning and judgment in decision making. Audiologists should be aware of potential solutions to overcome a collapsed ear canal during audiological testing such as using circumaural earphones, using insert earphones, manual positioning of the earphone, or polyethene tubing inserts (3).

Conclusion

This case demonstrates a typical case of finding a collapsed ear canal during audiological testing with supra-aural headphones. The approach of cross-checking test results to determine if the conductive component was reliable or not with the supra-aural headphones was used to accurately state the type and degree of hearing loss. There are certain risks to inaccurately diagnosing a hearing loss due to an undetected collapsed ear canal. Further research is needed to determine how these risks can be avoided and other ways to test a patient with a collapsed ear canal if insert earphones and other potential solutions suggested above are not accessible.

Abstract 2

Introduction: Sudden sensorineural hearing loss (SSNHL) is defined as a sensorineural hearing loss of 30 dB or greater over at least three contiguous audiometric frequencies occurring within a 72-hour period (3). There are a few treatment options as steroid therapy is the mainstay option; however, treatment does not always result in improved outcomes (1). Case Presentation: A 75 year-old male patient presented with a SSNHL on the left side with restricted hearing on the right side. Discussion: The proper identification of a sudden sensorineural hearing loss and immediate treatment is essential for the best outcomes after treatment. Results can be affected by the time between onset of hearing loss and treatment. Conclusion: Audiological education on sudden sensorineural hearing loss and the urgency needed between onset of hearing loss and treatment is crucial for best prognosis for individuals.

Sudden Sensorineural Hearing Loss

Introduction

Sudden sensorineural hearing loss (SSNHL) is seen in seen in about 27 per 100,000 patients, being slightly more predominant in males (5). SSNHL is typically idiopathic with some etiologies falling in the categories of infection, autoimmune, traumatic, vascular, neoplastic, metabolic, and neurologic (3). Some key characteristics of SSNHL include hearing loss varying from mild to profound, typically unilateral, tinnitus, hyperacusis, vertigo, and poor speech perception abilities (4). SSNHL is deemed an otologic emergency and immediate treatment in close proximation of time of onset is essential for better prognosis. Possible treatment options include antivirals, antibiotics, diuretics, and so forth with corticosteroid (systemic or intratympanic) being the most common form of treatment (1). Intratympanic steroid therapy for salvage is recommended within 2-6 weeks of onset of SSNHL. Additional audiological testing is vital at the conclusion of treatment to see results (2).

Case Presentation 2

A 75 year-old male patient was seen for an audiological evaluation due to a sudden decreased in hearing in the left ear. The patient reported a decreased in the ability to hear himself in addition to the left ear feeling asymmetrical to his right ear. The patient has a history of a right-sided sudden hearing loss four months prior with a reportedly full recovery of thresholds and speech perception abilities after multiple steroid injections. Additional history includes familial history of hearing loss, non-bothersome tinnitus, bilaterally that is described as a “rumbling” sound, and other neurological problems. Patient did not have a baseline prior to onset of sudden hearing loss in either ear.

Otoscopic examination revealed clear ear canals with visible appearing tympanic membranes, bilaterally. Tympanometry results revealed an intact tympanic membrane and middle ear function grossly within normal limits in the right ear (Jerger Type A). Tympanometry in the left ear revealed reduced tympanic membrane mobility and possible middle ear system stiffness (Jerger Type As). Pure tone air and bone conduction was performed to establish type and severity of hearing sensitivity. Results under insert earphones revealed moderate, rising to mild, sloping to moderately-severe sensorineural hearing loss in the right ear and a moderately-severe, rising to moderate, sloping to moderately-severe sensorineural hearing loss in the left ear. (It should be noted that bone conduction at 500 Hz in the right ear is 20 dB above the right air conduction threshold; clinician verified air conduction threshold as well as bone conduction threshold. This was discussed with his otolaryngologist). Speech recognition thresholds (SRTs) were obtained via monitored live voice presentation of adult spondee words down to 35 dB HL in the right ear and 50 dB HL in the left ear. Word recognition scores (WRS) were obtained using the recorded NU-6 word lists (1 and 2). Results revealed 88% correct in the right ear when presented at 65 dB HL and 68% correct when presented at 85 dB HL with contralateral masking present. When compared to the previous audiogram obtained for the right ear on July 7, 2022, thresholds and speech perception remained stable; however, when compared to previous audiogram obtained for the left ear on May 25, 2022, thresholds decreased about 20 dB HL across the frequency spectrum as well as speech perception decreased from 100% to 68%.

After this appointment, the patient was seen by otolaryngology immediately. Patient was treated with a corticosteroid injection in the left ear. The patient was then seen three weeks after the injection to see if thresholds and speech perception abilities improved. Overall, in the left ear the patient had a 20 dB HL improvement across the frequency spectrum when compared to the

previous audiogram. In addition, speech perception abilities increased from 68% to 96%. The patient's thresholds are now in the moderate, rising to mild, sloping to moderately-severe hearing loss range, bilaterally. This is consistent with the patient's "best" thresholds obtained in the last four months. Again, it is unknown if hearing loss was present prior to sudden sensorineural hearing loss in either ear.

Discussion

The prevalence of SSHNL continues to increase and remains a challenging condition in the audiology world (5). Prognosis of SSNHL can depend heavily on duration, specific impact on cochlear structures, and treatment options (3). As there are a few different treatment options of SSNHL, the two most effective treatments are trans-tympanic steroid injection and oral steroids. About 98% of U.S. otolaryngologists reported using oral steroid for treating SSNHL compared to only 8% using intratympanic steroids (3). Interestingly enough, the trans-tympanic injection as a treatment option is associated with greater chances of hearing improvement compared to other options. In particular cases, corticosteroid is combined with oral therapy as well for more severe hearing loss cases or after failure/insufficient recovery using other treatment options (3). It is important for audiologists to refer to otolaryngologist immediately as the critical period for intratympanic steroid therapy for salvage is within 2-6 weeks of onset of SSNHL. Although, corticosteroid treatment can be very effective, the configuration of the audiogram can affect recovery as well. About 54% of individuals with a low frequency SSNHL recovered, only 28% of individuals with a high frequency SSNHL recovered, and finally, those with a flat SSNHL saw a 49% improvement (4). On the other hand, for individuals with idiopathic SSNHL that do not obtain any therapy, about 45-65% of patients will regain their pre-loss hearing thresholds

with an average improvement of 35 dB (3). For this particular patient, the corticosteroid treatment was effective in improving thresholds as well as increasing word recognition abilities. However, how much his hearing recovered is indeterminant as no baseline audiogram was available for review. Again, audiologists should be aware and educated on the signs of SSNHL in order for individuals to be treated as quickly as possible.

Conclusion

This case demonstrates a typical case of SSNL when identified early. The corticosteroid injection is deemed the most effective approach for treatment of SSNHL. As it is considered an otologic emergency, there are risks of poor prognosis if not identified correctly by the audiologist. Further research is needed to determine the incident rate of reoccurrence for SSNHL in the same or opposite ear as well as standard protocol for monitoring thresholds post-treatment.

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Table 1.1 and 1.2 (Case 1)

Frequency (Hz): 226 Hz	**Right Ear**
Ear Canal Volume	1.6 ml
Peak Pressure	-20 daPa
Static Admittance	0.27 ml
Gradient	130 daPa
Jerger Type	Jerger Type A

Table 1.1

Frequency (Hz): 226 Hz	**Left Ear**
Ear Canal Volume	1.7 ml
Peak Pressure	10 daPa
Static Admittance	1.39 ml
Gradient	50 daPa
Jerger Type	Jerger Type A

Table 1.2

Table 1.1 and 1.2. Tympanometry results in the left and right ear were consistent with an intact tympanic membrane and middle ear function grossly within normal limits.

Figure 1.3 (Case 1)

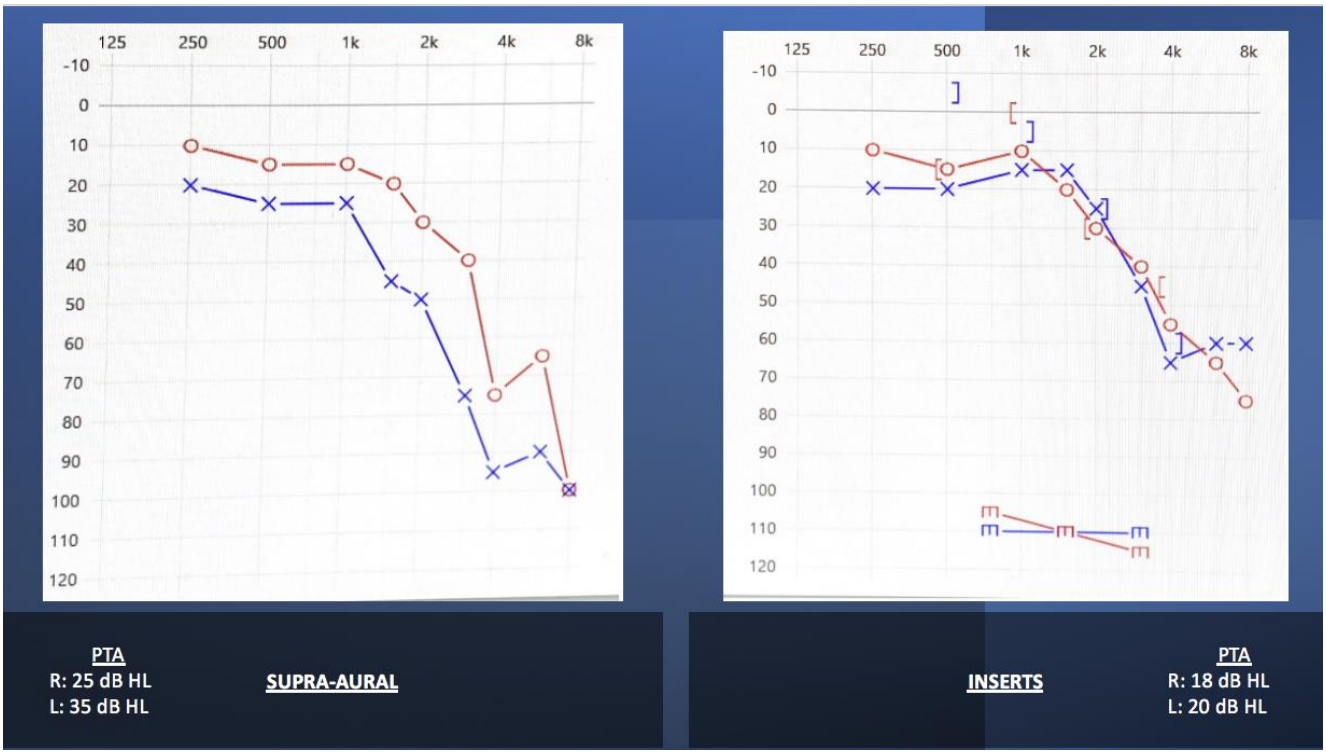

Figure 1.3. Audiometric data for the left and right ear for both supra-aural earphones and insert earphones. (NOTE: there is no bone conduction thresholds for the supra-aural audiogram due to it being a practice audiogram, time constraints, and realization of collapsed ear canal.)

Figure 1.4 (Case 2)

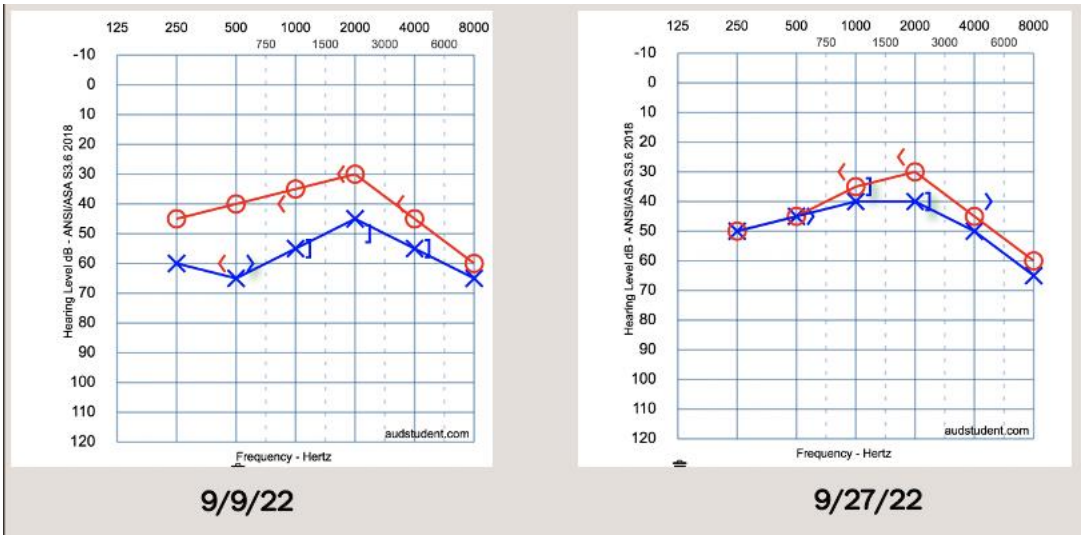

Figure 1.4. The audiogram on the left (9/9/22) has the results obtained at the appointment the patient presented with a decreased hearing sensitivity in the left ear. The audiogram on the right (9/27/22) has the results obtained after the patient was treated with corticosteroid injection.

Table/Figure (Case 2)

Word Recognition Scores	
Date	**Left Ear**
9/9	68%
9/27	96%

Table 1.3. Word recognition scores obtained on the day patient presented with decreased hearing snestivity in the left ear (9/9) was 68%. After corticosteroid injection, word recognition scores increased to 96% in the left ear.