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Part I

Hearing Disorders

1 Meniere's Disease and Aided Distortion

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1.1 Clinical History and Description

NA is a 61-year-old male diagnosed with Meniere's disease 10 years ago. He reports previous fluctuating hearing loss that has stabilized for approximately 1 year. Additional symptoms include intermittent bilateral low-frequency roaring tinnitus, but no recent episodes of vertigo or imbalance. NA states the primary symptoms of his Meniere's disease include fluctuating hearing and dizziness, and both have subsided following dietary changes (e.g., lower salt intake and no caffeine). He also reports a history of occupational noise exposure and his mother had hearing loss at a young age from an unknown cause. NA denies recent ear infections, aural fullness, or drainage.

1.2 Audiological Testing

Comprehensive audiometric testing was completed. The audiogram (▶ Fig. 1.1) revealed a bilateral symmetrical moderately severe sensorineural hearing loss. The Speech Recognition Threshold (SRT) was 75 dB hearing level (HL) for the right ear and 65 dB HL for the left ear, in good agreement with pure-tone averages (PTA) for each ear, and revealed a severe loss and a moderately severe loss in the ability to receive speech in the right and the left ears, respectively. Word recognition testing was conducted bilaterally via recorded CD version of the NU-6 (Northwestern University Auditory Test Number 6) using a male talker presented at 85 dB HL. Word Recognition Scores (WRS) obtained were 50% for the right ear and 66% for the left ear. These results indicate very poor ability to recognize speech in the right ear and moderate difficulty in the left ear. Immittance audiometry revealed middle ear pressure (daPa), static compliance (mL), and ear canal volume (mL) to be within the normal range bilaterally. Ipsilateral and contralateral Acoustic Reflex Thresholds (ARTs) at 500 to 4,000 Hz were absent bilaterally.

1.3 Questions to the Reader

1. **How would the scores of NA's word recognition testing guide an audiologist's counseling during a hearing aid evaluation?**
2. **What options for amplification would be most appropriate for NA's hearing loss and history?**
3. **Are there any causes for concern or unexpected inconsistencies in the audiologic testing?**

1.4 Discussion of Questions

1. **How would the scores of NA's word recognition testing guide an audiologist's counseling during a hearing aid evaluation?**

The scores indicate poor word recognition for the right ear and moderate difficulty for the left ear. This suggests that NA may also have difficulty understanding speech with amplification. It is essential for NA to be counseled so he does not have unrealistic expectations relative to his performance with amplification. Explaining the increased difficulty of aided performance in background noise when compared to quiet listening would be an important discussion. Also, NA should understand the methodology behind the WRS as the test was completed at comfortable loudness levels and in a sound-treated room. Therefore, these results may suggest (1) continued difficulty with speech clarity that will still be present with amplification and (2) greater difficulty with aided speech understanding with the right ear in comparison to the left ear.

2. **What options for amplification would be most appropriate for NA's hearing loss and history?**

At this point, based on the information gathered from the comprehensive audiologic evaluation, it seems as though conventional amplification would be the most appropriate option. It would be necessary to ensure sufficient gain and output and appropriate coupling of the hearing aids to NA's ears given NA's hearing loss. In this case, the audiologist recommended receiver-in-canal (RIC) hearing aids with custom c-shells. If a standard earmold were pursued, however, a parallel vent with a small vent (e.g., 1 mm) would be recommended to maintain amplification of the low frequencies and prevent feedback. Given the flat configuration of the hearing loss, a 3- or 4-mm Libby horn would also be recommended to provide additional gain in the frequency region above 2,000 Hz that is so critical to speech understanding.

Also, given NA's poor WRS it would be important to counsel on expectations with amplification. NA should be counseled to report any future fluctuations in hearing and the need for re-testing and re-programming changes would be noted.

3. **Are there any causes for concern or unexpected inconsistencies in the audiologic testing?**

NA's WRS, particularly of the right ear, are a cause for concern. The WRS are perhaps less symmetrical than would be expected given the symmetry of the hearing thresholds even though the difference in WRS does not exceed the bimodal distribution according to Carney and Schlauch.[1] This finding indicates that a referral to an otologist is appropriate to possibly uncover the cause for such asymmetry.

1.5 Additional Hearing Aid Fitting Options

RIC hearing aids with custom c-shells and power receivers were recommended for NA. Following medical clearance from NA's physician, the hearing aids were fitted and programmed to National Acoustics Laboratories prescriptive procedure for fitting linear hearing aids, version 2 (NAL-NL2)[2] and verified with real ear measurements (REM) to ensure real-ear insertion gain (REIG) was within 5 dB of prescribed targets at 50, 65, and 80 dB sound pressure level (SPL) input levels. A tinnitus

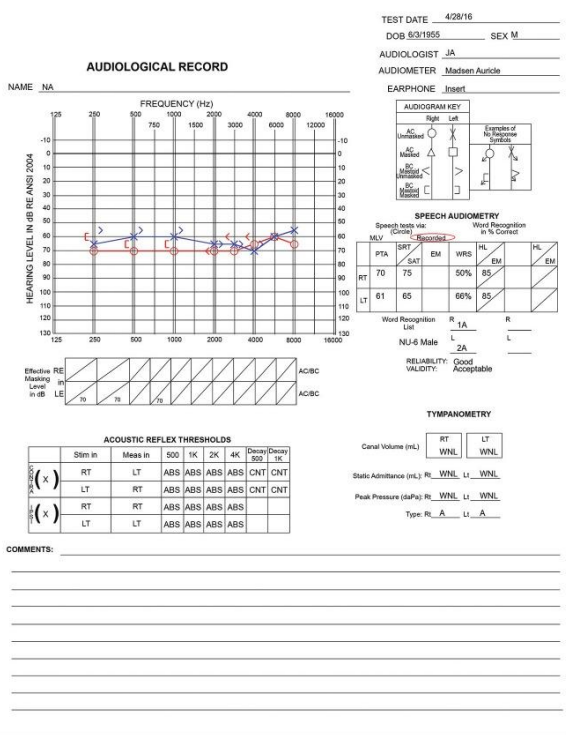

Fig. 1.1 Comprehensive audiological testing for NA.

program was included in the hearing aids to help distract from the roaring tinnitus that NA reported. This noise program utilizes a noise generator with customization of sound type and frequency.

NA returned after a month's trial and stated that the hearing aid for the left ear performed very well, but the hearing aid for the right ear was extremely distorted, even in quiet listening situations. NA said it sounded like "significantly distorted speech" and he could not distinguish any speech with the right hearing aid alone. Further, he felt that with bilateral amplification, speech was distorted and difficult to understand. He asked if he could return the hearing aid for the right ear as he seemed to hear better without it.

1.6 Additional Questions

1. **What are some steps that can be taken to ensure the right hearing aid is working within manufacturer specifications and the problem is not related to a malfunctioning hearing aid?**
2. **What other treatment options might be considered that may be appropriate for NA? What would be the benefits and limitations of these options?**
3. **Why are two hearing aids typically recommended for patients with bilateral hearing loss?**

1.7 Discussion of Additional Questions

1. **What are some steps that can be taken to ensure the right hearing aid is working within manufacturer specifications and the problem is not related to a malfunctioning hearing aid?**

It is essential to first ensure that the right hearing aid is working properly and is functioning within manufacturer specifications. External components should be checked including a wax trap (if the hearing aid has one) and visualization to be sure the hearing aid microphones are clear of debris and changing the microphone filters (if applicable). The receiver should be checked to