

Audiometric Protocol for Hyperbaric Registry

Executive audiological summary:

1. (OPTIONAL) Questionnaire - Hearing Handicap Inventory for Adults (HHIA)
 - a. Can be sent to patient or completed in the waiting room
 - b. This questionnaire should be completed at the first visit and at each follow-up visit to track progress
2. Bilateral air conduction audiometry from 250-8000 Hz
 - a. Inter-octave with additional frequency of 6000 Hz
 - b. Masking as needed
3. Bilateral speech reception threshold (SRT)
 - a. *If an SRT is not obtainable, find speech detection threshold (SDT)*
 - b. Recorded materials are preferred, but monitored live voice is adequate
4. If patient can compete SRT, complete word recognition testing 40 dB SL re:SRT
 - a. CID-W22 and NU-6 are preferred, but any consonant-nucleus (CN), nucleus-consonant (NC) and consonant-nucleus-consonant (CNC) word list is acceptable.

Protocol:

1. (OPTIONAL) Questionnaire – Hearing Handicap Inventory for Adults (HHIA)

- a. The HHIA will serve to provide qualitative data to compare to objective audiological tests and serve to track perceived benefit of treatment.
- b. The HHIA takes about 5 minutes and fits on a single sheet of paper
- c. The HHIA should can be completed **at every visit** prior to testing in the waiting room or mailed home.

2. Audiogram

- a. A pure-tone audiogram should be conducted using insert (preferred) or supra-aural headphones.
- b. Testing should begin at 1000 Hz, because this frequency is easily heard by most patients and has the greatest test-retest reliability.
- c. A common frequency sequence for pure-tone threshold testing is:
 - i. 1000, 2000, 3000, 4000, 6000 8000, 1000 (repeat), 500, and 250 Hz.
- d. **A Modified Hughson-Westlake method should be used.**
 - i. A ascending technique could be used if the patient is a suspected malingerer.
 - ii. Test inter-octave frequencies of 750 and 1500 Hz if there is a 20 dB or greater difference in threshold between octaves
- e. **Masking will most likely be required** as most sudden SNHL is unilateral.
 - i. Audiometer **MUST** be able to mask better ear for accurate measures of affected ear
 1. i.e. loud sounds played into the affected ear may be heard by the good ear giving an inaccurate result. “Masking” prevents this.)
 - ii. When recording the masking level utilized in the non-test ear, record the starting and ending levels or the highest noise level at which the correct threshold was established.
 - iii. Inter-aural attenuation is 50 - 60 dB for air conduction (with inserts).

3. Speech Reception Threshold (SRT) Testing

- a. SRT is the softest hearing level for speech at which an individual can recognize and repeat back 50% of the speech material using spondees (words with two stressed syllables like “toothache”).

- b. Testing begins at a comfortable listening level for the patient and familiarize patient with spondaic words if needed.
 - i. Spondaic words (or spondees) are two-syllable words with equal stress on both syllables.
 - ii. Recoded spondees are preferred but using monitored live voice is acceptable.
- c. Utilize descending technique (Modified Huston Westlake) to **obtain threshold response of 50%**, i.e., 3 of 6 or 2 of 4 spondees at same level.
- d. SRT *should* be within 10 dB of the pure-tone average (PTA)
 - i. PTA = average of 500, 1000, and 2000 Hz pure tone thresholds.
 - ii. Agreement with PTA may not be applicable in the affected ear.
- e. Mask if necessary, inter-aural attenuation for speech is 50 - 60 dB with insert earphones and 40 dB with TDH. Use the following procedure for masking SRT:
 - i. Instruct the patient that he/she will hear a noise in one of the ears, but that he/she should ignore this noise and keep repeating the words heard in the other ear to the best of his/her ability.
 - ii. Introduce the masking noise (preferably the noise marked "speech noise" on the audiometer, or if this is unavailable, "white noise") to the non-test ear. The noise is presented at 20 dB above the SRT of the non-test ear.
 - iii. Present 6 spondee words at the same level at which the threshold was measured before, with the masking noise presented to the non-test ear.
 - iv. If the patient still attains 50% recognition at this level, increase the masking by 5dB and present six more words.
 - v. Repeat this process, until the masking level has been increased by 15 dB (three steps of 5 dB) from the original masking level. Record the masking level that was used (e.g. 20-35 dB).
 - vi. If the patient is unable to attain 50% recognition at the previously measured SRT level once masking is introduced, keep the masking level constant and increase the speech level in the test ear by 5 dB, presenting six words at that level.
 - vii. Continue this process until the patient attains 50% recognition.
 - viii. Increase the masking level by 5 dB and present six more words, repeating this process until the masking level is 15 dB higher than the initial level.

4. **Speech Detection Threshold (SDT) or Speech Awareness Threshold (SAT) if SRT is unobtainable**

- a. SDT is the softest level one can *detect* the presence of words (does not have to repeat back accurately).
 - i. The listener does not have to identify the material as speech but must indicate awareness of the presence of sound.
- b. This test is often used when an individual's hearing loss is so great that the person is unable to recognize/repeat the words yet is aware that words have been presented.
 - i. Patient will sometimes hear a buzzing or humming, but not be able to repeat words.
- c. Like SRT, testing begins at a comfortable level and descends until the presence of spondee words is 50% of the time.
- d. Be aware of loudness recruitment or near-normal loudness perception in response to high sensation levels even with significant hearing loss.
- e. Of note, serial audiometric testing may show improvements, but patients may still not be able to complete a SRT or word recognition testing due to their hearing loss.

5. **Word Recognition Testing**

- a. Word recognition testing is the percentage of single syllable words a patient can accurately repeat back at a comfortable listening level (i.e. suprathreshold testing).

- i. Suprathreshold testing = Above threshold (i.e. speech perception testing with increased volume)
- b. Testing begins at **40 dB above the SRT** and is presented with a list of 25 words.
 - i. Lists should be made up of single syllable consonant-nucleus (CN), nucleus-consonant (NC) and consonant-nucleus-consonant (CNC) words
 - ii. **Word lists:**
 - 1. **Recommended:** Central Institute for the Deaf list 22 (CID W-22), Northwestern University Auditory Test No. 6 (NU-6), or Maryland CNC.
 - 2. Any word list that has CN, NC, or CNC words will also work
 - iii. Try not to exceed 110 dB HL, and mask if necessary
 - iv. Utilize recorded materials, **do NOT use monitored live voice**
- c. The percentage of words the patient accurately repeated should be calculated and recorded.
- d. This test is not adaptive like the audiometry, SRT, or SDT (i.e. changing the level of the stimulus to obtain a threshold). Present entire list (25 words) and calculate percentage correct.
- e. If initial score is lower than expected, a second list may be presented at an increased presentation level but be aware of loudness recruitment and uncomfortable listening levels.

6. **Of note:**

- a. **Confirmation** of sudden *Sensorineural Hearing Loss* and **NOT** Conductive or Mixed hearing loss
- b. When a patient first presents with sudden sensorineural hearing loss, conductive hearing loss (CHL) should be ruled out.
 - i. CHL may be due to an abnormality in the ear canal, tympanic membrane, or middle ear.
 - ii. Physical examination will help determine if there is obstructing cerumen or a foreign body in the ear canal, if there is a perforation of the tympanic membrane, or if there is fluid in the middle ear.
 - iii. Bone-conduction audiometry and/or tuning fork testing will enable the initial treating clinician to distinguish CHL from SNHL.
 - iv. This is imperative for both initial assessment and follow-up to avoid spurious findings.