Audiological Aspects of the Diagnosis of Acoustic Neuromas*

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Auditory symptoms are usually the first indication of a developing acoustic neuroma. A high index of suspicion and the use of sophisticated auditory tests will frequently make it possible to diagnose this tumor at a time when it is still contained in the internal auditory canal and presents only auditory clues. The advent of micro-surgical techniques for the approach to these small tumors has emphasized the diagnostic value of precise auditory testing.5,9,10,11

The purpose of this article is to review briefly the auditory tests used in the diagnosis of acoustic neuroma. The typical test findings will be discussed and screening tests which may be performed in the general physician's office will be described.

What Are We Evaluating?

Auditory evaluation in the past has been limited to a pure tone audiogram, testing air and bone conduction. The resulting audiogram showed either a conductive or nerve type of impairment (Fig. 1). A nerve impairment was found in patients with acoustic neuroma. The audiogram was of little help in early diagnosis because there were many other conditions which could be the cause of a similar audiogram.

It became apparent, however, that there were many differences in the way a patient with an acoustic neuroma responded to speech, to loud tones, and to prolonged stimulation of soft tones. These differences were correlated with the clinical picture and began to show a typical pattern. Patients whose nerve impairment was due to a cochlear disorder such as Menière's disease showed one type of pattern, whereas those with a true nerve or retrocochlear lesion such as an acoustic neuroma showed quite a different response.

We now refer to a nerve impairment as sensori-neural, indicating that the area involved may be either sensory (that is cochlear or inner ear) or truly neural. Tests of speech discrimination, auditory fatigue, and loudness function help to identify the exact site of the lesion, cochlear or retrocochlear. It is the retrocochlear type of pattern that is found in most cases of acoustic neuroma.

Pure Tone Audiometry

The establishment of the pure tone audiogram is the first step in audiologic evaluation. The patient with an acoustic neuroma will have a sensori-neural type of hearing impairment, usually limited to or worse on the affected side. Furthermore, the configuration or pattern for loss of frequency may be significant. Seventy per cent of 53 surgically confirmed tumors in a recent series6 had audiograms that showed a loss of high frequency tone perception (Fig. 2).

Speech Audiometry

The second step in auditory evaluation is testing the patient's ability to hear and to understand speech. Understanding of speech (speech discrimination) is usually grossly impaired in retrocochlear lesions.

The tests may be administered by "live voice," record or tape recording through a speech circuit in the audiometer. We prefer tape recording because it reduces distortion and is free from the surface noise present after records have been played a number of times.

The speech reception threshold (SRT) is established by using bisyllabic words (spondee words) such as baseball, cupcake, wash-board, etc. The intensity level at which the patient repeats 50 per cent of these words correctly is the SRT and should approximate the threshold for pure tones.

The patient's ability to understand speech is of greater importance. To determine the speech discrimination, monosyllabic words (phonetically balanced or PB words) such as

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rip, goose, earth, nudge, etc. are presented to the patient 20 to 40 decibels above the SRT. This increased intensity is to insure that the words are heard loud enough to be understood if possible.

A list of fifty words is presented. The percentage correct is recorded as the PB or discrimination score. Normal patients, and those with a conductive impairment, will have perfect scores (90 to 100 per cent). Those with a sensori-neural hearing impairment will show a varying degree of impaired discrimination.

Cochlear lesions such as Ménière's disease or hereditary or aging changes in the inner ear will show a moderate loss of discrimination. More than half of the words will be understood in most cases.

The patient with an acoustic neuroma will usually show gross discrimination impairment. In the series of confirmed tumors, two thirds had a PB score of 30 per cent or less. Half of those in this group had absolutely no capacity for understanding speech.

**Auditory Fatigue Tests**

A person with normal hearing or one with a conductive impairment is able to hear a continuous tone, presented just above threshold, for a prolonged period of time without developing significant auditory fatigue. In sensori-neural impairments a varying amount of adaptation or auditory fatigue will occur, depending upon the location of the lesion.

Auditory fatigue is minimal, and usually limited to the higher frequencies in cochlear disorders. In cases of acoustic neuroma there may be severe or total tone decay (auditory fatigue).

There are two tests designed to measure this auditory fatigue or adaptation: the modified tone decay test (MTDT), and diagnostic Békésy audiometry.

**Modified Tone Decay Test.** The MTDT is the simpler of the 2 tests. It may be carried out with any standard audiometer in a very brief period of time. The procedure is as follows:

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**Fig. 1.** Audiogram illustrating conductive impairment in the right ear and sensori-neural (nerve) impairment in the left ear. Solid line represents air conduction and dotted line bone conduction.

**Fig. 2.** Audiogram showing high-frequency loss configuration in a verified acoustic neuroma (solid circles). The opposite ear (open circles) is normal.