Hearing examination

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Hearing tests are a common medical procedure. For older children and adults - using speech, hearing aids and conventional audiometry. In young children, by sound toys. In both groups - tympanometry, objective audiometry, otoacoustic emissions.

In most Czech maternity hospitals, newborn hearing screening is performed by otoacoustic emissions. Since 2014, hearing screening of five-year-old children is performed by tonal audiometry.

Examination by speech

It is performed by full voice – vox magna (V), **or by whispering** – vox sibilans (vs). In a noiseless room at least 6 m long; We use **words that contain low, medium and high formants**:

- deep - words with **„u“** – school, wood, moon, book;
- medium - words with **„a“** and **„o“** – water, coat, tobacco, garden;
- high - words with **„i“**, **„e“** and with syllables – slide, time, shine.

Performed monoaurally, the other ear is covered. The examinee sits with the examined ear to the doctor, the patient should not look at the doctor.

Evaluation:

- **normal hearing** – more than 10 m for loud speech, and more than 6 m for whispering;
- **impairment of high pitched words** – judge for sensorineural hearing loss (mark „I“ in the record);
- **impairment for medium and deep vowels** is marked with „a“, „u“ – conductive hearing loss.

Entry:

normal hearing		
right		**left**
10	**V**	10
6-10	**vs**	6-10

conductive hearing loss on the right				
i	***u***		***i***	***u***
3	4	**V**	10	
0,5	1	**vs**	6	

sensorineural hearing loss left				
i	***u***		***i***	***u***
10		**V**	4	10
6		**vs**	0,5	6

Tuning fork examination

Important to distinguish between **conductive** and **sensorineural** hearing loss. We use a tuning fork with a chambered "a" with a foot.

Weber's test (W)

We place the sounded tuning fork in the midline on the vertex, asking the patient where they hear it more.

- If it lateralizes to the worse-hearing ear → conductive defect of that ear.
- If it lateralizes to the better-hearing ear → the other ear has a sensorineural defect.

  Lateralization is denoted by (W→), normal finding (‹W›).

Rinne's test (R)

- Compares bone and air hearing of the same ear.
- The healthy ear and the sensorineural ear hear the tuning for longer through air than through bone → therefore Rinne's test is positive (R+).
- In conductive hearing loss – the patient hears better and longer through the bone conduction (R-).

Schwabach test (Sch)

- Compares the length of bone conduction hearing of the patient and the doctor.
- If the patient hears the tuning fork on the planum mastoideum as long as the doctor → Schwabach normal (Sch norm).
- If the doctor hears longer than the patient → the patient's ear has perceptual hearing loss → Schwabach shortened.
- If the patient hears longer than the doctor → the patient's ear has conductive hearing loss → Schwabach prolonged

Entry:

normal hearing		
<	**W**	>
+	**R**	+
norm.	**Sch**	norm.

conductive hearing loss on the right		
←	**W**	
-	**R**	+
prolonged	**Sch**	norm.

percepční vada vlevo		
←	**W**	
+	**R**	+
norm.	**Sch**	shortened.

Audiometry

There are more articles for this query in WikiLectures.

- Audiometry
- Audiometry (physiology)
- Audiometry (biophysics)

Tonal audiometry

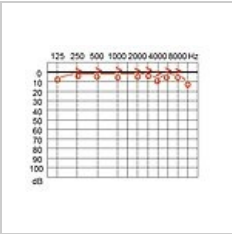
It is performed with a device that generates tones of a certain frequency (Hz) and intensity (dB). The tone is conducted into the patient's ear through either an air or bone hearing aid. It is usually performed in the range of 125 Hz to 10 kHz, from −10 dB do 100 dB. We aim to find the hearing threshold - the lowest intensity at a given frequency at which the patient can hear the tone.

We **record the result in an audiogram**:

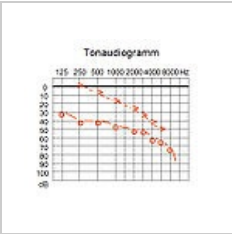
- bone conduction in dashed lines ([right,] left), air conduction in solid lines (O right, X left);
- right ear in red, left ear in blue.

Evaluation – normal hearing is within 15 dB of loss,

- sensorineural hearing loss – decrease will be both bone and air components, greater decrease in higher tones,
- conductive hearing loss – the drop will be in the air conduction, bone will be normal,
- mixed - combination.



Physiological findings



Mixed hearing loss

Threshold audiometry

It is one of the simplest types of audiometry. It allows the examination of hearing threshold at a few selected frequencies. It is used for orientation and **screening** of hearing disorders in selected groups in society, e.g. workers in noisy workplaces.

Absolute hearing threshold

Hearing threshold curve is defined by acoustically precise tones of different frequencies in Hz (X-axis) and the intensity or magnitude of sound pressure in dB (Y-axis). This procedure gives a curve that is convexly curved downwards or upwards, i.e. depending on whether the rising intensity is in descending or ascending order. The result is then referred to as the **absolute hearing threshold**. The most common display in clinical practice is the descending audiogram display.

Relative hearing threshold

Although absolute hearing threshold can be measured in various acoustic experiments, in audiometry the determination of the so-called **relative hearing threshold**is commonly used, where audiometers are designed so that the thresholds of a normal audiogram lie on a straight line. These values are based on the subjective hearing threshold of many healthy people examined and differ from precise physical measurements (dB SPL - Sound Pressure Level) and are therefore referred to as dB HL (Hearing Level) for method identification.

Hearing impairment

Hearing impairment in audiometry is recorded as a noticeable drop in the curve (loss audiogram) to higher decibel values (threshold rise), which indicate how much hearing perception is reduced from normal.

When an increase in the threshold of audibility of any frequency of more than 20 dB is detected (air conduction), further values on the diagnostic audiometer (reduction of measurement errors) and a supplementary examination also for bone conduction are necessary for a more detailed diagnosis. The bone conduction threshold is 40-50 dB higher, but the audiometers are designed so that the threshold curves of the two types of conduction normally coincide.

Speech audiometry

We use **word sets of 10 words**, balancing words with medium, high and low formants. They are played back to the patient at different intensities and he repeats them. The number of correct answers is recorded depending on the intensity. **Rating**:

- conductive disorders – the curve maintains an axis shape but is shifted to higher intensities.
- sensorineural hearing loss is manifested by speech discrimination - lower discrimination scores.
  - The patient hears but does not understand and increasing the intensity does not usually improve this.

Also important in determining the appropriateness of wearing hearing aids.

Supra-threshold audiometry

To distinguish a disorder in the hair cells or in the n. VIII.

Otoacoustic emissions

🔎 *For more information see Otoacoustic emissions.*

It is based on the observation that the healthy ear generates sounds by periodic oscillation of the outer rows of hair cells, which are emitted outward by the middle ear, these can then be recorded and analyzed. They are formed spontaneously or as an echo to a sound stimulus. The emissions may be absorbed by a malfunction in the

conductive system. In their absence, the ear should be examined tympanometrically. The method is simple and is used to **screen at-risk newborns**

Objective audiometry

Most of the previous methods require the patient's cooperation (it is therefore subjective). Objective audiometry is used in young children, mentally unstable, for voluntary inhibitions... It is a method based on the principle of **action potentials**. Depending on where the potentials are detected (it depends on the time interval after the impulse - how far it is enough to reach) we distinguish:

- **ECPG** – electrocochleography;
- **BERA** – Brain Evoked Response Auditory;
- **CERA** – Cortical Evoked Responses Audiometry.

The examination is time-consuming. The method contributes to the **topodiagnosis** of the lesion.

Tympanometry

Measures directly the mechanical and acoustic properties of the tympanic membrane and indirectly measures the properties of the conductive system by sound reflection. Essentially, **we measure the compliance (malleability) of the eardrum**. The instrument sends out sound and changes the pressure in the olive-enclosed external ear canal, then reverse-mics the intensity of the sound reflected by the eardrum. **Tympanometric curve**[1]

- **Type A curve** – normal, has a peak at a pressure that corresponds to the pressure in the middle ear (looks like a mountain or tent);
- **Type B curve** – if there is fluid in the middle ear instead of air - this leads to a flattening of the curve;
- **Type C curve** – when there is negative pressure in the middle ear - the peak is shifted to the left.

Eardrum compliance is changed by involvement of middle ear muscles → **stapedial reflex** – occurs at intensities **75 – 85 dB**. Auditory sensation is transferred to n. VII. a m. stapedius

Examination when simulation is suspected

Simulation of unilateral deafness – test using a Barany deafener. It is based on automatic control of speech intensity by hearing. The patient is made to count loudly and during this process the hearing of the healthy ear is knocked out by the deafener. If the remaining ear is deaf, it stops hearing and the voice is raised and amplified and the tempo is quickened. If he simulates and hears the ear, he still counts the same.

Simulating bilateral deafness – imilarly using two deafening devices.

Links

Related articles

- audiometry (physiology)
- Units Describing Human Noise Load
- Hearing
- Hearing Loss
- Classification of hearing loss

References

1. ŠLAPÁK, Ivo – JANEČEK, Dalibor – LAVIČKA, Lukáš. *Základy otorinolaryngologie a foniatrie pro studenty speciální pedagogiky* [online]. Lékařská fakulta Masarykovy univerzity, ©2009. The last revision 2009, [cit. 2012-06-12]. <https://is.muni.cz/elportal/estud/pedf/js09/orl/web/pages/1_2_vysetrovaci_metody_ucha.html>.

External links

- Fyziologický ústav 1. lékařské fakulty (http://fyzi-web.lf1.cuni.cz/index_cz.html)
- Odkaz na praktické cvičení Vyšetření sluchu (kapitola 15.) v PDF na internetových stránkách Fyziologického ústavu 1. LF UK (https://fyziologie.lf1.cuni.cz/file/5643/iv-blok.pdf)

Source

- BENEŠ, Jiří. *Studijní materiály* [online]. ©2007. [cit. 2009]. <http://jirben2.chytrak.cz/materialy/orl_jb.doc>.

Used literature

- KLOZAR, Jan, et al. *Speciální otorinolaryngologie.* 1. edition. Praha : Galén, 2005. 224 pp. ISBN 80-7262-346-X.