Al- mustaqbal University College
Anesthesia Techniques Department
First stage /medical physics
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Lecture 6:

Physics of the Ear and Hearing

The human ear has a specific range of frequencies which from 20 to 20,000 Hz. Sounds below 20 Hz are called infrasound, whereas those above 20,000 Hz are ultrasound. Other animals have hearing ranges different from that of humans. Dogs can hear sounds as high as 30,000 Hz, whereas bats and dolphins can hear up to 100,000-Hz sounds. While Elephants respond to frequencies below 20 Hz.

-The sense of hearing involves

•The mechanical system that stimulate the hear cells in the cochlea.

•The sensors produce action potential in the auditory nerves.

•The auditory cortex, the part of the brain that decodes and interprets the signals from the nerve.

The ear is cleverly designed convertor of Mechanical waves in air into electrical pulses in the auditory Nerves.

-The ear consist of

- The outer ear
- The middle ear
- Inner ear

-The outer ear

The outer ear does not refer, as you might think, to the visible part of the ear, which in medical jargon is called the pinna. The outer ear is the external auditory canal, which end at the eardrum.

The outer structure, is the least important part of the hearing system; it aids only in funneling sound waves into the canal and can be completely removed with no noticeable loss in hearing. The external auditory canal considered as storage place for ear wax.

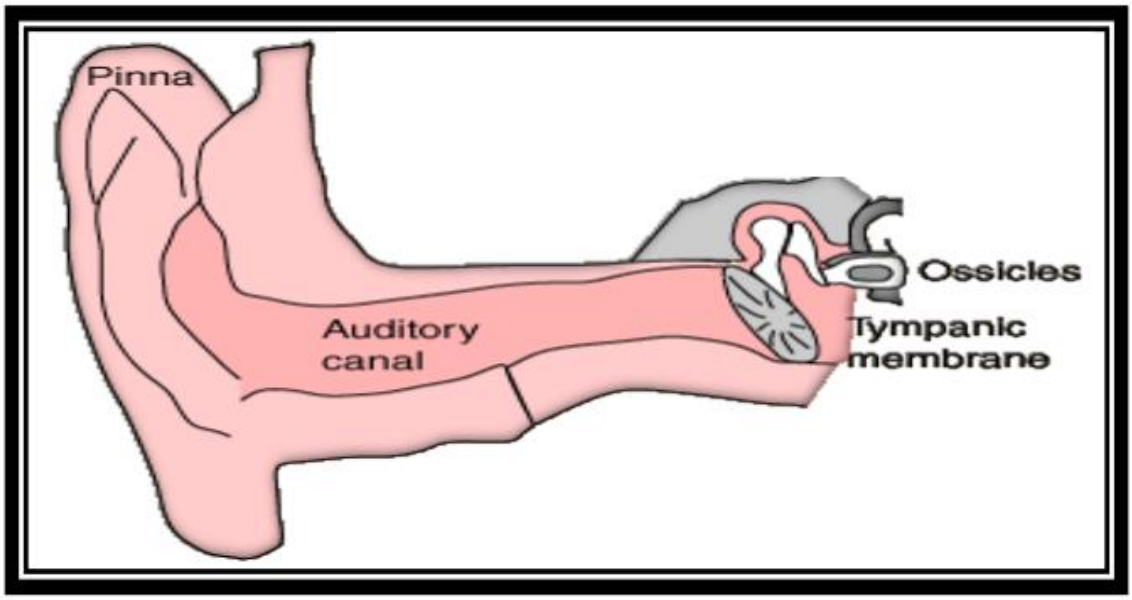

Figure 1: The outer ear

-The middle ear

The features of the middle ear are the three small bones (ossicles). These bones are full adult size before birth. (The fetus can hear while it is still in the womb).

The ossicles play an important role in matching the impedance of the sound waves at the eardrum to the liquid-filled of the inner ear. The ossicles are named after the objects they resemble: (hammer), the incus (anvil), and the stapes (stirrup).

They are arranged so that they efficiently transmit vibrations from the eardrum to the inner ear.

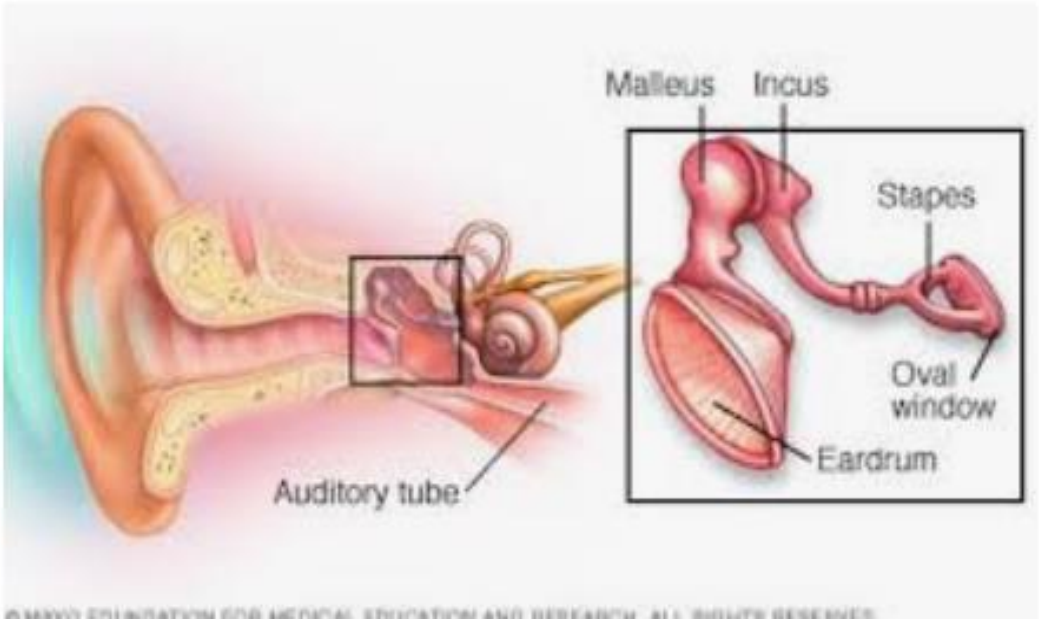

Figure 2: The middle ear

-The Inner Ear

The inner ear, hidden deep within the hard bone of the skull, is man's best-protected sense organ. The inner ear consist of a small spiral-shaped, fluid-filled structure called the cochlea. The ossicles of the middle ear communicate with the cochlea via a flexible membrane .the stapes transmits its pressure variations of incoming sound waves across this membrane to the cochlea.

The cochlea communicates with the brain via the auditory nerve-a bundle of about 8000 conductors that inform the brain via coded electrical pulses.

The auditory nerve provides information on both the frequency and the intensity of the sounds that we hear. The cochlea is about the size of the tip of the little finger.

Figure 3: the ear fitting.