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Anesthesia Techniques Department
First stage /medical physics
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Lecture 6:

Physics of the Ear and Hearing

-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

•ear canal

•The middle ear consist of three small bones (ossicles) and opening to the mouth (Eustachian tube).

•Inner ear consist fluid filled spiral shaped cochlea containing the Organ Of Corti: hair cells convert vibrations into coded nerve pulses

-The outer ear

It aids in funneling sound waves into the canal, the external auditory canal besides storage place for ear wax serves to increase the sensitivity in the region of 300—4000 Hz, the canal is about 2.5 cm length. Length = (λ/ 4) and resonance frequency about (3300 Hz).

λ = 10 cm, the sensitivity of the ear is best in the region in Fig The eardrum or tympanic membrane is about (0.1 mm) thick. The movement of eardrum is less than the movement of air molecules in the sound waves

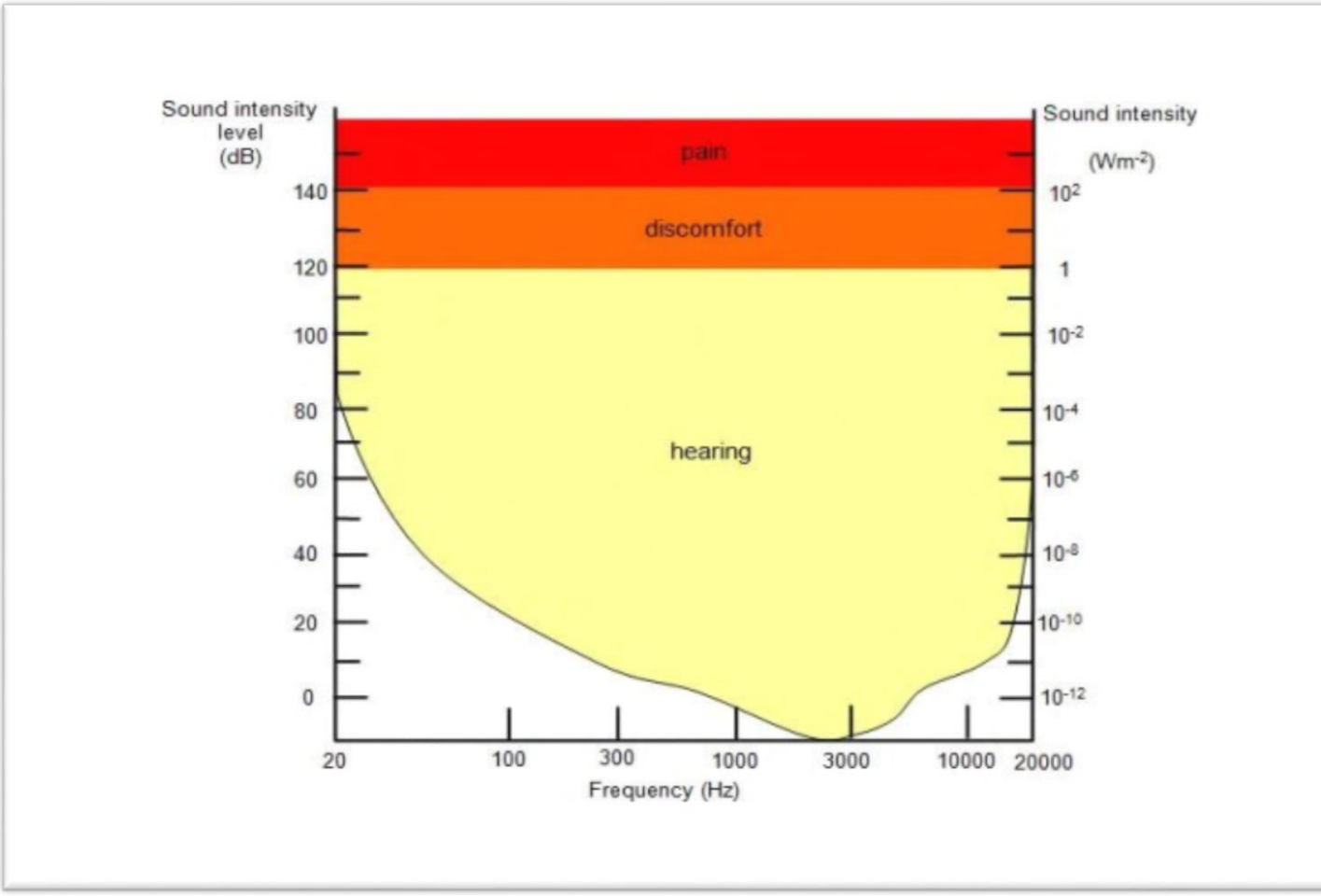

Figure 1: the sensitivity of the ear

It is possible for sound pressure above 160 dB to rupture the eardrum; a ruptured eardrum normally heals just as other living tissue.

-The middle ear

Consist of three bones called ossicles are full adult size. Before birth, the fetus can hear while it is still in the womb. They transmit vibrations from eardrum to inner ear; the ossicles amplify pressure of sound waves to inner ear.

-The Inner Ear

The inner ear consist of small spiral shaped, fluid filled structure called cochlea, the ossicles of the middle ear communicate with cochlea cross flexible membrane (the oval window) the stapes transmit its pressure variation of incoming sound to cochlea.

-The Stethoscope

The act of listening to the sound of the heart and lung with stethoscope is called auscultation. The main part of the stethoscope is bell, which is either opened or closed. The volume of the tube should be small, and there should be little frictional loss of sound to the walls of the tube.

If the diameter of the tube is too small, frictional losses occur, and if it is too large, the moving air volume is too great: in both cases efficiency reduced. At 200 Hz 15 dB is lost in changing from about 7.5 cm long to a tube 66 cm long, a good size is a tube with length of about 25 cm and diameter of 0.3 cm.

H.W:

What is the function of ossicles?