



Medical Physics

Sound in Medicine

Lecture Eight

Introduction

The audible sound: the range is usually defined as 20 Hz to 20.000 Hz (20 kHz).

Older people often lose the ability to hear frequencies above 10 kHz.

Infrasound: refers to sound frequencies below the normal hearing range or less than 20 Hz.

It is produced by natural phenomena like earthquake waves and atmospheric pressure changes.

Ultrasound: sound with a frequency range above 20 kHz. It is used clinically in a number of specialties.

It often gives more information than an X-ray, and it is less hazardous for the fetus.

General properties of sound

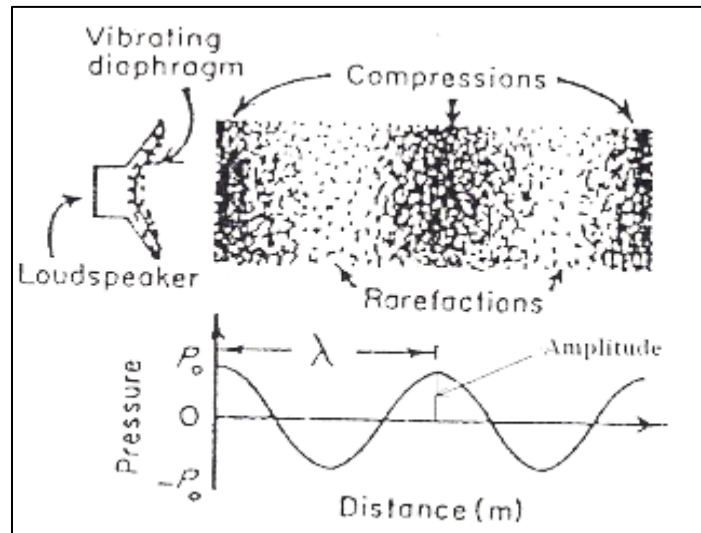
- A sound wave is a mechanical disturbance in a gas, liquid, or solid.
- The vibrations cause local increases and decreases in pressure relative (compressions & rarefactions)
- The relationship between the frequency of vibration of the sound wave is

$$v = \lambda f$$

f = frequency of vibration of the sound wave.

λ = wavelength of the sound wave.

- A special unit, the bel has been developed for comparing the intensities of two sound waves (I_2 / I_1) (1 bel = 10 dB) decibel.



Stethoscope

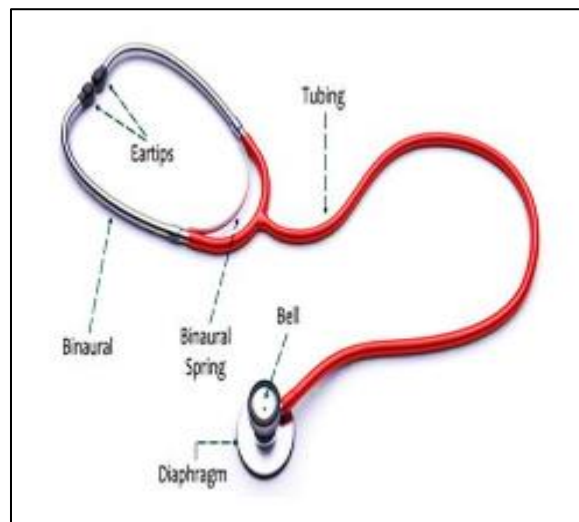
A stethoscope is a medical device that is used, generally, by doctors, nurses and other medical professionals.

Bell: The bell of a stethoscope is the cup-shaped part at the end of the tubing, usually opposite the diaphragm. Not all stethoscopes have a bell. The bell is used to listen to low pitched sounds.

Diaphragm: The diaphragm of a stethoscope is the flat part at the end of the tubing, with a thin plastic “drum-like” covering. The diaphragm is used to listen to high-pitched sounds. Some stethoscopes have a diaphragm but no bell.

Tubing: The stethoscope tubing transmits sound from the bell or diaphragm to the earpieces. Some stethoscopes have single tubes, some have double tubes. Double tubes are more sensitive but may rub against one another causing “squeaks” to be heard.

Earpieces: fit into the ears. They should angle slightly forward for the best fit. Earpieces made of soft rubber are more comfortable and may prevent outside sounds from interfering with your listening.



Ultrasound Scanning modes:-

1. A-Scan

To obtain diagnostic information about the depth of the structures in the body, we send pulses of ultrasound into the body and from the time required to receive the reflected sound (echoes) from the various surfaces in it.

Pulses of A-scan work are typically a few microseconds long. They are usually emitted at 400 to 1000 pulses/sec.

A-scan is used in:

1. Echoencephalography:

It is used in the detection of brain tumors. Pulses of ultrasound are sent into a thin region of the skull slightly above the ear and echoes from different structures within the head are displayed on a screen.

The usual procedure is to compare the echoes from the left side of the head to those from the right side and to look for a shift in the midline structure.

A tumor on one side of the brain tends to shift midline toward the other side. Generally, a shift of more than 3mm for an adult, or 2mm for a child is considered abnormal.

Ophthalmologic

The application of the A-scan in ophthalmology can be divided into two areas:-

a) The first one is concerned with obtaining information for the diagnosis of eye diseases.

b) Biometry: measurement of distance in the eye such as lens thickness, depth from the cornea to the lens, the distance to the retina, and the thickness of vitreous humor.

2. B-Scan:

The B scan method is used to obtain a two-dimensional view of parts of the body. The principle is the same as for the A-scan, except that, the transducer is moved. As a result, each echo produces a dot on the oscilloscope at an opposition corresponding to the location of the reflecting surface. B scan provides information about the internal structure of the body.

B-scan has been used:

1. in diagnostic studies of the eye, liver, breast, heart and fetus.
2. in detecting pregnancy as early as the fifth week.
3. in providing information about uterine anomalies.
4. in giving information on the size, location, and the change with time of a fetus.
5. in giving information about abnormal bleeding and threatened abortion of pregnancy.