Cardiac Auscultation Essays

The Stethoscope

Key Points

- Normal hearing is not attuned to audible heart sounds
- Ear piece fit can be improved by understanding the anatomy of the external auditory canal
- Nodding one's head exploringly to adjust ear piece alignment may improve heart sound audibility
- Tubing should be kept comfortably short and inspected for cracks and leaks
- Both a bell and a diaphragm are required to hear the full spectrum of heart sounds
- The amount of pressure exerted with the chest piece influences the audibility of heart sounds
- Ambient sound exerts a detrimental effect on audibility of heart sounds

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Hearing and Heart Sounds:

The human auditory system is not automatically attuned to the *intensity* (volume) and *frequency* (pitch) of the sounds emitted by the heart.

The *intensity* of cardiac sounds is lower than what the ear is accustomed to hearing.

A large component of the *frequencies* produced by heart vibrations resides below the threshold of human hearing. These vibrations may be more readily detectable by precordial palpation than by auscultation.

AUDIBILITY THRESHOLD (*) DECREASES AS FREQUENCY INCREASES

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      INTENSITY  |     *
        dB       |      *           Lower frequency
                 |       *          heart sounds must
                 |        *         be louder to be heard.
                 |         *
                 |          *
                 |
                 |             *
                 |
                 |                  *
                 |                      *    *    *
                 |
                 |     Inaudible Heart Sounds
                 |
                 |_________________________________________

                           20                    1000   Hz

                       GALLOPS       MURMURS
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Human hearing decreases with age. A child can hear from 20 to 20,000 Hz. Adults lose the ability to hear high frequencies to a greater degree than lower frequencies. Adult hearing ability ranges from 50 to 12,000 Hz. Verbal communication ranges from 200 to 8000 Hz. The best frequency discrimination of human hearing is between 1000 and 2000 Hz. Heart sounds begin below the audible threshold and do not reach 1000 Hz.

The intensity of cardiac sound decreases with increasing frequencies. Fortunately, the sensitivity of the human ear increases for these higher frequencies. If this was not the case, all one would ever hear during auscultation would be low frequency precor dial sounds reminiscent of distant thunder.

By the same token, low frequency heart sounds present audibility problems if they are faint. Decreasing the frequency of a sound in the 30 to 500 Hz range by half requires increasing the volume 5.6 times in order for audibility to remain the same. Higher volume is required for low frequencies to be heard.

Since the ear is working so closely to threshold levels, proper stethoscope choice, maintenance, and use are all extremely important.

Anatomy of the Ear Canal

The stethoscope ear piece usually rests in the apex of a funnel formed by the concha (the hollow bowl-like part of the external ear). The stethoscope ear piece aperture lies adjacent to the orifice of the external ear canal. At this point the concha is elliptical rather than round with marked individual differences in size and configuration. Orifice size ranges from 6 to 14 mm. The axis of the concha is usually directed anteriorly and superiorly, but there is considerable variation in the vertical and horizontal plane.

Ear Pieces:

Because of the above anatomy, the angle of direction of ear pieces is very important. A good stethoscope should allow easy adjustment of this angle to permit forward tilting to align with the external ear canal and to create a complete seal that excludes ambient noise. Carrying a stethoscope around by stuffing it into a lab coat pocket can easily change and misalign this critical angle. *A good habit to try to optimize this angle at the onset of auscultation consists of moving the head up and down in an exploratory manner while listening for improved audibility of heart sounds.*

Ear pieces should feel comfortable. The fit should be snug without causing discomfort when used for prolonged periods of time. An ear piece can be too large, allowing ambient noise to enter. It can also be too small, too soft, or applied with too great a pressure - making it rest too deeply in the concha with the earpiece aperture partly or even completely occluded by the anterior wall of the cartilaginous meatus. A common mistake is to choose ear pieces that are too small and enter too far. The ear canal should be occluded, not invaded. Larger, looser fitting ear pieces can be made more snug during auscultation, if needed, by *pressing the arms* of the stethoscope together with the free hand. Listening from the right side of the patient keeps the stethoscope in a relatively straight line from the ears to the chest. Ear pieces should be periodically inspected for cracks and for ear wax accumulation.

Tubing

Tubing should be kept comfortably short to better hear high frequency heart sound components. It should be long enough to allow a comfortable listening posture. This is determined to some degree by the listener's height, arm length, lower back ability and degree of personal willingness to lean over patients from the right side.

Separate tubes starting at the chest piece can lead to each ear. The tubing should be relatively unyielding rather than elastic. The bore of the tubing should be small measuring one eighth to three sixteenths of an inch in diameter.

Elastic, thin tubing walls with a large bore will *decrease* the amplitude of the audible heart sounds.

Tubing should be visually inspected for cracks. Leaks can be detected by blowing into one ear piece while the other is obstructed. The absence of leaks can also be confirmed by abruptly *breaking the seal* of the stethoscope bell with the skin during routine auscultation. Rapid removal of the bell should elicit a pressure sensation in t he ear.

Chest Pieces

Chest pieces have evolved with time. Laennec's original wooden stethoscope had no diaphragm. Bowles patented the diaphragm in 1894. Prior to that time, there were stethoscopes with diaphragms that were recessed to avoid contact with the skin. Bowles consi dered sound conveyed by such instruments to be transmitted from the edge of the bell to the membrane - similar to beating a drum on the edge of its frame.

Laennec's stethoscope was monophonic and monaural: sound was transmitted from a single point on the chest (monophonic) to one ear (monaural). The binaural stethoscope with two ear pieces was invented by Cammann in 1855. A composite binaural stethoscope in corporating both a bell and a diaphragm was introduced in 1926 by Sprague.

A binaural stereophonic (also known as differential or double) stethoscope with two chest pieces - one for each ear; is useful for comparing breath sounds in homologous pulmonary segments. It is not used in routine cardiac auscultation.

Modern stethoscopes are monophonic (one chest piece) and binaural (two ear piece head set). The chest piece has both a diaphragm and a bell, or a diaphragm with provision for a bell effect (by variable chest piece pressure) as discussed below.

Chest Piece Pressure.

The amount of pressure exerted with the chest piece during auscultation influences audibility of heart sounds.

There are cardiac stethoscopes that do not have a bell. The bell effect (accentuation of low frequency heart sounds) is created by light pressure on the stethoscope, enhancing low frequency sounds, such as gallops and rumbles. Firm pressure makes this typ e of stethoscope behave like it should with a diaphragm - favoring higher frequency heart sounds.

It is possible to evaluate and *practice* the bell effect in a normal patient by listening at the apex where the mitral component of the first heart sound is loudest. Light pressure with the bell (just creating an air seal) will make the normally l ow pitched first heart sound seem booming in comparison to the normally higher pitched second heart sound. Increasing the pressure will attenuate the first heart sound and the second heart may actually become louder than the first sound.

High-pitched murmurs such as those of aortic insufficiency and such as those of most cases of mitral insufficiency are better heard with the use of a diaphragm that filters out the low frequency components of other distracting heart sounds. Variable press ure on the diaphragm changes the spectrum of audible high frequency sound. The strain within the diaphragm determines the nature of the audible components in the same way that tightening a drum head alters the pitch of the drum. The amount of pressure ex erted with a diaphragm in order to hear a faint high frequency murmur may (and sometimes should) actually leave a visible imprint of the chest piece on the skin (a consequence of "adequately tightening" the diaphragm).

Ambient Noise

High ambient noise levels and intermittent loud sounds from speech or electronic equipment interfere significantly with auscultation. Faint sounds are masked by louder sounds. The loud sound does not even have to coincide with the faint sound. The ear sim ply tunes to the louder sound and ignores the fainter sound. Proper auscultation technique requires listening to one thing at a time. Faint sounds require concentration. They should be listened to (without loud distractors) for a period of time that will (hopefuly) progressively decrease with experience. This allows the ear to become attuned to the full intensity of that particular sound level. Sometimes it also helps to close one's eyes.

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