How to use a stethoscope

The stethoscope was invented by Rene Theophile Hyacinthe Laennec in 1816 and has become the symbol by which the modern physician is recognised. He chose the name from the Greek words for chest, stethos, and to inspect, skopeein. Direct auscultation placing the ear on the chest wall had been known from ancient times but was little used. In Laennec's words: "Direct auscultation was as uncomfortable for the doctor as it was for the patient, disgust in itself making it impracticable in hospitals. It was hardly suitable where most women were concerned and, with some, the very size of their breasts was an obstacle to the employment of this method."

His two volume masterpiece, De l'Auscultation Mediate, was published in 1819 for 13 francs (£1.70) and accompanied by a wooden stethoscope for 2.50 francs. The book contained the accumulation of his vast clinical experience in which he correlated the physical findings of lung and heart disease with necropsy findings. Much of the nomenclature of auscultation can be ascribed to Laennec. He described the two varieties of normal breath sounds (vesicular and bronchial) and various bruits etrangers (adventitious sounds). He used the term rale (or rattle), but because he thought the resemblance to le rale de la mort (the death rattle) might frighten patients, he used the latin term ronchus when speaking at their bedside. Although Laennec's classification of heart sounds was not as complete as for lung sounds, he described the first and second heart sounds, cardiac irregularities caused by ectopic beats, and bruits (murmurs) resulting from valvular disease.

The stethoscope

The original stethoscope, a rigid wooden cylinder with a funnel, has evolved into the modern instrument which has two chest pieces, a shallow bell and a stiff diaphragm, connected to the ear pieces by 25-30 cm of tubing. You should perform auscultation after the traditional examination sequence of inspection, palpation, and percussion. The patient should be lying comfortably in a quiet environment-clinical signs may occasionally be missed in a noisy casualty department. It is helpful to be aware of the findings expected in health and disease before approaching the patient with a stethoscope. This avoids spending many hours listening without hearing.
The bell or the diaphragm?

High frequency sounds or murmurs (for example, splitting of sounds, opening snaps, aortic diastolic murmurs) are easier to hear with the diaphragm. The bell, which should be applied lightly to the chest, transmits low frequency sounds more effectively—for example, diastolic murmur of mitral stenosis and third and fourth heart sounds. For routine examination of the heart you should use both the bell and diaphragm. The diaphragm is usually adequate for examination of the chest and abdomen.

Measurement of blood pressure

The patient should be sitting or lying comfortably. Wrap an occlusion cuff connected to a sphygmomanometer around the upper arm and inflate it to a pressure about 30 mm Hg above the level at which the radial pulsation can no longer be felt. Place the stethoscope lightly over the brachial artery—it helps to feel for this artery before inflating the cuff. Next lower the pressure until you hear the first sounds (phase I Korotkoff). This is the systolic blood pressure. You should then lower the cuff pressure continuously until the sounds become faint or muffled (phase IV) and subsequently disappear completely (phase V). The phase V reading is usually taken as the diastolic pressure, but the true pressure probably lies between phases IV and V. Blood pressure should be recorded as rapidly as accuracy allows because compression of the arm can itself cause a rise in blood pressure.

In patients with severe aortic regurgitation, when the disappearance point may be extremely low or even 0 mm Hg, the Korotkoff IV reading is closer to the true diastolic pressure. If you find a large difference between phase IV and V pressures both readings should be recorded. Occasionally a gap may occur between the first appearance of the Korotkoff sounds and their reappearance at a lower pressure. This auscultatory gap, if not appreciated, may cause you to overestimate the diastolic pressure or underestimate systolic pressure.

The average adult cuff measures 12 cm, but if the patient has very fat arms a wider cuff such as a thigh cuff should be used to avoid false readings. It is important that the patient should be as relaxed as possible when the blood pressure is taken. Readings can be significantly altered by anxiety, exertion, postural changes, or the "white coat" effect. The first reading is often high due to anxiety, which may be indicated by a high pulse rate. The second reading is usually more representative. Patients should not be regarded as having hypertension on the basis of a single measurement unless the blood pressure is very high. You should normally have evidence of raised blood pressure on at least three occasions several weeks apart to confirm hypertension.

Auscultation of the heart

It is useful to have a routine for auscultation of the heart which you can follow at every examination. Tell the patient what you are doing and warm up the stethoscope before placing it on the patient's chest. Traditionally, the precordium is divided up into four
areas where the sounds or murmurs from each valve can be heard. These are the mitral area (apex beat), tricuspid area (left sternal edge, fourth intercostal space), pulmonary area (second intercostal space to left of Sternum) and aortic area (second intercostal space to right of sternum). However, the sounds related to these valves are not always loudest at their respective areas and auscultation should not be limited to these sites alone.

Begin your examination at the apex beat, where the first heart sound is usually loudest, and move up the left sternal edge ending with the aortic area and carotid arteries. The diaphragm and bell should be used alternately during the examination. You should repeat the examination with the patient leaning to the left side (mitral sounds and murmurs louder) and sat forward (aortic and tricuspid murmurs louder). Inspiration increases right heart flow and accentuates right heart sounds and murmurs. During expiration there is increased flow to the left heart which increases left heart murmurs.

HEART SOUNDS

<table>
<thead>
<tr>
<th>Table 1 - The heart sounds. Valve sounds are heard best with the diaphragm and ventricular sounds with the bell</th>
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</thead>
<tbody>
<tr>
<td><strong>Sound</strong></td>
</tr>
<tr>
<td><strong>Valve:</strong></td>
</tr>
<tr>
<td>1st Sound</td>
</tr>
<tr>
<td>2nd Sound</td>
</tr>
<tr>
<td>Ejection sounds*</td>
</tr>
<tr>
<td>Opening snaps*</td>
</tr>
<tr>
<td><strong>Ventricular:</strong></td>
</tr>
<tr>
<td>3rd Sound(*)</td>
</tr>
<tr>
<td>4th Sound*</td>
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</tbody>
</table>

* Not normally audible.

You need to know about the cardiac cycle to understand the events that make up the heart sounds (table 1). The first heart sound is easiest to hear with the diaphragm medial to the
apex at the lower sternal border. It is often accentuated in mitral stenosis, short P-R
tachycardias, left atrial myxoma, and mitral valve prolapse. It may be diminished in P-R
prolongation, calcification of the mitral valve, severe left ventricular failure, left bundle
branch block, and mitral regurgitation. The mitral valve closes slightly before the
tricuspid valve but the interval is short and difficult to detect.

The second heart sound is heard best in the second right and left intercostal space along
the sternal borders. The aortic (A₂) and pulmonary (P₂) sounds are more widely separated
and you can hear the split. A₂ occurs first and is audible in all areas whereas P₂ is usually
heard in the pulmonary area and just below. The split is widest during inspiration, when
increased venous return to the heart prolongs right ventricular systole and closure of P₂ is
delayed. Exaggerated splitting of the second sound may occur in right ventricular outflow
tract obstruction (for example, pulmonary stenosis) and right bundle branch block. Fixed
splitting of the second sound is pathognomonic of atrial septal defect. The second sound
(P₂) may be loud in pulmonary hypertension. In left ventricular outflow tract obstruction
(for example, hypertrophic obstructive cardiomyopathy and aortic stenosis), the closure
of A₂ may be delayed so that reversed splitting of the second sound occurs.

The third sound may be normal in healthy young adults but its presence in older patients
is often a sign of impaired left ventricular function. This gives rise to a gallop or triple
rhythm with a tachycardia. The fourth sound is heard only in sinus rhythm when a
hypertrophied left atrium pumps blood into a stiffened left ventricle.

You may hear a high pitched opening snap in patients with mitral stenosis when the valve
is still mobile but the sound disappears in patients with a stiff and calcified valve. The
interval between the second heart sound and opening snap shortens in severe mitral
stenosis. Aortic ejection clicks, also high pitched, usually occur with bicuspid aortic
valves or congenital aortic stenosis and are due to opening of abnormal cusps. Mid-
systolic clicks may occur in mitral valve prolapse and occasionally with a small
pneumothorax.

MURMURS

FIG 1 - Murmurs of aortic and mitral valve lesions
Murmurs arise from turbulent blood flow and are characterised by their timing, quality, and intensity. Systolic murmurs can occur with physiological increases in blood flow—for example, in pregnancy—but diastolic murmurs are almost invariably due to disease. Intensity is graded from 1 (just audible) to 6 (audible without a stethoscope). Figure 1 shows the murmurs associated with the common valve lesions. Pulmonary and tricuspid murmurs have a similar quality to aortic and mitral murmurs respectively.

Ventricular septal defects typically produce a rough pansystolic murmur at the left sternal edge. Small defects are often associated with loud murmurs (maladie de Roger). An atrial septal defect may produce a pulmonary ejection systolic murmur and characteristic fixed splitting of the second sound. Mitral valve prolapse is often accompanied by a mid-systolic click and a pansystolic murmur if mitral regurgitation is present. Continuous murmurs throughout systole and diastole are characteristic of arteriovenous fistulas. They should not be confused with a pericardial rub, which is also heard in systole and diastole and occurs in acute pericarditis. This sound may be accentuated by leaning the patient forward.

**Respiratory system**

**BREATH SOUNDS**

![Diagram of vesicular and bronchial breath sounds]

Normal breath sounds are termed vesicular and have a rustling quality. The sounds arise from the turbulent airflow of the trachea and proximal bronchi and are transmitted through the chest, with high frequencies being filtered out by aerated alveoli. The expiration phase is quieter and shorter than inspiration and the phases are continuous. In bronchial breathing you hear sounds of higher pitch (because there is no filtering by the alveoli), inspiration is separated from expiration by a gap, and the two phases are of equal length and intensity (table 2).

**TABLE 2 - Diagrammatic representation of vesicular and bronchial breath sounds**

<table>
<thead>
<tr>
<th>Valve</th>
<th>Lesion</th>
<th>Murmur</th>
<th>Quality</th>
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</thead>
<tbody>
<tr>
<td>Aortic</td>
<td>Stenosis</td>
<td>Ejection systolic</td>
<td>Like cry of a seagull</td>
</tr>
</tbody>
</table>
Aortic Regurgitation Early diastolic Blowing murmur Sometimes associated with Austin Flint murmur (apical presystolic)

Mitrail Stenosis Mid-diastolic Low pitched rumbling

Mitrail Regurgitation Pansystolic

Breath sounds may be reduced bilaterally in patients with obesity, hyperinflation, or hypoventilation. Localised reduction may occur with bronchial occlusion or when air (pneumothorax) or fluid (effusion) is present in the pleural cavity. Bronchial breathing occurs when the normal alveolar filtering mechanism is abolished, most commonly by consolidation in the lungs. Occasionally you can hear bronchial breathing over the top of a pleural effusion. Normally, when speech is transmitted through the lungs to the stethoscope, high frequencies are filtered and words are unintelligible. However, when the alveolar filter is lost as in consolidation, speech ("ninety nine") becomes clear (bronchophony) and whispered sounds can be detected by the stethoscope (whispering pectoriloquy). Aegophony is a term for the high pitched nasal bleating quality of speech heard over the top of a pleural effusion where low frequency sounds are dispersed. Table 3 summarises the changes in breath and voice sounds heard in five common lung conditions.

<table>
<thead>
<tr>
<th></th>
<th>Consolidation</th>
<th>Pneumothorax</th>
<th>Pleural effusion</th>
<th>Collapse</th>
<th>Pulmonary fibrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breath sounds</td>
<td>Bronchial</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Decreased or absent</td>
<td>Decreased</td>
</tr>
<tr>
<td>Voice sounds</td>
<td>Bronchophony</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td></td>
<td>Whispering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ADDED (ADVENTITIOUS SOUNDS)**

The terminology of added lung sounds found in older textbooks has now been simplified to crackles (old terms: rale, crepitation) and wheezes (old term: ronchus). Crackles are brief, explosive sounds thought to arise either from bubbling of air through airway secretions or explosive reopening of airways. Coarse inspiratory and expiratory crackles that may clear on coughing are a feature of bronchiectasis. Fine mid to late inspiratory crackles are a feature of interstitial fibrosis and pulmonary oedema. Early inspiratory crackles may sometimes be heard in chronic bronchitis and emphysema.
Wheeze arise from the oscillations of narrowed airways and their adjacent tissues. Widespread polyphonic expiratory wheezes are a feature of asthma and airway obstruction in chronic bronchitis and emphysema. A fixed monophonic wheeze may result from localised narrowing of an airway most commonly due to a carcinoma. A fixed inspiratory wheeze is termed stridor and is caused by obstruction of the upper airways. Occasionally sequential inspiratory wheezes or squawks may be heard in patients with pulmonary fibrosis.

Pleural rubs are caused by friction between two inflamed pleural surfaces and vary in quality from a creak to a musical note. They tend to recur at the same point in the respiratory cycle.

**Gastrointestinal system**

Normal bowel sounds are low pitched gurgles that occur every 5-10 seconds. If there is no peristalsis, as in a paralytic ileus, bowel sounds are absent. When peristalsis is increased, the volume and frequency of sounds increases, and if the bowel is also distended by mechanical obstruction the sounds may become high pitched or tinkling. Arterial bruits may be audible over stenosed renal or mesenteric arteries or over a hepatoma.

**Summary**

Practice and application are necessary to become proficient at auscultation. However, a good quality stethoscope is important. The thin tubed variety found on most wards is adequate for measurement of blood pressure but is not recommended for clinical examination. If you are going to buy one choose a good quality stethoscope such as a Littman. I would advise you to put a name tag on your stethoscope as they are easily lost on the wards.

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