Heart auscultation (Types of heart sounds and murmurs)

What is heart auscultation?

Auscultation of the heart is not synonymous with examination of the heart. That is not to diminish the importance or difficulty of acquiring the necessary skills.

Examination of the heart starts with general inspection for cyanosis, dyspnoea, oedema or cachexia. It is followed by assessment of jugular venous pressure (JVP), examining the pulse and checking blood pressure. This includes checking the fingers for clubbing or splinter haemorrhages. Only then is it time to move to the chest and even then it is still not yet time to produce the stethoscope.

The interpretation of heart murmurs in children can be especially difficult and it is discussed elsewhere in the separate Heart Murmurs in Children article.

Mechanism of heart sounds

Heart sounds (normal or pathological) are caused by turbulent blood flow. They include the sound of the closing heart valves. Laminar flow is silent. Turbulent flow makes a sound. A thrill is turbulence or a murmur that is so marked that it is palpable.

Inspection and palpation

Look at the chest.

- Note whether there is asymmetry.
- Pectus excavatum can cause a flow murmur in the absence of cardiac disease.

- A tapping apex beat may be apparent on inspection as may a parasternal heave from right ventricular hypertrophy.

Feel for the apex and note its character and position.

- The normal position is at or near the 5th intercostal space in the mid-clavicular line.
- If the apex is not readily palpable, feel further around laterally and lower. In cardiomegaly it can be quite markedly displaced.
- It is less easy to feel in the obese or with a hyperinflated chest as in emphysema. If it is not palpable, try the right-hand side in case of dextrocardia but this is rare.
- Place the palm of the hand to the left of the sternum. Note whether there is a parasternal heave or whether any thrill can be felt.

Sites for heart auscultation

The bell of the stethoscope is better for detecting lower-frequency sounds whilst the diaphragm is better for higher frequencies. The bell is usually used to listen to the mitral valve and the diaphragm at all other sites. Heart auscultation is usually performed with the patient sitting up or reclined at about 45°. Where variations are required, they will be described.

Mitral area

- At the apex beat, as the left ventricle is closest to the thoracic cage.

Tricuspid area

- Lower left sternal edge is the point closest to the valve in which heart auscultation is possible.

Pulmonary area

- Left second intercostal space close to the sternum is where the infundibulum is closest to the thoracic cage.

Aortic area

- Right second intercostal space close to the sternum is where the ascending aorta is nearest to the thoracic cage.

The best place to hear the heart valves is not necessarily directly over the anatomical site.

Heart sounds

The intensity of heart sounds and murmurs is graded as follows on Levine's scale:

- I - lowest intensity: difficult to hear even by experts.
- II - low intensity: however, usually audible to all listeners.
- III - medium intensity: easy to hear even by inexperienced listeners, but without a palpable thrill.
- IV - medium intensity: with a palpable thrill.
- V - loud intensity: with a palpable thrill. Audible even with the stethoscope placed on the chest, with the edge of the diaphragm.
- VI - loudest intensity: with a palpable thrill. Audible even with the stethoscope raised above the chest.

Listen first for the heart sounds. They are called S1 and S2 and are traditionally described as 'lub' and 'dub' respectively. The first sound (S1) is caused by closure of the mitral and tricuspid valves and the two sounds tend to merge as one. When considered separately, the closure of the mitral and tricuspid valves is called M1 and T1 respectively. The second sound (S2) is caused by closure of the aortic and pulmonary valves. They are slightly apart with the aortic component, also called A2, slightly after the pulmonary closure called P2.

- The first sound may be split if there is pacing that triggers the right ventricle before the left or if mitral valve closure is delayed by high left atrial pressure or atrial myxoma.
- The sounds may be softer than normal where there is severe mitral regurgitation, immobility from calcification, severe aortic regurgitation or left bundle branch block.

- Prolapsed mitral valve or significant mitral stenosis may cause a loud M1.
- Normally A2 and P2 are so close that they are heard as a single sound, although they may split slightly on deep inspiration as P2 is delayed. Some people have significant splitting on lying down but it disappears on sitting up. This is a normal variation.
- Beat to beat variation in the intensity of S2 occurs with complete or incomplete heart block if there is A-V dissociation.
- P2 is delayed and will accentuate splitting in pulmonary hypertension, pulmonary stenosis and right bundle branch block.
- Ectopic beats and pacing will delay A2 and cause 'reverse splitting' of the sound.

Additional heart sounds

The differentiation of 3rd sounds, 4th sounds, opening snaps and widely split S1 or S2 can be daunting.

- A 3rd sound occurs in heart failure and produces a cadence like a galloping horse[1] . Hence the term 'gallop rhythm'. An innocent 3rd sound can occur in children and young adults but never over 30 years old.
- A 4th sound occurs just before the 1st and is an abnormal sound of the A-V valves opening as the atria contract. Therefore it cannot occur in atrial fibrillation. It occurs with ventricular hypertrophy, coronary heart disease, dilated cardiomyopathy, hyperdynamic circulation, arrhythmia and heart block.
- The timing of an opening snap in mitral stenosis is similar. It is usually of rheumatic origin. Again atrial systole is essential and so it cannot occur in atrial fibrillation.
- An atrial myxoma can 'plop' during atrial systole and cause a late diastolic sound.

Heart murmurs

Note the timing of murmurs. Establish whether systolic or diastolic. First listen to the *lub dub* and then get the timing. Some murmurs may obscure the heard sounds. Systolic murmurs can be innocent but are rarely so unless the patient is a child or pregnant [2] . Diastolic murmurs are always pathological.

Mitral murmurs

- Mitral murmurs are best heard at the apex and radiate to the axilla.
- Mitral sounds can be accentuated with the patient in the left lateral position.
- Hence, to listen to a mitral murmur, first listen to the apex, then listen round to the mid-axillary line at the same level. Return the bell to the apex and, keeping it there, ask the patient to lie on the left side.
- Note the timing of any murmur. Mitral regurgitation produces a pansystolic murmur of roughly even intensity throughout systole.
- Mitral stenosis produces a diastolic murmur described as presystolic. As soon as the murmur finishes, the first sound is heard.
- Mitral valve prolapse produces a mid-systolic click.
- Austin Flint's murmur may occur in aortic regurgitation. This is a soft, rumbling, low-pitched, late diastolic murmur which is heard best at the apex. It is thought to be due to a functional mitral valve stenosis, as the backflow of blood from the aorta presses on the anterior leaflet of the mitral valve, slightly occluding the flow from the atria. The atrial kick just before systole accentuates this flow, to produce Austin Flint's murmur.

Tricuspid murmurs

- Tricuspid murmurs are uncommon. The timing is as for mitral murmurs but they are best heard at the lower left sternal edge.
- Tricuspid stenosis is very rare. Regurgitation may occur in right ventricular hypertrophy and dilated cardiomyopathy. It will produce a marked wave on the JVP.

- Tricuspid regurgitation will not radiate to the axilla.

Pulmonary and aortic murmurs

The pulmonary and aortic valves are both best heard in the 2nd intercostal space, to the left and right respectively. This can make differentiation quite difficult. Sound from the aortic valve is often transmitted to the carotid and can be heard by placing a stethoscope over the carotid bifurcation.

- Pulmonary stenosis will produce a flow murmur that gets louder then softer (crescendo-decrescendo) during systole. Pulmonary ejection sounds, unlike aortic ones, tend to diminish or disappear in inspiration.
- A similar sound occurs with aortic stenosis but it is transmitted to the carotids.
- Aortic sclerosis occurs in the elderly and produces a murmur similar to aortic stenosis but it is poorly transmitted or not transmitted to the carotids. It is transmitted to the apex and the mid-axillary line [3] .
- In aortic stenosis, A2 is soft. In aortic sclerosis, A2 is normal or loud. Systolic murmurs in the elderly are quite common. They indicate cardiac disease and are associated with increased cardiac mortality [4] .
- Pulmonary regurgitation or aortic regurgitation produces an early diastolic murmur, as this is when the arterial pressure is at its height. An aortic murmur of regurgitation is best heard using the diaphragm of the stethoscope with the patient sitting forward in full expiration. Ask the patient to sit forward, and put the stethoscope in place. Say, 'Take a big breath in - breathe right out - and hold it'. This will give a few seconds to listen for the murmur. Few people can hold their breath in full expiration for more than a few seconds, especially if unfit.
- Not all murmurs arise from heart valves. Some are flow murmurs where rapid flow during ejection causes turbulence, especially at the pulmonary or aortic outlet. This occurs in a hyperdynamic state as in anaemia, severe thyrotoxicosis or possibly with fever. It may also occur in pregnancy but it is essential to exclude cardiac disease. The flow murmur of atrial septal defect is described below.

Septal defects

- Atrial septal defect with a significant left to right shunt will produce a pulmonary flow murmur. The murmur does not originate from the atria and, unless there is a significant shunt, there may be no murmur.
- Ventricular septal defect produces a harsh systolic murmur, heard best along the left sternal edge. It may be necessary to auscultate all along the line to find it if it is small. There is little correlation between the size of ventricular septal defect and the intensity of the murmur. Maladie de Roger can be very loud and a massive defect quiet. It may be part of a more complex syndrome such as Fallot's tetralogy.

Other heart murmurs

- Dilatation of the root of the pulmonary artery or aorta will cause a flow murmur. Aortic aneurysm due to syphilis or Marfan's syndrome are examples. These sounds are not transmitted well to the carotids, nor are they well heard at the apex.
- A patent ductus arteriosus causes a late systolic murmur into diastole. It is best heard across the back. There may also be a continuous *machinery murmur* or a *to and fro* murmur in both systole and diastole, but louder in systole. It often obliterates the second heart sound.
- Pericarditis causes a sound like boots tramping through snow and is best heard at the left sternal edge.
- Infective endocarditis can be difficult to diagnose but carries a high mortality and a change in the murmur may be an important feature.
- Prosthetic valves, such as the Starr-Edwards or modern variations, produce a very loud sound that can often be heard across a quiet room, without a stethoscope.

Heart murmurs in children

- Turbulence in the great veins can cause an innocent venous hum in very small children.

- Heart murmurs in children are often innocent systolic flow murmurs and are common in children aged 3 to 8. They are grade III intensity or less and there is no abnormal physiology such as impaired exercise tolerance. They tend to change in nature with changes in posture and can vary from examination to examination.

Differential diagnosis

The following is a very simple approach to the differentiation of some of the more common and simpler problems of identifying murmurs on heart auscultation:

- Aortic stenosis, aortic sclerosis and pulmonary stenosis (including effective pulmonary stenosis as with an atrial septal defect or hyperdynamic circulation) all produce a crescendo-decrescendo systolic murmur. Aortic stenosis is transmitted well to the carotids. Aortic sclerosis almost never occurs before 50 years of age and the patient is usually much older. It may be transmitted to the apex and axillary line. Pulmonary stenosis should not produce such a flat pulse wave as the others and the murmur may reduce on inspiration.
- Mitral regurgitation starts at the beginning of systole and is a harsh sound of almost constant amplitude, best heard at the apex and transmitted to the axilla.
- Aortic regurgitation is early diastolic and best heard at the aortic area with the patient sitting forward in expiration. It is only if regurgitation is severe that a collapsing pulse and low diastolic blood pressure will be found. Mitral stenosis is becoming rarer these days. It is late diastolic and best heard in the mitral area.
- An innocent murmur in pregnancy is only systolic. It is a typical crescendo-decrescendo murmur that may be transmitted to the carotids. It may change with posture. There is a bounding pulse. There is no cardiac history including any shortness of breath on exertion. If in doubt, echocardiography provides a safe and reliable diagnosis.

Referral[5]

The National Institute for Health and Care Excellence (NICE) recommends referral for any adult with a heart murmur as follows:

Referral for echocardiography

Consider an echocardiogram for adults with a murmur and no other signs or symptoms if valve disease is suspected based on:

- The nature of the murmur.
- Family history.
- Age (especially if over 75).
- Medical history - eg, a history of atrial fibrillation.

Offer an echocardiogram to adults with a murmur if valve disease is suspected (based on the nature of the murmur, family history, age or medical history) and they have:

- Signs (such as peripheral oedema) or symptoms (such as angina or breathlessness) or an abnormal ECG.
- An ejection systolic murmur with a reduced second heart sound but no other signs or symptoms.

Referral for urgent specialist assessment or urgent echocardiography

If valve disease is suspected (based on the nature of the murmur, family history, age or medical history):

- Offer urgent (within two weeks) specialist assessment that includes echocardiogram or if not available an urgent echocardiogram alone to adults with a systolic murmur and exertional syncope.
- Consider urgent (within two weeks) specialist assessment that includes echocardiogram for adults with a murmur and severe symptoms (angina or breathlessness on minimal exertion or at rest) thought to be related to valvular heart disease.

For guidance on referral and assessment for adults with murmur and non-exertional syncope, follow the recommendations in the NICE guideline on transient loss of consciousness ('blackouts') in over-16s.

For guidance on referral and assessment for adults with breathlessness but no murmur, follow the recommendations in the NICE guideline on chronic heart failure in adults.

Referral to a specialist after echocardiography

Mild valve disease is common and rarely progresses to become clinically significant. Offer referral to a specialist to:

- Adults with moderate or severe valve disease of any type.
- Adults with bicuspid aortic valve disease of any severity (including mild valve disease).

For pregnant women and women considering pregnancy

- Most women with valve disease can have a pregnancy without complications.
- Offer advice on the implications of treatment choices on any future pregnancy to women who need heart valve intervention.
- Offer advice on family planning to women with severe valve disease, particularly aortic and mitral stenosis.
- Refer pregnant women or women who are considering a pregnancy to a cardiologist with expertise in the care of pregnant women, if they have any of the following:
    - Moderate or severe valve disease.
    - Bicuspid aortic valve disease of any severity (including mild disease) and associated aortopathy.
    - A prosthetic valve. Refer whether they have symptoms or not.
- Consider seeking specialist advice on the choice of replacement valve if heart valve replacement surgery is being considered for women of childbearing potential.

Conclusion

In these days of ready access to echocardiography and even cardiac catheterisation, it is easy to forget the simple techniques of heart auscultation. Rheumatic heart disease is becoming rare these days and surgery corrects very many congenital cardiac defects, leaving no murmurs. Nevertheless the ability to use the traditional methods in the surgery is cheap, effective and very satisfying. Not all systolic murmurs need assessment by echocardiography [6] . Listening to recordings of heart sounds can be a very effective way to learn to recognise them [7] . The ability to recognise sounds is said to be low but can be improved with training [8] .

Further reading

- Easy Auscultation

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