Cardiac Physical Diagnosis: A Proctor Harvey Approach

By
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Cardiac Physical Diagnosis

- The great majority of diagnosis of cardiovascular disease can be made at the office or the bedside.
- Usually you do not need sophisticated, elegant laboratory equipment.

Cardiac Physical Diagnosis

- The complete cardiovascular examination consists of the 5 finger method:
- history
- physical exam
- ECG
- chest x-ray
- simple laboratory tests.
- History is generally the most important.

Cardiac Physical Diagnosis

- Pulsus alternans: A pulse that alternates amplitude with each beat. (i.e. STRONG, weak, STRONG, weak)
- You may miss it if you palpate with very firm pressure; use light pressure like a blow of breath on our fingers.

Cardiac Physical Diagnosis

- The Harvey method is:
- 1. Inspection, take time to look closely
- 2. Start at the left lower sternal border for an overview. Listen to the first sound, then the second sound, then sounds in systole, murmurs in systole, and sounds in diastole and murmurs in diastole.

Characteristics of Precordial Motion in Various Cardiac Abnormalities*

Aortic regurgitation

- Apex impulse hyperdynamic in mild to moderate AR
- Severe AR: LV dilatation results in sustained impulse that is displaced laterally and downward (especially in chronic AR)
- Systolic retraction medial to PMI
- Palpable a wave may be present

Mitral regurgitation

- Apical systolic thrill in severe MR
- Apex impulse hyperdynamic
- Severe and/or chronic MR: apex is displaced laterally, sustained with amplitude
- Can have late parasternal impulse with severe MR without pulmonary hypertension
- Parasternal (RV) heave if significant pulmonary hypertension
- S3 visible and palpable if severe MR
- S4 palpable with acute onset MR

Congestive cardiomyopathy

- Sustained and displaced LV impulse, usually felt over 2 interspaces
- Palpable a wave (S4) and S3 common
- Parasternal lift, midsystolic bulge common

Coronary artery disease

- Usually normal at rest unless prior MI
- Palpable S4 in left decubitus position
- Ectopic LV thrust if dyssynergy or LV aneurysm. May have transient abnormalities (eg, bulge, heave) during acute infarction or attack of angina

Hypertrophic cardiomyopathy

- Systolic thrill superior, medial to apex impulse
- Vigorous LV apical impulse, often sustained
- Large palpable a wave, especially in left decubitus position
- Occasional mid- or late systolic bulge—"tripple ripple"

Atrial septal defect

- Hyperdynamic parasternal impulse
- PA impulse may be present
- RV impulse may be sustained if pulmonary hypertension is present and occasionally with large left to right shunt without elevated PA pressure

Mitral stenosis

- Small or impalpable apex impulse but S1 typically palpable
- Opening snap palpable medial to apex
- Apical diastolic thrill in left decubitus position
- Parasternal lift is common, suggests pulmonary hypertension at rest or with effort

Valvular aortic stenosis

- Systolic thrill—aortic area, 2 LICS. Or occasionally at apex
- Sustained and forceful LV apical impulse
- Little lateral (leftward) displacement of apex unless LV dilatation has occurred
- Palpable a wave (S4) is common and indicates severe aortic obstruction

AR = aortic regurgitation; LV = left ventricular; PA = pulmonary artery; RV = right ventricular; MI = myocardial infarction; MR = mitral regurgitation; LICS = left intercostal space

*Adapted from Abrams, J. Examination of the precordium. Primary Cardiol 1982; 8:156.

Cardiac Physical Diagnosis

- S3 gallop is heard better and louder with the patient:
- in the left lateral decubitus position
- after palpating the PMI, keeping your finger on the location of the PMI and placing the bell of the stethoscope over the PMI
- The gallop may alternate in intensity with every other beat and pressure on the scope can eliminate the gallop.

Table 10-9: Hemodynamic Determinants of the S_3

Ability of the ventricle to accept flow during the rapid phase of diastolic filling
Rate of relaxation of the ventricle
End-systolic or residual volume of the ventricle
Compliance of the relaxed ventricle
Nonobstructed atrioventricular valve
Atrial pressure head
Atrial blood volume
Atrial compliance
Dynamic impact of the heart with the chest wall
Architecture of the thorax
Cardiac size
Cardiac motion within the thorax
Phase of respiration
Position of the patient

SOURCE: From Shaver JA, et al. Early diastolic events associated with the physiologic and pathologic S_3. *Am J Cardiol* 1984; 14(suppl 5):45. Reproduced with permission from the publisher and authors.

Table 10-10: Third Heart Sound (S_3), Ventricular Diastolic Gallop, Protodiastolic Gallop, and Pericardial Knock

Physiologic S_3-children and young adults
Decreased prevalence with increasing age
Pathologic S_3
Ventricular dysfunction-poor systolic function, increased end-diastolic and end-systolic volume, decreased ejection fraction, and high filling pressures
Idiopathic dilated cardiomyopathy
Ischemic heart disease
Valvular heart disease
Congenital heart disease
Systemic and pulmonary hypertension
Excessively rapid early diastolic ventricular filling
Hyperkinetic states
Anemia
Thyrotoxicosis
Arteriovenous fistula
Atrioventricular valve incompetence
Left-to-right shunts
Restrictive myocardial or pericardial disease
Constrictive pericarditis (pericardial knock)
Restrictive cardiomyopathy
Hypertrophic cardiomyopathy?

Cardiac Physical Diagnosis

- PEARL: S3 or S4 may be missed in an emphysematous chest with an increase in AP diameter secondary to COPD, if you listen at the usual space, LLSB or apex.
- If you listen over the xyphoid or epigastric area, it may easily detected.

Cardiac Physical Diagnosis

- Gallops are diastolic filling sounds S3 and S4.
- The best position to hear gallops, as they may only be heard in the left lateral decubitus position, over the PMI with the bell barely making a seal with the chest wall.
- Firm pressure diminishes or eliminates S3 or S4.

Table 10-11: Fourth Heart Sound (S_4), Atrial Diastolic Gallop, and Presystolic Gallop

ysiologic-recordable rarely audible
athologic
Decreased ventricular compliance
Ventricular hypertrophy
Left or right ventricular outflow obstruction
Systemic or pulmonary hypertension
Hypertrophic cardiomyopathy
Ischemic heart disease
Angina pectoris
Acute myocardial infarction
Old myocardial infarction
Ventricular aneurysm
Idiopathic dilated cardiomyopathy
Excessively rapid late diastolic filling secondary to
Vigorous atrial systole
Hyperkinetic states
Anemia
Thyrotoxicosis
Arteriovenous fistula
Acute atrioventricular valve incompetence
Arrhythmias
Heart block

Cardiac Physical Diagnosis

- How to differentiate between an S4, a split S1, and an ejection sound:
- S4 is eliminated with pressure on the stethoscope
- Pressure does NOT eliminate ejection sounds or a split S1
- S4 is usually NOT heard over the aortic area
- Aortic ejection sound IS heard over the aortic area

Cardiac Physical Diagnosis

- A S4 is frequently found in patients with coronary artery disease.
- Harvey says: "If an S4 isn't found in a patient with a previous history of MI, one might wonder if such a diagnosis was correct."

Cardiac Physical Diagnosis

- S4 is a common finding in patients with HTN.
- Harvey personal approach; "If the S4 is present and the blood pressure is 140/90 or greater, medication is indicated for HTN, because the presence of the S4 already means that the heart has been affected."

S3 Gallop

- S3 is not a loud sound. Most of them are faint.
- Most S3's are heard every 3rd or 4th beat rather than with every beat. On the other hand, S4 is more likely to be heard with almost every beat.
- S4 disappears with atrial fibrillation. S3 persists with atrial fibrillation.

S3 Gallop

- Some instructors have used the words "Tennessee" and "Kentucky".
- Ten-nes-see = S4. Ken-tuck-y = S3.
- These are often confusing and are discouraged.

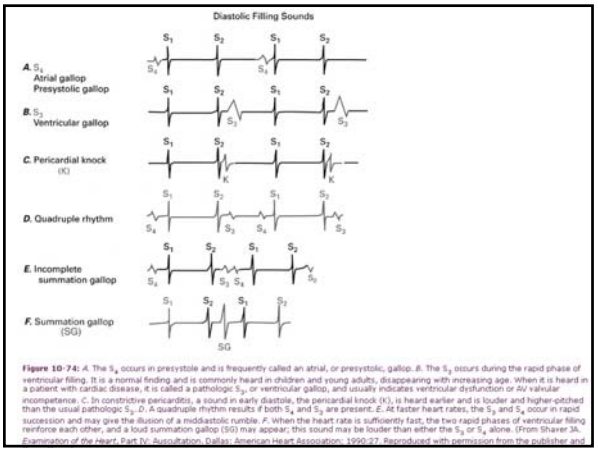


Figure 10-74: *A.* The S_4 occurs in presystole and is frequently called an atrial, or presystolic, gallop. *B.* The S_3 occurs during the rapid phase of ventricular filling. It is a normal finding and is commonly heard in children and young adults, disappearing with increasing age. When it is heard in a patient with cardiac disease, it is called a pathologic S_3, or ventricular gallop, and usually indicates ventricular dysfunction or AV valvular incompetence. *C.* In constrictive pericarditis, a sound in early diastole, the pericardial knock (K), is heard earlier and is louder and higher-pitched than the usual pathologic S_3. *D.* A quadruple rhythm results if both S_4 and S_3 are present. *E.* At faster heart rates, the S_3 and S_4 occur in rapid succession and may give the illusion of a middiastolic rumble. *F.* When the heart rate is sufficiently fast, the two rapid phases of ventricular filling reinforce each other, and a loud summation gallop (SG) may appear; this sound may be louder than either the S_3 or S_4 alone. (From Shaver JA. *Examination of the Heart*. Part IV: Auscultation. Dallas: American Heart Association; 1990:27. Reproduced with permission from the publisher and

Congestive Heart Failure

- The earliest, most subtle signs and findings of cardiac decompensation are:
- Pulsus alternans
- S3

Hydrothorax

- It accompanies CHF and may be bilateral. More commonly presents in the right thorax. Why?
- Gravity
- Patients are more likely to sleep on their right side. Patients with large hearts and arrhythmias such as a fib are conscious of the heart action while lying on the left, therefore they prefer to sleep on their right side.

Hydrothorax

- PEARL: When a left hydrothorax is present in a patient with heart disease, rule out the possibility of an etiology other than heart failure.

Congestive Heart Failure

- Cheyne-Stokes respirations, which usually indicates very advanced heart failure. It can also indicate cerebrovascular disease or drug effects, such as narcotics.

Congestive Heart Failure

- When it is not possible to control atrial fibrillation after trying several antiarrhythmic drugs, it may be best for both physician and patient to accept and live with a chronic atrial fibrillation with a ventricular rate in the 60's or 70's.
- Diuretics may be more effective on the days when less physical activities and more rest takes place.

The Inching Technique

- The inching technique is the most accurate and most practical way of timing extra heart sounds and murmurs.
- The stethoscope is moved or "inched" down over the precordium from the aortic area to the apex.

The Inching Technique

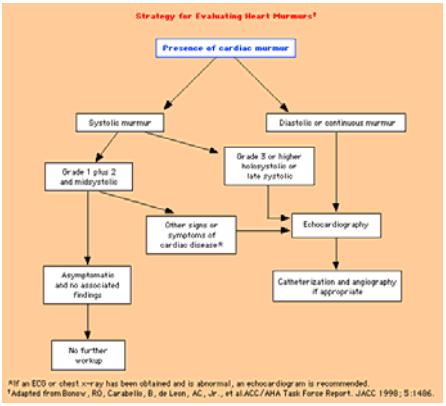
- You can also start at the apex and LLSB and inch upward towards the base of the heart.
- First, start over the aortic area, remembering that the second heart sound over the aortic area is almost always louder than the first.

Classification of Cardiac Murmurs

Systolic murmurs
Holosystolic (pansystolic) murmurs
Midsystolic (systolic ejection) murmurs
Early systolic murmurs
Mid to late systolic murmurs

Diastolic murmurs
Early high-pitched or low-pitched diastolic murmurs
Middiastolic murmurs
Presystolic murmurs

Continuous murmurs



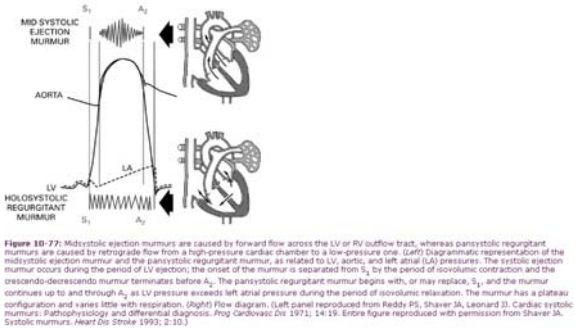
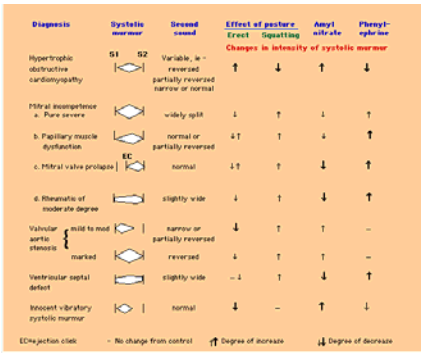


Figure 10-77: Midsystolic ejection murmurs are caused by forward flow across the LV or RV outflow tract, whereas pansystolic regurgitant murmurs are caused by retrograde flow from a high-pressure cardiac chamber to a low-pressure one. (Left) Diagrammatic representation of the midsystolic ejection murmur and the pansystolic regurgitant murmur, as related to LV, aortic, and left atrial (LA) pressures. The systolic ejection murmur occurs during the period of LV ejection; the onset of the murmur is separated from S_1 by the period of isovolumic contraction and the crescendo-decrescendo murmur terminates before A_2. The pansystolic regurgitant murmur begins with, or may replace, S_1, and the murmur continues up to and through A_2, as LV pressure exceeds left atrial pressure during the period of isovolumic relaxation. The murmur has a plateau configuration and varies little with respiration. (Right) Flow diagram. (Left panel reproduced from Reddy PS, Shaver JA, Leonard JJ. Cardiac systolic murmurs: Pathophysiology and differential diagnosis. *Prog Cardiovasc Dis* 1971; 14:19. Entire figure reproduced with permission from Shaver JA. Systolic murmurs. *Heart Dis Stroke* 1993; 2:10.)



Diagrammatic representation of the character of the systolic murmur and of the second heart sound in several abnormalities. The effects of posture, amyl nitrite inhalation, and phenylephrine injection on the intensity of the murmur are shown. (With permission from Barlow, JB. Perspectives on the Mitral Valve. F.A. Davis, Philadelphia 1987.)

Aortic Regurgitation

- Positions and techniques for auscultation:
- The murmurs of aortic regurgitation are generally heard when the patient is sitting upright, leaning forward, breath held in deep expiration.

Aortic Regurgitation

- Using firm pressure of the flat diaphragm of the stethoscope and listening along the 3rd left sternal border.
- There should be firm pressure on the stethoscope, enough to leave an imprint of the diaphragm chest piece on the chest wall, which may be necessary to bring out a faint murmur, grade I or II.

Aortic Regurgitation

- A faint aortic diastolic murmur may be overlooked if only the bell of the stethoscope is used.

Aortic Regurgitation

- Other positions for auscultation of the diastolic murmur of aortic regurg:
- 1. When the patient lying on his or her stomach, and propped up on the elbows. Also this position is useful to detect a pericardial friction rub.
- 2. The patient standing, leaning forward with his/her hands on the wall.
- The great majority of murmurs of aortic regurgitation are heard louder at the left sternal border compared with the counterpart on the right.

Aortic Regurgitation

- However, some diastolic murmurs are best heard along the right sternal border rather than the left.
- The right-sided aortic diastolic murmur is usually associated with dilatation and rightward displacement of the aortic root.

Aortic Regurgitation

- This has been associated with:
- -aortic aneurysm
- -aortic dissection
- -HTN
- -arteriosclerosis
- -rheumatoid spondylitis
- -Marfan's syndrome
- -osteogenesis imperfecta
- -VSD with aortic regurgitation
- -syphilis

Aortic Regurgitation

- The key interspaces are the 3rd and 4th right, as compared with their counterparts, the 3rd and 4th left interspaces.
- The 3rd interspaces are more likely to show the definitive difference.
- An aortic diastolic murmur louder at the right sternal border than the left immediately suggests the diagnosis just described.

Aortic Regurgitation

- Another cardiac PEARL concerning right-sided aortic diastolic murmurs is what we term a formula.
- Diastolic + aortic diastolic + right-sided =
- HTN mumur aortic diastolic murmur

Aortic Regurgitation

- Aneurysm and or dissection of the first portion of the ascending aorta.
- Severe pain in the upper back between the shoulder blades is a clue to an aortic dissection.
- If the chest x-ray shows rightward displacement of the aortic root and a murmur of aortic regurgitation is present, it is most likely to be the right-sided type.

Aortic Regurgitation

- If atrial fibrillation is present, suspect the possibility of concomitant mitral valve lesions.

Aortic Regurgitation

- Other findings of severe aortic regurgitation include:
- typical up and down bobbing of the head, (demusset's sign)
- frequent and profuse sweating
- unexplained pain or tenderness to touch over the carotid arteries
- unexplained mid-abdominal pain
- quick rise or collapsing arterial pulse

Aortic Regurgitation

- Proctor Harvey says you should palpate simultaneously the radial, brachial or carotid pulse with the femoral pulse. If the carotid, brachial or radial pulsations are better felt than the femoral, diagnose coarctation of the aorta in addition to severe aortic regurgitation.

Aortic Regurgitation

- The neck pain from aortic regurgitation can be a transient tenderness and pain over the carotid arteries, may be characterized by exacerbations and remissions that are unaffected by aortic valve surgery, the etiology of which is uncertain, probably produced in the wall of the carotid artery-could be from carotid pulsations against tender lymph nodes.

Aortic Regurgitation

- The patient with aortic regurgitation has a loud aortic systolic murmur, even with a palpable systolic thrill.
- With aortic regurgitation, at the apex generally a localized spot over the left ventricle is best heard with the patient in the left lateral decubitus position. Listen with the bell of the stethoscope over the PMI. A diastolic rumble may be present. This is the Austin-Flint rumble.

Aortic Regurgitation

- In Proctor Harvey's experience with the most severe leaks of the aortic valve, the Austin-Flint murmur occurs approximately in the mid portion of systole and often with some components in pre-systole.

Aortic Regurgitation

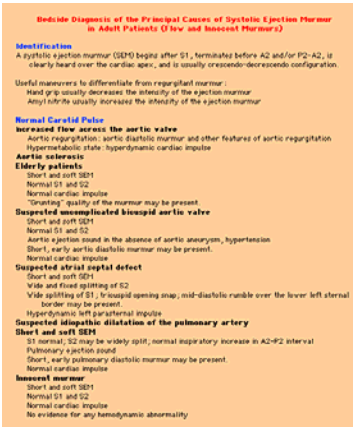
- The quick rise, or flip, of the radial pulse may be even better detected by having the patient raise his arms over his head. This simple maneuver may make this type of pulse more evident.
- The prompt recognition of acute severe aortic regurgitation as can occur from infective endocarditis affecting the aortic valve may be life-saving.

Aortic Regurgitation

- The failure to do so is understandable because the diastolic blood pressure may be low-normal or be slightly or moderately reduced compared with the very low diastolic blood pressure present with severe chronic acute regurgitation.

Aortic Regurgitation

- Also, with the acute type, the to and fro systolic and diastolic murmurs heard best along the left sternal border may be shorter in duration and fainter. Also, the first heart sound is likely to be faint.
- Early closure of the mitral valve is due to a great leak of the aortic valve into the left ventricle, thereby closing the mitral valve prematurely.



Bedside Diagnosis of the Principal Causes of Systolic Ejection Murmur in Adult Patients (Flow and Innocent Murmurs)

Identification
A systolic ejection murmur (SEM) begins after S1, terminates before A2 and/or P2-A2, is clearly heard over the cardiac apex, and is usually crescendo-decrescendo configuration.

Useful maneuvers to differentiate from regurgitant murmur:
Hand grip usually decreases the intensity of the ejection murmur
Amyl nitrite usually increases the intensity of the ejection murmur

Normal Carotid Pulse
Increased flow across the aortic valve
Aortic regurgitation: aortic diastolic murmur and other features of aortic regurgitation
Hypermetabolic state: hyperdynamic cardiac impulse
Aortic sclerosis
Elderly patients
Short and soft SEM
Normal S1 and S2
Normal cardiac impulse
"Grunting" quality of the murmur may be present
Suspected uncomplicated bicuspid aortic valve
Short and soft SEM
Normal S1 and S2
Aortic ejection sound in the absence of aortic aneurysm, hypertension
Short, early aortic diastolic murmur may be present.
Normal cardiac impulse
Suspected atrial septal defect
Short and soft SEM
Wide and fixed splitting of S2
Wide splitting of S1, tricuspid opening snap; mid-diastolic rumble over the lower left sternal border may be present.
Hyperdynamic left parasternal impulse
Suspected idiopathic dilatation of the pulmonary artery
Short and soft SEM
S1 normal; S2 may be widely split, normal inspiratory increase in A2-P2 interval
Pulmonary ejection sound
Short, early pulmonary diastolic murmur may be present.
Normal cardiac impulse
Innocent murmur
Short and soft SEM
Normal S1 and S2
Normal cardiac impulse
No evidence for any hemodynamic abnormality

Aortic Stenosis

- The typical murmur of aortic stenosis is harsh, similar to the sound of clearing one's throat. Aortic events are usually well heard at the apex.
- The murmur of aortic stenosis characteristically radiates up into the supraclavicular area of the neck, over the carotids, and the suprasternal notch.

Aortic Stenosis

- Aortic stenosis murmur is heard equally loud on both sides of the carotid arteries.
- Palpation can be of great aid in the clinical diagnosis of aortic stenosis using both hands; the right hand is placed over the apex of the left ventricle and left hand over the aortic area.

Aortic Stenosis

- Left ventricular impulse indicating hypertrophy of the left ventricle can be felt, and a palpable systolic thrill may be detected over the aortic area, the direction of which is towards the right neck and shoulder.
- The direction of the thrill with aortic stenosis is towards the right neck or clavicle.
- The direction of the thrill of pulmonic stenosis is towards the left neck or clavicle.

Differentiating Mitral Regurgitation from Aortic Stenosis after a Pause

- The systolic murmur of mitral regurgitation remains unchanged after a pause.
- In contrast the systolic murmur of aortic stenosis is louder after a pause following a premature beat.

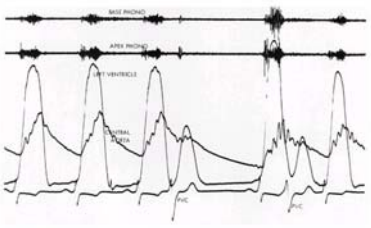
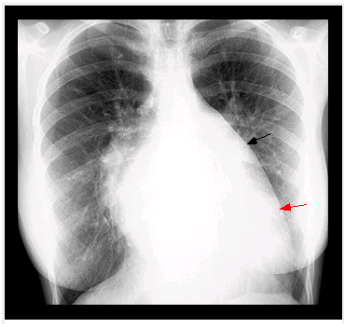


Figure 10-80: Effect of the long diastolic filling period following a premature ventricular contraction (PVC) on the intensity of a systolic ejection murmur (SEM). There is a marked increase in the intensity of the aortic stenosis murmur recorded at the base and at the apex. Despite the higher-frequency content of the apical murmur, this response clearly identifies this murmur as ejection in nature. (From Paley H. Left ventricular outflow tract obstruction: Heart sounds and murmurs. In: Leon DF, Shaver JA, eds. *Physiologic Principles of Heart Sounds and Murmurs*. Monograph 46. Dallas: American Heart Association; 1975:112. Reproduced with permission from the publisher and the author.)

- There may be wide transmission of aortic systolic murmur over the entire precordium, may be heard over the aortic area, the pulmonic area, the 3rd left sternal border, the left lower sternal border, and the apex.
- Aortic events are often clearly heard at the apex.
- Aortic stenosis murmurs are usually widely transmitted throughout the neck as well.

- The systolic murmur is often louder over the clavicles, illustrating the importance of transmission by bone.
- The radial pulse, brachial and carotid may show a slow rise with a slow descent, which is consistent with aortic stenosis.
- Proctor Harvey suggests that the diagnosis of aortic stenosis may be made from palpation alone.



Mitral regurgitation This plain chest radiograph from a female with known mitral regurgitation demonstrates cardiomegaly with left atrial (black arrow) and left ventricular enlargement (red arrow), as well as mild pulmonary venous redistribution, all features characteristic of mitral regurgitation. (Photo courtesy of Jonathan Kruskal, MD.)

Aortic Stenosis

- Concentrate on the murmur after a pause with atrial fibrillation or with a pause after a premature beat.
- With aortic stenosis, the murmur increases in intensity after a pause.

Aortic Stenosis

- With mitral regurgitation, the murmur remains essentially unchanged.
- PEARL: The Musical Murmur
- If one hears a high-frequency, musical, diamond-shaped systolic murmur heard only at the apex, immediately think of and rule out aortic stenosis.

Aortic Stenosis

- It is clinically apparent that the typical harsh, low frequency murmur of aortic stenosis can be filtered or altered by emphysematous changes and an increase in diameter to result in this musical murmur.

Aortic Stenosis

- Another cardiac PEARL is the rhythm.
- The rhythm with a single aortic lesion is regular normal sinus. This applies to aortic stenosis, aortic regurgitation, or when there is both stenosis or regurgitation.

Mitral Regurgitation

- However, if one thinks that there is only single aortic lesion, such as aortic stenosis, when atrial fibrillation is present, always look carefully for concomitant mitral valve involvement.

Mitral Regurgitation

- Careful search may then detect, for example, an unsuspected mitral stenosis, a rumble of which may only be detected when the patient is turned onto the left lateral position and the physician listens over the PMI with the bell of the stethoscope held lightly and barely touching the skin of the chest wall.

The Rheumatic Heart

- Another cardiac PEARL is the rheumatic heart.
- If only the aortic valve is diseased, it is most likely NOT of rheumatic etiology.
- Rheumatic heart generally has 2 valves involved, the aortic and the mitral.
- Cardiac PEARL: In men, the aortic valve is most likely to be diseased. In women, it's the mitral valve.

Syncope in Aortic Stenosis

- The patient having symptoms of syncope, near syncope, or dizziness related to severe, advanced aortic stenosis should be promptly referred for surgical valve replacement.
- Their next episode of syncope could be their last.

Systolic Murmurs of the Elderly

- As people live longer, they often develop an aortic systolic murmur that may progressively increase in intensity, produce symptoms of fatigue, dyspnea, near syncope or syncope.
- This is usually caused by a tricuspid aortic valve.
- This is the most common cause of valve stenosis in patients age 60-90 yrs old.

The Innocent Systolic Murmur in the Elderly

- -can happen in elderly patients with systolic murmurs over the aortic area as well as the pulmonic area.
- Elderly people ages 60-90 develop an aortic systolic murmur due to a mild to moderate degree of sclerosis or stenosis.

The Innocent Systolic Murmur in the Elderly

- Calcium deposits of varying degree occur on the valve, but may not affect its function and the patient may have no symptoms.
- This murmur is termed “innocent systolic aortic murmur of the elderly”.
- Usually no treatment is required, nor is heart catheterization necessary.

The Innocent Systolic Murmur in the Elderly

- The pathology of valve shows dense sclerotic changes with calcification of portions of the three leaflet aortic valve.
- The commissures are not fused at their junction with the aortic ring.

The Innocent Systolic Murmur in the Elderly

- Although a murmur of grade 3 or less may have been heard in a patient with such a valve, no symptoms may be present.
- They may have a faint 1 or 2 aortic diastolic murmur.

The Innocent Systolic Murmur in the Elderly

- An innocent murmur of the elderly (more likely in males) may continue a benign course for years; on the other hand, progression can gradually occur and cause symptoms.

Cardiac PEARL

- Sometimes, unexplained GI bleeding occurs in patients with aortic stenosis.
- Following an operation for aortic stenosis, the bleeding was alleviated. Often no explanation was found.

Bicuspid Aortic Valve

- From ages 6 to approximately 60, bicuspid aortic valve is the most likely cause of aortic stenosis, and ranks second only to mitral valve prolapse as the most common valvular lesion.

Bicuspid Aortic Valve

- For example, if aortic stenosis is diagnosed in a man aged 55 and it is a single valvular lesion, the diagnosis in the great majority of patients will be congenital bicuspid aortic valve.
- Calcification of the valve will be present in virtually 100% of these patients.

Bicuspid Aortic Valve

- After the age of 60, the most common cause of aortic stenosis is not congenital in origin, but rather a three leaflet (tricuspid) aortic valve.
- Cardiac PEARL: If the aortic valve is involved as a single lesion, the heart rhythm is regular. If atrial fibrillation is present, always suspect and rule out concomitant mitral valve pathology.

Bicuspid Aortic Valve

- It is of great importance to differentiate the murmur of congenital aortic stenosis from an innocent systolic murmur.
- Early diagnosis can be readily accomplished in the physician's office.
- Most commonly, a congenital bicuspid valve shows an early to mid-systolic murmur of grade 1-3 intensity is present.

Bicuspid Aortic Valve

- Frequently, it has a harsh quality similar to the sound of clearing one's throat.
- In some, an early blowing, high frequency aortic diastolic murmur of grade 1 to 3 is heard.

Bicuspid Aortic Valve

- Firm pressure on the stethoscope's flat diaphragm chest piece should always be used to best detect this diastolic murmur, listening along the left sternal border, with the patient sitting upright, leaning forward, and breath held in deep expiration.

Bicuspid Aortic Valve

- Since aortic events are usually well heard at the apex, the systolic murmur of aortic stenosis may be detected from the aortic area to the apex.
- This is also true of the aortic ejection sound that is another key to this condition.
- Congenital bicuspid aortic valve ejection sound is unchanged by respiration and is the same over the pulmonic area, the 3rd LSB, and at the LLSB.

Bicuspid Aortic Valve

- The ejection sound is not eliminated with firm pressure of the stethoscope, as should be the case with an atrial gallop.
- Cardiac PEARL: The ejection sound is a hallmark of a congenital bicuspid aortic valve and occurs with "doming" of the valve in early systole.

Bicuspid Aortic Valve

- It is of interest that, as part of the spectrum of findings in congenital bicuspid aortic valve, aortic regurgitation rather than stenosis may be the dominant lesion and in perhaps 5% of cases it may be of an advanced, severe degree.

How to Differentiate Congenital Bicuspid Aortic Stenosis from an Innocent Murmur

- An innocent murmur will have no ejection sound, and would be associated with a normal EKG and chest x-ray.
- EKG may show abnormalities such as left axis deviation and some increase in voltage over the left ventricle, consistent with LVH.
- The chest x-ray may show some post-stenotic dilatation of the ascending aorta or other variant from normal.

Chest Pain

- Cardiac PEARL: If possible, try to obtain an EKG while the patient still has the chest pain.
- It is also helpful to have the patient have an EKG during any arrhythmia or palpitation or other symptom of which he complains.

Pain of Myocardial Infarction

- -severe precordial substernal discomfort that radiates up to the left shoulder and then down the left arm and along the inside of the arm rather than the outside.
- At times, both the right and left arms are involved with the radiation of the pain, and in rare patients the pain is more noticeable in the right arm than the left.

Pain of Myocardial Infarction

- The pain may also radiate up into the neck, more likely the left, but sometimes the right or both sides of the neck.
- Occasionally, the pain seems to be localized in the jaw, making the patient think that this is a pain in a tooth.
- Descriptions of the classic chest pain may feel "like an elephant stepping on my chest" or a lasso around the chest pulling tighter and tighter.

Pain of Myocardial Infarction

- Sweating frequently accompanies the more severe pain of an acute myocardial infarction.
- Nausea and vomiting may also be present.
- The patient cannot seem to find a position where there is relief from the pain.

Pain of Myocardial Infarction

- To elicit a description of the typical pain caused by myocardial ischemia, ask the question, "What happens if you walk briskly up a hill, against the wind, in cold weather?"

Pain of Myocardial Infarction

- Levine's sign, is when the patient while describing his symptoms of coronary ischemic chest pain, may make a fist with his hand and press it over his substernal area. This is the Levine's Sign, described by the late Samuel A. Levine of Boston.

Pain of Myocardial Infarction

- As a variant of this sign, the patient may press over this area with the extended fingers of both hands; less commonly, the patient points and presses with one finger (usually the index finger) over the substernal area in describing the discomfort.

Pain Between the Shoulders

- Chest pain more localized in the shoulders or between the shoulder blades in the back should alert one to the possibility of aortic dissection.
- Although, the pain of acute myocardial infarction can indeed radiate to this area in the back, the localization of the pain in the shoulder region and the back also is very consistent with the pain caused by rupture of the aorta.
- Be especially suspicious if the EKG does not indicate myocardial infarction.

Pain Between the Shoulders

- Occasionally, a patient will describe the radiation of the ischemic pain from coronary artery disease as being "like an advancing tidal wave", from the substernal area to the left shoulder and then down the left arm to the fingertips. When the pain begins to subside, the "tidal wave" reverses direction back to the heart.

Non-Coronary Chest Pain

- It is worthwhile to explain to patients the type of chest pain that generally is NOT related to heart disease:
- -A constant “aching” pain that might be in the substernal area and lasts all day is usually not caused by heart disease.
- Nor is pain that is present only in one position and not in others.

Non-Coronary Chest Pain

- -Coronary pain is not accentuated by external pressure over the precordium.
- -Pain over the apical region of the heart or over the right anterior chest region is not typical of coronary artery pain.
- -The fleeting, momentary pain in the chest described as a needle jab or stick, lasting only a second or two, is not heart pain.

Ear Lobes

- At times you may see movement of the patient’s ear lobes coincident with systole.
- This should immediately suggest two possible causes: -severe aortic regurgitation, or, severe tricuspid regurgitation
- In each instance, the movement of the ears reflects the transmitted impulse from the carotid artery (aortic regurgitation) or the jugular vein (tricuspid regurgitation).

Carcinoid Tumor

- When flushing occurs or the patient has persistent violaceous or erythematous facial flushing, then the carcinoid tumor of the intestine has metastasized to the liver.
- The serotonin in the bloodstream of patients with the carcinoid syndrome can cause scarring of the pulmonic valve, producing the pulmonic systolic murmur.

Infective Endocarditis

- Antibiotic prophylaxis as outlined by the AHA is indicated not only for extractions of teeth but also for the simple procedures of cleaning and/or filling.
- Infective endocarditis has been definitely documented to occur with these simpler procedures.
- Antibiotic prophylaxis should also be given to patients with valvular heart disease. Infective endocarditis can also affect valves replaced at surgery.

Mitral Valve Prolapse

- It should be policy to give antibiotic prophylaxis to ALL patients with mitral valve prolapse-those having a click or clicks, as well as those patients with a systolic murmur.
- Some authorities recommend prophylaxis only for patients with mitral valve prolapse who have a systolic murmur.

Mitral Valve Prolapse

- Harvey disagrees with this, as he can cite many patients with MVP who have transient murmurs as well as clicks.
- He has personally observed patients with proven infective endocarditis who had only a single click or clicks and never had a systolic murmur detected on careful auscultation.

- At times, proper and efficient auscultation over the chest and neck is accomplished by having the patient stop breathing.
- In this way breath sounds are not interfering.
- When we ask the patient to do so, we too, should also stop breathing. This reminds us when to tell the patient to resume breathing; if we don't remember, we may find our patient struggling to keep from taking a breath.

- Sometimes a particularly garrulous patient continues to talk while we try to listen; several things are helpful:
- politely ask to please stop talking
- say "let me see your tongue"
- say "hold your breath

The Five Year Rule

- A new drug, procedure, technique or piece of equipment should ideally stand the test of time – about five years – before it is fully utilized.
- If at the end of this "watching" period nothing negative has evolved, then it may be utilized as indicated.

Innocent Systolic Murmurs

- The innocent systolic murmur is short, occurring in early to mid systole. It is not holosystolic. Normal splitting of the second heart sound is present also.
- The innocent systolic murmur is very common. It is a frequent finding in children and teenagers, and less likely in adults.

Innocent Systolic Murmurs

- Out of 100 school children aged 11 or 12, Harvey found approximately 60% who had an innocent systolic murmur.
- It is also of interest that in this particular group, he found 100% had a normal physiologic third heart sound; 100% had a normal physiologic venous hum that was detected listening over the right supraclavicular fossa, with the head turned "on a stretch" to the opposite direction.

Innocent Systolic Murmurs

- The innocent systolic murmur is early to mid systolic; it is generally grade 1 to 3 on a basis of six (Samuel A. Levine's classification)
- Splitting of the second heart sound is normal, becoming wider with inspiration and single or closely split with expiration.
- The EKG and cardiac silhouette of the heart are normal.
- The history is negative, except for the finding of a murmur.

Murmurs of pathologic conditions can be similar to innocent murmurs, but they have other associated findings.

- For example, atrial septal defect has a wide, so-called "fixed" splitting of the second heart sound.
- The EKG has changes, particularly in lead V1: right ventricular conduction delay (RSR1), RBBB or RVH.

Murmurs of pathologic conditions can be similar to innocent murmurs, but they have other associated findings.

- The x-ray shows increased blood flow in the lungs and enlarged pulmonary arteries.
- The murmur of a congenital bicuspid aortic valve can in itself be similar to the innocent murmur, but an ejection sound is present with the aortic stenosis which is well heard over the precordium from the aortic area to the apex.

Location

- A common misconception is that an innocent murmur is localized over one area, such as the pulmonic area, third left sternal border, or aortic area.
- Instead, innocent murmurs are frequently heard in other areas of the precordium, although they may be loudest over one particular area.

Innocent systolic murmurs

- are commonly found in children and in the early teen years. They are less common in adults.
- An interesting exception is the fact that innocent systolic murmurs were found in more than 90% of 90 NFL players personally examined.

Innocent systolic murmurs

- Innocent systolic murmurs occur in early to mid-systole.
- They are generally Grade 1-3 in intensity and in the great majority are readily diagnosed in the office or at the bedside.
- The second heart sound is of normal intensity, normally split and the degree of splitting increases in normal fashion with inspiration.

Innocent systolic murmurs

- More sophisticated laboratory studies such as echocardiography and cardiac catheterization are usually not necessary for diagnosis and only add to the expense incurred by the patient or family.

Differentiation from other conditions

- Innocent systolic murmurs are often similar to murmurs caused by a bicuspid aortic valve, mild pulmonic stenosis, or atrial septal defect. How to tell the difference?
- Consider the concomitant findings.

Differentiation from other conditions

- A murmur due to a bicuspid aortic valve has an aortic ejection sound that is unaffected by respiration.
- A murmur due to congenital valvular pulmonic stenosis also has an ejection sound but it will vary, becoming fainter or even disappearing on inspiration, although heard louder on expiration.
- The murmur of pulmonic stenosis also is more likely to have a wider split of the second heart sound that does not become single on expiration.
- RVH may be noted on the EKG.

Differentiation from other conditions

- With a murmur due to ASD, there is wide “fixed” splitting of the second heart sound.
- This finding, together with the EKG and x-ray changes of ASD, can quickly make the distinction between this serious murmur and an innocent murmur.

Differentiation from other conditions

- Innocent murmurs are better heard in young people who have thin chests than in those who are obese or muscular.
- Once the diagnosis of innocent murmur is established, it is not wise or necessary to have the patient return at intervals of several months or a year to keep check on this murmur. Otherwise, it can be logically interpreted: “The doctor is not sure; if not, why do I have to return?”

Innocent Murmurs

- 4 s
- Soft
- Short
- Systolic
- Split (normal split s2)

Systolic Murmur in the Elderly

- Systolic murmurs in the elderly population are an expected and usually innocent finding.
- They are usually grade 1 to 3 in intensity and best heard over the aortic area or left sternal border; it may also be heard over the clavicles (bone transmission); in the suprasternal notch, supraclavicular areas of the neck, including over the carotid arteries.

Systolic Murmur in the Elderly

- The murmur frequently has a somewhat musical quality and can be transmitted down to the apex. Sometimes it can even be better heard at the apex.
- Occasionally a faint aortic diastolic murmur (grade 1 or 2) is heard in addition to the systolic murmur.

Cardiac Pearl

- The person who carefully sketches what is heard on auscultation becomes progressively more expert in the art of auscultation.
- Never has an exception been seen.

Grading Systolic Murmurs

- Grading of systolic murmurs is important and very helpful. They are graded from 1 to 6 based on a system introduced by the late Samuel A. Levine:

Grading Systolic Murmurs

- Grade 1: the faintest murmur that one hears with the stethoscope, but often is not detected immediately.
- Grade 2: is also a faint murmur, but one will hear it immediately on placing the stethoscope over the chest.
- Grade 3: is still on the faint side, but is louder than the Grade 2 murmur.

Grading Systolic Murmurs

- On the opposite end of the grading scale, Grade 6 is the loudest murmur and can even be heard without the stethoscope actually touching the chest wall.
- However, as long as one can see daylight between the stethoscope and the chest wall and still hear a murmur, it is a Grade 6 murmur.

Grading Systolic Murmurs

- Grade 5 is also a loud murmur, but it is not heard unless the stethoscope is actually touching the chest wall.
- Grade 4 is a loud murmur and is a significant jump in intensity from Grade 3.
- Grade 4 murmurs and above can be accompanied by a palpable systolic thrill

Intensity of Murmur

- If a palpable systolic thrill is felt, the murmur is at least a Grade 4 intensity.

Cardiac Pearl

- Always rule out aortic stenosis in a patient with the following findings:
- A very high pitched musical systolic murmur that peaks in mid-systole and can be heard over the precordium (although it may be detected only at the apex)
- heart sounds that may be distant or absent.

Cardiac Pearl

- If one hears a *holosystolic (or pansystolic)* murmur that occupies all of systole, think of three conditions: MR, TR, and VSD.
- The innocent murmur is not holosystolic.

Cardiac Pearl

- Therefore, in MR and VSD, there is earlier emptying of the blood from the left ventricle with systole, resulting in earlier closure of the aortic component of the second sound, thereby producing a wider split.

Cardiac Pearl

- An early to mid-systolic murmur, with normal splitting of the second heart sound, plus an intermittent third heart sound is a perfectly normal finding if there are no symptoms or signs of heart disease.

Diastolic Murmurs

- Aortic diastolic murmurs can be loud and can be caused by varying etiologies.
- They can be associated with a palpable thrill along the third left sternal border. Sometimes the murmur has a “to and fro” quality, loud with a very low, somewhat musical quality.
- Sometimes the diastolic murmur resembles sawing wood, with the loud component being in diastole.

Pregnancy

- A faint grade 1 or 2 early, blowing diastolic murmur of aortic regurgitation might not be detected in a pregnant woman, particularly in her last trimester.
- Remember, also, that almost all pregnant women have an innocent grade 2 or 3 early to mid systolic murmur, which may not be heard before or after her pregnancy.
- Most pregnant women have innocent venous hums in the neck and innocent systolic murmurs.

Mitral Valve Prolapse

- Mitral valve prolapse is synonymous with other terms such as:
  - Systolic click-murmur syndrome
  - Billowing mitral valve leaflet syndrome
  - Floppy valve syndrome
  - Barlow’s syndrome
- The basic pathophysiology is so-called myxomatous degeneration of the mitral valve.

Mitral Valve Prolapse

- The mitral valve is made up of two basic components: a fibrosa element and a spongiosa element.
- In this condition, the spongiosa element proliferates. Excessive leaflet tissue can cause a scalloping or hooding effect of the valve.
- There may be thinning and elongation of the chordae tendinae.

Detecting Mitral Valve Prolapse

- Mitral valve prolapse often is first diagnosed by echocardiogram.
- Your stethoscope, however, is still the best instrument to detect and diagnose prolapse of the mitral valve.

Detecting Mitral Valve Prolapse

- Both the echocardiogram and angiogram can fail to document prolapse.
- It also can be missed by the stethoscope; however, generally that is because the physician is not “mentally set” to listen specifically for the typical auscultatory findings, or has not listen carefully in a quiet room with the patient in the following positions:

Detecting Mitral Valve Prolapse

- Supine
- Turned to the left lateral position
- Sitting
- Standing
- Squatting
- Valsalva Maneuver
- As a rule, findings of mitral valve prolapse on auscultation are best detected using the flat diaphragm chest piece of the stethoscope.

Detecting Mitral Valve Prolapse

- The findings may be transient, intermittent, varying at times, with some heartbeats having:
- No click or murmur
- Only a click or clicks
- Only a murmur
- Combinations of click and murmur
- A musical murmur termed “whoop” or “honk”

Detecting Mitral Valve Prolapse

- The great majority of patients with mitral valve prolapse are completely asymptomatic and need no treatment.
- Some patients have palpitations and a degree of chest discomfort.

Detecting Mitral Valve Prolapse

- Occasionally sedatives, beta-blockers and antiarrhythmics are needed and may be effective in treatment, although some patients hare not helped by these drugs.
- The most serious complication is rupture of a chorda tendinea, which may occur spontaneously or as a result of infective endocarditis on the valve.

Complications and Associated Findings of Mitral Valve Prolapse

- Progressive, increasingly severe MR
- Ruptured chordae tendinae
- Rupture of valve leaflet
- Calcification of mitral annulus
- Transient ischemic attacks

Complications and Associated Findings of Mitral Valve Prolapse

- Arrhythmias
- Chest pain
- In some patients, symptoms compatible with neurocirculatory asthenia (DaCosta's syndrome, effort syndrome)
- Anxiety
- Cardiac neurosis
- Sudden death (rare)

Seldom Recognized Variant of Mitral Valve Prolapse

- Systolic clicks generally occur in mid to late systole. However, a seldom recognized variant of mitral valve prolapse is that they can occur in early to mid systole.
- They can be multiple and rapid and can simulate the flipping of a deck of cards or the creaking of new leather.

Seldom Recognized Variant of Mitral Valve Prolapse

- It can simulate and be misdiagnosed as a pericardial friction rub because of these multiple rapid sounds in systole.
- A pericardial friction rub has 2 or 3 components rather than only one in systole:
- the atrial systolic
- the ventricular systolic
- the ventricular diastolic

Differentiating Mitral Valve Prolapse from Innocent Systolic Murmur

- This differentiation generally is not difficult.
- The typical murmur of mitral valve prolapse is in mid to late systole, whereas the innocent murmur is in the early to mid portions of systole. A click (or clicks) frequently accompanies the murmur of mitral valve prolapse but is absent with an innocent murmur.

Differentiating Mitral Valve Prolapse from Innocent Systolic Murmur

- A maneuver that increases volume to the left side of the heart, such as squatting, may delay these auscultatory findings, and therefore the click or murmur may move closer to the second heart sound.

Differentiating Mitral Valve Prolapse from Innocent Systolic Murmur

- On prompt standing and with a decrease in volume they may move in the opposite direction in systole—closer to the first heart sound.
- Also contributing is the bending of the knees and hips, which can increase peripheral arterial systolic pressure, and cause movement closer to the second sound, and closer to the first sound on standing.

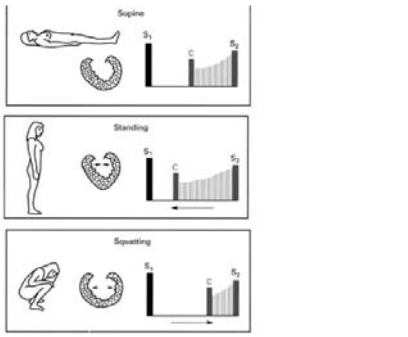


Figure 10-68: A midsystolic nonejection sound (C) occurs in mitral valve prolapse and is followed by a late systolic murmur that crescendos to S_2. With assumption of the upright posture, venous return decreases, the heart becomes smaller, the *C* moves closer to S_1, and the mitral regurgitant murmur has an earlier onset. With prompt squatting, both venous return and afterload increase, the heart becomes larger, the C moves toward S_2, and the duration of the murmur shortens. (From Shaver JA. *Examination of the Heart*, Part IV: Auscultation. Dallas: American Heart Association; 1990:13. Reproduced with permission from the publisher and the

Ejection Sound Terminology

- It is suggested that the term "systolic click" be reserved for and identified with mitral valve prolapse.

Mitral Valve Prolapse-Chest Abnormalities

- When we find on examination of our patients that there is a chest anomaly such as straight back, pectus excavatum, pectus coronatum, or chest asymmetry, we have a clue that mitral valve prolapse might be present.
- Perhaps 50% of patients with such anomalies may have mitral valve prolapse.

Hypertrophic Cardiomyopathy

- Now let's shake hands again with another patient, and then place our palpating fingers over the radial pulse.
- We note a quick rise of the pulse; this is called a "flip".
- The quick-rise pulse (also termed Corrigan's or watterhammer pulse) is consistent with aortic regurgitation, a diagnostic possibility to be ruled in or out.

Hypertrophic Cardiomyopathy

- Now, searching for the aortic diastolic murmur, we listen with the patient sitting upright, leaning forward, and breath held in deep expiration.
- We listen with the flat diaphragm of the stethoscope pressed firmly against the chest wall at the third left sternal border.

Hypertrophic Cardiomyopathy

- We expect to hear the early blowing diastolic murmur of aortic regurgitation; however, we don't hear it.
- Instead, there is a *systolic* murmur. Even at this point, we should think of hypertrophic cardiomyopathy.

Hypertrophic Cardiomyopathy

- The next step is to use the squatting maneuver.
- On squatting, the murmur decreases in intensity (on rare occasions it may even disappear).
- The murmur becomes louder again on standing, and the diagnosis of hypertrophic cardiomyopathy is made.

Hypertrophic Cardiomyopathy

- We term this the “one, two, three, four diagnosis” of hypertrophic cardiomyopathy.
- Number one: we find the quick rise pulse
- Number two: we look for aortic regurgitation
- Number three: we don’t find it; instead a systolic murmur is present
- Number four: with the squatting maneuver, the murmur becomes fainter, and on standing again, the murmur gets louder (often louder that it was originally).
- This is a superb diagnostic maneuver.

Hypertrophic Cardiomyopathy

- Simple and more effective way:
- The patient stands facing the physician, steadying himself or herself with the left hand on the examining table.
- The physician listens with the stethoscope over the patient’s left sternal border or apex, thereby obtaining a baseline of the auscultatory findings; the patient is then told to squat, and then return to the standing position.
- This is repeated several times.

Hypertrophic Cardiomyopathy

- The Valsalva maneuver, too, can be helpful in diagnosing hypertrophic cardiomyopathy.
- While listening along the left sternal border or apex, have the patient take a deep breath, blow the breath out and then strain as if having a bowel movement.
- The murmur may increase in intensity, indicating a positive response.

Hypertrophic Cardiomyopathy

- However, some patients, such as the elderly, may have difficulty in performing this maneuver.
- A simple and efficient way is to have the patient place his index finger in his mouth, seal it with his lips, exhale and at the point of deep expiration, “blow hard” on the finger.

Table 9 *Diagnosis of obstructive hypertrophic cardiomyopathy*

Maneuvers	Hemodynamic changes	Left ventricular outflow tract size	Left ventricular outflow pressure gradient	Intensity of the murmur
Standing	↓ LV volume ↑ Heart rate	↓	↑	↑
Squatting	↑ LV volume ↑ SVR, ART pressure	↑	↓	↓
Valsalva phase 2	↑ Heart rate ↓↓ LV volume	↓↓	↑↑	↑↑
Hand grip	↓ Heart rate ↑ ART pressure	↑	↓	↓
Post-PVC	↑↑Contractility ↑ LV volume	↓↓	↑↑	↑↑
Amyl nitrite inhalation	↑ Heart rate ↓ LV volume ↓ ART pressure	↓↓	↑↑	↑↑

Hypertrophic Cardiomyopathy

- Precordial Impulse: With the patient turned to the left lateral position and palpating over the point of maximum impulse of the left ventricle, three impulses may be felt:
  - The presystolic movement and a double systolic impulse. This is called the "triple ripple" impulse associated with hypertrophic cardiomyopathy.

Aortic Stenosis v/s Hypertrophic Cardiomyopathy

- Although both valvular aortic stenosis and hypertrophic cardiomyopathy can, with more severe degrees of obstruction, produce paradoxical splitting of the second heart sound, it is much more common in patients with hypertrophic cardiomyopathy.
- At times, differentiating the systolic murmur of hypertrophic cardiomyopathy from that due to rupture of chordae tendinae can be quite difficult indeed.

Cardiac Pearl

- The differentiation of these two similar murmurs:
  - If paradoxical splitting of the second heart sound in present (in the absence of left bundle branch block on the EKG) the diagnosis should immediately be made of hypertrophic cardiomyopathy.

EKG Signs of Hypertrophic Cardiomyopathy

- In the absence of any history, symptoms, or signs of coronary artery disease, the presence of significant Q-waves and ST and T wave changes should alert one to the possibility of hypertrophic cardiomyopathy-particularly in a teenager or young adult.
- A normal EKG practically rules out the diagnosis of hypertrophic cardiomyopathy. Dilated cardiomyopathy, too, often has some abnormality of the EKG.

Mitral Regurgitation

- Holosystolic: A holosystolic (pansystolic) murmur suggests three conditions: mitral regurgitation, tricuspid regurgitation, and ventricular septal defect.
- If a murmur is holosystolic, this finding alone immediately takes it out of the ballpark of innocent murmurs, which are early to mid-systolic.

Mitral Regurgitation

- If the holosystolic murmur radiates band-like (like a belt) from the LLSB to the apex, anterior mid and posterior axillary lines and even to the posterior lung base, this is diagnostic of mitral regurgitation.

Radiation of the Systolic Murmur of Mitral Regurgitation

- With significant posterior leaflet damage, the radiation is anterior, upward over the precordium to the base;
- If anterior leaflet damage predominates, then the radiation is apt to be posterior, from the apex to the axillary lines and posterior lung base.

Mitral Regurgitation as a Single Valvular Lesion

- If a patient has mitral regurgitation alone, and no other significant findings, you can be almost certain it is *not* of rheumatic etiology as formerly thought, but related to a complication of mitral valve prolapse, such as floppy valve or rupture of a chorda tendinea.

Acute Mitral Regurgitation

- The murmur of severe acute mitral regurgitation is loud (grade 4 or above), occupies all of systole, peaks in mid-systole and decreases in the letter part of systole.
- Although women have a higher incidence of mitral valve prolapse, men are more likely to have rupture of chordae tendineae, producing mitral regurgitation.

Mitral Regurgitation

- Mitral regurgitation is also a cause of wide splitting of the second sound.
- With systole, blood is ejected through the usual aortic outflow track and simultaneously through the incompetent mitral valve into the left atrium.
- The left ventricular contents thereby empty earlier than usual, and the aortic valve closure (A2) is earlier, which results in a wider split in both expiration and inspiration.

Mitral Regurgitation

- All valvular lesions can, at times, be “silent” with no murmur.
- The most common silent lesion is mitral stenosis—but the majority of these, failure to detect a murmur is because the bell of the stethoscope is not over the PMI, a localized spot (which may be the size of a quarter) where the diagnostic rumble is heard.

Mitral Regurgitation

- A third heart sound (S3) is an expected finding in the more advanced, more severe leaks of the mitral valve.
- A short diastolic rumble may also be heard in such patients.
- These auscultatory findings are caused by the large volume of blood in the enlarged left atrium filing the ventricle and producing, in the rapid filling phase, the third sound plus low-frequency vibrations. This rumble is usually not the result of stenosis of the mitral valve.

Mitral Stenosis

- If a diastolic rumble of mitral stenosis is present it is almost always heard over the PMI of the LV with the patient turned to the left lateral position.
- Sometimes one has difficulty in palpating this impulse.
- Almost always, an opening snap of mitral stenosis is heard, even with the most extensive degree of stenosis.

Loud First Heart Sound

- If a patient who has a normal heart rate has a loud first sound, always think of two conditions: mitral stenosis and a short P-R interval on the EKG.
- The length of a P-R interval can affect the first heart sound. The increase in intensity of the sound is most likely due to the position of the A-V valves at the time systole occurs.
- If the valves are deeper in the ventricles and systole occurs promptly after the atrial systole, the valves close, making a louder sound.

Loud First Heart Sound

- If the P-R interval is prolonged and the A-V valves have had time to move upward in the ventricles, systolic contraction produces a faint first sound.
- A loud first heart sound due to a short P-R interval can simulate the sound of mitral stenosis.
- The presence of a normal physiologic third heart sound can be misinterpreted as an opening snap.

Causes of First Heart Sound (S_1) Abnormalities

Abnormality	Causes
Increased intensity	
Atrioventricular valve obstruction	
Mitral	Mitral stenosis and left atrial myxoma
Tricuspid	Tricuspid stenosis and right atrial myxoma
Increased transvalvular flow	
Mitral	Patent ductus arteriosus; ventricular septal defect, atrial septal defect
Tricuspid	
Forceful ventricular systole	Hyperkinetic heart syndrome; tachycardia (eg, exercise); mitral valve prolapse
Short PR interval	Pre-excitation syndrome; Lown-Ganong-Levine
Decreased intensity	
Immobility of mitral valve	Calcific mitral stenosis
Lack of apposition of the mitral leaflets	Rheumatic mitral regurgitation
Presystolic semiclosure of the atrioventricular valves	Long PR interval; acute aortic regurgitation; significant aortic stenosis; dilated cardiomyopathy
Conduction anomaly	Left bundle branch block
Wide splitting of S_1	
Conduction abnormalities	Complete right bundle branch block; left ventricular pacing; pre-excitation syndrome (left ventricular connection); Ebstein's anomaly
Mechanical	Tricuspid stenosis; atrial septal defect, Ebstein's anomaly
Reversed splitting of S_1	
Arrhythmia	Premature beats (right ventricular origin)
Mechanical	Severe mitral stenosis and left atrial myxoma

Graham Steell Murmur

- It has been said that one cannot tell the difference between the diastolic murmur of pulmonary regurgitation (Graham Steell) associated with mitral stenosis and that of aortic regurgitation associated with mitral stenosis.
- The murmur of aortic regurgitation may be heard over the aortic area and transmitted along the LLSB to the apex.

Graham Steell Murmur

- The Graham Steell murmur is not heard over the aortic area and often is localized to the LLSB and generally not heard at the apex.
- The peripheral pulse has a quick rise “flip” with aortic regurgitation and not with the Graham Steell murmur.

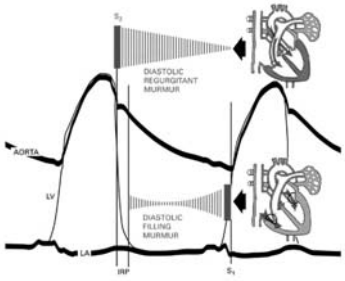


Figure 10-B4: Diastolic filling murmurs or rumbles are caused by forward flow across the AV valves, whereas diastolic regurgitant murmurs are caused by retrograde flow across incompetent semilunar valves. (*Left*) Diagrammatic representation of the diastolic filling murmur and the diastolic regurgitant murmur as related to LV, aortic, and left atrial (LA) pressures. The diastolic filling murmur occurs during the diastolic filling period and is separated from S_2 by the isovolumic relaxation period. The rumbling murmur is most prominent during rapid, early ventricular filling and presystole, terminating with S_1. The diastolic regurgitant murmur begins immediately after S_2 and continues in a decrescendo fashion up to S_1, closely paralleling the aortic LV diastolic pressure gradient. (*Right*) Flow diagram. (From Shaver JA. Diastolic murmurs. *Heart Dis Stroke* 1993; 1:98-103. Reproduced with permission from the American Heart Association.)

Hemoptysis

- Hemoptysis can occur in the patient having advanced tight mitral stenosis.
- Fortunately, the bleeding, which is due to a rupture of a bronchial vein, is generally self limited and does not represent an emergency situation.

Hemoptysis

- However, there have been isolated case reports where the bleeding did not spontaneously subside and surgery was necessary to control it.
- Pulmonary emboli can also cause hemoptysis with mitral stenosis as well as with other conditions. This can represent a serious complication requiring prompt recognition and treatment.

Differential Diagnosis of the opening snap of mitral stenosis and 3rd heart sounds

- Exert pressure on the stethoscope, which should eliminate the normal third heart sound or the S3 (ventricular) diastolic gallop; pressure on the stethoscope is not likely to eliminate the opening snap.
- The opening snap is heard over the pulmonic area (sometimes aortic area) but not the third sound.

Differential Diagnosis of the opening snap of mitral stenosis and 3rd heart sounds

- The opening snap of a “tight mitral stenosis” is closer to the second sound than the third sound.
- The opening snap serves as a clue to listen over the PMI of the LV for the “tell tale” diastolic rumble-not so with the third sound, which does not initiate the diastolic rumble.

CARDIAC PEARL

- : In a woman of approximately 30 years of age, who never had any previous heart problem and then had a sudden onset of an arrhythmia, the diagnosis that should head the differential is mitral valve prolapse.

Atrial Flutter

- Poorly recognized is that atrial flutter can have a change in intensity of the first heart sound.
- Similar to the fact that a short P-R interval produces a loud first sound and a prolonged P-R interval produces a faint heart sound, so too, with complete heart block, when the independent atrial and ventricular contractions result in a P-wave occurring just before the R wave, the first heart sound in loud.

Atrial Flutter

- When the P wave is farther from the R wave, the first heart sound is faint.
- This is what causes the changes in intensity of the first heart sound in complete heart block.

Atrial Fibrillation

- The unexplained onset of atrial fibrillation in a patient who is 50 years or older may be a clue to the presence of underlying coronary artery disease.
- However, this is not necessarily true, since other conditions can cause this.

Heart Block

- When the P-R interval on the EKG is short, the first heart sound may be loud.
- On the other hand, in the same patient, when the P-R interval is prolonged (such as in first-degree heart block) the first heart sound may be faint.
- The intensity of the first heart sound will relate to the length of the P-R interval.

Heart Block

- A slow ventricular heart rate plus a changing intensity of the first heart sound indicates complete heart block.
- When the P is close to the first heart sound, it may be loud.
- On the other hand, when it is not close and the P-R interval is prolonged and at a distance away from the first heart sound, the sound may be faint.

Heart Block

- This results in a changing intensity of the first heart sound; at intervals, when the P-R interval is short, an abrupt loud first sound (the “bruit de canon” or “cannon shot”) occurs which is an auscultatory finding diagnostic of complete heart block.

Heart Block

- **Cannon Wave of the Jugular Venous Pulse**
- The diagnosis of complete heart block can be suspected by paying attention to the jugular venous pulsations in the neck and by observing a slow regular heart rate approximately 40 bpm).
- If a sudden “cannon wave” occurs, it indicates that atrial contraction is occurring simultaneously with ventricular contraction.
- This is common with complete heart block.

Heart Block

- A short P-R interval (0.14-0.16 sec) equals a loud first sound.
- P-R interval of 0.17-0.18 sec equals average intensity.
- P-R interval of 0.20-0.24 equals faint.

Impulses of Hypertrophy

- An impulse felt laterally over the apical area is due to left ventricular enlargement and/or hypertrophy.
- A left ventricular aneurysm resulting from a previous myocardial infarction may produce a paradoxical systolic bulge with systole as the other areas of the left ventricle are contracting inward.

Impulses of Hypertrophy

- In such circumstances, the EKG may show another diagnostic clue:
  - Persistent elevation of the S-T segments in the left precordial leads.
- The combination of this impulse plus the persistent electrocardiographic findings (in the absence of acute infarction where the same findings may be present) indicates left ventricular aneurysm, most likely due to an old myocardial infarction.

Palpation

- It is important to palpate over the base of the heart.
- A palpating hand can feel:
  - A loud pulmonic valve closure of P2
  - A systolic ejection sound
  - A systolic thrill of pulmonic valve stenosis
  - A right ventricular lift with the bottom (heel) of the palm

Palpation

- A palpating hand can feel:
  - A loud aortic valve closure of A2
  - An aortic systolic ejection sound
  - A systolic thrill of aortic stenosis
  - A diastolic thrill of aortic regurgitation

The Significance of a Paradoxical Pulse

- The term “paradoxical pulse” is really a misnomer because when it is clinically apparent, it is really only an exaggeration of the normal pulse.
- The decrease in amplitude of the pulse coincident with inspiration may be of help in diagnosing constrictive pericarditis.

The Significance of a Paradoxical Pulse

- Paradoxical pulse also is an important sign of pericardial tamponade, and may be a sign of restrictive cardiomyopathy, or chronic pulmonary disease such as emphysema or asthma.

Significance of a bisferiens pulse

- The double systolic impulse in the radial, brachial, carotid or femoral arterial pulse is called a bisferiens pulse.
- When this is present, think of three possibilities:
  - A combination of aortic stenosis plus aortic regurgitation
  - more severe aortic regurgitation
  - hypertrophic cardiomyopathy.

Jugular Venous Pulse

- The best way to detect the specific waves of the jugular venous pulse in the neck is to be able to SEE both the venous pulsation and the carotid arterial pulsation in the same localized area.
- If we detect a pulsation of the jugular vein just before that of the carotid artery, then this has to be an A-wave.

Jugular Venous Pulse

- There are only a few conditions that cause a “giant” A-wave in the jugular venous pulse:
  - 1. Obstruction between the right atrium and the right ventricle occurring with tricuspid stenosis or atresia, or right atrial myxoma, can cause a prominent A-wave with atrial systole.
  - Increased pressure in the right ventricle, as may occur from severe obstruction of the pulmonary outflow tract with pulmonic stenosis, will result in a significant A-wave on atrial contraction.

Jugular Venous Pulse

- There are only a few conditions that cause a “giant” A-wave in the jugular venous pulse:
  - Pulmonary hypertension (“Eisenmenger syndrome”)- pulmonary hypertension, with atrial defect, ventricular defect, and patent ductus arteriosus) can cause pressure to be reflected back to the right ventricle, which produces an A-wave with atrial systole.

Jugular Venous Pulse

- There are only a few conditions that cause a “giant” A-wave in the jugular venous pulse:
  - Primary pulmonary hypertension (unknown etiology)
  - Recurrent pulmonary emboli can produce a prominent A-wave of the jugular venous pulse.

The First Heart Sound

- If there is a short P-R interval, the first heart sound is accentuated (e.g., 0.14 or 0.15 seconds).
- If the P-R interval is prolonged, the first sound is faint (e.g., 0.19-0.22 seconds or longer).
- When one hears a loud first heart sound in a patient whose heart rate is normal, think of two possibilities: A short P-R interval on the EKG and mitral stenosis.

The First Heart Sound

- Splitting of the first sound is due to closure of the mitral valve followed by tricuspid valve closure. The second sound split is due to aortic valve closure followed by tricuspid valve closure.
- Normally, left sided events of the heart occur before the right; therefore the mitral valve closure component occurs before the tricuspid valve closure component of the first heart sound and the aortic valve closure before the pulmonic valve closure of the second heart sound.

The First Heart Sound

- The mitral component is generally louder than the tricuspid component of the first heart sound, so when the tricuspid component is louder, two conditions should immediately come to mind: Ebstein’s anomaly and atrial septal defect.

The First Heart Sound

- Wide Splitting:
  - Wide splitting of the first heart sound can occur with complete left bundle branch block, complete right bundle branch block, Ebstein’s anomaly, and at times with premature ventricular beats.
  - Splitting of the first sound can be confused with an atrial sound (S4) plus a first sound, or a first sound plus an ejection sound. How to tell the difference?

The First Heart Sound

- Press firmly with the diaphragm of your stethoscope against the skin of the chest wall at the lower left sternal border and /or apex.
- The S4 will disappear. The two components of the split first sound are not eliminated with pressure; they sound alike and at the aortic area only one component of the split S1 is heard.

Atrial Septal Defect

- **A real cardiac pearl and an auscultatory finding that has withstood the test of time is the wide splitting of the second heart sound present with atrial septal defect.**
- In fact, when one hears wider splitting of the second heart sound over the pulmonic area or third left sternal border, and this does not become single or very closely split with expiration, then the possibility of atrial septal defect must be considered, particularly if a pulmonic systolic murmur is also present.

Atrial Septal Defect

- In the presence of atrial septal defect, the second heart sound can simulate that of complete right bundle branch block
- however, one major difference is that patients with right bundle branch block often have no murmur over the pulmonic area as do patients with atrial septal defect.

Atrial Septal Defect

- It is rare that a grade 2 or grade 3 systolic murmur is not heard in early or mid portions of systole in patients with atrial septal defect.
- In addition, with complete right bundle branch block, the second heart sound generally has more movement that the so-called “fixed” splitting of atrial septal defect.

Atrial Septal Defect

- When the patient sits up or stands, the wide, fixed splitting remains.
- This wide splitting is due to the increased volume of blood shunted to the right side of the heart with the more common (ostium secundum) type of atrial septal defect. It also may occur with ostium primum defect.

Atrial Septal Defect

- Often the only clue to an ostium primum defect is left axis deviation on the EKG.
- Also, with the larger shunts at the atrial level, a “flow” rumbling murmur may be heard along the lower left sternal border; this is the result of the increased flow of blood shunted from the left atrium to the right side of the heart, producing a more turbulent flow across the tricuspid valve.

Atrial Septal Defect

- Of course, occasionally an innocent pulmonic systolic murmur can be present in a patient having right bundle branch block.
- However, the total cardiovascular evaluation can make the correct diagnosis.
- For instance, the chest x-ray will show the atrial defect with an enlarged pulmonary artery segment, plus increased vascular markings.

Atrial Septal Defect

- A simple maneuver is to have the patient sit or stand up; if the second sound then becomes single, or very closely split on expiration, this is most likely a normal variant, and not the wide splitting of atrial septal defect.
- However, “never say never…” Occasionally, a small atrial septal defect can have a single or closely split S2 with expiration.
- Also, remember that the *absence* of a systolic murmur (even faint) heard over the pulmonic area or left sternal border practically eliminates the diagnosis of atrial septal defect.

Atrial Septal Defect

- A patient with atrial septal defect would have wide, fixed splitting of the second heart sound and a systolic murmur of grade 2 or 3.
- There would be EKG changes, particularly noted in V1, such as right ventricular conduction delay, indicated by an RSR1.
- Or the patient would have incomplete right bundle branch block, complete right bundle branch block, or right ventricular hypertrophy.

Atrial Septal Defect

- The x-ray would show an enlarged pulmonary artery segment with increased vascular markings, and the echocardiogram might show findings consistent with atrial septal defect.
- The echocardiogram and cardiac catheterization could, of course, document this.

Atrial Septal Defect

- Wide splitting of the second heart sound also can be found in patients with anomalous venous return.
- This defect is often associated with atrial septal defect but, uncommonly, it does occur alone; in such cases the second heart sound is more likely to have more movement of the split with respiration than that of the typically “fixed splitting” of atrial septal defect.

Second Heart Sound

- Just as the delay of the pulmonic component with inspiration results in wider splitting, earlier closure of the aortic component can produce wider splitting of the second heart sound.
- An example of this is mitral regurgitation of more advanced degrees in which the more significant leaks of the incompetent mitral valve result in earlier emptying of the contents of the left ventricle, thereby producing an early closure of the aortic valve.

Second Heart Sound

- Wider splitting can also occur in patients with large ventricular septal defects; the mechanism is similar to that of mitral regurgitation.
- With paradoxical splitting of the second heart sound, the reverse of normal splitting takes place. Instead of the degree of splitting increasing with inspiration, the splitting is wider with expiration and more closely split or single with inspiration.

Second Heart Sound

- Complete left bundle branch block is associated with delayed electrical conduction to the left side of the heart, which thereby delays left ventricular contraction.
- While aortic valve closure normally precedes pulmonic valve closure, in patients with left bundle branch block the order may be reversed. With expiration, therefore, P2 may occur before A2, with inspiration P2 moves toward it, resulting in close splitting, or a single second sound; with expiration the splitting is wider again.

Second Heart Sound

- Paradoxical splitting of S2 can occur with aortic outflow obstruction.
- It is more likely to occur with hypertrophic cardiomyopathy than valvular aortic stenosis.

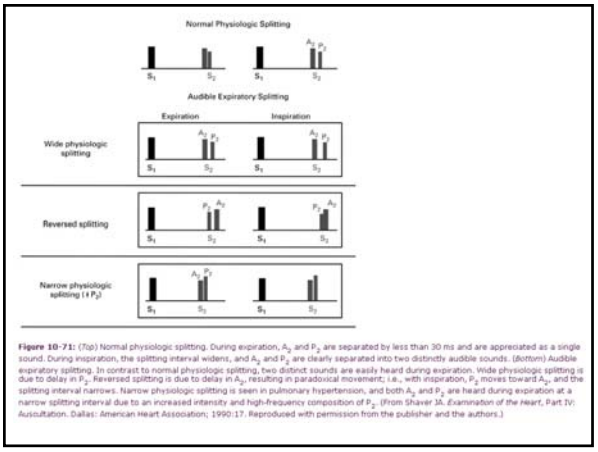


Figure 10-7: (*Top*) Normal physiologic splitting. During expiration, A_2 and P_2 are separated by less than 30 ms and are appreciated as a single sound. During inspiration, the splitting interval widens, and A_2 and P_2 are clearly separated into two distinctly audible sounds. (*Bottom*) Audible expiratory splitting. In contrast to normal physiologic splitting, two distinct sounds are easily heard during expiration. Wide physiologic splitting is due to delay in P_2. Reversed splitting is due to delay in A_2, resulting in paradoxical movement; i.e., with inspiration, P_2 moves toward A_2, and the splitting interval narrows. Narrow physiologic splitting is seen in pulmonary hypertension, and both A_2 and P_2 are heard during expiration at a narrow splitting interval due to an increased intensity and high-frequency composition of P_2. (From Shaver JA. *Examination of the Heart*, Part IV: Auscultation. Dallas: American Heart Association; 1990:17. Reproduced with permission from the publisher and the authors.)

Table 10-7: Wide Physiologic Splitting of the Second Heart Sound

Delayed pulmonic closure
Delayed electrical activation of the right ventricle
Complete RBBB (proximal type)
Left ventricular paced beats
Left ventricular ectopic beats
Prolonged right ventricular mechanical systole
Acute massive pulmonary embolus
Pulmonary hypertension with right heart failure
Pulmonic stenosis with intact septum (moderate to severe)
Decreased impedance of the pulmonary vascular bed (increased "hangout")
Normotensive atrial septal defect
Idiopathic dilation of the pulmonary artery
Pulmonic stenosis (mild)
Atrial septal defect, postoperative (70%)
Unexplained AES in the normal
Early aortic closure
Shortened left ventricular mechanical systole (LVET)
Mitral regurgitation
Ventricular septal defect

ABBREVIATIONS: RBBB = right bundle branch block; AES = audible expiratory splitting; LVET = left ventricular ejection time.
SOURCE: From Shaver JA, et al. The second heart sound: Newer concepts: 1. Normal and wide physiological splitting. *Mod Concepts Cardiovasc Dis* 1977; 46:9. Reproduced with permission from the American Heart Association, Inc., and the authors.

Table 10-8: Reversed Splitting of the Second Heart Sound

Delayed aortic closure
Delayed electrical activation of the left ventricle
Complete LBBB* (proximal type)
Right ventricular paced beat
Right ventricular ectopic beats
Prolonged left ventricular mechanical systole
Complete LBBB (peripheral type)
Left ventricular outflow tract obstruction
Hypertensive cardiovascular disease
Arteriosclerotic heart disease
Chronic ischemic heart disease
Angina pectoris
Decreased impedance of the systemic vascular bed (increased "hangout")
Poststenotic dilation of the aorta secondary to aortic stenosis or regurgitation
Patent ductus arteriosus
Early pulmonic closure
Early electrical activation of the right ventricle
Wolff-Parkinson-White syndrome, type B

*LBBB = left bundle branch block.
SOURCE: From Shaver JA, et al. The second heart sound: Newer concepts: 2. Paradoxical splitting and narrow physiological splitting. *Mod Concepts Cardiovasc Dis* 1977; 46:13. Reproduced with permission from the American Heart Association, Inc., and the authors.

Atrial Septal Defect v/s Pulmonic Stenosis

- Ostium secundum septal defect and a mild congenital pulmonic valve stenosis can have both similar murmur and a wider split of the second sound that does not become single on expiration. How to tell the difference?
- Presence of a pulmonic systolic ejection sound immediately indicates pulmonic stenosis.
- The ejection sound may decrease in intensity or disappear on inspiration.

Atrial Septal Defect v/s Pulmonic Stenosis

- The presence of left axis deviation on the EKG should be an immediate clue to change the diagnosis of secundum defect to that of primum defect.
- Unless lead V1 on the EKG shows RSR1, right ventricular conduction delay, right bundle branch block, or right ventricular hypertrophy, be cautious in making the diagnosis of atrial septal defect.
- The great majority of patients with atrial septal defect will have one of these findings.

Atrial Septal Defect v/s Pulmonic Stenosis

- Absence of a Systolic Murmur
  - The absence of a systolic murmur practically rules out the diagnosis of uncomplicated ostium secundum atrial septal defect.

The Second Heart Sound: Pulmonary Hypertension

- As a rule, with pulmonary hypertension of a significant degree, the pulmonic component of the second sound becomes greatly accentuated and splitting usually becomes closer.
- Pulmonary hypertension of this kind may occur with ventricular septal defect, atrial septal defect, patent ductus arteriosus, primary pulmonary hypertension, or recurrent pulmonary emboli.

The Second Heart Sound: Pulmonary Hypertension

- The second heart sound becomes quite loud and easily palpable.
- If pulmonary hypertension is associated with an atrial septal defect, more distinct splitting of the second heart sound generally is heard and is one clinical clue to atrial defect.

Friction Rub

- A friction rub is usually best heard over the third or fourth left sternal border using the diaphragm chest piece of the stethoscope pressed firmly against the chest wall.
- Suspect acute pericarditis when a patient says, “I have pain in my chest when I am lying down, but I can get relief if I sit up and get in a certain position”.

Pericardial Knock Sound

- The pericardial knock sound of constrictive pericarditis is present in the great majority of patients who have this condition, if one carefully searches for it.
- This is a solid cardiac pearl aiding in the diagnosis.
- The knock sound is present in 90% or more of patients with constrictive pericarditis. The sound occurs in the ventricle during the rapid filling phase of early diastole and is probably produced by blood striking the ventricular walls.

Pericardial Knock Sound

- It may be misinterpreted as the opening snap of mitral stenosis.
- However, in timing it occurs later after the second sound than does the opening snap of a tight mitral stenosis, but earlier than the normal physiological third heart sound or ventricular (S3) gallop.

How to differentiate the opening snap of mitral stenosis from the pericardial knock sound of constrictive pericarditis

- The first sound in mitral stenosis is usually loud when the opening snap is heard. The first sound associated with the pericardial knock is often not accentuated, although it can be.
- P2 is accentuated with mitral stenosis, but not with constrictive pericarditis.

How to differentiate the opening snap of mitral stenosis from the pericardial knock sound of constrictive pericarditis

- The diastolic murmur of mitral stenosis is usually heard over the point of maximum impulse of the left ventricle.
- A diastolic murmur is hardly ever present with constrictive pericarditis.
- An exception: Very very rarely, constriction between the left atrium and left ventricle has occurred, resulting in a diastolic murmur.

How to differentiate the opening snap of mitral stenosis from the pericardial knock sound of constrictive pericarditis

- Neck vein distention is characteristic of constrictive pericarditis, but does not usually occur with mitral stenosis.
- Rheumatic heart disease usually has two valves involved, the aortic and the mitral.
- This is not so with constrictive pericarditis.

Coarctation of the Aorta

- The diagnosis of coarctation of the aorta can generally be made by several simple findings:
  - Hypertension in the upper arms, a basal systolic murmur, and decreased or absent femoral arterial pulsations.

Continuous Murmurs

- **All that is continuous is not patent ductus.**
- Dr. William Nelson of the University of South Carolina has a list of the possible causes of continuous murmurs:
  - Patent ductus arteriosus
  - Aortic pulmonic window
  - Truncus I-II-III
  - Anomalous origin of left coronary artery from the pulmonary artery

Continuous Murmurs

- Accessory coronary artery
- Sinus of Valsalva fistula
- Coronary arterial fistula
- Systemic arteriovenous fistula
- Blalock-Taussig operation
- Potts operation
- Waterson operation
- Coarctation of the aorta
- Coarctation of the pulmonary artery
- Pulmonary Thromboembolism

Continuous Murmurs

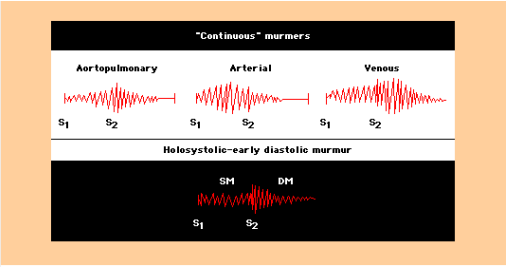
- -Arteritis
- -Arteriosclerosis obliterans
- -Coronary “stenosis”
- -Venous hum-neck
- -Mammary hum – breast (pregnancy)
- -Total anomalous pulmonary venous connection
- -Coarctation collaterals
- -Bronchial collaterals
- -Trucus-IV
- -“Pseudo-truncus”
- -Tricuspid atresia
- -Severe Tetralogy of Fallot
- -Cruveiller-Baumgarten Syndrome

Continuous Murmurs

- **A continuous innocent venous hum murmur in the neck is a common finding in children.**
- The patient should be in the sitting position (the hum’s origin is venous blood flow in the jugular vein which empties into the right atrium).
- On auscultation, the right hand places the bell of the stethoscope over the right supraclavicular fossa; the left hand holds the patient’s chin from behind and tilts it upward and to the left.
- When an optimal position of the neck “on a stretch” is reached, the hum, if present, will be heard.

Continuous Murmurs

- It frequently has the character of a continuous loud, low frequency roaring murmur, and it usually can be made to disappear by moving the head to the forward position.
- Light pressure with the finger over the upper part of the jugular vein will cause the murmur to cease.



Schematic of continuous murmurs Continuous murmurs begin in systole and continue without interruption through the second heart sound (S2) into all or part of diastole. The continuous murmers shown here are aortopulmonary, systemic arterial, and systemic venous. A holosystolic murmur (SM) followed by a holodiastolic murmur (DM) represents two separate murmurs, not one continuous murmur. (With permission from Heart Disease: A Textbook of Cardiovascular Medicine, Braunwald, E (Ed), WB Saunders, Philadelphia, 1997.)

Venous Hum

- **On careful examination of approximately 90 NFL players, a venous hum was detected in all.**
- Remember that the venous hum is probably the result of a degree of normal mild obstruction of venous blood flow in the jugular vein to the right side of the heart, heard with the bell of the stethoscope placed over the supraclavicular fossa, especially when the patient's head is turned to the opposite direction and the neck is on a stretch.

Venous Hum

- **Hyperthyroidism – The absence of a venous hum practically rules out hyperthyroidism.**

S_3 and S_4

- **Electrocardiography**
- Normal Variants: The absence of an S4 or S3 gallop may be helpful in evaluation of a patient who has findings on the ECG suspicious for coronary artery disease, myocarditis, or cardiomyopathy.

Prosthetic Valves

- Multiple Systolic Sounds – Following a valve replacement utilizing the Starr-Edwards ball valve, numerous systolic sounds can be heard which might simulate the rolling of dice on a hard surface or the flipping of a stick on a picket fence.

Prosthetic Valves

- **Porcine Valves**
- An early to midsystolic murmur, usually grade 2 or 3, is a normal finding following successful valve replacement with a porcine valve.
- Prosthetic valve sounds are sometimes loud enough that the patient can hear them, especially at night or other times when everything is quiet. Sometimes other members of the family also can hear the sounds.

Holosystolic Murmurs

- The murmur of ventricular septal defect is usually best heard along the lower left sternal border, although there is radiation of this murmur to the apex.
- The papillary muscle rupture is more likely to have the murmur loudest at the apex, with radiation laterally to the left axillary lines.
- Be sure to carefully search for a palpable thrill, for this may clinch the diagnosis.

Holosystolic Murmurs

- A palpable systolic thrill along the left sternal border is characteristic of septal perforation, whereas with papillary muscle rupture the palpable systolic thrill is more likely localized over the apical area.

Pulmonary Hypertension

- Signs of pulmonary hypertension include:
  - A right ventricular lifting impulse along the lower left sternal border;
  - A palpable pulmonic valve closure;
  - Possibly an A-wave detected on examination of the jugular venous pulse in the neck.

Pulmonary Hypertension

- On auscultation there may be a loud closely split second heart sound (which might even be suspected on palpation), an ejection sound in early systole that becomes fainter on inspiration might be present, and with more advanced degrees of pulmonary hypertension, an atrial (S4) gallop might be heard in presystole.

Pulmonary Hypertension

- Syncope Due to Primary Pulmonary Hypertension
  - Any time a young woman has episodes of syncope always thing of primary pulmonary hypertension.

From:

- Cardiac Pearls by W. Proctor Harvey
- Cardiovascular Medicine Volume 2 by Eric Topol
- Up to Date 2004
- Hurst's The Heart Online Edition