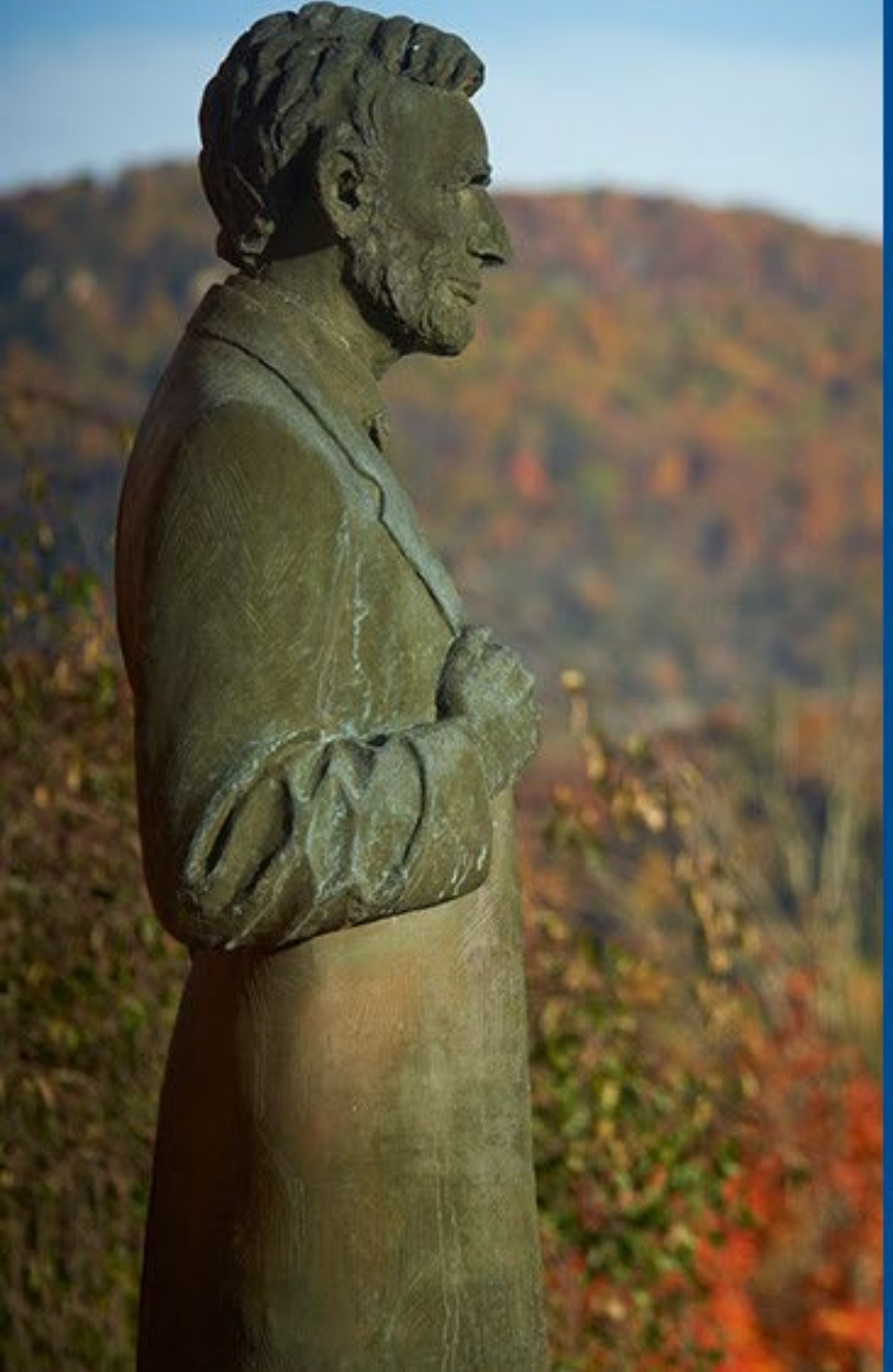

Comprehensive Review of Cardiac Auscultation

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Disclosures

- The presenter reports no relevant financial relationships with any commercial interests and has no conflicts of interest to disclose.

Objectives

After completing this module, learners should be able to perform the following:

- Identify splits and gallops during the auscultation of a patient.
- Identify the most likely etiology of a murmur with auscultation of the heart.
- Describe the pathophysiology and clinical presentation of the unique cardiac murmurs
- Describe the physiology of the different maneuvers of interrogation and use those to further evaluate cardiac murmurs.
- Describe and document the interpretation of a murmur from a clinical evaluation.
- Identify adventitious lung sounds

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Outline of Content

- Splits and Gallops
- Basics of murmur interpretations
- Techniques of interrogation
- Individual murmur details with details related to interrogation
- Describing the findings of a murmur.
- Auscultation of respiratory adventitious sounds and bruits

Cardiac Splits

Major Splits

- Physiologic Split of S2
- Fixed split of S2
- Paradoxical Split of S2

Features

- Location: Left Upper Sternal Border
- Length: Separation of the same sound

Physiologic Split of S2

- Delayed closure of Pulmonic valve because of increased right ventricular filling during inspiration secondary to decreased intrathoracic pressure. The delay is around 0.13 seconds.
  - Increased venous return to the right heart
  - Inspiration lowers intrathoracic pressure
  - This “pulls” more blood into the right atrium and right ventricle
  - The right ventricle takes longer to eject blood

Fixed split of S2

- Caused by persistent delay in pulmonic valve secondary to prolonged right ventricular systole like an atrial septal defect.
  - Chronic left-to-right shunt
  - Blood flows from left atrium → right atrium
  - This leads to constant volume overload of the right ventricle

Paradoxical Split of S2

- Splitting that appears during exhalation and disappears during inhalation. Caused by a delayed aortic valve and that is absent during inhalation because of the delayed pulmonic valve. A LBBB is the most common cause.
- Left ventricular ejection is prolonged
  - Causes include:
  - Left Bundle Branch Block
  - Aortic Stenosis
  - Severe LV dysfunction
  - The left ventricle takes longer to empty
  - A2 is delayed

SAM (Splits)

Gallops (Best heard with the Bell)

- S3
- S4
- S3 + S4

S3

- An early diastolic sound created during the rapid filling phase caused by blood or an excessive amount of blood hitting a compliant ventricle. It is relatively normal in the young growing heart. It is often a sign pathology in patients over 40. Increased atrial pressures and changes in ventricular compliance are factors in creating the sound. It is a late finding in congestive heart failure.
  - https://www.ncbi.nlm.nih.gov/books/NBK342/
- "Kentucky" — likely from Iroquoian/Shawnee forms (e.g., *Kentahten*, *Kenhtà:ke*)
- Keen --------Tuck,E

S4

- A late diastolic sound created by an atrial contraction that occurs after the opening of the atrioventricular valves and blood hitting a "Stiff" ventricle. (Not present in A fib.) Common in early MI. Pathologic in most patients but could be normal an incidental finding in older patients.
  - https://www.ncbi.nlm.nih.gov/books/NBK344/
- "Tennessee" — original form: *Tanasi* (Cherokee)
- Ten,Eh ---------See

S3 + S4 (Summation Gallop)

- S3 + S4 = a ventricle that is BOTH volume-overloaded and stiff (noncompliant)
- Causes:
  - Advanced Heart Failure
  - Ischemic Cardiomyopathy
  - Long standing Hypertension
  - Hypertrophic Obstructive Cardiomyopathy (HOCM)

Identify the extra heart sounds

Identify the extra heart sounds

Identify the extra heart sounds

The Basics of Interrogating Cardiac Murmurs

- The Cardiac cycle
- Sound projection of the chest
- Algorithm

The Cardiac Cycle

Sound Projection of the Chest

- Projections of the valves
- Anatomical structures of the heart
  - Atrial
  - Ventricular
  - Radiation
  - Ductus

Interpretation Algorithm

1. **Where is the murmur the loudest?** Is the murmur loudest at the Aortic, Pulmonic, Tricuspid, Mitral, Atrial or Ventricular locations?
2. **When does it occur?** Does it occur in systole, diastole or both?

When does the murmur occur?

When does the murmur occur?

Memorize to Quickly Interpret a Murmur

Systolic Murmurs	Diastolic Murmurs	Systolic & Diastolic
Aortic Stenosis	Aortic Regurgitation	Patent Ductus Arteriosus
Pulmonic Stenosis	Mitral Stenosis	Pericardial Friction Rub
Hypertrophic Cardiomyopathy		Venous Hum
Mitral Regurgitation		
Tricuspid Regurgitation	Pulmonary Regurgitation	
Ventricular Septal Defect	Tricuspid Stenosis	

Basics of Interpretation

- A systolic murmur loudest at right second intercostal space =
- Aortic Stenosis, because blood is flowing through a narrow valve during systole and the sound of that turbulent flow radiates to the right second intercostal space and often up in the neck.
- A systolic murmur loudest at the left fifth intercostal space at the mid clavicular line =
- Mitral Regurgitation, During systole blood should not be flowing though the mitral valve and if it does it is regurgitant. The sound of the mitral valve projects to the lower left side of the chest.

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Techniques Used to Interrogate Cardiac Murmurs

Maneuver	Cardiovascular Effect	Effects on Systolic Sounds & Murmurs		
		Mitral Valve Prolapse	Hypertrophic Cardiomyopathy	Aortic Stenosis
Squatting / Valsalva Release Phase ↑ Blood in ventricle	**Increased left ventricular volume** (↑venous return)	↓ Prolapse of mitral valve	↓ outflow obstruction	↑ blood volume ejected into aorta
	Increased vascular tone (↑ arterial pressure, ↑peripheral resistance)	Delay of click & shortens murmur	↓ Intensity of murmur	↑ Intensity of murmur
Standing / Valsalva Strain Phase ↓ blood in ventricle	**Decreased left ventricular volume** (↓venous return)	↑ Prolapse of mitral valve	↑ outflow obstruction	↓ blood volume ejected into aorta
	Increased vascular tone (↓ arterial pressure)	Click moves earlier and murmur lengthens	↑ Intensity of murmur	↓ Intensity of murmur
Handgrip	**Increases afterload** and blood in the ventricle	↑ Intensity of murmur	↓ Intensity of murmur	↓ Intensity of murmur

Physiologic Murmurs/Innocent Murmurs

Systolic Ejection Murmurs

- Stills Murmur (Most Common)
  - Adolescent to adult murmurs, lower left sternal border, loudest supine, No radiation
- Innocent Pulmonary Flow Murmur (second most common)
  - Left upper sternal border, may radiate to back and axillae.
- Peripheral Pulmonary Artery Stenosis
  - Usually in 1st year of life, premies most likely, right/left upper sternal border, radiation to axillae.
- Arterial Supraclavicular Murmur
  - Late childhood and early adolescence, loudest in supraclavicular fossa, can radiate to the neck.

Aortic Stenosis

- Loudest location: Right second intercostal space
- Radiation: to carotids or to the apex.
- Shape: Crescendo-decrescendo (Starts low, then increases to peak and then decreases after the peak)
- Maneuvers: Louder while sitting and then leaning forward.
- Could have S4 with progressive disease

Mitral Regurgitation

- Loudest location: Apex
- Radiation: Back or Left Axillae
- Shape: Holosystolic murmur
- Maneuvers: Squatting increases murmur, Standing & Valsalva decrease the murmur
- A. Fib is common, sometimes a S3 is present, and PMI could be laterally displaced.

Mitral Valve Prolapse

- Loudest location: Apex
- Radiation: Left Axillae
- Shape: Mid-systolic click with mid to late systolic murmur
- Maneuvers: Standing and Valsalva increase the murmur because the maneuvers reduce LV chamber size, squatting decreases the murmur because it increases the chamber size often delaying the onset of the click and murmur.
- Caused by a redundant leaflet.

Ventricular Septal Defect

- Loudest location: Fourth left intercostal space
- Shape: Holosystolic, harsh and blowing and often has a thrill

Atrial Septal Defect

Mild systolic ejection murmur secondary to increased blood flow

- Loudest location: Pulmonic
- Has fixed split S2, can have diastolic "rumble" in tricuspid area secondary to increased blood flow.
  - Delayed P2 → fixed split
  - Pulmonic flow murmur (systolic)
  - Tricuspid flow murmur (diastolic)

Hypertrophic Cardiomyopathy

- Loudest location: Lower left sternal border
- Radiation: Down the left side of chest, toward the apex
- Shape: Crescendo-decrescendo
- Maneuvers: Anything that decreases the blood volume increases the obstruction and murmur, Anything that increases the blood volume, decreases the obstruction and decreases the murmur.

Aortic Regurgitation

- Loudest location: left sternal border (2^{nd} – 4^{th})
- Radiation:
- Shape: Blowing decrescendo murmur
- Maneuvers: Anything that increases venous return or afterload will increase the murmur.
- An S3 and displaced PMI can be found.

Mitral Stenosis

- Loudest location: Apex
- Radiation: None
- Shape: Opening snap followed by a decrescendo diastolic murmur

Patent Ductus Arteriosus

- Loudest location: Left second intercostal space
- Radiation: Toward the left clavicle
- Shape: A continuous murmur in systole and diastole that may have a small period of silence late in diastole.

Categories Used to Describe a Murmur

- **Intensity** (Systolic 1-6) (Diastolic 1-4)
- **Quality** (Blowing, harsh, musical. Etc.)
- **Shape** (holosystolic, crescendo-decrescendo, etc.)
- **Location** (Loudest)(R 2nd intercostal space, L 4th intercostal space, etc.)
- **Radiation** (to the neck, to the axillae, etc.)
- **Associated signs** (S3, S4, Lateraly displaced PMI, etc.)

Rating the Intensity of a Murmur

Systolic Murmurs

1/6 Very faint

2/6 Equal in volume to S1 & S2

3/6 Louder than S1 & S2

4/6 Louder than S1 & S2 with palpable thrill

5/6 Has thrill and is heard with scope partially off the chest

6/6 has thrill and maybe heard with scope off the chest

Diastolic Murmurs

1/4 Barely audible

2/4 Faint but audible

3/4 Easily heard

4/4 Very loud

What is the adventitious heart sound?

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Key Points

- Start murmur interpretation by identifying:
  - Where the murmur is loudest
  - Whether it occurs in systole or diastole
- The location of maximal intensity often identifies the valve or structure involved.
- Systolic and diastolic murmurs have different clinical implications and differential diagnoses.
- Timing, radiation, shape, and associated findings further refine interpretation.
- Splits and gallops provide important clues about cardiac physiology and pathology.
- Bedside maneuvers help distinguish murmurs by changing preload, afterload, and blood flow.
- Careful auscultation remains a powerful bedside diagnostic tool.

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