TOPIC 7 Cardiovascular Disorders
OBJECTIVES

Cardiac Anatomy Review

Materials

- Large and small heart models
- Preserved human heart in plastic
- Torso models
- Transverse torso section models

Objectives

1. Identify the layers of the heart wall, pericardium and pericardial cavity on diagrams, models, and/or preserved hearts; describe their structure and function.
   - Fibrous pericardium
   - Parietal pericardium
   - Pericardial cavity
   - Epicardium (visceral pericardium)
   - Myocardium
   - Endocardium

2. Identify the following chambers and structures on preserved human hearts, models, and diagrams; state the function or importance of each:

   **External Features**
   - Right and left atria (atrium is singular)
     - Auricles of the right and left atria
   - Atrioventricular groove (coronary sulcus)
   - Right and left ventricles
   - Anterior interventricular sulcus
   - Ligamentum arteriosum

   **Internal Features**
   - Interatrial septum
     - Fossa ovalis
   - Interventricular septum
   - Tricuspid (right atrioventricular [AV]) and Mitral (bicuspid; left atrioventricular [AV]) valve
   - Aortic and pulmonary semilunar valves
3. State the function of the atrioventricular valves.

4. State the function of the semilunar valves.

5. Identify the following blood vessels on models and diagrams. Indicate whether they are part of the pulmonary circulation, systemic circulation, or coronary circulation (a subset of systemic circulation); and whether they carry oxygenated or deoxygenated blood.

- Pulmonary trunk
  - Right and left pulmonary arteries
- Right and left pulmonary veins
- Aorta
  - Ascending Aorta
  - Right coronary artery
  - Left coronary artery
    - Circumflex artery
    - Anterior interventricular artery
- Great cardiac vein
  - Coronary sinus

6. Review the normal anatomy of the fetal heart and associated blood vessels and compare it with the post-natal heart. Identify and state the function of the foramen ovale and ductus arteriosus. State what each of these structures becomes after birth and the consequences of failure to close.
Cardiac Physiology Review and Diagnostic Tests

Materials

- Stethoscope
- iWorx equipment
- ECG leads & electrodes
- Computer
- ECGs of various disorders
- Heart conduction system models
Objectives

1. What are the different pulses?

![Diagram of Palpated Pulse with labeled arteries: Temporal artery, Facial artery, Common carotid artery, Brachial artery, Radial artery, Femoral artery, Popliteal artery, Posterior tibial artery, Dorsalis pedis artery.]

![Images of anatomical illustrations showing the carotid, superficial temporal, brachial, radial, and femoral arteries.]

![Detailed anatomical drawings highlighting the carotid, superficial temporal, brachial, radial, and femoral arteries.]

![Images of anatomical drawings outlining the carotid, superficial temporal, brachial, radial, and femoral arteries.]
2. Why do we feel pulses? And what are different feelings when you have a pulse?

3. Does not having a pulse a significance toward a cardiac arrest?


5. What are the cause of the widening of the blood pressure and narrowing blood pressure?

6. The main factors influencing blood pressure are:

7. Auscultate heart sounds; correlate the sounds with the events of the cardiac cycle.

WHAT are:
- S1,
- S2,
- S3,
- S4
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<thead>
<tr>
<th></th>
<th>Intercostal space</th>
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<tbody>
<tr>
<td>Pulmonary valve (to trunk)</td>
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<td>Aortic valve (to aorta)</td>
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<td>Mitral valve (to left v.)</td>
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<td>Tricuspid valve (to right v.)</td>
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**Differential Diagnosis of Causes of an S₃**

**Differential Diagnosis of Causes of an S₄**

**Gradations of Murmurs**

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<tr>
<th>Grade</th>
<th>Description</th>
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<td>Grade 1</td>
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- [http://www.med.ucla.edu/wilkes/intro.html](http://www.med.ucla.edu/wilkes/intro.html)
- [http://www.blaufuss.org/tutonline.html](http://www.blaufuss.org/tutonline.html)
- [http://depts.washington.edu/physdx/heart/demo.html](http://depts.washington.edu/physdx/heart/demo.html)
Auscultation of the heart

Aortic area:
- Systolic murmur
- Aortic stenosis
- Flow murmur
- Aortic valve sclerosis

Left sternal border:
- Diastolic murmur
- Aortic regurgitation
- Pulmonic regurgitation

Pulmonic area:
- Systolic ejection murmur
- Pulmonic stenosis
- Flow murmur (e.g., atrial septal defect)

Tricuspid area:
- Pansystolic murmur
- Tricuspid regurgitation
- Ventricular septal defect
- Diastolic murmur
- Tricuspid stenosis
- Atrial septal defect

Mitrval area:
- Systolic murmur
- Mitral regurgitation
- Diastolic murmur
- Mitral stenosis

*ASU commonly presents with a pulmonary flow murmur (flow through pulmonary valve) and a diastolic rumble (flow across tricuspid). The murmur later progresses to a louder diastolic murmur of pulmonic regurgitation from dilatation of the pulmonary artery.
Auscultation of the Heart.
(Image courtesy of Charlie Goldberg, M.D., UCSD School of Medicine and VA Medical Center, San Diego, California)
8. Trace the pathway of action potentials through the heart’s intrinsic conduction system on diagrams and models and state the function of each component.

Sinoatrial (SA) node
Atrioventricular (AV) node
Bundle of His (AV bundle)
Right and left bundle branches
Purkinje fibers

http://www.youtube.com/watch?v=xS5twGT-epo&feature=related

10. Use the iWorx equipment and Lab Scribe computer software to determine a volunteer’s ECG under various conditions. On the ECG, identify the ECG waves, segments and intervals;
describe the mechanical heart activity normally associated with each. State the normal duration in milliseconds.

a) P wave
b) QRS complex
c) T wave
d) PR (PQ) interval
e) ST segment
f) QT interval

11. Describe the following arrhythmias. Identify each on ECG tracings provided.
   http://www.blaufus.org/
   http://www.youtube.com/watch?v=x67vRkooZDc&feature=related
   a) Sinus Tachycardia
   b) Sinus Bradycardia
c) Atrial flutter
d) Atrial fibrillation
e) Ventricular Fibrillation
f) Ventricular tachycardia
g) Complete heart block

12. Describe the procedure for echocardiography. (This video is very long, but teaches the procedure and the diagnoses that can come from it. Start at time = 5:40:
   http://www.youtube.com/watch?v=VF_OGTSdSlO

13. Describe the procedure for a cardiac stress test
   (http://www.youtube.com/watch?v=x_Z0GF6AuTw).

The common approach for stress testing by American College of Cardiology and American Heart Association indicates the following:

- Treadmill test: sensitivity 67%, specificity 70%
- Nuclear test: sensitivity 81%, specificity 85-95%
14. Describe the procedure for a **cardiac catheterization**
   (http://www.youtube.com/watch?v=1I6vCR7MIJE&feature=related).

Describe the procedure for a **coronary angiography**
(http://www.youtube.com/watch?v=kY5gKdFWT3k&NR=1&feature=fvwp)

1. **Define and use in proper context:**
   a. anastomosis  
   b. aneurysm  
   c. angina pectoris  
   d. arrhythmia  
   e. Aschoff body  
   f. beriberi heart disease  
   g. carcinoid heart disease  
   h. cardiac tamponade  
   i. cardiogenic shock  
   j. cardiomyopathy  
   k. chronic ischemic heart disease  
   l. coarctation of the aorta  
   m. conduction system of the heart  
   n. congenital heart disease  
   o. congestive heart failure  
   p. contraction band necrosis  
   q. cor bovinum  
   r. cor pulmonale  
   s. coronary artery disease  
   t. dextrocardia  
   u. diastole  
   v. Dressler syndrome  
   w. ductus arteriosus  
   x. Ebstein anomaly/malformation  
   y. endocardial fibroelastosis  
   z. endocarditis  
   A. foramen ovale  
   B. heart failure  
   C. hemopericardium  
   D. hypertension  
   E. hypertensive heart disease  
   F. hypertrophy of the myocardium  
   G. ischemic heart disease  
   H. Libman-Sacks endocarditis  
   I. marantic endocarditis
19. mitral valve prolapse  27. rheumatic heart disease  34. truncus arteriosus
20. myocardial infarct  28. ring abscess  35. unstable angina
21. myocarditis  29. stenosis  36. valvular insufficiency
22. pericarditis  30. sudden cardiac death  37. valvular regurgitation
23. pericarditis  31. systole  38. valvular stenosis
24. Prinzmetal angina  32. tetralogy of Fallot  39. vegetation
25. reperfusion injury  33. transposition of great vessels  40. verruca

1. DEFINE THE FOLLOWING:

2. ARTERIO-sclerosis
3. AHERO-sclerosis
4. Aneurysm
5. Dissection
6. Thrombus
7. Hypertension
8. Vasculitis/Vasculitides, infectious/NON-infectious (often-autoimmune)
9. Varicosity
10. DVT/Thrombo-phlebitis/Phlebo-thrombosis
11. Lymphangitis
12. Lymphedema
13. Angioma/Hemangioma (generic)
14. Lymphangioma
15. Angiosarcoma (generic)
16. Lymphangiosarcoma
CVP = 5cm + this Height
Assuming the top of the pulse wave reached this point of the neck.

Location of Carotid Arteries
1. Define and use in proper context:

1. aneurysm
2. angiitis
3. arteriolosclerosis
4. arteriosclerosis
5. arteriovenous fistula
6. arteriovenous malformation
7. arteritis
8. atheroma
9. atherosclerosis
10. deep vein thrombosis (DVT)
11. false aneurysm
12. fatty streak
gy
13. fibromuscular dysplasia
14. fibrous cap
15. fibrous plaque
16. fusiform aneurysm
17. gangrene
18. hemorrhoid
19. hypertension
20. leukocytoclastic vasculitis
21. lymphedema
22. Marfan syndrome
23. mycotic aneurysm
24. obliterative endarteritis
25. phlebosclerosis
26. phlebothrombosis
27. pseudoaneurysm
28. pyogenic granuloma
29. Raynaud disease
30. Raynaud phenomenon
31. saccular aneurysm
32. superior vena cava syndrome
33. telangiectasias
34. thrombophlebitis
35. varicose veins
36. vasculitis

17. Blood vessels: Normal anatomy & function, vascular disorders, diagnostic tests and treatments.

a) Compare and contrast the structure and functions of the major types of blood vessels. (Lab)
b) Identify and locate blood vessels of clinical importance. (Lab)
c) Describe the development of a deep vein thrombosis, name some vessels likely to be affected, and describe the techniques used to diagnose deep vein thrombosis. (Lab)
d) Explain why a deep vein thrombosis may lead to pulmonary emboli. (Lab)
e) Describe the pathophysiology, etiology, signs and symptoms, diagnostic tests and treatment of aortic aneurysms. (Lab and text)
f) Describe the pathophysiology, etiology, signs and symptoms, diagnostic tests and treatment of varicose veins. (Lab and text)
g) Describe the pathophysiology, etiology, signs and symptoms, diagnostic tests and treatment of peripheral vascular disease (peripheral arterial disease; PAD) and atherosclerosis.
h) Describe the pathophysiology, etiology, signs and symptoms, diagnostic tests and treatment of **thrombophlebitis** and **phlebothrombosis**.

18. Heart: Normal structure and function, Cardiac disorders, diagnostic tests and treatments
   a) Describe the normal anatomy of the fetal and post-natal heart including the valves, great vessels, coronary vessels, and membranes associated with the heart and their functions. (Lab)
   b) Correlate the normal heart sounds with the cardiac cycle and valve function. (Lab)
   c) Describe the procedure for an aortic valve by-pass surgery. (Lab)
   d) Trace the pathway of action potential conduction through heart. (Lab)
   e) Describe the process for performing and ECG. Describe the electrocardiogram and state the normal durations of important waves and intervals. (Lab)

1 Describe common nodal and conduction abnormalities and arrhythmias. (Lab)
2 Explain the treatments cardiac dysrhythmias (arrhythmias).
3 Describe the procedure and uses of echocardiography, cardiac stress tests, cardiac catheterizatrons, and coronary angiography.
4 Define **murmur** and regurgitation.
5 Differentiate between **stenosis** and **incompetence** of a valve. www.blaufus.com
6 Explain the normal neural and endocrine control of the heart.
7 Define the following, state their importance and correlate them with the cardiac cycle:
   a) Diastole
   b) Systole
   c) End diastolic volume (EDV)
   d) End systolic volume (ESV)
8 Define the following, state their importance:
   a) Ejection fraction (EF)
   b) Afterload
   c) Preload
9 Describe the general treatment measures that can be instituted for cardiac disorders.
10 Describe the pathophysiology, etiology, diagnostic tests and treatment of **arteriosclerosis** and **atherosclerosis**, **angina pectoris**, **myocardial infarction**, and **congestive heart failure**.

2. Discuss mechanisms of blood pressure regulation, including:
   - cardiac influences
• neural factors
• hormonal factors
• vasoactive agents
• renin-angiotensin system

3. Compare and contrast the following types of hypertension:
   • essential
   • malignant
   • renovascular
   • secondary
   in terms of:
   o etiology
   o pathogenesis
   o level of blood pressure elevation
   o vascular morphologic findings
   o clinical features
   o prognosis

4. Discuss the morphologic effects of hypertension on:
   • heart
   • brain
   • kidneys
   • placenta
   and enumerate the clinical consequences thereof

5. Describe the development, anatomy, and clinical consequences of the major congenital malformations of arteries.
6. Discuss the following vascular diseases:

- arteriosclerosis
- atherosclerosis
- arteriolosclerosis
- Mönckeberg medical calcific sclerosis
- vasculitis
- lymphangiitis
- lymphedema
- phlebothrombosis
- thrombophlebitis
- varicose veins

in terms of:
- etiologic/predisposing factors
- morphologic features
- type and size of vessels involved
- organs involved
- complications of lesions
- fate of lesions
- clinical features and prognosis

7. Discuss the following forms of vasculitis:
   - infectious vasculitis
   - giant cell (temporal) arteritis
   - Takayasu arteritis
   - polyarteritis nodosa
   - Kawasaki (mucocutaneous lymph node) syndrome
   - microscopic (hypersensitivity) polyangiitis
   - Wegener granulomatosis
   - thromboangiitis obliterans (Buerger disease)

in terms of:
   - incidence
   - age distribution
   - etiology
   - pathogenesis
   - size, type, and distribution of vessels involved
   - morphology of lesions
   - laboratory findings
   - clinical features, complications, and prognosis

8. Compare and contrast the following disorders:
   - atherosclerotic aneurysm
   - syphilitic aneurysm
   - aortic dissection (dissecting hematoma)
   - berry aneurysm
   - Charcot-Bouchard microaneurysm

in terms of:
   - incidence
   - etiology
   - pathogenesis
   - type and distribution of vessels involved
   - morphology
   - clinical features
   - complications and prognosis

9. Compare and contrast thoracic and abdominal aortic aneurysms on the basis of:
   - etiologic factors
   - incidence
10. Discuss the effects of the following on the pathogenesis and prevalence of atherosclerosis:
   - age
   - sex
   - geographic location
   - risk factors

11. Outline the development of the atherosclerotic lesion with respect to:
   - pathogenic mechanisms
   - morphology
   - clinical manifestations
   - complications

12. Compare and contrast:
   - hyaline arteriolosclerosis
   - hyperplastic arteriolosclerosis

   in terms of:
   - pathogenesis
   - morphology
   - clinical significance

13. Compare and contrast the following vascular tumors:
   - vascular ectasias
   - glomus tumor (glomangioma)
   - hemangioma
   - angiosarcoma
   - hemangioendothelioma
   - bacillary angiomatosis
   - hemangiopericytoma
   - Kaposi sarcoma
   - lymphangioma

   in terms of:
   - age distribution
   - etiology
   - pathogenesis
   - morphology
   - clinical features
   - prognosis

11. Discuss the pathophysiology, etiology, diagnostic tests and treatment of common congenital heart defects.

12. Discuss the pathophysiology of rheumatic fever and the signs and symptoms, diagnostic tests and treatment of rheumatic heart disease.

13. Describe the pathophysiology, etiology, diagnostic tests and treatment of infective endocarditis and pericarditis.

19. Blood pressure, hypertension and shock
   1. Discuss how blood pressure normally arises and is controlled.
   2. Discuss the pathophysiology, signs and symptoms, and treatment of hypertension.
3. Discuss the pathophysiology, etiology, signs and symptoms, and treatment of circulatory shock.

4. Differentiate among the different types of circulatory shock.

20. List the most common forms of heart disease in the United States.

21. Compare and contrast the following:
   - congestive heart failure
   - high-output heart failure
   - forward heart failure
   - backward heart failure
   - left-sided heart failure
   - right-sided heart failure
   - cor pulmonale
   - etiology
   - pathogenesis
   - compensatory mechanisms
   - morphology
   - clinical features

22. Discuss cardiogenic shock in terms of:
   - etiologic factors
   - pathogenesis
   - morphology
   - stages
   - clinical manifestations

23. Discuss congenital heart disease in terms of:
   - genetic and environmental factors
   - types which result in:
     - left-to-right vs. right-to-left shunt
     - cyanotic vs. acyanotic disease
   - types which present in:
     - infancy
     - childhood
     - adulthood

24. Compare and contrast the following forms of congenital heart disease:
   - atrial septal defect (ASD)
   - patent ductus arteriosus (PDA)
   - ostium primum
   - transposition of the great vessels
   - ostium secundum
   - coarctation of the aorta
   - ventricular septal defect (VSD)
   - preductal
   - tetralogy of Fallot
   - postductal
   - endocardial cushion defects
   - anomalous pulmonary venous return
   - hypoplastic left heart syndrome
in terms of:
  - incidence
  - embryologic abnormality
  - pathogenesis
  - gross morphology
  - hemodynamic abnormalities
  - associated defects
  - clinical features
  - complications
  - treatment
  - prognosis

25. Discuss:
- endocarditis
- myocarditis
- pericarditis
- pericardial effusion
- cardiac tamponade
- pancarditis

in terms of:
  - classification/types
  - epidemiology
  - etiology/pathogenesis
  - morphology
  - clinical features
  - prognosis

26. Compare and contrast:
- acute rheumatic fever.
- chronic rheumatic heart disease

in terms of:
  - pathogenesis
  - diagnostic criteria
  - morphology (cardiac and extracardiac)
  - complications
  - laboratory findings
  - clinical features

27. Compare and contrast the following forms of valvular heart disease:
  - calcific aortic stenosis
  - aortic insufficiency
  - mitral stenosis/insufficiency
  - mitral valve prolapse
  - mitral annular calcification
  - tricuspid insufficiency
  - pulmonic insufficiency
  - endocarditis
    - infective
    - noninfective
  - carcinoid heart disease
in terms of:
  o epidemiology
  o etiology
  o pathogenesis
  o morphology (cardiac and extracardiac)
  o clinical features
  o complications
  o prognosis

28. List long term complications associated with prosthetic heart valves

29. Compare and contrast:
   • dilated (congestive) cardiomyopathy
   • hypertrophic cardiomyopathy (idiopathic hypertrophic subaortic stenosis (IHSS)
   • restrictive cardiomyopathy
   • endomyocardial fibrosis
   • eosinophilic (Loeffler) endomyocarditis
   • endocardial fibroelastosis
   in terms of:
     o etiology
     o pathogenesis
     o morphology
     o clinical course

30. Discuss coronary artery disease, in terms of:
    o epidemiology
    o risk factors
    o etiologic factors
    o pathogenesis
    o complications

31. Discuss myocardial infarct, in terms of:
    o etiologic factors
    o risk factors
    o pathogenesis
    o morphology
       evolution of morphologic changes with time
       correlation of morphologic distribution of infarct with site of coronary artery disease
    o clinical, laboratory, and electrocardiographic findings with increasing time after event
    o complications, including timing thereof after event
    o prognosis, including most common causes of death with increasing time after event

32. Discuss sudden cardiac death, in terms of:
    o causes
    o relationship to arrhythmias
33. Discuss the following cardiac tumors

- myxoma
- rhabdomyoma
- lipoma
- metastatic
cardiac effects of noncardiac neoplasms

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<th>Cardiac Valve (to)</th>
<th>Intercostal Space</th>
<th>Sternal Border</th>
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<tbody>
<tr>
<td>Pulmonary valve (to pulmonary trunk)</td>
<td>second intercostal space</td>
<td>left upper sternal border</td>
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<tr>
<td>Aortic valve (to aorta)</td>
<td>second intercostal space</td>
<td>right upper sternal border</td>
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<tr>
<td>Mitral valve (to left ventricle)</td>
<td>fifth intercostal space</td>
<td>lateral to left midclavicular line</td>
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<tr>
<td>Tricuspid valve (to right ventricle)</td>
<td>fourth intercostal space</td>
<td>lower left sternal border</td>
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One can remember the positions of the sounds by the mnemonic "All The Presidents Men".

- A - Aortic - Right second intercostal space
- T - Tricuspid - Left fourth intercostal space sternal border
- P - Pulmonic - Left second intercostal space sternal border
- M - Mitral - Fifth intercostal space lateral to left midclavicular line

**Differential Diagnosis of Causes of an S₃**

It is associated with heart failure, caused by conditions which have:

- Rapid ventricular filling
- **Mitral regurgitation** - this is when one of the heart valves that usually stops blood going from the left ventricle to the left atria fails, allowing blood into the atria during systole. This means they will be overfilled when they come to contract, leading to the rapid ventricular filling.
- Elevated left atrial and left ventricular filling pressures, usually a result of a stiffened and dilated left ventricle
- **Ventricular septal defect** - this is a hole in the wall between the two ventricles, which allows rapid filling from the other ventricle.
- Elevated atrial pressure
- High-output states

### Poor Left Ventricular Function

- **Post-MI** - the death of tissue in the ventricular wall due to loss of blood supply causes areas which do not move as well, if at all (hypokinetic and akinetic), meaning they do not relax quickly enough so the ventricular filling is relatively too quick.
- **Dilated cardiomyopathy** - the ventricular walls are abnormal for a variety of reasons, and become thin and stiff so do not relax well.
- **Hypertrophic obstructive cardiomyopathy**
- **Cardiomegaly** of a variety of causes

In conditions affecting the pericardium or diseases that primarily affect the heart muscle (restrictive cardiomyopathies) a similar sound can be heard, but is usually more high-pitched and is called a 'pericardial knock'.

The S3 can also be confused with a widely split S2, or a mitral opening snap, but these sounds are typically of much higher pitch and occur closer to the onset of S2.

### Differential Diagnosis of Causes of an S₄

The S₄ rhythm is associated with disorders that increases the stiffness of the ventricle, including:

- Long-standing hypertension
- Aortic stenosis
- Overload of the ventricle
- Fibrosis of the ventricle
- Left ventricular hypertrophy
- Coronary Artery Disease
- Hypertrophic Cardiomyopathy
Vessels

- **Pulmonary Hypertension**

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**Clicks:** With the advent of newer, non-invasive imaging techniques, the origin of other, so-called *adventitial sounds* or "clicks" has been appreciated. These are short, high-pitched sounds.

- The atrioventricular valves of patients with mitral stenosis may open with an *opening snap* on the beginning of diastole.
- Patients with mitral valve prolapse may have a mid-systolic click along with a murmur.
- Aortic and pulmonary stenosis may cause an ejection click immediately after $S_1$.

**Rubs:** Patients with pericarditis, an inflammation of the sac surrounding the heart (pericardium), may have an audible pericardial friction rub. This is a characteristic scratching, creaking, high-pitched sound emanating from the rubbing of both layers of inflamed pericardium. It is the loudest in systole, but can
often be heard also at the beginning and at the end of diastole. It is very dependent on body position and breathing, and changes from hour to hour.

S4
S1 = Mitral, Tricuspid then pulmonary artery valve, aortic valve
S2 = Aortic, Pulmonary valve then tricuspid mitral valve

Sounds of aortic valve are heard in 2nd intercostal space at right sternal margin.
Sounds of pulmonary valve are heard in 2nd intercostal space at left sternal margin.
Sounds of mitral valve are heard over heart apex, in 5th intercostal space in line with middle of clavicle.

Sounds of tricuspid valve are typically heard in right sternal margin of 5th intercostal space; variations include over sternum or over left sternal margin in 5th intercostal space.