MODULE: CARDIOVASCULAR SYSTEM

OBJECTIVES:

Upon completion of this module, the student will be able to:

1. Explain the physiology of S1, S2, S3 and S4.


3. Perform a cardiovascular examination on a client.

4. Describe normal and abnormal heart sounds.

5. Describe common murmurs, including functional murmurs.

REQUIRED READINGS:

Bates’ guide to physical examination and history taking, Chapter 9, The Cardiovascular System, and Chapter 16, The Peripheral Vascular System.

PRACTICE:

Equipment Needed: Stethoscope
                   Watch with a second hand
                   Ruler and straight edge card
                   Good source of lighting
MODULE: CARDIOVASCULAR

STUDY QUESTIONS

1. State the features of a good stethoscope.

2. What type of sound is the bell best suited for? Give example.

3. What type of sound is the diaphragm best suited for: Give example.

4. Identify the phases of ventricular diastole (2 phases), isovolumetric contraction and rapid ventricular ejection on a diagram of the cardiac cycle.

5. Identify the heart sound representing the beginning of ventricular systole.

6. Identify the heart sound representing the end of ventricular systole.

7. Diagram the anatomy of the heart (chambers, valves, muscles, vessels) and explain the physiology of blood flow through the heart (changes in pressures, valvular movements, muscle contraction).

8. Describe the AV valvular pathophysiology which may occur during systole? During diastole?

9. Describe the aortic and pulmonic valvular pathophysiology which may occur during systole? During diastole?

10. Describe the traditional areas of cardiac auscultation.

11. Explain the physiology of the first heart sound.

12. List the factors influencing the frequency and intensity of S2.

13. Explain the physiological splitting of S2.

14. Name the major causes of a pathological S3.

15. Explain how you would differentiate a normal S3 or S4 from an abnormal S3 or S4.

16. Explain the physiology of S3 and S4.

17. Name the major causes of a pathological S4.

18. Graph the following murmurs:
   a. midsystolic
   b. holosystolic
   c. early diastolic
19. Define the grades used to classify the loudness of a murmur.

20. Define the categories used to fully describe murmurs.

21. Describe the characteristics of innocent murmurs and pathological murmurs.

22. List additional systolic and diastolic sounds which may be heard during auscultation.

23. Explain at least four pathophysiologic valvular causes of systolic murmurs.

24. Name the valvular abnormalities causing diastolic murmurs.

25. List the maneuvers and/or positions which can be used as auscultatory aids.

26. Explain the positioning techniques used to accentuate an S3 and a murmur of aortic regurgitation.

27. Describe the common objective findings of arterial insufficiency and venous insufficiency.

28. What are the cardinal symptoms of the cardiovascular system?

29. Write the chart note for a complete cardiovascular exam.
ASSESSMENT OF THE CARDIOVASCULAR SYSTEM:

CONDUCTION SYSTEM

The cardiac cycle occurs because of electrically active tissue which forms the conduction system of the heart. Every cell of the conduction system (and muscles) has a sodium-potassium pump which pumps sodium and potassium ions in and out. When the resting electrical gradient is disturbed, a cell contracts, and the one next to it and so on, resulting in an impulse propagated through the conduction system and muscles. The SA Node in the R atrium spontaneously depolarizes at a rate of between 60-100 beats per minute. The impulse travels down the conducting system through the atria. The atria then depolarize electrically which produces the P wave in the ECG, and the mechanical contraction. Conduction slows in the AV node. Conduction then spreads through the HIS Bundle, the L and R bundle branches, and the Purkinje fibers. After the impulse leaves the Purkinje fibers, ventricular depolarization occurs, and a QRS is produced on the ECG, and the ventricles contract. The cycle is initiated again after a recovery period. (Refer to Mosby text, p. 374, Fig. 11-9 and 11-10)

ANATOMY AND PHYSIOLOGY OF THE HEART

The right side of the heart collects venous blood and pumps it to the lungs via the pulmonary artery; the blood returns via four pulmonary veins to the left atrium, then it is pumped from the left ventricle to the body. Events happen simultaneously on the right and left side.

The Cardiac Cycle
(Refer to p. 280 in Bates’ text)

I. History
A. Present Problem
   1. current cardinal symptoms: analyze each symptom or symptom complex
      a. chest discomfort
      b. increased dyspnea on exertion (DOE), breathlessness
      c. PND (paroxysmal nocturnal dyspnes), orthopnea, nocturnal cough
      d. edema
      e. dizzy, syncope
      f. palpitations
      g. fatigue
      h. hemoptysis
      i. claudication
      j. nocturia
      k. cyanosis
   2. Trace, chronologically, from when patient last felt well to present
   3. Coronary risk factors
   4. Functional severity
   5. Modifications of history for acutely, severely ill
   6. Source: patient, chart, family, friends

B. Related past health history

C. Related social history

D. Related family history

E. Review of systems

II. Physical Assessment of Cardiac Status
A. General appearance
   1. Facial and skeletal manifestations of congenital and systemic disorders: Marfanoid appearance, syndrome of mitral valve prolapse
   2. cachexia, obesity, affect
   3. Skin: color, texture, temperature, hair distribution, moistness, xanthomata
4. Nails: clubbing, cyanosis
5. Edema
   a. dependent
   b. generalized

B. Radial Pulse
   1. Compare for strength, equality, regularity, contour, volume, amplitude
   2. rate

C. Blood pressure: cuff width 20-25% wider than diameter of extremity
   1. check both arms if elevated, along with a standing blood pressure
   2. Hemodynamic BP
   3. Narrowed pulse pressure < 30mm Hg
   4. Widened pulse pressure > 40 mm Hg
   5. Paradoxical pulse

D. Lung assessment--check particularly for:
   1. Basilar crackles
   2. Pleural effusion

E. Jugular Venous pressure Determination
   1. Estimate vertical distance of venous pulsation above sternal angle
      a. venous pulsations can be observed on either side of neck, in suprasternal notch or supraclavicular fossae.
   2. characteristic of venous pulsations:
      a. cannot be palpated
      b. 3 distinct waves
      c. are easily obliterated
      d. decrease with sitting or standing
      e. pulsations vary with respirations
   3. Slowly raise head of supine patient. Note distance above the sternal angle at which veins collapse
      a. normally distention of the jugular vein is less than 3 centimeters above the sternal angle (of Louis) when the head of the bed is elevated 45 degrees.
   4. Increased venous pressure: common causes include R ventricular failure, tricuspid regurgitation, pregnancy, anemia thyrotoxicosis, respiratory distress, anxiety
   5. If suspected R heart failure, perform the HEPATOJUGULAR REFLUX TEST--sustained pressure over the R upper quadrant while the patient breathes easily.
      a. abnormal if venous pressure rises more than 1 cm.
   6. Decreased pressure: common causes include hypovolemia, dehydration

F. Jugular venous pulsations: reflect changes in pressure and volume of the R atrium and ventricle
   1. Normal
      a. A wave: produced by right atrial contraction, begins before S1
      b. C wave: often can't be seen on exam: occurs simultaneously with the beginning of ventricular systole
      c. X descent: follows A wave; caused by atrial relaxation
      d. V wave: caused by atrial filling prior to tricuspid opening
      e. Y descent: caused by opening of tricuspid valve

G. Carotids: Examine one side at a time
   1. palpate for amplitude, contour. Palpate just inside the lower medial border of relaxed SCM muscle at level of cricoid cartilage (avoid carotid sinus)
      a. decreased pulsation may be secondary to decreased stroke volume or atherosclerotic narrowing of the carotid artery
   2. auscultate for bruits: short systolic ejection noises secondary to partial obstruction to blood flow in an artery, or secondary to increase velocity and volume of flow. Auscultate supraclavicular areas too., Always consider that what you are hearing may be a heart murmur as heart murmurs may radiate to the neck.
a. **innocent bruits:** common in young adults and children (venous hum)
b. **pathologic bruits:** louder, higher pitched, extending into diastole, associated with thrill, older patient

**H. Examination of the heart**

1. **Inspection**
   a. able to lie flat
   b. chest symmetrical
   c. apex impulse
   d. movement elsewhere in precordium
2. **Palpation:** precordial impulses
   a. apical impulse: size, character, location
      i. normal: inside mid-clavicular line at 4-5 intercostal space, less than 2 cm. in diameter, occurring in early systole
      ii. abnormal: displaced alterally and downward, less than 1 intercostal space, holosystolic
   b. **thrills:** low-frequency palpable vibrations associated with heart murmurs
      i. thrill of mitral stenosis is palpable at the apex in diastole
      ii. thrill of mitral regurgitation is palpated in systole at the apex
      iii. thrill of aortic stenosis is palpated in the second right intercostal space
      iv. thrill of pulmonary stenosis is palpated in the second left intercostal space
      v. ventricular septal defects produce thrills palpable in the 3 and 4th intercostal spaces
   c. **sternal motion:** abnormal except with chest wall deformity
3. **Percussion:** occasionally of value to detect enlarged or displaced heart
4. **Auscultation:**
   a. stethoscope
      i. ear pieces should be snug and angle slightly forward
      ii. tubing should be double
      iii. tubing no longer than 15"
      iv. diaphragm best for listening to high-pitched sounds and murmurs-S1 and S2 ejection sounds, clicks, opening snaps; murmurs of aortic and pulmonary regurgitation VSD, apply firmly
      v. Bell—for listening to low-pitched sounds and murmurs. S3, S4, mitral and tricuspid diastolic rumbles. Apply with very light pressure.
   b. **how to listen**
      i. state of mind—focused concentration
      ii. tune in to individual sounds
      iii. listen for all sounds in order. e.g. S1, S2 one can predetermine the sound one wishes to hear—a sound can be missed unless you listen for it.
      iv. identify rate
      v. rhythm
      vi. identify S1 (use the apex impulse and carotid pulse to assist in Id systole and diastole) the apical impulse and carotid impulse immediately follow S1; S2 occurs after these pulses are FELT.
      vii. concentrate on each sound by thinking and saying “I will now listen to the first heart sound—is it normal, abnormal, diminished, intensified, blurred, split..."
      viii. identify S2 next, —is it normal, abnormal, diminished, intensified, blurred, split...
      ix. listen to systole by dividing it into thirds—early, mid, and late.
      x. identify extra sounds in systole—ejection sounds, clicks, rubs
      xi. listen to diastole—early, mid late
      xii. ID extra sounds in diastole—opening snaps, S3 (early of mid), S4 late
      xiii. listen for systolic murmurs
      xiv. listen for diastolic murmurs
c. positions: sitting, supine and left lateral
d. areas of auscultation
   i. “inch” from one site to another
   ii. concentrate on above steps in each area one listens
   iii. Areas of auscultation

Refer to Bates' text for areas of listening.

III. Physical Assessment of Vascular Status
A. Pulses: compare strength, contour, equality, and regularity of radial pulses

B. Blood pressure: right are--if Karotkoff sounds not audible palpate hemodynamic BP and P if hypotensive or if orthostatic symptoms if BP increased--compare both arms, both legs

C. head and Neck: palpate and auscultate carotids, great vessels at root of aorta for bruits

D. Abdomen: Asucultate, palpatate course of aorta, and auscultate iliac, renal, and femoral arteries

E. Legs
   1. inspect: color, temperature, dilated superficial veins, nails, hair distribution, edema
   2. Palpate: popliteal, post. tibia, dorsalis pedis pulses
      a. if thrombotic disease is suspected, inspect for engorged veins cords, tenderness, Homan’s sign, leg circumference
      b. suspected varicosities--standing exam
      c. suspected arterial insufficiency
         i. supine--raise legs 12” above R atrium & note color--pallor?
         ii. sitting with legs dependent--note time for color to ret. to skin n= 20 sec.
         iii. legs dependent for extended period: arterial deficit produces violaceous color
         iv. note time for color to return to area blanched by finger pressure
         v. skin: inspect for temperature, atrophy, hair loss, ulceration
         vi. nails--inspect for thickening, ridging, malnourishment
## CARDIOPULMONARY EXAMINATION

** ** Branching Exam Procedure

<table>
<thead>
<tr>
<th>COMPONENT ACTIVITIES</th>
<th>DONE</th>
<th>NOT DONE</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td><strong>NECK (sitting)</strong></td>
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<tr>
<td>1. Inspect carotid pulses</td>
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<td>2. Palpate carotid pulses—one side at a time</td>
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<tr>
<td>3. Auscultate carotid pulses</td>
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<td>4. Inspect jugular venous pulsations</td>
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<td><strong>UPPER EXTREMITIES</strong></td>
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<tr>
<td><strong>Inspection</strong></td>
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<tr>
<td>1. Both hands and arms—fingertips to shoulders</td>
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<tr>
<td>a. Inspect nails</td>
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<td>b. Inspect hands, arms</td>
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<tr>
<td><strong>Palpation</strong></td>
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<tr>
<td>1. Nails—capillary filling</td>
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<td>2. Skin temperature hands, lower arms</td>
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<td>3. Radial pulses</td>
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<td>4. <strong>Ulnar pulses</strong></td>
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<td>5. **Allen test—check patency of radial and ulnar pulses</td>
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<td>6. Brachial pulses</td>
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<td>7. Epitrochlear nodes</td>
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<td><strong>POSTERIOR CHEST</strong></td>
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<td>1. Inspect symmetry, shape, quality of respirations, chest expansion</td>
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<td>2. Estimate anteroposterior diameter</td>
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<td>3. Palpate to assess chest expansion</td>
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<td>4. Palpate for tenderness</td>
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<td>5. ** Palpate for fremitus changes</td>
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<td>6. Percuss for symmetrical note</td>
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<td>7. Auscultate all lung fields</td>
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<td>8. Auscultate for:</td>
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<td>a. ** Post-tussive crackles</td>
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<td>b. ** Egophony changes</td>
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<td>c. ** Whispered pectoriloquy</td>
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<td>d. ** Bronchophony</td>
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<td><strong>ANTERIOR CHEST</strong></td>
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<tr>
<td>1. Inspect chest and precordium for deformities, respiratory distress, heaves</td>
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<td>2. Observe quality and rate of respiration</td>
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<td>3. Palpate for tenderness, lesions</td>
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<td>4. Percuss for symmetrical note</td>
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<td>5. Auscultate all lung fields for quality of breath sounds and adventitious sounds</td>
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<td>6. Auscultate heart (diaphragm and bell), starting at the base</td>
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<td>a. State where S1 is best heard and where S2 is best heard</td>
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<td>b. Aortic second right intercostal space at right sternal border</td>
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<td>c. Pulmonic second left intercostal space at left sternal border</td>
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<td><strong>d.</strong> Second pulmonic area: third left intercostal space at left sternal border</td>
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<td><strong>e.</strong> Tricuspid area: fourth left intercostal space at left sternal border</td>
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<td><strong>f.</strong> Mitral (apical) fifth left intercostal space mid clavicular live apex</td>
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<td><strong>g.</strong> **Use diaphragm to listen to aortic area and LSB with client leaning forward after complete exhalation for aortic murmurs</td>
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**NECK VESSELS (supine)**

**HOB elevated at 30°**

1. Inspect external and/or internal jugular venous pulsations
2. Measure and record jugular venous pressure in cm (above or below sternal angle) along with the angle of the bed
3. **Abdomino jugular test**
4. Observe timing of jugular venous pulsations—compare wave patterns with ausculted heart sounds

**HEART (supine)**

1. Inspect precordium
2. Palpate with palmar surface of hand at base of fingers
   a. Right 2nd interspace (aortic)
   b. Left 2nd interspace (pulmonic)
   c. 2nd pulmonic, 3rd left interspace
   d. 4th left interspace (tricuspid)
   e. 5th left interspace (mitral)
3. Auscultation
   a. Diaphragm
   b. Bell
   c. **Left lateral position-listen at apex with bell**

**ABDOMEN**

1. Inspect abdominal aortic pulsations
2. Auscultate for bruits using bell:
   a. Epigastrium
   b. R and L upper quadrants (renal arteries)
   c. R and L lower quadrants (iliac arteries)
   d. Femoral arteries
   e. **Renal bruits often heard better over CVA with client sitting**
3. Palpate aortic pulsations (deep palpation)
4. Palpate for lateral pulsations (R/O aneurysm)

**LOWER EXTREMITIES**

1. Inspect both legs
2. Palpation
   a. Skin temperature of legs and feet
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<td>c. Femoral vein for tenderness</td>
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<td>d. Femoral pulses</td>
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<td>e. Popliteal pulses</td>
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<td>f. Dorsalis pedis pulses</td>
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<td>g. Posterior tibial pulses</td>
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<td>h. Edema-palpate for 5 seconds</td>
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<td>i. Behind medial malleoli</td>
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<td>ii. Dorsum of feet</td>
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<td>iii. Shins</td>
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<tr>
<td>i. Calf tenderness, tension</td>
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<tr>
<td>i. **Have client sit up, legs dangling-look for delay in color return of venous filling or marked redness</td>
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<td>ii. **Sitting, standing, squatting, Valsalva maneuver can be used to accentuate or diminish a murmur</td>
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<td>iii. **Client standing-look for varicosities inspect for redness/discholoration and palpate for tenderness or cords</td>
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