How to Examine the Cardiovascular System The Essentials

Joel Niznick MD FRCPC

 …...bridging the care gap

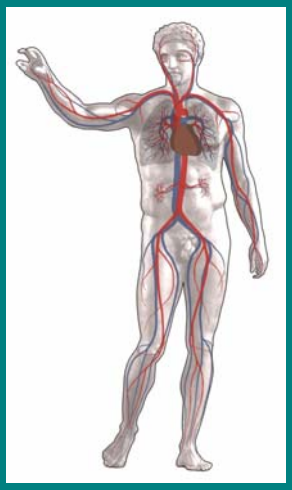
Learning Objectives

- Explain a basic approach to the physical examination of Cardiovascular System including inspection, palpation and auscultation.
- Demonstrate the basic use of the stethoscope.
- Demonstrate how to properly measure the heart rate, and respiratory rate.
- Demonstrate how to take an office blood pressure as per the Canadian Hypertension Program (CEHP).
- Demonstrate the normal location of the apical impulse.
- Demonstrate manoeuvres to elicit the apical impulse and auscultation of the heart.

 …...bridging the care gap

Examining the Heart and Circulation

- **Inspect the patient**
- **Feel the pulses, rate and rhythm**
- **Measure the BP**
- **Inspect the neck veins**
- **Palpate and auscultate the carotids**
- **Palpate the precordium and apex**
- **Auscultate the precordium and apex**
- **Palpate the peripheral pulses and listen for bruits**
- **Examine the extremities for venous insufficiency/trophic changes**



How to Examine the Heart & Circulation

- Need to be able to recognize normal to diagnose abnormal
- Examine the heart & circulation from peripheral to central putting the pieces of the puzzle together as you go
- By the time you put the stethoscope on the chest you should know what you will hear

Establish the Stability of the Patient

- A - Airway – patent/obstructed
- B - Breathing – rate/pattern
- C - Circulation – HR/BP
- D - Describe the patient

- Comfortable/distressed
- Dyspneic/fatigued
- Pale/cyanosed
- Diaphoretic
- Dehydrated/volume depleted
- Congested/edematous/ volume overloaded

Inspection

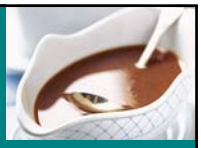
- Cyanosis
- Clubbing
- Xanthoma and xanthelasma
- Arcus senilis
- Stigmata of endocarditis
- Pectus excavatum/body habitus

Cyanosis/Clubbing

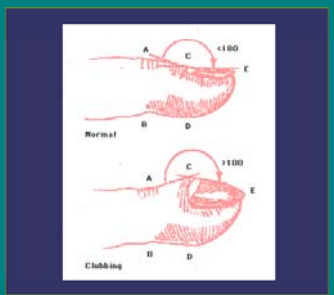
Cyanosis

Clubbing

Differential Diagnosis of Clubbing



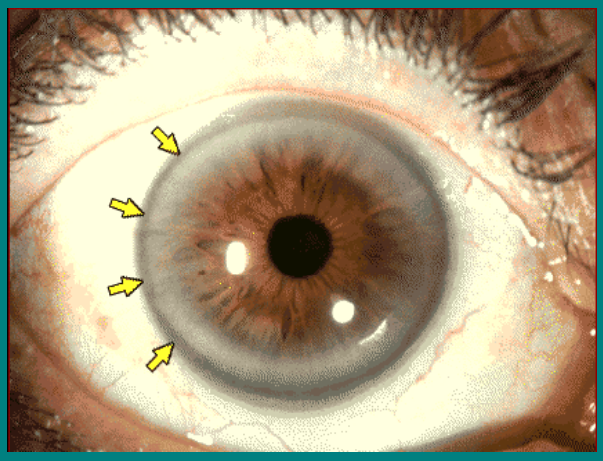
- Cyanotic congenital heart disease
- Lung disease
  - Cystic fibrosis
  - Interstitial fibrosis
  - Malignancy
  - Sarcoidosis
  - Bronchiectasis
- Hyperthyroidism



Clubbing of the fingers In a normal finger, the length of the a perpendicular dropped from point A to point B should be greater than a similar line from C to D. In clubbing, the relationships are reversed – that is, the distance C-D is greater than the distance A-B. The other important change is the angle described by A-C-E. In the normal finger this is usually <180 degrees whereas in clubbing it is >180 degrees. Redrawn from DeRemee, RA. Facets of the algorithmic synthesis. In: DeRemee, RA, (Ed), Clinical profiles of diffuse interstitial pulmonary disease, Mount Kisco, NY, Futura Publishing Company, Inc, 1990, pp. 9-44.

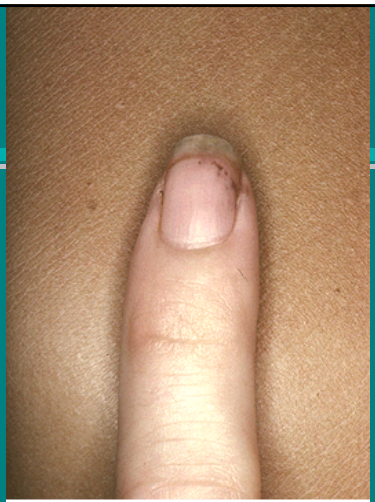
Arcus senilis (juvenilis)

Arcus juvenilis. This ring is associated with premature atherosclerosis

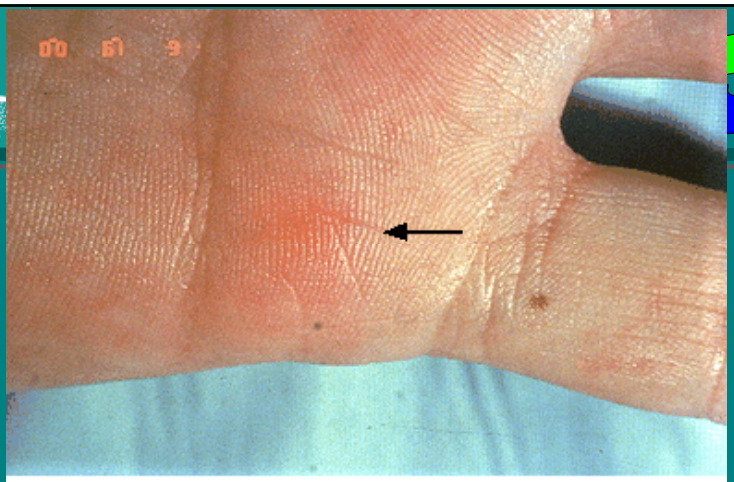


Xanthelasma Yellow plaques are present bilaterally. With permission from Slomovits, TL (Ed), Basic and clinical science courses section, American Academy of Ophthalmology, San Francisco 1996.

Subconjunctival petechiae in infective endocarditis Subconjunctival petechiae are prominent in this case of bacterial endocarditis caused by Staphylococcus aureus. Courtesy of Jan V Hirschmann. (The Skin and Infection: A Color Atlas and Text, Sanders, CV, Nesbitt, LT Jr (Eds), Williams & Wilkins, Baltimore, 1995.)



Splinter hemorrhages in infective endocarditis Splinter hemorrhages, linear reddish-brown lesions, are seen in the nail bed of this patient with bacterial endocarditis due to group B streptococcus. Courtesy of Gene Beyt. (The Skin and Infection: A Color Atlas and Text, Sanders, CV, Nesbitt, LT Jr (Eds), Williams & Wilkins, Baltimore, 1995.)



Janeway lesion in infective endocarditis A Janeway lesion (arrow) occurred on the palm in this patient with bacterial endocarditis due to Streptococcus bovis. These lesions are macular, blanching, and nonpainful, and are located on the palms and soles. Courtesy of Jan V Hirschmann. (The Skin and Infection: A Color Atlas and Text, Sanders, CV, Nesbitt, LT Jr (Eds), Williams & Wilkins, Baltimore, 1995.)

Osler's nodes in infective endocarditis Osler's nodes are tender, papulopustules located on the pulp of the finger in a patient with bacterial endocarditis caused by Staphylococcus aureus. Courtesy of Charles V Sanders. (The Skin and Infection: A Color Atlas and Text, Sanders, CV, Nesbitt, LT Jr (Eds), Williams & Wilkins, Baltimore, 1995.)

Pigmentation due to amiodarone

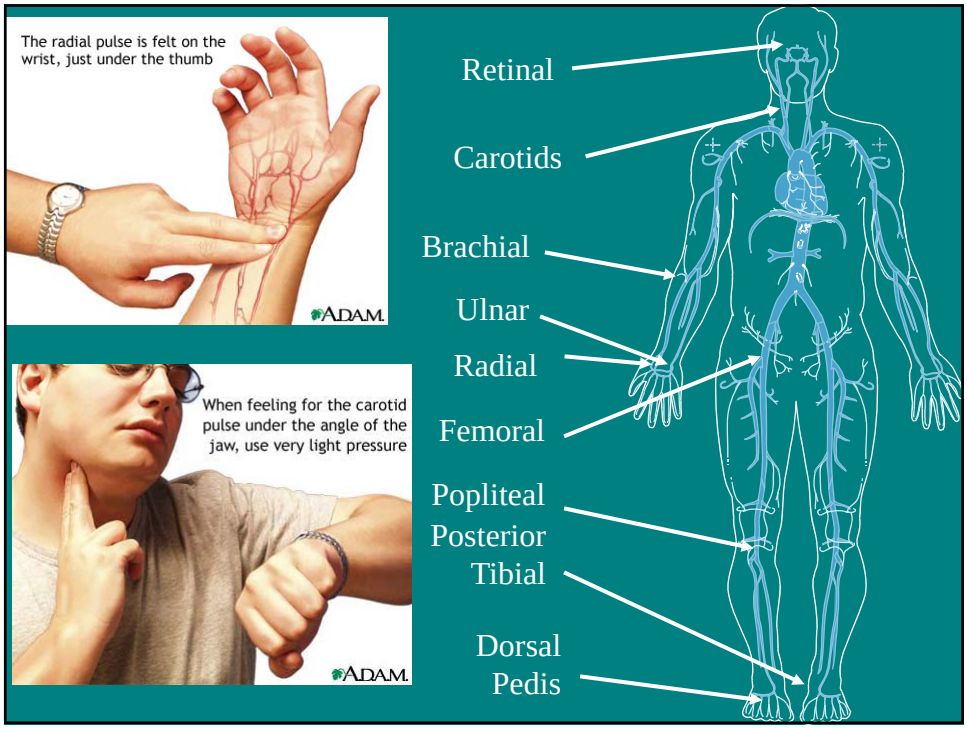
Describe the Pulse

Rate

- Normal sinus 60-100 bpm
- Sinus bradycardia < 60 bpm
- Sinus tachycardia > 100 bpm

Regularity

- Sinus arrhythmia- varies with respiration
- Intermittent irregularity –ectopic beats
- Continuously irregular (irregularly irregular – atrial fibrillation)



Feel Pulse Volume & Contour

Palpate at large vessels:

- Forearm/Brachial/Carotid/Femoral

Describe:

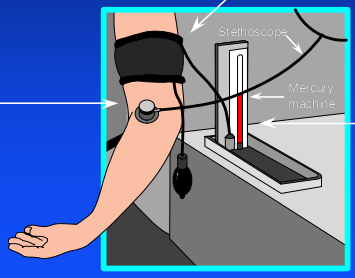
- Volume: Normal/increased/decreased
- Slow rising +/- brachial-radial delay (aortic stenosis -AS)
- Collapsing or water hammer pulse - (aortic regurgitation - AR)
- Bifid (bisferiens –AS/AR or IHSS)
  - Pulsus paradoxus
    - Tamponade
    - COPD
  - Pulsus alternans
    - LV dysfunction

Measure the Blood Pressure

RECOMMENDED BLOOD PRESSURE MEASUREMENT TECHNIQUE

1.
- The patient should be relaxed and the arm must be supported.
- Ensure no tight clothing constricts the arm.

2.
- The cuff must be level with heart.
- If arm circumference exceeds 33 cm, a large cuff must be used.
- Place stethoscope diaphragm over brachial artery.



3.
- The column of mercury must be vertical.
- Inflate to occlude the pulse. Deflate at 2 to 3 mm/s. Measure systolic (first sound) and diastolic (disappearance) to nearest 2 mm Hg.

3

Blood Pressure Assessment: Patient preparation and posture

Standardized technique:

Posture

The patient should be calmly seated for at least 5 minutes, with his or her back well supported and arm supported at the level of the heart. His or her feet should touch the floor and legs should not be crossed.

The patient should be instructed not to talk prior and during the procedure.

Blood Pressure Assessment: Patient position

Blood Pressure Assessment: Patient preparation and posture

Standardized technique:

Patient

1. No caffeine in the preceding hour.
2. No smoking or nicotine in the preceding 15-30 minutes.
3. No use of substances containing adrenergic stimulants such as phenylephrine or pseudoephedrine (may be present in nasal decongestants or ophthalmic drops).
4. Bladder and bowel comfortable.
5. Quiet environment. Comfortable room temperature.
6. No tight clothing on arm or forearm.
7. No acute anxiety, stress or pain.
8. Patient should stay silent prior and during the procedure.

Recommended Technique for Measuring Blood Pressure (cont.)

Select a cuff with the appropriate size

Cuff size

Arm circumference (cm)	Size of Cuff (cm)
From 18 to 26	9 x 18 (child)
From 26 to 33	12 x 23 (standard adult model)
From 33 to 41	15 x 33 (large, obese)
More than 41	18 x 36 (extra large, obese)

Recommended Technique for Measuring Blood Pressure (cont.)

- Locate brachial and radial pulse
- Position cuff at the heart level
- Arm should be supported

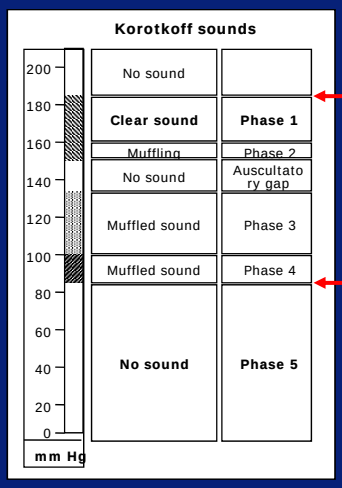
Recommended Technique for Measuring Blood Pressure (cont.)

- To exclude possibility of auscultatory gap, increase cuff pressure rapidly to 20-30 mmHg above level of disappearance of radial pulse
- Place stethoscope over the brachial artery

Recommended Technique for Measuring Blood Pressure (cont.)

- Drop pressure by 2 mmHg / sec
  - Appearance of sound (phase I Korotkoff) = systolic pressure
- Record measurement
- Drop pressure by 2 mmHg / beat
  - Disappearance of sound (phase V Korotkoff) = diastolic pressure
- Record measurement
- Take 2 blood pressure measurements, 1 minute apart

Recommended Technique for Measuring Blood Pressure (cont.)



Systolic BP

Diastolic BP

Possible readings:
184 / 100
136 / 100
184 / 86 = correct
136 / 86

Recommended Technique for Measuring Blood Pressure (cont.)

Record the blood pressure to the closest 2 mmHg on the manometer (avoid digit preference (0,5)

Record HR

Record the arm used

Record whether the patient was supine, sitting or standing.

Recommended Technique for Measuring Blood Pressure

Standardized technique:

- For initial readings, take the blood pressure in both arms and subsequently measure it in the arm with the highest reading.
- Thereafter, take two measurements on the side where BP is highest.

Recommended Technique for Measuring Blood Pressure (cont.)

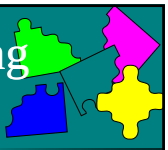
- The seated blood pressure is used to determine and monitor treatment decisions.
- The standing blood pressure is used to test for postural hypotension: elderly, diabetics, diuretics.
- A fall in systolic BP > 10 mm Hg is significant

BP Treatment Targets	Condition
160/100	Treatment threshold if no risk factors, TOD or CCD
< 140/90 Normal office BP	Treatment target for office BP measurement
< 135/85 Normal Home BP	Treatment target for for ABP or HBP measurement
< 130/80	Treatment target for for Type 2 diabetics or non-diabetic nephropathy or CAD (AHA)

What are the indications for checking the BP in both arms?

- The presence of both arms
  - R/O
    - Atherosclerotic obstruction
    - Scalenus anticus syndrome/cervical rib
    - Aortic coarctation above left subclavian
    - Anomalous origin right subclavian artery in aortic coarctation

What are the indications for checking BP in the lower extremities?



- Hypertensive patient under 40 years of age.
- Elderly patient with suspected PVD

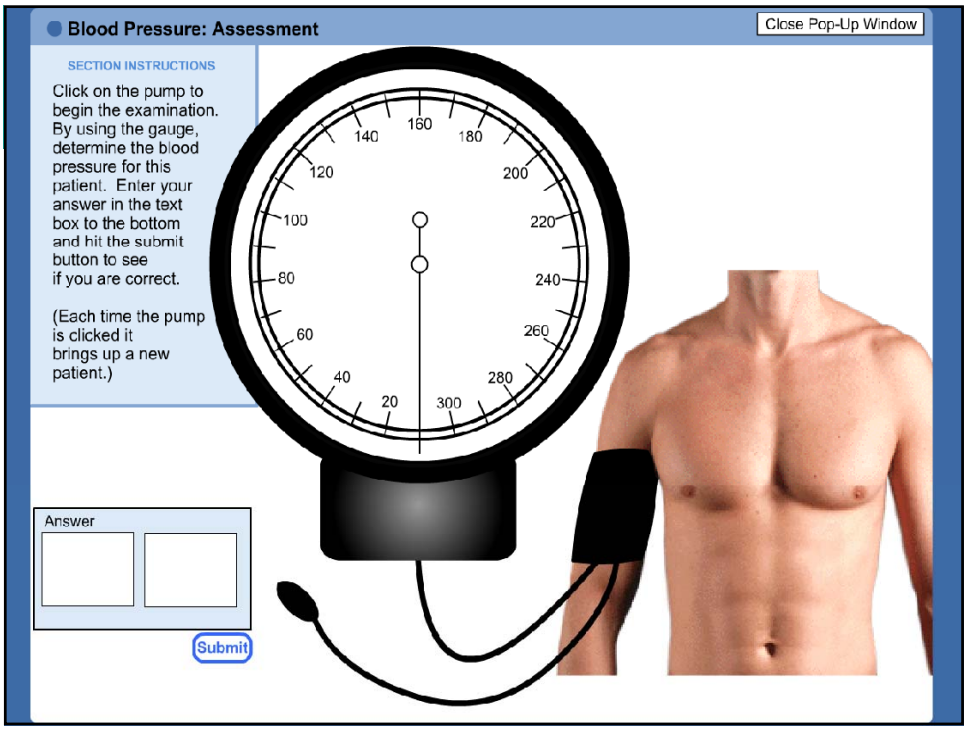
How do you do it?

- Thigh cuff-auscultate over popliteal artery
- Large arm cuff around calf (bladder posterior) -palpate PT or DP

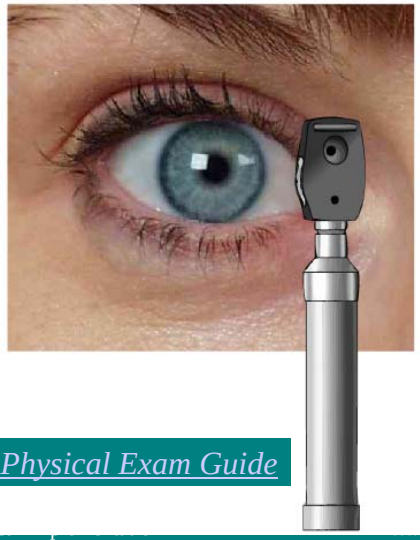
Which is normally higher- arm or leg BP?

Ankle-Brachial Index

- Resting and post exercise SBP in ankle and arm.
  - Normal ABI > 1
  - ABI < 0.9 has 95% sensitivity for angiographic PVD
  - ABI 0.5- 0.84 correlates with claudication
  - ABI < 0.5 indicates advanced ischaemia



Look at the Fundi

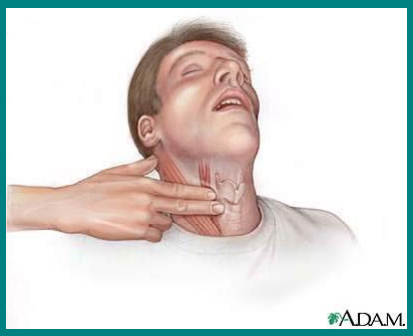


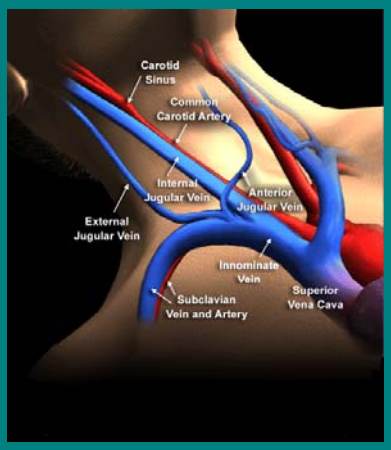
OSU Interactive Physical Exam Guide

Look at the Fundi

- Disc
- Vessels
  - Hypertensive retinopathy
  - Diabetic retinopathy
- Hemorrhages
- Exudates

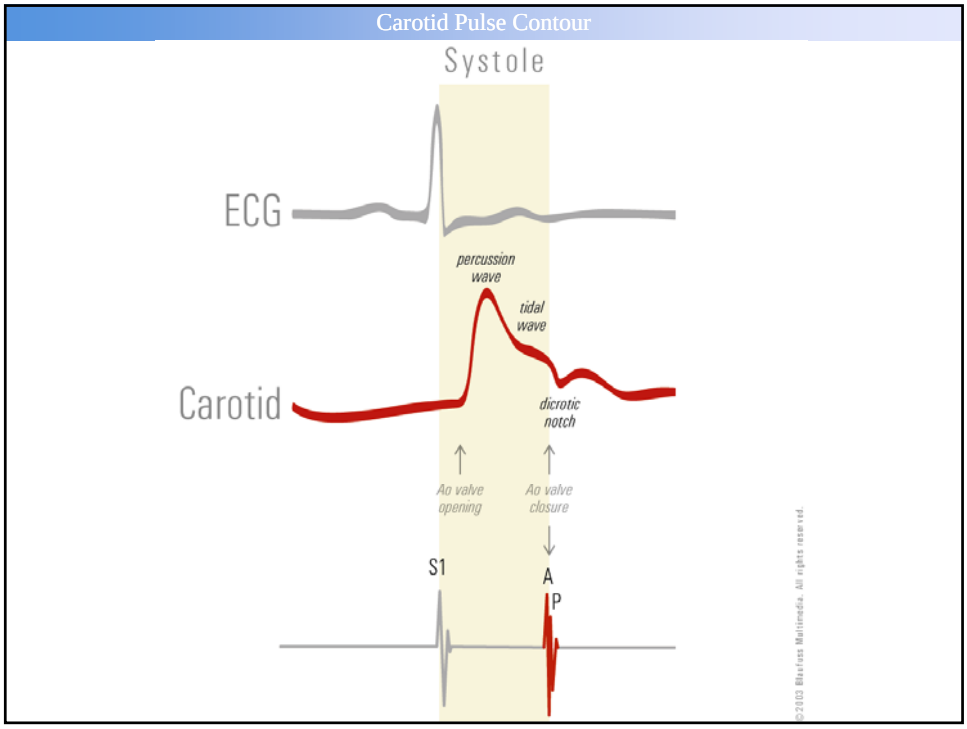
Palpate the Carotid





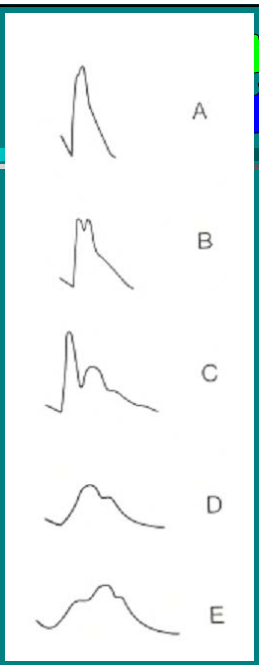
Carotid Examination

- Carotid upstroke
  - brisk, normal or delayed
  - volume: normal, increased or decreased
  - Anacrotic or Bisferiens
- Carotid auscultation
  - Bruit
  - Transmitted murmur
  - A^2 audible in neck? Presence excludes severe AS



Carotid Pulse Contours

- A. Hyperkinetic
  - Aortic regurgitation
- B. Bifid
  - AS/AR
- C. Bifid typical of
  - IHSS
- D. Hypokinetic
  - LV dysfunction
- E. Parvus et Tardus
  - Aortic stenosis



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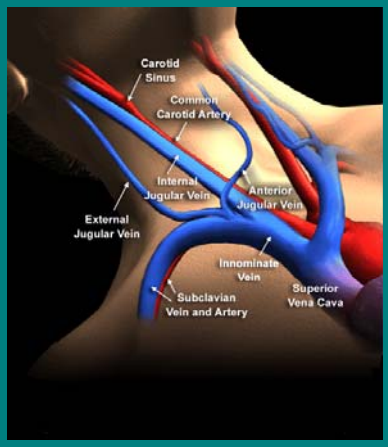
JVP Inspection

Jugular Venous Pressure

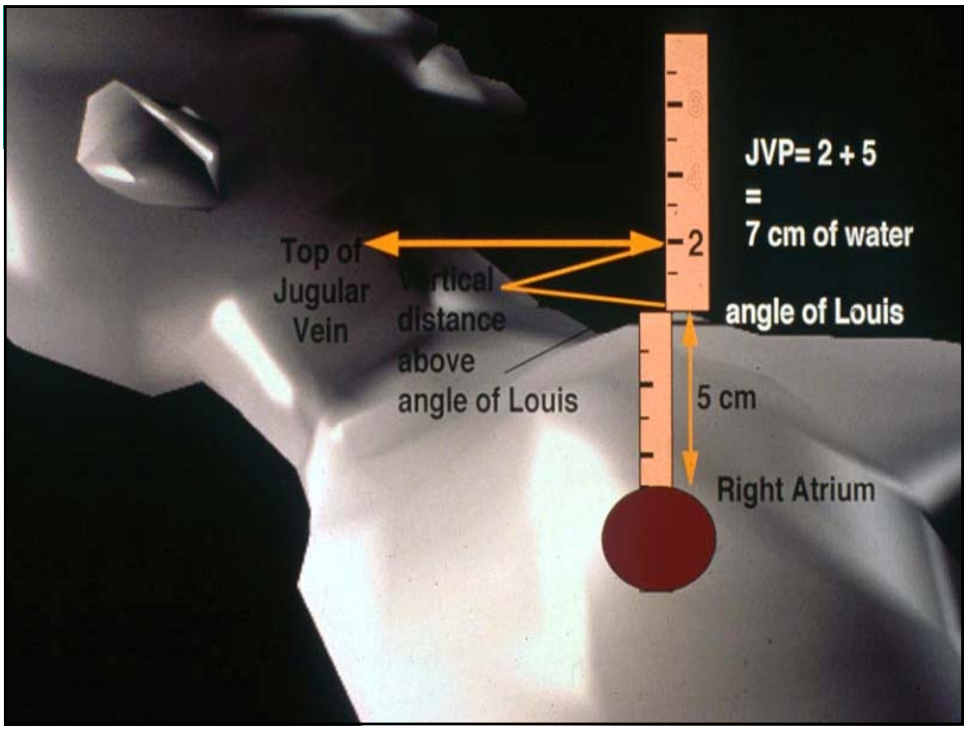
- **To assess the volume status of the circulation**
- **Level**
- **Waveform**
- **Differentiate from carotid**
  - **Multiple wave forms**
  - **Compressible**
  - **Varies with inspiration and abdominal pressure**



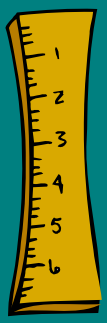
Jugular Venous Pressure

- Sternal angle is the reference point for JVP
- Level of sternal angle is about 5 cm above the level of mid right atrium IN ANY POSITION.
- JVP is measured in ANY position in which top of the column is seen easily.
- Usually JVP is less than 8 cm water

  < 3 cm column above level of sternal angle.



Use the hand made ruler



Normal JVP Waveform

- Consists of 3 positive waves
  - a,c & v
- And 3 descents
  - x, x'(x prime) and y

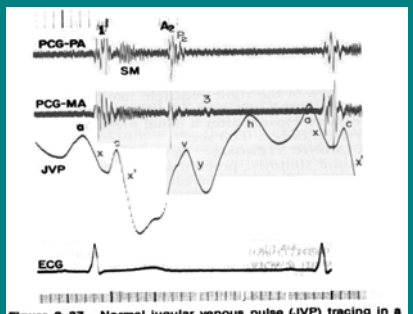
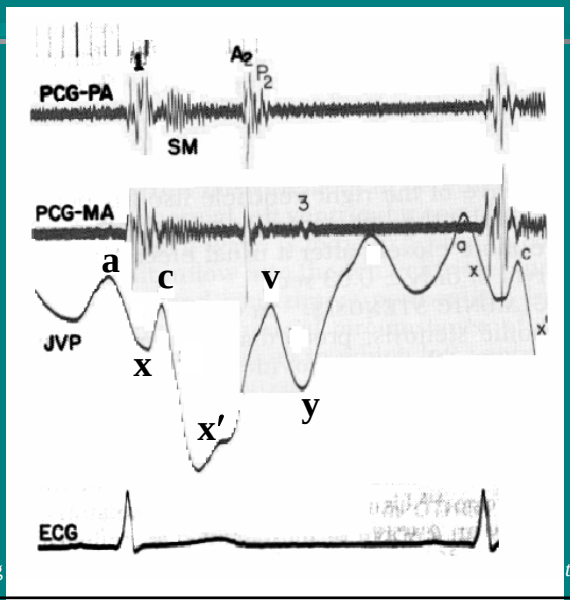


Figure 3–37. Normal jugular venous pulse (JVP) tracing in a young person with a functional systolic murmur (SM). The major features of the JVP are as follows: *a* wave, resulting from right atrial systole; *x* descent, atrial relaxation; *c* wave, tricuspid closure resulting from right ventricular contraction; *x'* descent, descent of the base plus continuing effect of atrial relaxation, associated with antegrade flow from the great veins; *v* wave, passive accumulation of blood in the right atrium while tricuspid valve is closed; *y* descent, passive filling of the right ventricle following opening of the tricuspid valve; *h* wave, a stasis wave in the venous system, apparent only at slower heart rates.

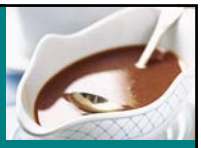
Normal JVP Waveform



JVP Waveform Identification

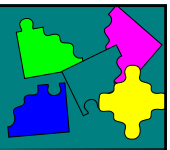
- It's easier than it looks !!!
- Look for descents not waves
- Time deepest descent with systole
- **This is the x' (prime) descent !!!**
  - Occurs during systole due to RV contraction pulling down the TV valve ring "descent of the base"
  - A measure of RV contractility
  - If the dominant descent is systolic-this is the x' descent- and JVP waveform is normal

Hepato-Jugular reflux and Kussmaul's sign



- Hepato-jugular reflux (various definitions)
  - sustained rise 1 cm for 30 sec.
  - ↑ venous tone & SVR
  - ↓ RV compliance
- Positive HJR correlates with LVEDP > 15
- JVP normally falls with inspiration
- Kussmaul's sign
  - inspiratory ↑ in JVP
  - constriction
  - rarely tamponade
  - RV infarction

Precordial Palpation



Sequence: (same sequence for Auscultation):

- Upper right sternal border -2ICS (intercostal space)
- Upper left sternal border - 2ICS
- Parasternal (left sternal border 3rd - 5th ICS)
- Apex
- Apex left decubitus (patient rolled over halfway)
- Apex upright leaning forward

Precordial Palpation

Parasternal:

- Lift: RV enlargement or severe MR
- Thrill: VSD, HOCM (IHSS)
- Palpable P2 (ULSB): pulmonary hypertension
- Medial retraction: LV enlargement
- Lateral retraction: RV enlargement

Palpation - Apex

Apex:

- Palpable in 1 of 5 adults age 40
- Best felt with fingertips or finger pads

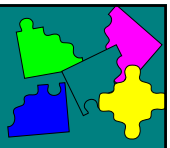
Normal Location:

- No more than 10 cm from mid-sternal line in the supine position
- Left decubitus position not reliable for apical location

Normal Size:

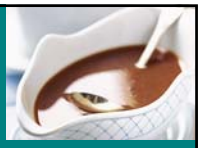
- No larger than 3 cm (about 2 finger breadths)

Apex-Dynamic Qualities



- LV impulse outward movement like a ping pong ball protruding between the ribs
- Apex moves outward for the first third of systole and falls away rapidly
- Lasts for no more than 2/3 of systole
- Sustained apex-hangs out to S2
  - correlates with pressure overload
  - (> 2/3 systole-hangs out to S2)
  - AS, LVH or LV systolic dysfunction

Apex–Dynamic Abnormalities



Hyperdynamic Apex:

- correlates with volume overload AR/MR

Palpable S4 (atrial kick) – stiff LV

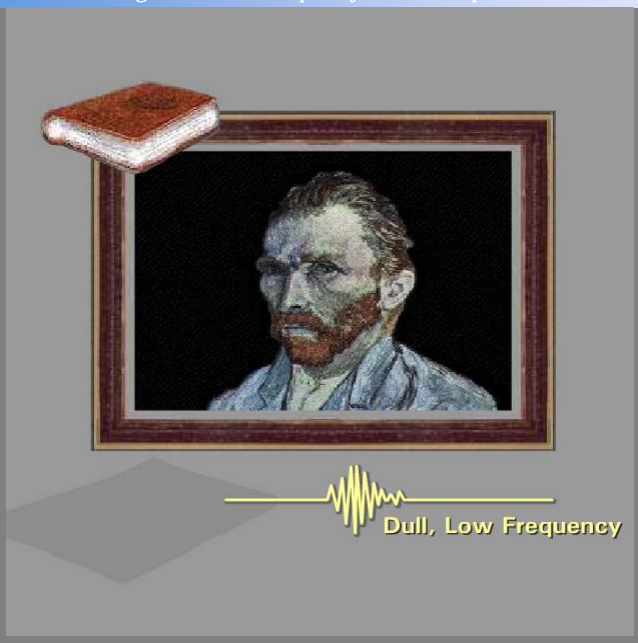
- Loss of LV compliance
- LVH 2º Hypertension
- Aortic Stenosis
- Hypertrophic Cardiomyopathy

Palpable S1 (MS)

Palpable non-ejection click (MVP)

Auscultation

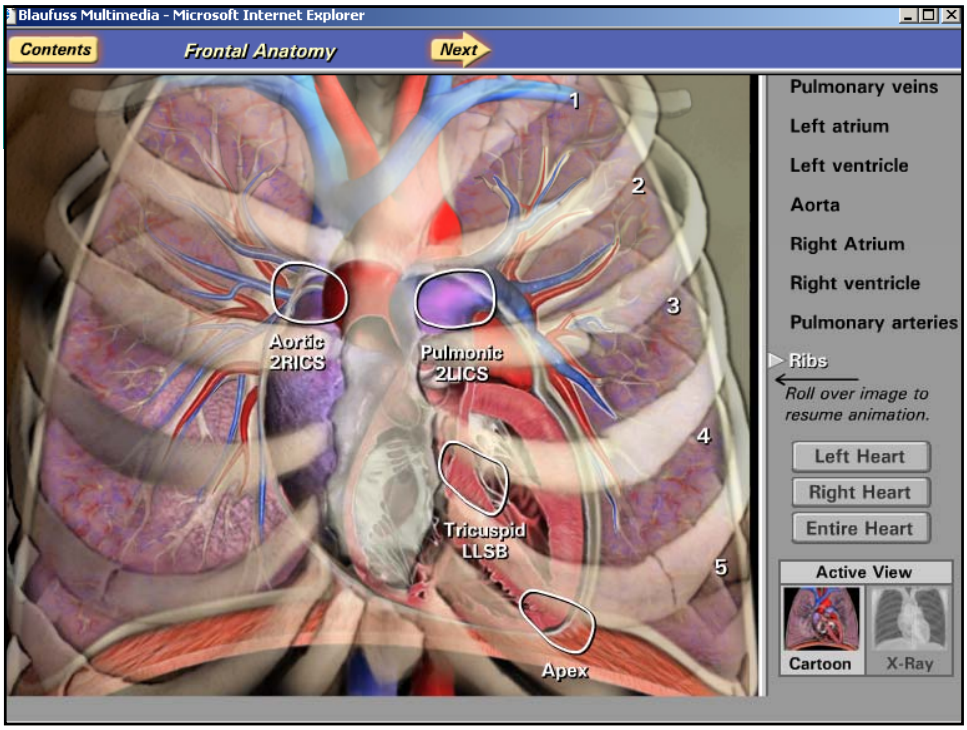
High- and Low-frequency Sounds Explained

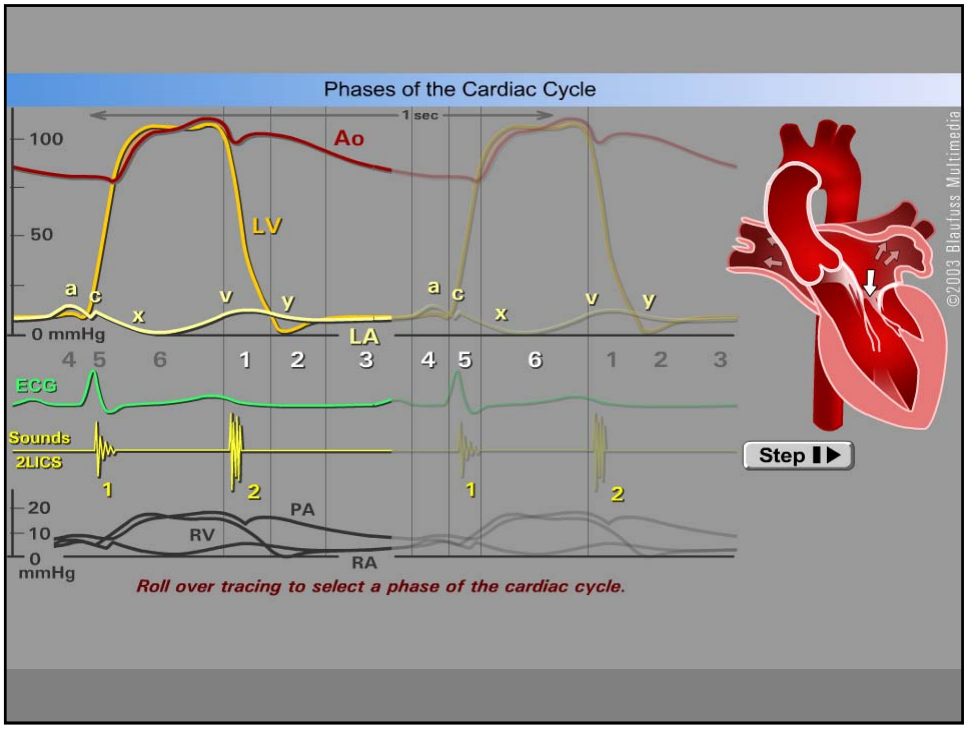


Auscultation

- Use the diaphragm for high pitched sounds and murmurs
- Use the bell for low pitched sounds and murmurs
- Sequence of auscultation
  - Upper right sternal border (URSB) with diaphragm
  - Upper left sternal border (ULSB) with diaphragm
  - Lower left sternal border (LLSB) with diaphragm
  - Apex with diaphragm and then bell
  - Apex - left lateral decubitus position with bell
  - Lower left sternal border (LLSB)- sitting, leaning forward, held expiration with diaphragm

 …...bridging the care gap

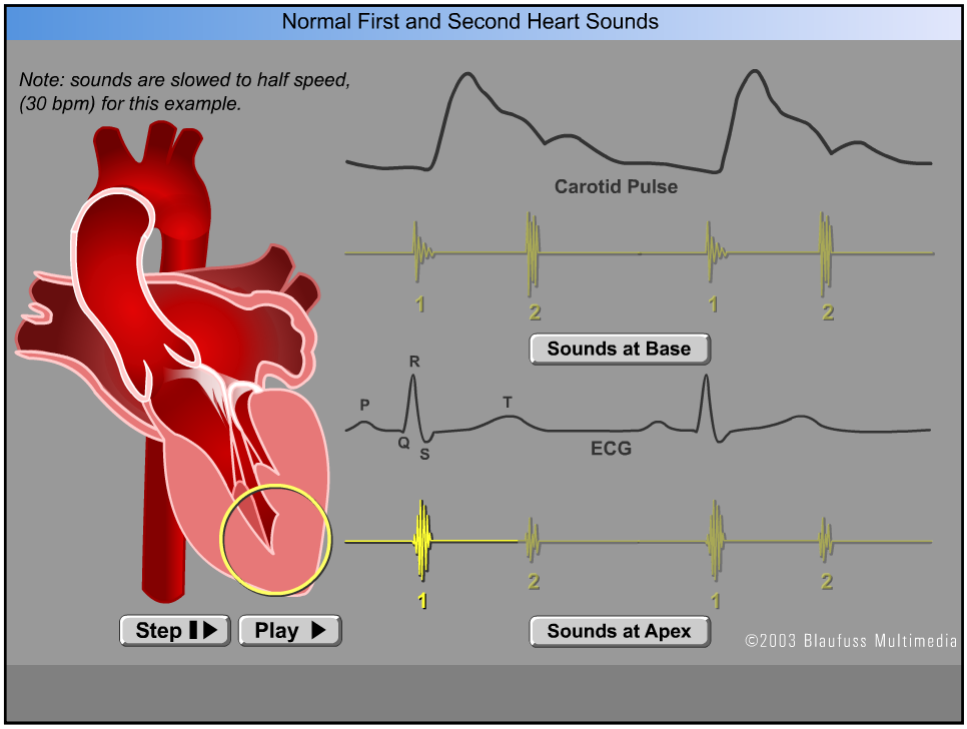




Identify Heart Sounds

- S1 – closure of mitral valve
- S2 – closure of aortic (A2) and pulmonary valves (P2)
- S4 – pre-systolic sound
  - atrial contraction filling non-compliant ventricle
  - Low pitched, bell, apex
- S3 – early diastolic filling of volume overloaded ventricle
  - Low pitched, bell, apex

…..bridging the care gap


Normal First and Second Heart Sounds
Note: sounds are slowed to half speed, (30 bpm) for this example.
Carotid Pulse
1
2
1
2
Sounds at Base
R
P
T
Q
S
ECG
1
2
1
2
Step
Play
Sounds at Apex
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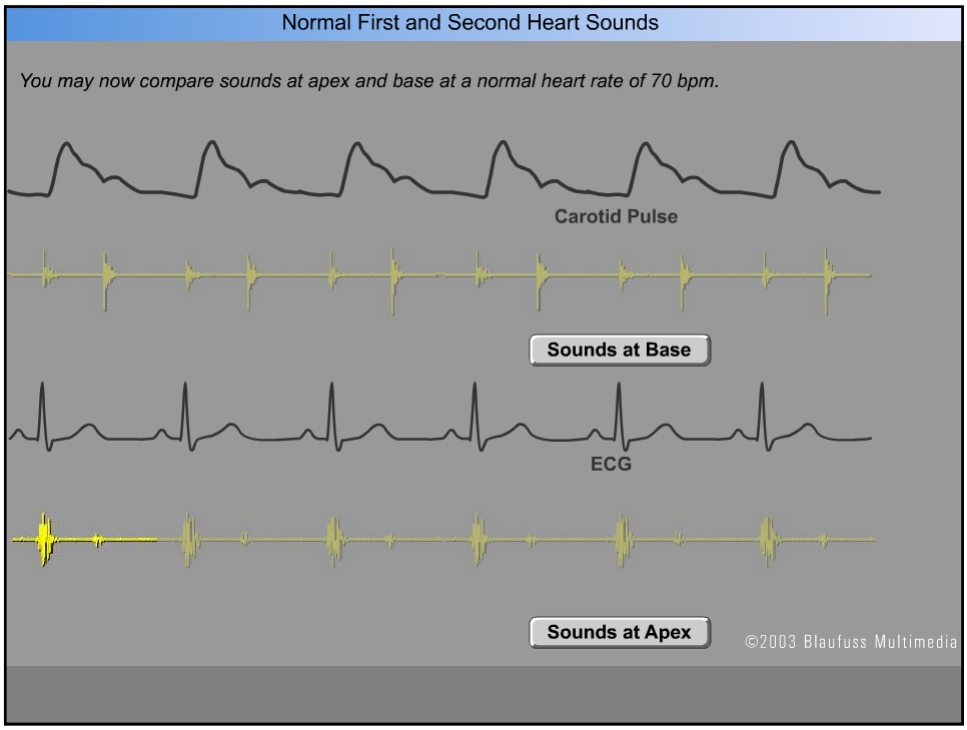
Normal First and Second Heart Sounds
You may now compare sounds at apex and base at a normal heart rate of 70 bpm.
Carotid Pulse
Sounds at Base
ECG
Sounds at Apex
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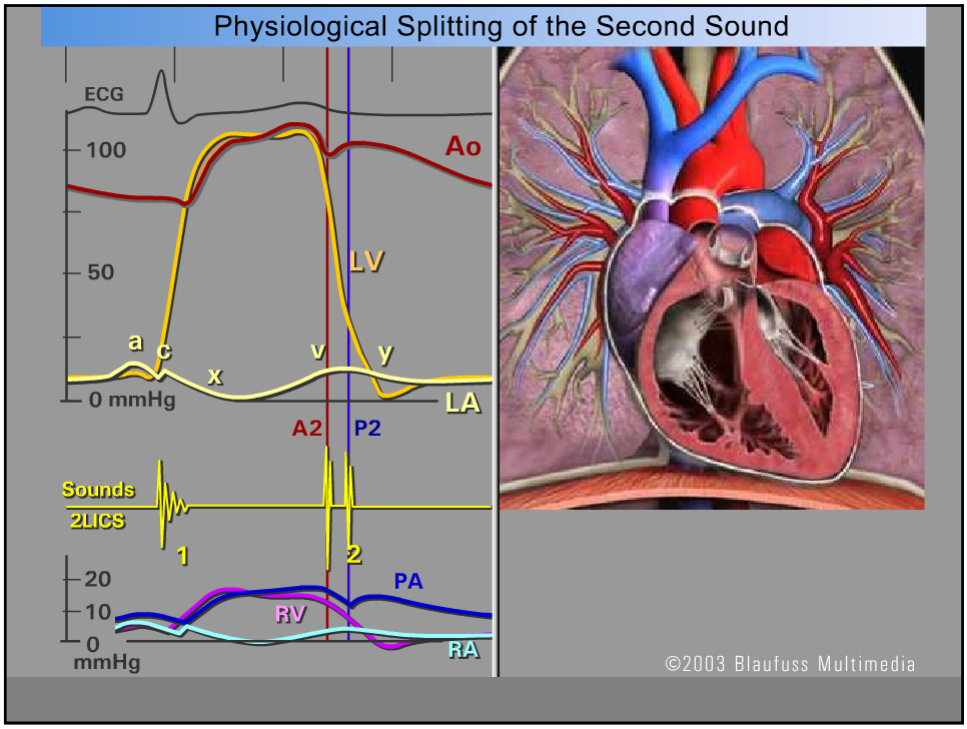
Physiological Splitting of the Second Sound
ECG
100
Ao
50
LV
a
c
x
v
y
0 mmHg
LA
A2
P2
Sounds
2LICS
1
2
20
10
0
mmHg
PA
RV
RA
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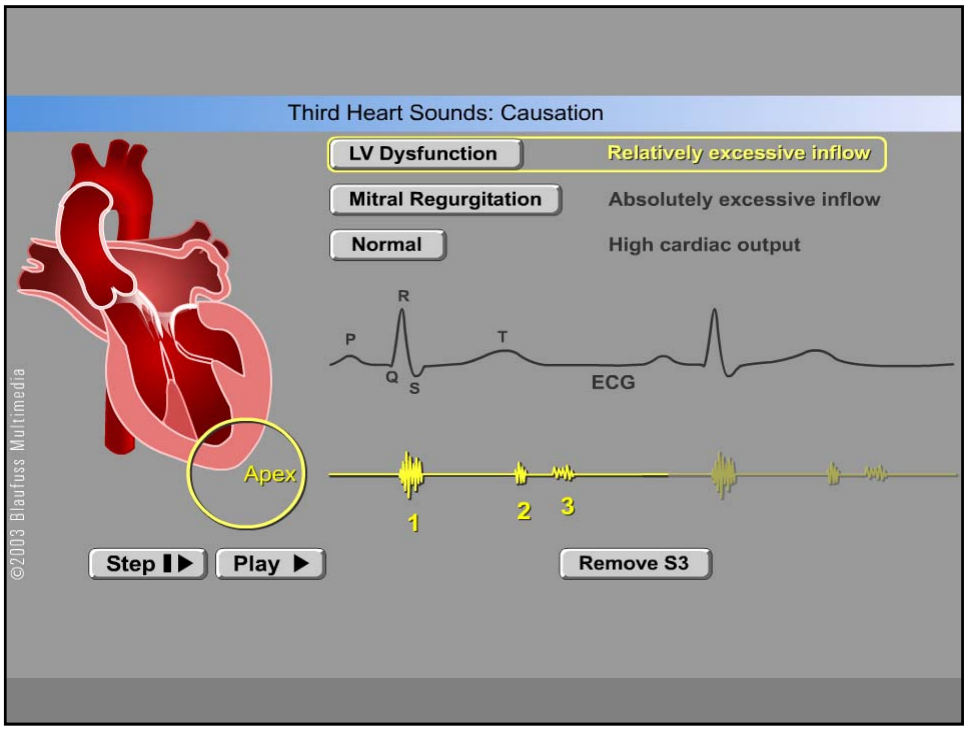
Third Heart Sounds: Causation
LV Dysfunction
Relatively excessive inflow
Mitral Regurgitation
Absolutely excessive inflow
Normal
High cardiac output
R
P
T
Q
S
ECG
Apex
1
2
3
Step
Play
Remove S3
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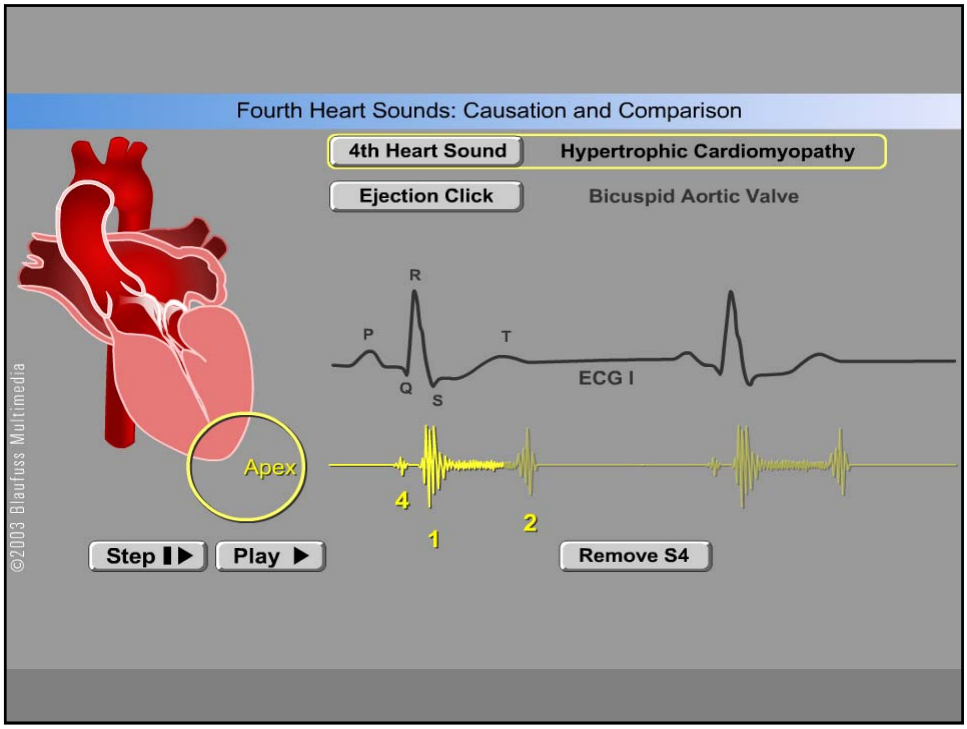
Fourth Heart Sounds: Causation and Comparison
4th Heart Sound
Hypertrophic Cardiomyopathy
Ejection Click
Bicuspid Aortic Valve
R
P
T
Q
S
ECG I
Apex
4
1
2
Step
Play
Remove S4
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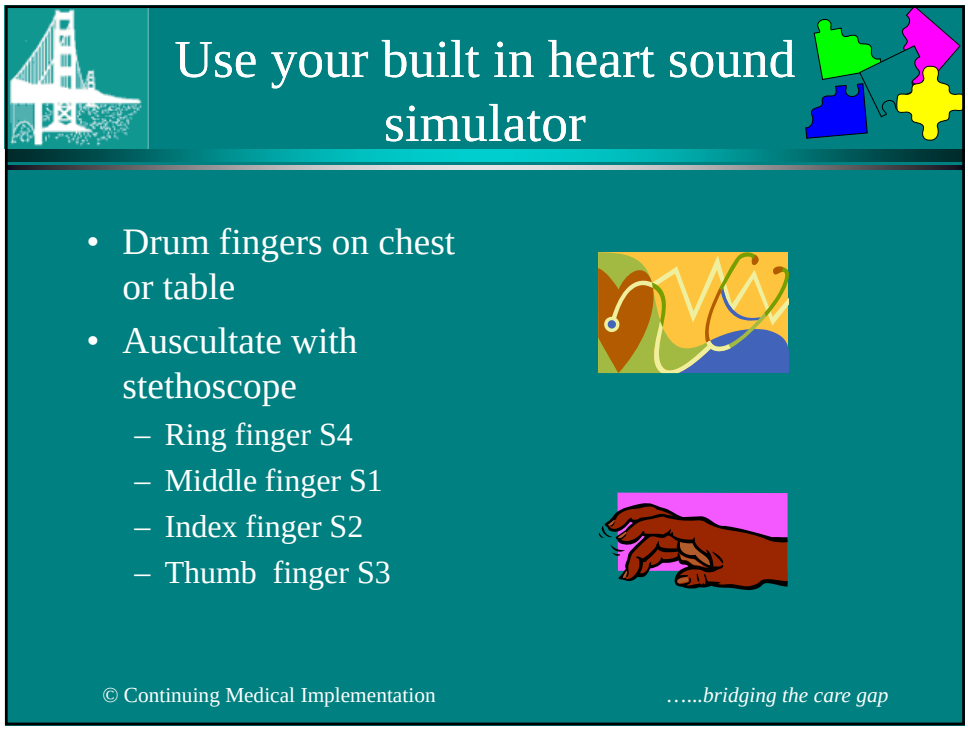
Use your built in heart sound simulator
• Drum fingers on chest or table
• Auscultate with stethoscope
– Ring finger S4
– Middle finger S1
– Index finger S2
– Thumb finger S3
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Listen for Extra Sounds

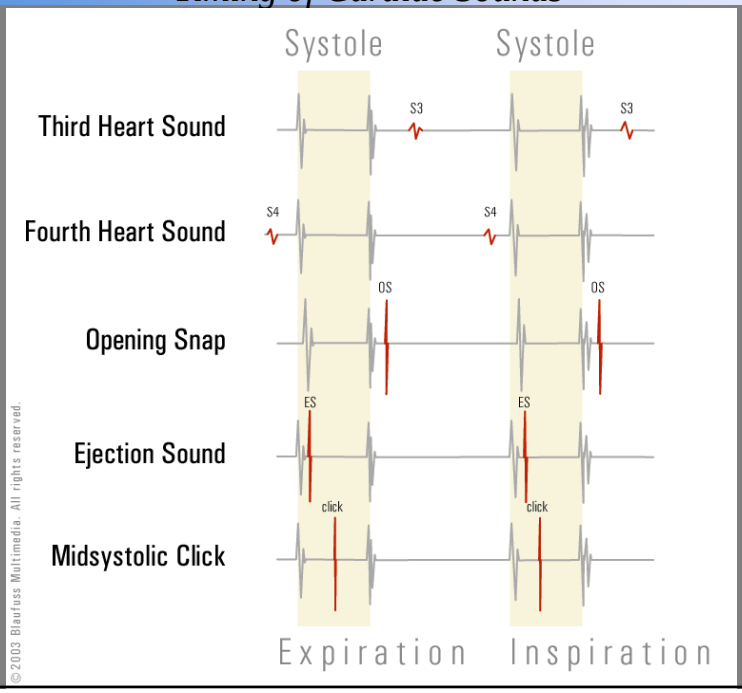
Systolic extra sounds

- Ejection click
  - Bicuspid aortic valve
  - Aortic root
- Non Ejection click
  - Mitral valve prolapse

Diastolic extra sounds

- Wide split S2
- Pericardial knock
- Opening snap of mitral stenosis

Timing of Cardiac Sounds



Listen for Murmurs

What is a murmur?

- A sound/vibration made by blood flowing through a normal valve or an abnormal valve.
- A sound made by blood flowing backwards through a leaking valve
- Murmurs may be functional or pathologic

Assessing Murmur Intensity

Grading of Murmurs:

Grade 1 - only a staff man can hear - faint

Grade 2 - audible to a resident – need to focus to hear

Grade 3 - audible to a medical student –easily heard

Grade 4 - associated with a thrill or palpable heart sound

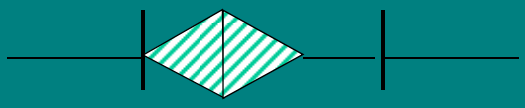
Grade 5 - audible with the stethoscope partially off the chest

Grade 6 - audible at the bed-side

Functional Murmurs
Common in Asymptomatic Adults

Characterized by

- Grade I – II @ LSB
- Systolic ejection pattern - no ↑ with Valsalva



- Normal precordium, apex, S1
- Normal intensity & splitting of second sound (S2)
- No other abnormal sounds or murmurs
- No evidence of LVH

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What are the types of murmurs?

Systolic

- Ejection quality
- Early, mid or late systolic
- Pan-systolic e.g mitral or tricuspid regurgitation

Diastolic

- Early diastolic regurgitant quality e.g. aortic or pulmonary regurgitation
- Diastolic rumble e.g. mitral stenosis =/- presystolic accentuation.

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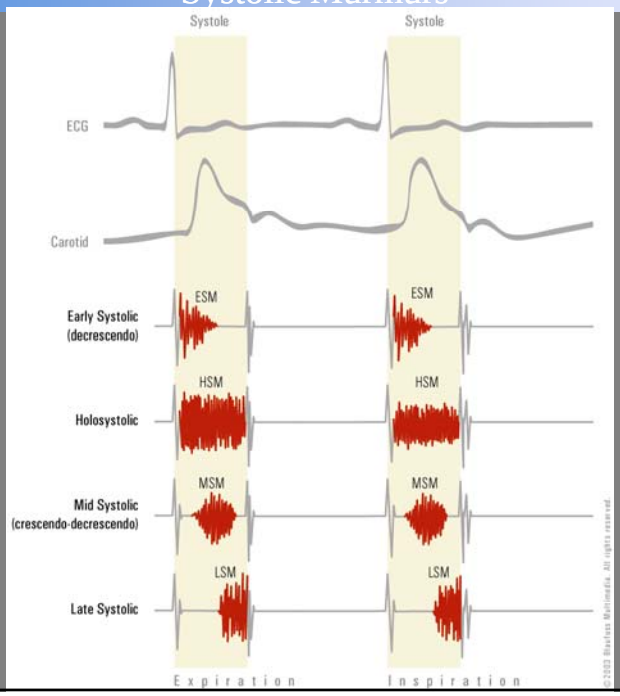
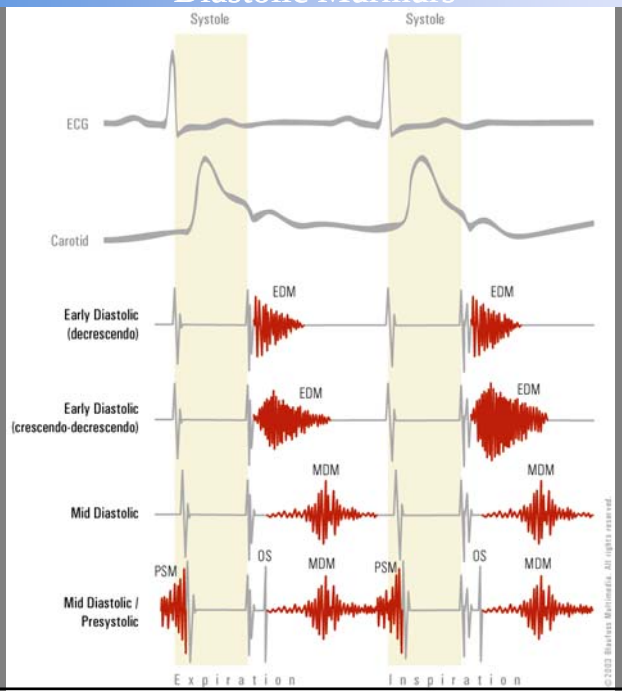
Characteristic of Pathologic Murmurs

- Diastolic murmur
- Loud murmur - grade 4 or above
- Regurgitant murmur
- Murmurs associated with a click
- Murmurs associated with other signs or symptoms e.g. cyanosis
- Abnormal 2nd heart sound – fixed split, paradoxical split or single

Systolic Murmurs



Diastolic Murmurs



Identify Murmurs and Timing

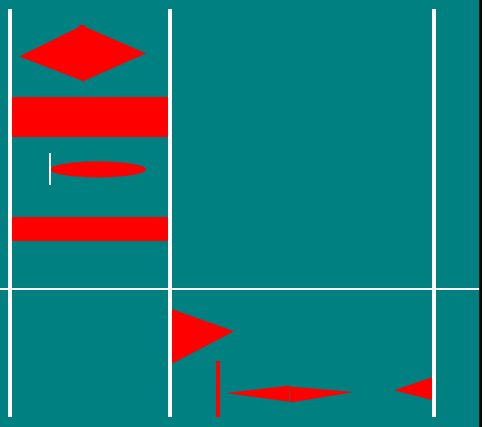
(Scroll over murmur icons to play)

<u>Systolic Murmurs</u>

- Aortic stenosis
- Mitral insufficiency
- Mitral valve prolapse
- Tricuspid insufficiency

<u>Diastolic Murmurs</u>

- Aortic insufficiency
- Mitral stenosis



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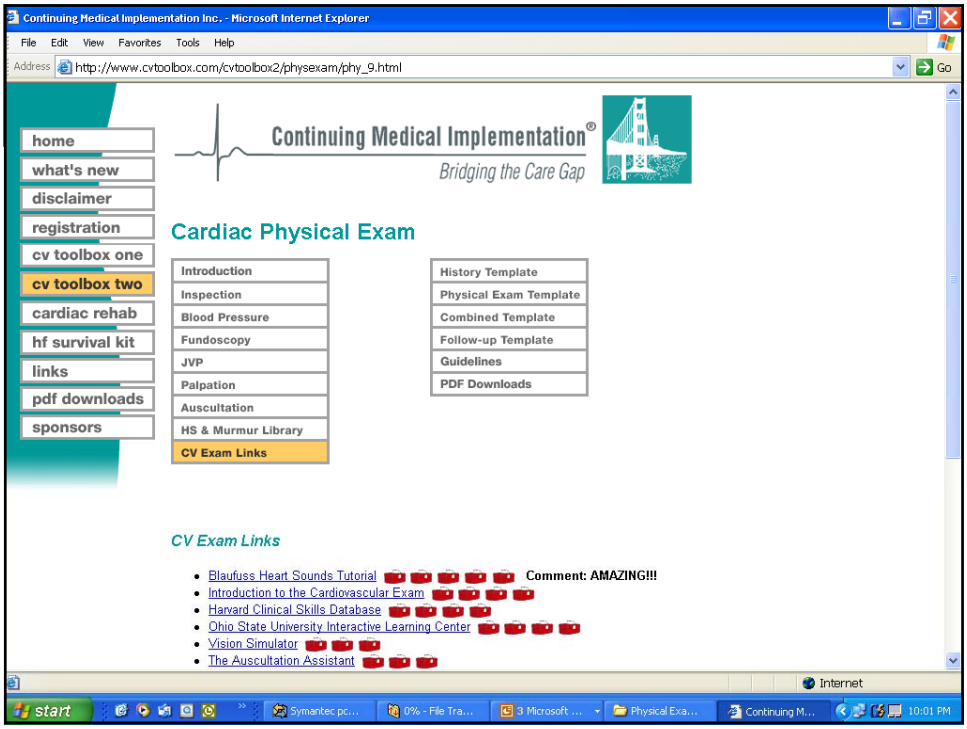
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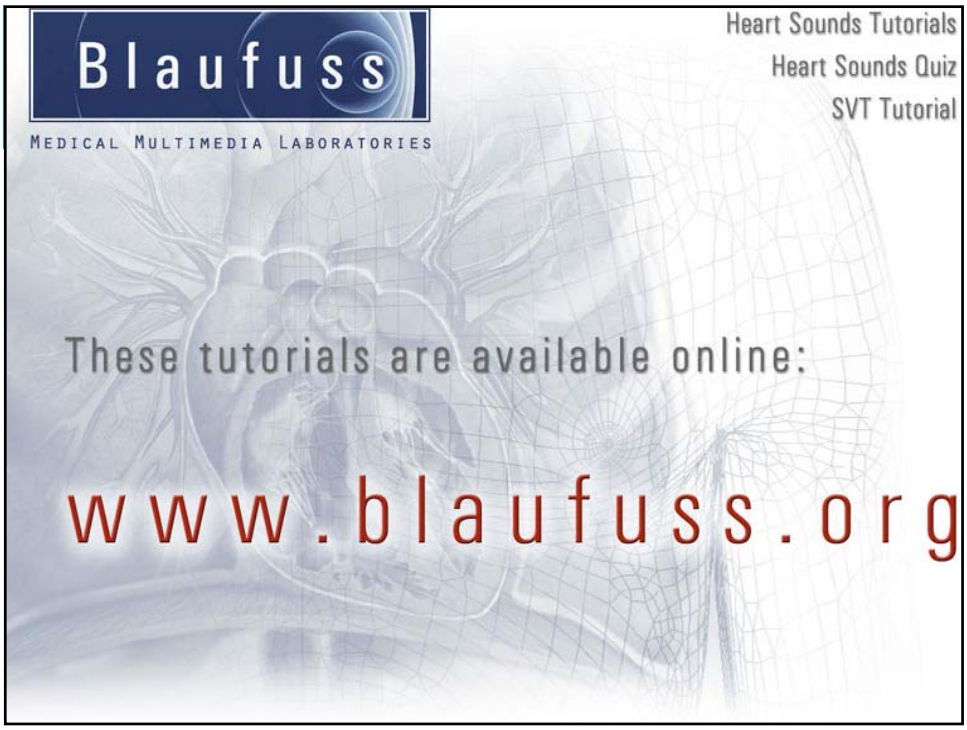
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