How to Examine the Cardiovascular System
The Essentials
2013

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To Become a Skilled Physician

You Must Develop Physical Skills

Specific Objectives

Specific Objective(s)
A. 12077 - Describe a basic approach to the Physical examination of the Cardiovascular system including Inspection, palpation and auscultation.
B. 12078 - Explain the basic heart sounds.
C. 12079 - Describe how to perform a blood pressure.
General Objectives:

- Demonstrate the basic use of the stethoscope.
- Approach to Vital Signs
  - Demonstrate how to properly measure the heart rate and respiratory rate.
- Blood Pressure Measurement
  - Demonstrate how to take an office blood pressure as per the Canadian Hypertension Program (CHEP).

How to Examine the Heart & Circulation

- For now we are just taking about the process and sequence of the exam
- 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

Examining the Heart and Circulation

1. Inspection
   - Form clinical impressions
   - Disease likelihood
2. Pulses
   - Rate and rhythm
3. BP
4. JVP
   - Height and waveform
5. Carotids
   - Palpate and auscultate
6. Palpation
   - Precordium and apex
   - Location, size, abnormal impulses
7. Auscultation
   - Precordium and apex
8. Peripheral pulses
   - Palpate and listen for bruits
9. Examine extremities
   - Arterial/venous insufficiency/trophic changes
**Pulse**

The radial pulse is felt on the wrist, just under the thumb.

**Vital signs**

- Heart Rate
  - Count the pulse for 15 seconds - multiply X 4
  - Count respiratory rate for 15 seconds X 4
  - Patient should be unaware you are counting

**Auscultation**
Establish the Stability of the Patient

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

**Elective Evaluation**
- Comfortable/distressed
- Dyspneic/distressed
- 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

Differential Diagnosis of Clubbing

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

Arcus senilis (juvenilis)

Arcus juvenilis. This ring is associated with premature atherosclerosis.
**Kantholasma** Yellow plaques are present bilaterally. With permission from Stenovits, TI (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, DV, Needell, LF Jr (Eds), Williams & Wilkins, Baltimore, 1995.)

**Splinter hemorrhages in infective endocarditis** Splinter hemorrhages, seen at right, are common in the nail bed of patients with bacterial endocarditis due to group A streptococci. Courtesy of Stan Bayl. (The Skin and Infection: A Color Atlas. Sanders, DV, Needell, LF Jr (Eds), Williams & Wilkins, Baltimore, 1995.)
MARFAN Syndrome
http://www.io.com/~cortese/marfan/
photographs used with permission

Body Habitus
• Tall/thin long facies
• Long fingers
  – Thumb sign
  – Wrist sign
• Ligamentous laxity
• Scoliosis/kyphosis
• Pectus excavatum/carinaatum
• Exotropia lentis
• Narrow long facies
• High arched palate

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Pigmentation due to amiodarone

Feel & 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 (bioparoiens – AS/AR or IHSS)
  - Pulsus paradoxus
  - Tamponade
  - COPD
  - Pulsus alternans
  - LV dysfunction

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Canadian Hypertension Education Program (CHEP)

RECOMMENDED BLOOD PRESSURE MEASUREMENT TECHNIQUE

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.

2.2. 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.

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

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

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.

3.3. 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.

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.

http://hypertension.ca/chep/recommendations-2009/
Blood Pressure Assessment:
Patient position

Blood Pressure Assessment:
Patient preparation and posture

Recommended Technique
for Measuring Blood Pressure (cont.)
### Cuff size

<table>
<thead>
<tr>
<th>Arm circumference (cm)</th>
<th>Size of Cuff (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 18 to 26</td>
<td>9 x 18 (child)</td>
</tr>
<tr>
<td>From 26 to 33</td>
<td>12 x 23 (standard adult model)</td>
</tr>
<tr>
<td>From 33 to 41</td>
<td>15 x 33 (large, obese)</td>
</tr>
<tr>
<td>More than 41</td>
<td>18 x 36 (extra large, obese)</td>
</tr>
</tbody>
</table>

### Recommended Technique for Measuring Blood Pressure (cont.)

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

- 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.)

Possible readings:

- 184 / 100 = 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.

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

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

Carotid Examination

• Carotid upstroke
  – Brisk, normal or delayed
  – Volume: normal, increased or decreased
  – Anacrotic or Bisteriens
• Carotid auscultation
  – Bruit
  – Transmitted murmur
  – A² 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


JVP Inspection

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'(prime), and y

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—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
Sequence of Precordial Palpation

Sequence same as 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

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

Apex
- Location
- Size
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 moves outward 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:
  – > 2/3 systole - hangs out to S2
  – correlates with LV pressure overload
  – AS, LVH or LV systolic dysfunction

Hyperdynamic Apex:
• correlates with volume overload AR/MR
Palpable S4 (atrial kick) – stiff LV
  – Loss of LV compliance
  – LVH 2nd Hypertension
  – Aortic Stenosis
  – Hypertrophic Cardiomyopathy
Palpable S1 (MS)
Palpable non-ejection click (MVP)
Auscultation

• Use the diaphragm for high pitched sounds and murmurs
  – Use firm pressure to bring out high pitched sounds and murmurs
• Use the bell for low pitched sounds and murmurs
  – Use light pressure to bring out low pitched sounds and murmurs
• If using tunable diaphragm
  – Firm pressure for high pitched sounds
  – Light pressure for low pitched sounds
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
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

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
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

Functional Murmurs
Common in Asymptomatic Adults

Characterized by
– Grade I – II @ LSB
– Systolic ejection pattern - no \uparrow with Valsalva
– Normal precordium, apex, S1
– Normal intensity & splitting of second sound (S2)
– No other abnormal sounds or murmurs
– No evidence of LVH

Identify Murmurs and Timing
(Click over murmur icons to play)
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

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.

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
Examining the Heart and Circulation

1. Inspection
2. Pulses
3. BP
4. JVP
5. Carotids
6. Palpation
7. Auscultation
8. Peripheral pulses
9. Examine extremities
Examining the Peripheral Pulses

- Femoral
- Popliteal
- Posterior Tibial
- Dorsal Pedis
- Radial
- Ulnar
- Brachial
- Retinal
- Carotids
- Renal
Examination of Pulses

- Grading:
  - Normal/Increased/Decreased/Absent
  - 2+/3+/1+/0
  - Allen's test
- Trophic changes/Ulceration
- Perfusion
  - Pallor on elevation
  - Rubor on dependency
  - Venous refill with dependency (should be less than 30 seconds)
- Bruits

Trophic Changes

Shiny, hairless skin, dystrophic nail changes and dependent rubor associated with peripheral arterial occlusive disease of the patient’s right foot

Pallor on elevation

Rubar on dependency
Digital Ischaemia Gangrene

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A Practical Guide to Clinical Medicine - UCSD

Acute Arterial Insufficiency: Mottled Appearance of Skin

Chronic Arterial Insufficiency with Ulcers

http://medicine.ucsd.edu/clinicalmed/extremities.htm

Measurement of the Ankle-Brachial Index (ABI)

Hiatt W. N Engl J Med
1001;344:1608-1621

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Stasis Dermatitis/Ulceration

Edema

Cellulitis vs DVT