An Illustrated Guide For Cardiovascular System Examination

Bedside Teaching for 2\textsuperscript{nd} year medical Students

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Cardiovascular System
Examination

**Inspection**
- Shape of precordium
- Apex beat
- Pulsation in other areas
  - a. Pulmonary
  - b. Parasternal
  - c. Aortic
  - d. Neck
  - e. Epigastric
  - f. JVP

**Palpation**
- i. Apex beat localization
- ii. Pulsation in following areas
  - Pulmonary
  - Parasternal
  - Aortic
- iii. Thrills:
  - Mitral
  - Aortic
  - Carotid artery
  - Pulmonary
  - Parasternal
- iv. Palpates liver for hepatojugular reflux,
- v. Feels for pulsatile liver
- vi. Palpates for oedema

**Auscultation**
- i. Heart sounds:
  - Mitral area M
  - Pulmonary area P
  - Aortic area A
  - Tricuspid area T
  - Opening snap
- ii. Murmurs:
  - Mitral area
  - Aortic area
  - Bruit over carotids
  - Pulmonary area
  - Tricuspid area
  - Parasternal area
- iii. Pericardial rub
- iv. Listening to the base of lungs.
Before Examination:

- Wash hands
- Introduce yourself
- Confirm patient details – name / DOB
- Explain the examination
- Gain consent
- Expose the patient’s chest
- Position patient at 45°
- Ask patient if they have pain anywhere before you begin!

General Examination

- **Appearance**: Looks Well/Ill, Consciousness, Alert.
- **Body Built**: Average, Thin, Obese (Depends On BMI).
- **Color**: Pale, Cyanosed.
- **Decubitus**: Patient's position in bed.
- **Distress**: Difficulty In Breathing (Dyspnoeic).
- **Any surrounding Clues**: IV Line, Catheter, O₂ Mask, ECG, Wheelchair, etc.

**Vital Signs**

- **Pulse**:
  1. Radial Artery.
  2. Brachial Artery.
3- Carotid Artery:
- This is the best place to assess the pulse volume and character.
- Be careful not to compress both carotids at once, for fear of diminishing blood flow to the brain.

4- Femoral Artery:
- Can be felt midway between the pubic tubercle and the anterior superior iliac spine.

5- Popliteal Artery.

6- Posterior Tibial Artery
- Palpate at the ankle just posterior and inferior to the medial malleolus.

7- Dorsalis Pedis:
- This runs lateral to the exterior hallucis longus tendon on the superior surface of the foot between the bases of the first and second metatarsals.

1. Radial artery
2. Brachial artery
3. Axillary Artery
4. Subclavian Artery

5. Femoral Artery
6. Popliteal Artery
7. Dorsalis Pedis
5. Carotid Artery

6. Facial Artery

7. Superficial Temporal Artery

8. Dorsalis Pedis Artery
9. Posterior Tibial Artery

10. Abdominal Aorta

11. Femoral Artery pulses and check of radiofemoral delay
Special Pulse Characters:

Detection of Water Hammer Pulse

Synchronization:

1- Radio-Radial Delay:
- Occur Usually Due To Occlusion Or Stenosis On One Side, Dissection Of Thoracic Aorta Or Aortic Aneurysm.

2- Radio-Femoral Delay:
- Suggest The Diagnosis Of Coarctation Of Aorta.

3- Radio-Brachial Delay:
- Occur In Case Of Aortic Stenosis.
Blood Pressure (BP):

<table>
<thead>
<tr>
<th>BP</th>
<th>Systolic BP (mmHg)</th>
<th>Diastolic BP (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal</td>
<td>&lt;120</td>
<td>&lt;80</td>
</tr>
<tr>
<td>Normal</td>
<td>&lt;130</td>
<td>&lt;85</td>
</tr>
<tr>
<td>High normal</td>
<td>130–139</td>
<td>85–89</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1 (mild)</td>
<td>140–159</td>
<td>90–99</td>
</tr>
<tr>
<td>Grade 2 (moderate)</td>
<td>160–179</td>
<td>100–109</td>
</tr>
<tr>
<td>Grade 3 (severe)</td>
<td>&gt;180</td>
<td>&gt;110</td>
</tr>
<tr>
<td>Isolated systolic hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td>140–159</td>
<td>&lt;90</td>
</tr>
<tr>
<td>Grade 2</td>
<td>&gt;160</td>
<td>&lt;90</td>
</tr>
</tbody>
</table>

Korotkoff sounds

Examination of the Upper Limb

- Clubbing
**Capillary Refill**: > 2 Seconds (Peripheral Vascular Disease, Hypothermia, Dehydration, Shock).

**Capillary Pulsation (Quinke's Sign)**: Aortic Regurge.

**Splinter Hemorrhage**, Osler Node Which Seen In Palmar Surface Of Fingertip: Infective Endocarditis

**Janeway Lesions**: Infective Endocarditis

, Petechial Rash, **Evidence Of IV Drug Abuse**: Infective Endocarditis.

**Peripheral Cyanosis**.
- **Pallor Which Seen In Palmar Creases**.
- **Tendon Xanthoma (Yellowish Discoloration Of Tendon At Wrist)**: Hyperlipidemia.

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**Examination of Head & Neck:**

- **Eye**:
  - Jaundice.
  - **Pallor** : Anemia
  - **Conjunctival Hemorrhage**: Infective Endocarditis.

- **Xanthelasma**: Hyperlipidemia.
**Mouth:**
- **Cyanosis:** Lips for Peripheral Cyanosis & Tongue for Central Cyanosis.

**Cheeks:**
- **Mitral Facies:** Severe Mitral Stenosis.

**Neck:**
- Lymph Nodes (See respiratory system examination).
- Jugular Vein.
- Carotid Artery.

5. Neck veins and carotid arterial pulsations

![Diagram of JVP](image-url)
Normal waveforms of the jugular venous pulse.

**JVP Waves:**
- **a Wave:** Caused by Atrial Contraction.
- **c Wave:** Due to Closure of Tricuspid Valve.
- **x Descent:** Atrial Relaxation.
- **v Wave:** Increasing pressure in right atrium with atrial filling.
- **y Descent:** Commencement of Ventricular Filling As Tricuspid Valve Opens.

**How to differentiate between arterial and venous neck pulsations?**
Examination of the Lower Limb

- Skin Changes, Muscle Wasting, Loss Of Hair.
- **Oedema**: Pitting / Non-Pitting - Unilateral / Bilateral - Level.
- **Pulse**: Femoral - Popliteal - Dorsalis Pedis - Posterior Tibial (See pulse section above).

Check Lower limb oedema

Pitting oedema

Local Heart Examination:

**Inspection**: 

Observe the patient from the end of the bed
1. **Symmetry**: localised bulge or retraction

2. **Deformity**: Kyphosis, Scoliosis, Pectus Excavatum, Pectus Carinatum

3. **Previous Scars**: Median Sternotomy, Lateral Thoracotomy
4. Dilated Veins

5. Any Visible Pulsations: Determine The Site.
- **Epigastric Pulsation**: Right Ventricle, Aorta Or Left lobe of the liver (Differentiated By Palpation).
- **Lt Parasternal Pulsation**: Right Ventricle Enlargement.
- **Aortic Area Pulsation (2nd Right ICS)**: Aortic Aneurysm, Systemic Hypertension.
- **Pulmonary Area Pulsation (2nd Left ICS)**: Pulmonary Hypertension.
- **Suprasternal / Carotid Pulsation**: Aortic Regurgitation (Corrigan's Sign).

**Palpation:**

"Don't Forget To Warm Your Hand"

1- **Apex Beat**.
   - **Definition**: Lower Most And Outer Most Visible And Palpable Pulsation Over The Chest.
   - **Normal Site**: 5th Left ICS, 1 Cm Medial To Mid-Clavicular Line.
   - **Normal Size**: Less Than 2 Intercostal Space And Localized.
   - **Normal Character**: Gentle Tap.

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**Apex beat** – *normal position is 5th intercostal space – mid-clavicular line*
2. Parasternal Heave:
- Rest the heel of the hand just to the left of the sternum with the fingers lifted slightly off the chest.

3. Other Pulsations

Figure: Seven areas to be examined for abnormal cardiovascular pulsations by inspection and palpation. (From Schlant RC, Hurst JW.

| Pulmonary area pulsations | Aortic area pulsations |
Epigastric Pulsations

4. Thrills (Palpable Murmurs):
Auscultation:

# Component Of Auscultation:
1- Heart Sound.
2- Murmurs.
3- Additional Sounds.

1. Heart Sounds:

<table>
<thead>
<tr>
<th>Location of Thrill</th>
<th>Associated Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over the base of the heart at the 2nd intercostal space, just to the right of the sternum, during systole</td>
<td>Aortic stenosis</td>
</tr>
<tr>
<td>At the apex during systole</td>
<td>Mitral regurgitation</td>
</tr>
<tr>
<td>To the left of the sternum at the 2nd intercostal space</td>
<td>Pulmonic stenosis</td>
</tr>
<tr>
<td>To the left of the sternum at the 4th intercostal space</td>
<td>Small muscular ventricular septal defect (Roger disease)</td>
</tr>
</tbody>
</table>
A- 1\textsuperscript{st} Heart Sound (\textit{S}_1) :
- Due To Closure Of Mitral And Tricuspid Valves (Indicate Beginning Of Ventricular Systole).
- Heard At:
  \(\triangleleft\) Mitral Area: 5\textsuperscript{th} Left ICS, Mid-Axillary Line (By Bell Of Stethoscope).
  \(\triangleleft\) Tricuspid Area: 4\textsuperscript{th} ICS, Parasternal (By Diaphragm Of Stethoscope).

B- 2\textsuperscript{nd} Heart Sound (\textit{S}_2) :
- Due To Closure Of Pulmonary And Aortic Valves.
- Heard At:
  \(\triangleleft\) Pulmonary Area: 2\textsuperscript{nd} Left ICS.
  \(\triangleleft\) Aortic Area: 2\textsuperscript{nd} Right ICS.
C. 3rd Heart Sound (S₃):
- This is a low-pitched mid-diastolic sound occurring after S₂. (Can just be heard with the bell).
- **Physiological**: Soft sound heard only at the apex, normal in fit adults up to age 30.
- **Pathological**: As in left ventricular failure.

D. 4th Heart Sound (S₄):
- This is a late diastolic sound (just before S₁).
- Caused by atrial contraction against a stiff ventricle.
- Never physiological.
- Causes are hypertrophic cardiomyopathy, aortic stenosis, pulmonary HTN, pulmonary stenosis.
- Don't occur if the patient is in atrial fibrillation.

Listen to normal heart sounds:

2. Murmurs:
- Comment on (Timing, site of maximum intensity, radiation, grade, relation to position).

**Timing**:
- You must decide whether the noise occurs in systole or diastole (compare to carotid artery to be sure).

**# Systolic Murmurs**:
- **Ejection Systolic**:
  - Start quietly at the beginning of systole.
  - Caused by: pulmonary stenosis, aortic stenosis.
- **Pansystolic**:
Lasts for the whole of systole and tends to be due to backflow of blood from a ventricle to an atrium.

Caused by: Tricuspid regurgitation, mitral regurgitation, VSD.

- **Late Systolic**:
  - There is an audible gap between S₁ and the start of the murmur, which then continues until S₂.
  - Typically this is due to tricuspid or mitral regurgitation through a prolapsing valve.

# Diastolic Murmurs:

- **Early Diastolic**:
  - It starts loudly at S₂ and decrescendos during diastole.
  - Usually due to aortic or pulmonary regurgitation.

- **Mid-Diastolic**:
  - Begin later in diastole and may be brief or continue up to S₁.
  - Usually due to mitral or tricuspid stenosis.

# Continuous Murmurs:

- Heard throughout both systole and diastole.
- Common causes: PDA, A-V fistula.

*Figure 1-11 Description of the timing of murmurs in the cardiac cycle.* (Adapted from Tilkan AG, Conover MB. Understanding Heart Sounds: With an Introduction to Lung Sounds; 4th ed. Philadelphia: Saunders; 2001 [p. 135, Figure 12-3].)
Site Of Maximum Intensity:
- The Site That You Can Hear The Murmur Louder.
- Aortic Regurgitation Is Heard Louder If You Ask The Patient To Sit Up And Lean Forward, Then Listen At The Left Sternal Border.
- Mitral Stenosis Is Louder If You Ask The Patient To Lie On Their Left Side, Then Listen With The Bell At The Apex.

**Mitral Area**

**Tricuspid Area**

**Pulmonary Area**

**Aortic Area**
Radiation:
- Murmur Of Aortic Stenosis Will Radiate To The Carotids.
- Murmur Of Mitral Regurgitation radiates to The Left Axilla.

Grade:
- Grading The Murmurs According To Loudness Into Six Grades (Levine's Grading System):
### Heart Murmur Intensity

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Barely audible</td>
</tr>
<tr>
<td>2</td>
<td>Soft but easily heard</td>
</tr>
<tr>
<td>3</td>
<td>Loud without a thrill</td>
</tr>
<tr>
<td>4</td>
<td>Loud with a thrill</td>
</tr>
<tr>
<td>5</td>
<td>Loud with minimal contact between stethoscope and chest</td>
</tr>
<tr>
<td>6</td>
<td>Loud with no contact between stethoscope and chest</td>
</tr>
</tbody>
</table>

**Listen to Heart murmurs:**
http://www.easyauscultation.com/heart-murmur

**3- Additional Sounds :**

**A- Opening Snap :**
- Sudden Opening Of The Stiffened Valve Can Cause An Audible High-Pitched Snap In Early Diastole .
- Present In Mitral Or Tricuspid Stenosis .

**B- Systolic Ejection Click :**
- High-Pitched Click Heard Early In Systole , Caused By The Opening Of A Stiffened Semilunar Valve .
- Present In Aortic Stenosis , And Associated With Bicuspid Aortic Valves .

**C- Pericardial Friction Rub :**
- Scratching Sound Has Three Components Occurring At Any Time During Cardiac Cycle , Heard With Each Heartbeat And Caused By Inflamed Pericardial Membranes .
- It Is Louder As The Patient Is Sitting Up , Leaning Forward , And Heard Best In Expiration .

### Additional Informations

**1- Surface Anatomy of the heart:**
2- Check Sacral Oedema

References:

2- Online osceskills website. www.osceskills.com
3- Macleod’s clinical examination, thirteenth ed. 2013
4- Step by Step Clinical examination Skills:Iqbal F , first edition 2009
5- Merck Manual:cardiovascular examination,professional online version.