EXAMINATION OF CARDIOVASCULAR SYSTEM
CHIEF COMPLAINTS

- Breathlessness (Grading)
- Poor feeding, 'suck-rest-suck' cycle
- Palpitation
- Chest pain
- Cough
- Edema
- Failure to thrive
- Joint pain / swelling
- Syncope
# Grading of Dyspnoea (NYHA)

<table>
<thead>
<tr>
<th>Class</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Vigorous exercise (e.g., climbing stairs)</td>
</tr>
<tr>
<td>II</td>
<td>Routine activity</td>
</tr>
<tr>
<td>III</td>
<td>Minimal activity (walking from one room to another)</td>
</tr>
<tr>
<td>IV</td>
<td>Dyspnea at rest</td>
</tr>
</tbody>
</table>
HISTORY

- Feeding habits
- Cyanotic spells
- Squatting episodes
- Sore throat
- Head sweating
- Pink frothy sputum
- Convulsions
- Recurrent LRTIs
ANTENATAL/NATAL HISTORY

• Maternal Infection:
  - Rubella (PDA, Pulm branch stenosis)
  - Mumps (EFE)
  - Diabetes (Septal hypertrophy, TGV)
  - SLE (Complete heart block)
  - PKU (TOF, VSD)

• Maternal drugs: Eg: Alcohol, Phenytoin, Lithium

• Preterm baby: PDA
GENERAL EXAMINATION

• Anemia
• Cyanosis
• Clubbing
• Oedema
• Signs of infective endocarditis
• Signs of cardiac failure
• Signs of Rheumatic fever
• Peripheral signs of aortic regurgitation
• In Syndromes – congenital heart disease
• Mitral Facies
• Moon Face
• Elfin Face
• Typical syndromes-eg: Downs syndrome
• Apprehensive facies produced by pain, anxiety and respiratory distress
  • PE
  • Arrhythmias as VT, fast AF
• Blue sclera
  - Marfan syndrome, Ehlers-Danlos syndrome, (associated with AR, MVP, ASD)

• Lens
  - [subluxation in Marfan- superior; homocystenuria - inferior]
  - Cataract: Congenital Rubella, Down syndrome

• Fundus:
  - Roth's spots [small red hemorrhage with pale center, due to vasculitis] (endocarditis).
  - Hypertensive changes
HANDS

• Cyanosis
• Clubbing of the fingers
• Features of Anemia
  – Koilonychia
  – Pallor of palmar creases
• Signs of Infective endocarditis
  – Osler nodes [0.5-1 cm red-brown painful subcutaneous papules on fingertips or toes, palmar eminences and plantar surface of foot]
  – Janeway lesions [rare, painless flat erythematous macules on thenar and hypothenar eminences]
  – Splinter hemorrhage (bacterial endocarditis)
• Wrist: tendon xanthoma [yellow deposit over extensors] (type II hyperlipidemia).
• Tremor & Heat (thyrotoxicosis)
**CYANOSIS**

- Bluish discolouration of skin, mucous membrane; reduced Hb >5 gm/dl
- Central – tip of tongue, lips, oral mucosa etc., in cyanotic heart disease- Rt-Lt shunts, heart failure, shock etc.,
- Peripheral – vasoconstriction due to hypothermia e.g unwrapped neonates
- Differential cyanosis – pink upper extremities and cyanosed lower extremities e.g COA, PDA with reversal
- Intermittent Cyanosis – Ebsteins anomaly
CLUBBING

• Normal angle between nail and nail plate (160°) LOVIBOND angle is lost

• Grading
  – I – softening of nail bed
  – II – obliteration of angle of nail plate and bed
  – III – parrot beak
  – IV – hypertrophic osteo arthropathy

• Types
  – Unidigital – gout, local injury
  – Unilateral – Aneurysmal dilatation of aorta
  – Differential – clubbing in lower limbs only , PDA with reversal
  – Bilateral – Rt → Lt shunts, infectious endocarditis, atrial myxoma
CLUBBING
CAPILLARY REFILL

• Blanch the nail bed with sustained pressure for several seconds on a toenail or fingernail.
• Release the pressure
• Observe the time elapsed before the nail regains full color
  – Should occur almost instantly – in less than 2 seconds.
  – Longer than 2 seconds implies circulatory system compromise (ie: arterial occlusion, hypovolemic shock, hypothermia).
SIGNS & SYMPTOMS OF INFECTIVE ENDOCARDITIS

- H/o CHD or any procedures
- Fever
- Chills
- Chest & abdominal pain
- Dyspnea
- Night sweats
- Weight loss
- CNS Manifestations

- Elevated temperature
- Anemia
- Tachycardia
- Embolic Phenomena – Roth spots, Osler nodes, petechiae, splinter nail bed hemorrhages
- Janeway lesions
- New or changing murmurs
- Splenomegaly
- Arthritis
- Heart failure
- Clubbing
- Metastatic infection
• Tender hepatomegaly
• Basal crepitation
• Edema in dependant region
  – Infants – periorbital puffiness, flanks, sacrum
  – Older child – pedal edema
• Elevated JVP
• Cardiomegaly
• Arthritis – migratory polyarthritis
• Subcutaneous nodules - at elbows, shin of tibia, occiput, spine
• Chorea - rapid, involuntary, purposeless, non-repetitive, jerky movements aggravated during work relieved during
• Erythema marginatum – skin lesions with erythematous ring, central clearing
PERIPHERAL SIGNS OF AORTIC REGURGITATION

- Head nodding- De Musset sign
- Corrigans carotid sign
- Dancing brachialis
- Pulsatile Uvula- Mullers sign
- Pulsatile nail beds- Quinckes sign
- Pistol shot femorals
- Hills sign
- Water hammer pulse
- Rosenbachs and Gerhards sign
- Landolfi’s sign
- Becker’s sign
• Typical syndromic features - Be alert!
• Downs syndrome – Endocardial cushion defects, VSD
• Congenital rubella syndrome – PDA
• Turner’s syndrome – COA
• Trisomy 13 – VSD, ASD, PDA, Dextrocardia
• Trisomy 18 – VSD
• Noonan Syndrome-PS
ANTHROPOMETRY

• Short stature – Down, Noonan

• Microcephaly- Down, Congenital Rubella

• US/ LS ratio, armspan – Marfan’s syndrome

• Failure to thrive
CVS - VITAL SIGNS

Temperature

Respiration

Pulse

Blood pressure
• Fever, chills and rigor
  • IE
  • RF
  • Myxoma
  • Pericarditis, myocarditis
  • Pulmonary embolism
  • Pneumonia sec to large left to right shunt
RESPIRATION

- Rate, rhythm, Type
- Effortless tachypnoea
- Breathlessness decreased in propped up position/while putting on shoulder
PULSE

- Rate
- Rhythm
- Volume
- Character
- Radio – radial delay
- Radio femoral delay
- Palpable Peripheral pulse
WHERE TO PALPATE FOR ARTERIAL PULSE?

- Radial – fore arm slightly pronated and wrist slightly flexed. Examine for rate and rhythm.
- Carotid – medial to sterno mastoid muscle. Examine for character and volume.
- Femoral – midway between iliac crest and pubic ramus
- Popliteal – knees flexed at 120° fingertips at popliteal fossa
- Dorsalis pedis – lateral to proximal 1/3 rd of extensor hallucis longus
- Anterior and posterior tibial
NORMAL ARTERIAL PULSE

- Steeper upstroke, higher systolic peak as pulse is transmitted to the periphery.
- Use central vessels to feel for the contour of the pulse.
HOW TO DETERMINE THE PULSE RATE

• Palpation of the radial pulse (arterial).
• Listen to the heart.
• Count the pulse for 60 seconds
• Pulse deficit – the difference between radial pulse rate and apical rate (AF)
# Normal Heart Rate for Different Ages

<table>
<thead>
<tr>
<th>Age</th>
<th>Rate</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>100–180</td>
<td>140</td>
</tr>
<tr>
<td>1–11 Months</td>
<td>80–160</td>
<td>120</td>
</tr>
<tr>
<td>2–3 Years</td>
<td>80–130</td>
<td>110</td>
</tr>
<tr>
<td>4–5 Years</td>
<td>80–120</td>
<td>100</td>
</tr>
<tr>
<td>6–8 Years</td>
<td>75–115</td>
<td>95</td>
</tr>
<tr>
<td>&gt;8 Years</td>
<td>70–110</td>
<td>90</td>
</tr>
</tbody>
</table>
VARIATIONS IN HEART RATE

**Bradycardia**

**Physiological**
- Sleep, athletes

**Pathological**
- Hypoxia
- Hypothermia
- Hypothyroidism
- Heart block
- Drugs – β blockers, digoxin

**Tachycardia**

**Physiological**
- Exertion, crying, anxiety

**Pathological**
- High output states – Anemia, thyrotoxicosis
- Hypovolemia
- Hypotension
- Drugs – Atropine, nifedepine
• Regular - Normal
• Irregular
  – Regularly: Atrial Tachyarrhythmia with fixed AV block
  – Irregularly: Atrial or ventricular ectopics, AF, Atrial tachyarrhythmia with varied AV block
PULSE - CHARACTER

1. **Collapsing pulse** (water hammer pulse) jerky pulse with full expansion followed by sudden collapse (AR, PDA, A-V fistulas, fever, thyrotoxicosis, anemia)

2. **Alternating pulse** pulses alternans (regular rate, amplitude varies from beat to beat) seen in LVF

3. **Pulses bisferiens** (two strong systolic peaks separated by a midsystolic dip) seen in HOCM, AS/AI

4. **Anacrotic pulse** slow rising pulse in A.S. (Parvus et tardus)

5. **Dicrotic pulse**, two systolic and diastolic peaks (sepsis, hypovolemic, cardiogenic shock)

6. **Pulsus paradoxus** (amplitude decreases with inspiration and increases during expiration) seen in cardiac tamponade, COPD, massive P.E.
LV OUTFLOW OBSTRUCTION

PULSUS BISFERIENS - AR

DICROTIC PULSE

DICROTIC PULSE
• Pulse Pressure – Difference between systolic and diastolic blood pressure

• Normal: 30 – 60 mm Hg

• Small volume – cardiac tamponade / failure

• Large volume – PDA, AR
• Normally femorals felt just before radial
• Radio – radial – pre subclavian COA
• Radio femoral – post subclavian COA
BLOOD PRESSURE

• Definition – Pressure exerted by the column of blood on the arterial wall
• Instrument -
• Korotkoff Sound – Phase I – Phase V
• Different methods to record BP
  – Palpatory
  – Auscultatory
  – Flush method
  – Oscillometry
  – Non invasive Doppler
• In COA – all 4 limbs BP recorded
PULSE PRESSURE

• Difference between the systolic and diastolic pressure

• Mean arterial pressure = Diastolic pressure + 1/3 of pulse pressure
WHAT IS THE RELATIONSHIP BETWEEN THE BLOOD PRESSURE IN THE LEGS AND ARMS?

• To measure the blood pressure in the legs, place the cuff around the thigh and listen or palpate over the popliteal artery.

• Indirect measurement – the SBP in the legs is 10 – 15 mm hg higher than in the arms.

• Direct measurement – no difference

• Hill’s sign - > 20mm Hg difference between the arms and the legs (AR).

• Coarctation of the aorta – BP in legs is much less than in the arms.
JUGULAR VENOUS PRESSURE

- **a wave** – atrial systole
- **c wave** – movement of tricuspid valve ring into rt. atrium
- **v wave** – peak pressure in rt. atrium
- **a-x descent** – atrial relaxation
- **v-y descent** – ventricular filling
JVP – MEASUREMENT

- Place patient in supine position initially to engorge jugular veins
- Gradually raise head of bed until jugular venous pulsations become evident between angle of jaw and clavicle.
- Palpating contralateral carotid pulse will help identify venous pulsations
- Place the end of a ruler in the mid axillary line at level of nipple, with ruler extended vertically.
- Using another ruler, place it horizontally to intersect the vertical ruler and the meniscus of the JVD. The value on the vertical ruler should be less than 9 cm H₂O
HOW TO MEASURE JVP

Top of Jugular Vein
Vertical distance above angle of Louis

Right Atrium

JVP = 2 + 5

7 cm of water

angle of Louis

5 cm
ABNORMALITIES OF JUGULAR VENOUS PULSE

• a wave
  – absent – AF
  – prominent – PS, PHT, TS
  – cannon waves – Arrhythmias, AV dissociations

• v wave
  – prominent – TR

• X descent
  – prominent - constrictive pericarditis

• y descent
  – slow – TS
  – fast – TR
  – Absent – cardiac tamponade
ABNORMALITIES OF JUGULAR VENOUS PULSE CONT.

• Low jugular venous pressure
  – Hypovolemia.

• Elevated jugular venous pressure
  – Intravascular volume overload conditions due to valvular disease (tricuspid or pulmonic stenosis or regurgitation), right ventricular ischemia or infarction, cardiomyopathy or secondary to left heart failure (mitral stenosis/regurgitation, aortic stenosis/regurgitation, cardiomyopathy, myocardial ischaemia/infarction).
  – Right ventricular failure.
  – Constrictive pericarditis.
  – Pericardial effusion with tamponade physiology.
  – Obstructive atrial myxoma.
  – Superior vena caval obstruction.
<table>
<thead>
<tr>
<th>Jugular Vein</th>
<th>Carotid Artery</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pulsations palpable.</td>
<td>Palpable pulsations.</td>
</tr>
<tr>
<td>Pulsations obliterated by pressure above the clavicle.</td>
<td>Pulsations not obliterated by pressure above the clavicle.</td>
</tr>
<tr>
<td>Level of pulse wave decreased on inspiration; increased on expiration.</td>
<td>No effects of respiration on pulse.</td>
</tr>
<tr>
<td>Usually two pulsations per systole (x and y descents).</td>
<td>One pulsation per systole.</td>
</tr>
<tr>
<td>Prominent descents.</td>
<td>Descents not prominent.</td>
</tr>
<tr>
<td>Pulsations sometimes more prominent with abdominal pressure.</td>
<td>No effect of abdominal pressure on pulsations</td>
</tr>
</tbody>
</table>
CVS – SYSTEMIC EXAMINATION

• Inspection
• Palpation
• Percussion
• Auscultation
• Position of trachea
• Precordial bulge – left of sternum, seen from leg end child lying supine => cardiomegaly
• Hyper dynamic precordium – thin patient, volume over load, Lt > Rt shunt
• Silent Precordium – obese child, pericardial effusion, severe cardio myopathy
• Parasternal Lift - RVE or severe MR
APICAL IMPULSE

- Lowest and outer most point of cardiac pulsation
- Normal position:
  - <4yrs : 4\textsuperscript{th} ICS 1cm outside MCL
  - 4-7yrs: 5\textsuperscript{th} ICS in MCL
  - 7yrs : 5\textsuperscript{th} ICS1cm inside MCL
- Lateral & inferior – LVH
- Only lateral – RVH
- On right side – dextrocardia, Lt pneumothorax
• Aortic – AR, aortic aneurysm, dilatation of ascending aorta
• Pulmonary – pulmonary hypertension
• Carotid – hyperdynamic states, COA, AR
• Supra clavicular - AR
• Supra sternal
• Inter & infra scapular – COA (Suzman’s sign)
• Epigastric – AR, RVH
• Hepatic – TR, TS
PALPATION

• Character of apex beat
  – Tapping - MS
  – Heaving – force full, well sustained - LVH, pressure over load – AS, Systemic HTN, COA
  – Hyper dynamic – ill sustained - Volume over load
    – MR, AR, VSD, PDA

• Para sternal heave
  – Right ventricular enlargement – ASD, VSD
  – Left atrial enlargement – MS, MR
• P₂ – Pulmonary hypertension
• A₂ – systemic hypertension, AS
• Opening Snap - MS

PALPATION – CONT..
• Thrills
  – Carotid - AS
  – Aortic - AS
  – Pulmonary – PS, ASD, VSD
  – Continuous – PDA, Rupture of Sinus of Valsalva
  – Apical
    • Diastolic – MS
    • Systolic - MR
  – Lower left para sternal - VSD

PALPATION – CONT..
• Outline cardiac borders
• Useful in
  – Pericardial effusion – Dullness beyond apex
  – Pulmonary hypertension - Dull 2nd left ICS also in left atrial enlargement, pericardial effusion
  – Dextrocardia
  – Dilated cardiomyopathy
AUSCULTATION

- Method – Bell & Diaphragm
- Areas – M T A P
- Normal heart sounds
- Abnormal heart sounds
- Additional sounds
- Murmurs
AUSCULTATION – CONT..

• 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)
  – upper left sternal border (ULSB)
  – lower left sternal border (LLSB)
  – apex
  – apex - left lateral decubitus position
  – lower left sternal border (LLSB) - sitting, leaning forward, held expiration
  – Back
NORMAL HEART SOUNDS

- **S₁** – Closure of AV valves “Lub”, Low pitched, Prolonged
- **S₂** – Closure of semilunar valves “Dub”, High pitched, Short, has two components (A₂, P₂)
- Physiological split – Normal splitting between A₂ & P₂ which varies with inspiration and expiration
ABNORMAL HEART SOUNDS – $S_1$

• Intensity
  – Loud $S_1$ - MS, TS, Sinus Tachycardia, High output states

  – Muffled $S_1$ – Pericardial effusion, Obesity, Calcified valve
ABNORMAL HEART SOUNDS – S₂

- **A₂**
  - SH, AR
  - Calc.AV, Aortic Atresia
  - AS, PDA, AR, LVF, LBBB
  - VSD, MR

- **S₂**
  - Accentuated
  - Diminished
  - Delayed
  - Early

- **P₂**
  - PAH
  - PS, PA
  - PS, ASD, TAPVC, RBBB
SPLITTING OF S2

Splitting

Expiration

Inspiration

Normal

Wide & Variable
MR, VSD, PS

Wide & Fixed
ASD, TAPVC, RBBB

Paradoxical
AS, PDA, AR

Single Second Sound
TOF

IAP UG Teaching slides 2015-16

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• 3\textsuperscript{rd} heart sound – due to maximal ventricular filling
  – S3 Gallop – Myocarditis, CCF

• 4\textsuperscript{th} heart sound – due to rapid emptying of atrium
  – Occurs in constrictive pericarditis, hypertrophic cardiomyopathy
ADDITIONAL SOUNDS

- Click – arise due to semi lunar valves
- Ejection systolic clicks – AS, PS
- Aortic- bicuspid aortic valve

- Opening snap – due to abnormal mitral & tricuspid leaflets
- Occurs in ASD, VSD, RHD – MS / TS

- Mid systolic Click – MVPS
- Multiple Clicks – Ebstein’s Anomaly

- Pericardial rub – Acute rheumatic fever, pericarditis
MURMURS

• Caused by normal flow through a abnormal valve or abnormal flow through a normal valve
• Types – Organic, Flow, Innocent
• Description
  – Intensity - Grading
  – Pitch
  – Timing
  – Variation with respiration / posture
  – Area of maximum intensity
  – Conduction to other areas
CHARACTERISTICS OF A “FUNCTIONAL” MURMUR

- Short and soft ESM
- Not radiating
- Grade I – II, No thrill
- Normal S1 and S2
- Normal cardiac impulse
- No evidence for any hemodynamic abnormality
CHARACTERISTICS OF A PATHOLOGICAL MURMUR

- Pansystolic murmur and all diastolic murmurs
- Murmur associated with thrill
- Harsh
- With abnormal heart sound
- Radiating
Grading I – VI
1 – Barely audible
2 – Medium intensity
3 – Loud but no thrill
4 – Loud with thrill
5 – Very loud still needs steth on the chest
6 – Audible with steth off chest
SYSTOLIC MURMURS

- Types
  - Early: AR, PR
  - MDM: MS, TS
  - Functional: Graham Steel, Carey Coombs, Austin Flint
DIASTOLIC MURMURS-GRADING

Grading I – IV
1. Very Soft
2. Soft
3. Loud
4. Loud with thrill
COMMON MURMURS AND TIMING

Systolic Murmurs
• Aortic stenosis
• Mitral insufficiency
• Mitral valve prolapse
• Tricuspid insufficiency

Diastolic Murmurs
• Aortic insufficiency
• Mitral stenosis
• Variation with respiration
  – Left sided murmurs well heard in expiration
  – Right sided murmurs well heard in inspiration

• Variation with posture
  – MDM of MS best heard in left lateral position
  – EDM of AR best heard in sitting and leaning forward
AUSCULTATION - AORTIC AREA

- 2nd right intercostal space (URSB)
  - compare S1 to S2-S1 should be softer. If the same, think Mitral Stenosis
  - identify ejection murmur-time the peak intensity in relation to systole
  - identify ejection click if present
AUSCULTATION - PULMONARY AREA

2nd left intercostal space (ULSB)
– listen for split S2 (A2/P2)
– identify the intensities of A2 and P2
– time split S2 with respiration
  • normally widens with inspiration, closes with expiration
  • wide split S2-RBBB, RV volume overload, PS, RV failure
  • wide fixed split = ASD
  • paradoxical split = LBBB, severe AS, severe LV dysfunction, pacemaker
AUSCULTATION - LEFT STERNAL BORDER

- Listen for early diastolic murmurs (AR/PR)
- Press firmly with diaphragm
- Listen upright with forced expiration
- Listen on hands and knees
AUSCULTATION - APEX

• Listen for intensity of S1
  – Soft-LV dysfunction, first degree heart block, pre-closure with sudden severe AR/MR
  – Loud-MS, sympathetic stimulation
  – Variable- Complete heart block with AV dissociation, Wenkebach

• Identify splitting of S1
  – M1/T1, M1/EC(aortic or pulmonary), M1/Non-EC (MVP), S4/M1
• Identify quality, timing and intensity of systolic murmurs
  – ejection quality vs regurgitant quality
  – pansystolic vs early or mid to late systolic murmur
AUSCULTATION – APEX – CONT..

– Listen for S3 and S4
– Consider differential diagnosis of S3
  • A2-wide P2, A2-OS, A2-PK, A2-S3
– Identify diastolic rumble
– Determine radiation of murmur e.g. MR to axilla
- Continuous
  - PDA, Tricuspid atresia
- To & fro
  - AS with AR, VSD with AR

MURMURS – CONT..
VENOUS HUM

- Low Pitched
- Soft
- Continuous
- Accentuated in early diastole, exercise
- Obliterated by compression of neck veins, valsalva maneuver
- Present in Children, young adults and anemia
• ASD – Accentuated S1, wide fixed S2
• VSD – muffled S1, wide variable S2, PSM
• PDA - Accentuated M1, Continuous murmur
• TOF – only A2, ESM
• PS – Delayed & muffled P2, ESM
• AS – reverse splitting, ESM
Thank You