TUTORIAL 8

EXAMINATION OF CARDIOVASCULAR SYSTEM

OVERALL OBJECTIVE

By the end of this module the student should be able to:

- Differentiate between the child with normal heart and the one with a heart disease
- If there is heart disease; is it congenital or acquired
- Recognise and manage common and life-threatening cardiovascular problems in infants and children
- Recognise by appropriate history taking and clinical examination and by doing appropriate investigations and be able to discuss principles of management of:
    - Cardiac failure (acute cardiac failure, pulmonary oedema)
    - Rheumatic fever (active carditis vs rheumatic heart disease)
    - Congenital heart disease (including but not limited to VSD, ASD, PDA, tetralogy of Fallot, transposition of great arteries)
    - Myocarditis, pericarditis, pericardial effusion
    - Cardiomyopathy

BORDERS OF THE HEART

Left border: from superior to inferior is formed by: Arch of aorta, pulmonary artery, left arterial appendix and left ventricle.
Right border: from superior to inferior is formed by: Ascending aorta, superior vena cava, right atrium and inferior vena cava.
When examining cardiovascular system, specially look for

- Plethora: may be due to cyanotic congenital heart defect
- Jaundice: may be due to sever CCF, hepatic congestion or prosthetic heart valve induced
- Mitral facies: rosy cheeks with bluish ting due to dilatation of malar capillaries associated with pulmonary haemorrhage or severe mitral stenosis due to reduced cardiac out put
- Malar rash may be due to mitral stenosis or pulmonary stenosis
- High arched palate: as a feature of Marfan's syndrome consider
    - Aortic regurgitation due to aortic root dilatation
    - Mitral regurgitation due to mitral valve prolapse
- Teeth: can be source of infective endocarditis
- Tongue, lips, and finger tips: look for central or peripheral cyanosis. If room is artificially lit, look again in natural day light. Avoid saying "pink or blue": say 'cyanosed' or 'not cyanosed'. Tongue has same colour in all races with good blood supply therefore, it presents as an important sign for central cyanosis. If the patient is cyanosed – state whether they are peripherally or centrally cyanosed.
- Mucosa: for petechiae, signs of IEC
- Neck
    - JVP (not commonly practical in small children due to short neck).
    - Central venous pressure height
    - Wave forms

- Abdominojugular reflex test
- Carotid pulse character

- **Signs of Infective Endocarditis, Acute Rheumatic Fever and Cardiac Failure:**

Infective Endocarditis	Acute Rheumatic Fever	Cardiac Failure
1. Fever 2. New or changing murmur 3. Pallor 4. Splenomegaly 5. Clubbing 6. Haematuria 7. Splinter hemorrhages 8. Osler's nodes 9. Janeway lesions 10. Arrhythmia 11. Tachycardia 12. Heart failure	Revised Jones criteria <u>Two Major (PECCS)</u> 1. Polyarthritis 2. Erythema marginatum 3. Carditis 4. Chorea 5. Subcutaneous nodules <u>Or 1 major and 2 Minor criteria (FAPPLE)</u> 1. Fever 2. Arthralgia 3. Previous Rh fever 4. Prolonged P-R interval 5. Leucocytosis 6. Elevated CRP & ESR	Two ↑ in number 1. RR – tachypnoea 2. HR – tachycardia may lead to gallop rhythm Two ↑ in size 1. Cardiomegaly 2. Hepatomegaly

An approach to cardiovascular examination

- Start your examination at the periphery and work towards the heart.
- Look for cyanosis, clubbing, respiratory difficulty, pallor or plethora or polycythaemia.
- Jugular venous pulse and pressure are difficult to appreciate in infancy due to relative shortness of neck.

1. PULSES

Pulse is a wave of increased pressure which passes along the arteries with each beat of heart. Following points need to be noted while examining the pulse:

- **Feel** radial, bracheal, axilary, facial, temporal, carotid, dorsalis pedis, posterior tibial, popliteal and femoral pulses - are all pulses present?

Picture: Palpation of the various pulses - radial, carotid, bracheal, dorsalis pedis, posterior tibial, popliteal and femoral (from top right to left)

- **Radio-femoral delay** (RFD) only relevant in the older child (>6yrs) once collaterals have had time to develop. Reduction of one femoral only is not due to coarctation but due to local trauma/cardiac catheterisation. Looking for RFD is important if there is history of hypertension.

Picture: Radio-femoral delay

- **Pulse rate:** pulse rate is counted by placing the finger tips on the radial artery while the forearm is pronated and wrist slightly flexed. It is counted for 1 minute. Normal pulse rate ranges between:

Age	Beats per minute
Birth to 3 months	120-160
1 yr	80-140
2 yrs	80-130
3 yrs	80-130
Older	70-115
In febrile condition each 1 degree ^{o}C rise in temp above normal increases pulse rate by 10 per min	

- Note:
  - Tachycardia:
    - Causess: anxious child, fever, anaemia, shock , heart failure, hyperthyroidism and in emotional state.
  - Bradycardia:
    - Causes: junior athelete, drugs (beta blockers, digoxin), complete heart block, increased intracranial pressure, and hypothyroidism.

- **Rhythm:**

Here the time interval between the beats is noted which is equal in most individuals. However in some patients there may be some disturbance during respiration. During inspiration, pulse becomes rapid while during expiration this becomes slow. This is a normal phenomenon which is called Sinus Arrythmia. There are other forms of arrythmias like:

- **Regularly irregular heart rate:** here the pulse is irregular but its irregularity is manifested after regular intervals like premature beat which comes after fixed number of beats; sinus arrythmia and 2nd and 3rd degree heart blocks.
- **Irregularly irregular heart rate:** here beats are non-equidistant seen in atrial fibrillitaion, multiple ectopic beats, and atrial flutter with variant block (uncommon in small children)

- **Volume** (small volume, large volume or absent)

This is amplitude of the wave passing through the blood vessel during the ventricular contraction. In other words this is the force by which the palpating fingers are lifted up. Conditions causing increased cardiac out put are associated with increased volume of pulse.

Small volume (narrow pulse pressure)	Full volume (increased/wide pulse pressure)

• Cadiac failure
• Shock: circulatory failure due to hypovolumia
• Out flow obstruction:
  ○ aortic stenosis
  ○ pericardial effusion
	• Anaemia
	• Carbon dioxide retention
	• Thyrotoxicosis
	• PDA & truncus arteriosus
	• Fever – sepsis (vasodilatation)
	• A-V malformation

- **Character**
  - Normal

- Slow rising - aortic stenosis

- **Collapsing or water hammer pulse**

This is a rapid, high volume nonsustained pulse.

Method: Hold the wrist of the patient with your hand. Feel for radial pulse and then suddenly raise the arm of the patient straight up. The volume of the pulse will increase if it is water hammer pulse. Sudden rise is due to increased stroke volume and collapsing character is due to backward leakage (seen in aortic incompetance) or due to low peripheral resistance which enhances the blood flow to peripheral vasculature during diastolic phase. This is seen in conditions which lead to increase in pulse pressure like:

- Aortic incompetence
- Thyrotoxicosis
- Fever
- Arteriovenous fistula
- Severe anaemia
- PDA (large volume – rapid collapse – often a neonate)
- Truncus arteriosus
- In adults: Beri-Beri and females; pregnancy

Picture: Collapsing pulse

Pulsus deficit

There is difference in the rate of pulse and the apex beat. This is seen in arterial fibrillation and multiple ectopic beats. This is due to the fact that certain beats are not strong enough to push the blood in the peripheral blood vessels. This is also called as missing beat.

Pulsus paradoxus

In normal circumstances there is decrease in the volume of pulse during inspiration due to decrease (5-10 mm of Hg) in cardiac output and the blood pressure. If there is exaggeration of normal response i.e., the volume of pulse decreases markedly or even become impalpable this is called as pulsus paradoxus. On auscultation the heart sounds are still audible even when the pulse becomes impalpable. This is present in the following conditions:

- Constrictive pericarditis
- Pericardial effusion
- Severe asthma and severe strider

Pulsus bisference
This is a combination of anacrotic and collapsing pulses. This is felt twice in one beat and is seen in combined lesions of aortic stenosis and aortic incompetence.

Delayed pulse
Normally, the radial and the femoral pulses can be felt simultaneously but in case of coarctation of aorta, the femoral pulse is delayed.

2 BLOOD PRESSURE

Types of blood pressure (BP)

- **Systolic** blood pressure is maintained by the elasticity of blood vessels and stroke volume
- **Diastolic** blood pressure is regulated by peripheral resistance
- **Pulse pressure** is the difference between systolic & diastolic blood pressure.

Method of checking the blood pressure
There are many types of sphygmomanometers like Mercury, Aneroid, and Electronic. Mercury sphygmomanometer is preferably used and students are also examined on this BP apparatus specifically in adolescents and adults as electronic sphygmomanometers are routinely used in infants and small children.

Patient should be sitting at ease or lying down on the bed comfortably (especially if a small child). Now place the sphygmomanometer at the level of heart and of doctor's eye. Choose the correct size of cuff which should cover 2/3rd of the upper arm. A range of cuff widths – 7cm, 9cm, 11cm and 13cm – will be required. The largest cuff which fits comfortably around the arm should be applied. There are two methods of taking blood pressure i.e., palpatory and the auscultatory.

Krotokof sounds (KS)
KS are blood flow sounds which are observed while taking blood pressure with a sphygmomanometer over an artery (most commonly brachial artery in the antecubital fossa). These sounds appear and disappear as the BP cuff is inflated and deflated. Following are phases of KS and a diagramatic presentation of reading a blood pressure of an adolescent.

Phases of Krotokof Sounds

	Systolic	→	→	Diastolic →	
Silence	Phase 1 Clear tapping sound	Phase 2 Softens and becomes swishing sound	Phase 3 Sharper sounds become criper sound	Phase 4 Muffling and Blowing sound	Phase 5 Silence ..^..
	120	110	100	90	80

Palpatory method
Palpate the radial pulse at the wrist and inflate the armlet. The mercury column will rise in the manometer. Now note the level of mercury column when the pulsation in the radial artery stops. Inflate further so that the column of mercury should further rise. Then deflate the armlet by opening the screw slowly. The level of mercury column at which the first pulse is felt, is noted. Mean of these two is systolic blood pressure.

Auscultatory method
Inflate the armlet and make the mercury column to rise above the level of systolic BP which was determined by the palpatory method. Now put the chest piece of stethoscope gently on the brachial artery in antecubital fossa and deflate the armlet slowly. Note the column of mercury when the sound is heard. This is systolic BP. Now gradually keep on deflating the cuff. The sound will come louder and louder and suddenly this will change its character, i.e., it becomes soft and finally inaudible. Note this point when it becomes soft, which is diastolic BP.

Check four limb BP if the child has primarily a CVS problem. For this patient should lie down on the bed with face downward. The cuff is applied on the lower part of the thigh and the stethoscope is applied on the popliteal artery to note the BP. Systolic is where sound is first heard. Diastolic is where sound softens and not where it disappears

Normal BP

- Normal systolic blood pressure = 2 x age in yrs + 65
- Mean diastolic blood pressure = 55 + age in yrs
- Mean systolic blood pressure = 90 + age in yrs
- Upper limits of normal blood pressure
    - Mean + 20 for diastolic
    - Mean + 18 for systolic

Single raised values are of no significance; they must be repeated several times. Blood pressures recorded on admission to hospital may be unreliable because of combination of anxiety plus obesity in the child.

Age Years	**Systolic Blood pressure**		**Diastolic Blood Pressure**	
	Systolic BP	Upper limit of normal	Diastolic Bp	Upper limit of normal
2-4	90	110	64	80
6	100	120	66	82
8	105	125	70	86
10	110	130	72	88
12	115	135	74	90
14	120	140	76	92
	Mean systolic BP = 90+age in yrs BP rises by aproximately 2.5mmHg per year thereafter.		Mean diastolic BP = 55+age in yrs Up to the age of 12 years there is no appreciable differences between boys' and girls' BP	

3. JUGULAR VENOUS PRESSURE (JVP)

JVP is unhelpful in the infant and small child because of their short necks but is useful in older children and adolescents.

Technique

Patient should recline at an angle of 45 degrees. This is the angle between the bed and the back of the patient. Now look for prominent jugular veins. The prominence of jugular veins in this position indicates some pathology. The basis of this test is that in healthy individuals in upright posture the upper level of venous column corresponds with manubrium sterni. This remains behind or slightly above the level of clavicle when the person is reclining at the angle of 45 degree so we cannot see the prominent veins. But in certain conditions like congestive heart failure (other conditions listed below), the column of blood in jugular veins rises up. So even when patient reclines at an angle of 45 degrees, the veins become prominent and visible.

Hepatojugular reflex (HJR)

When pressure is sustained over hepa for 10 seconds and there is a rise of >2-3 cm in children (4 cm in adults), it is considered significant which is called as HJR also known as abdominal jugular reflex.

The causes of prominent neck veins

- Congestive cardiac failure
- Constrictive pericarditis
- Pericardial effusion
- Cardiac temponade
- Enlarged lymphnode or mass compressing superior vena cava
- Tricuspid stenosis or incompitance
- Volume over load

4. PRECORDIUM

INSPECTION

- Look for congenital chest deformity or pericardial bulge due to bowing forward of sternum and the ribs, giving the chest an overblown appearance.
- Look for visible ventricular impulse:
- The right ventricular impulse may be visible under the xiphisternum.
- The left ventricular impulse or apex beat is frequently visible in children with hyperdynamic circulation (due to fever or excitement) and in children with true left ventricular enlargement.
- Look for any scars on precordium, do not miss thoracotomy or sternostomy scars (complex cardiac surgery), scar at groin (cardiac catheterisation) etc.

PALPATION

Palpation includes localisation of apex beat, appreciation of palpable sounds or murmur and search for right or left venricular enlargement

1. Apex beat:

At the most lateral and inferior point, left hand side of precordium

Method for localising the apex beat

Make the child to lay down and place the palm of your right hand over the left precardium. Feel the apex of heart beating under your palm. Now localise it by placing the index finger over it vertically and count the intercostal space.

The apex beat is normally found in the 4th intercostal space (ICS) in mid clavicular line (MCL) in infants and toddlers. In school children it is at 4-5th ICS in MCL and 1 cm medial to the left MCL in adolescents and adults. Followings may be the causes if it is not palpable:

- Plump, healthy infant and toddler
- Pleural effusion of left side
- Pneumothorax of left side
- Pericardial effusion
- Dextrocardia

Picture: Locating the apex beat

If apex beat is displaced, check position of the trachea to make sure that this is due to cardiomegaly and is not displaced due to a mediastinal shift.

Thrill: a palpable murmur is referred to as a thrill. A thrill in the suprasternal notch may suggest coarctation or aortic stenosis

2. **Search for right or left venricular enlargement**

Right ventricular enlargement (RVE) is outwards and downwards.

Method of assessing ventricular enlargement

Right ventricular enlargement: Place fingertips of your right hand between 2^{nd} , 3^{rd} and 4^{th} ribs along the left sternal border or use ulner border of your right hand and feel for tap of lift. A slight ventricular tap in a thin child may be a normal finding. An epigastric pulsation and a left parasternal lift is indicative of right ventricular hypertrophy (RVH).

Left ventricular enlargement: See method of localising apex beat (above). Apex beat displacement towards left may be due to left ventricular enlargement.

Causes of apex beat displacement

Apex beat displaced to left side

- LV enlargement
- Scoliosis
- Pectus excavatum
- Pneumothorax on the right side
- Pleural effusion of the right side

Apex beat displaced to the right side

- Congenital dextrocardia - feel for the liver (Kartagener's syndrome)
- Acquired dextroposition – heart pushed or pulled to the right
- Left diaphragmatic hernia
- Collapsed lung in the right side
- Percussion is really only used if a large pericardial effusion is suspected and then the dullness will extend beyond the apex beat

Character of the apex beat

Character of apex beat is of two types:

1. **Heaving:** Place index finger of your right hand over the apex beat and note if it gently lifts the palpating finger. If the tip of finger is moving significant upward with apex beat during systole and downward during diastole this is called as heaving of apex beat. This is present in left ventricular hypertrophy.

   Causes of left ventricle enlargement

   - Mitral incompetence
   - Aortic incompetence
   - Aortic stenosis
   - Hypertension

- Coarctation of aorta – older children
- Tricuspid atresia
- AVSD

2. **Tapping:** This is palpable first heart sound. In this the apex strikes the palpating finger and goes back nicely. This is present in case of mitral stenosis or tricuspid stenosis leading to RVH

Causes of right ventricular enlargement

- Secondary to failure of LV
- Mitral stenosis
- Pulmonary stenosis
- Cor-pulmonale
- Tricuspid incompetence
- Pulmonary incompetence
- Primary pulmonary hypertension
- Coarctation in infants

Palpable P2 can also be felt in pulmonary area in patients with pulmonary hypertension

Picture: Palpation of P2

PERCUSSION

Percussion has got limited value in examination of cardiovascular system especially in children but can be of value in an academic clinical exam. Therefore, technique should be leaned which is same as for adults.

Percussion of right border of heart: first percuss the upper border of the heart and then percuss in vertical direction, from lateral to medial side in 4th intercostal space. Mark where percussion note becomes dull this will be the right border of heart.

Percussion of left border of heart: left border of the heart runs from above downward and laterally, so percussion is done in an oblique fashion. Now do the percussion in 4th intercostal space, on left chest from left to medial side till the percussion note becomes dull.

Same way percuss the 3rd and 5th intercostal spaces and mark the left border of the heart. The area of dullness is decreased in case of pneumothorax and increased in pericardial effusion.

AUSCULTATION

By the time auscultation is performed a short list of possibilities should have been compiled:

- Peripheral findings – pulse, blood pressure, JVP
- Cyanotic or acyanotic
- Heart failure or no heart failure
- Precordium findings

Auscultation is done in all four areas of the heart which are as follows:

1) Mitral area
2) Tricuspid area
3) Aortic area
4) Pulmonary area

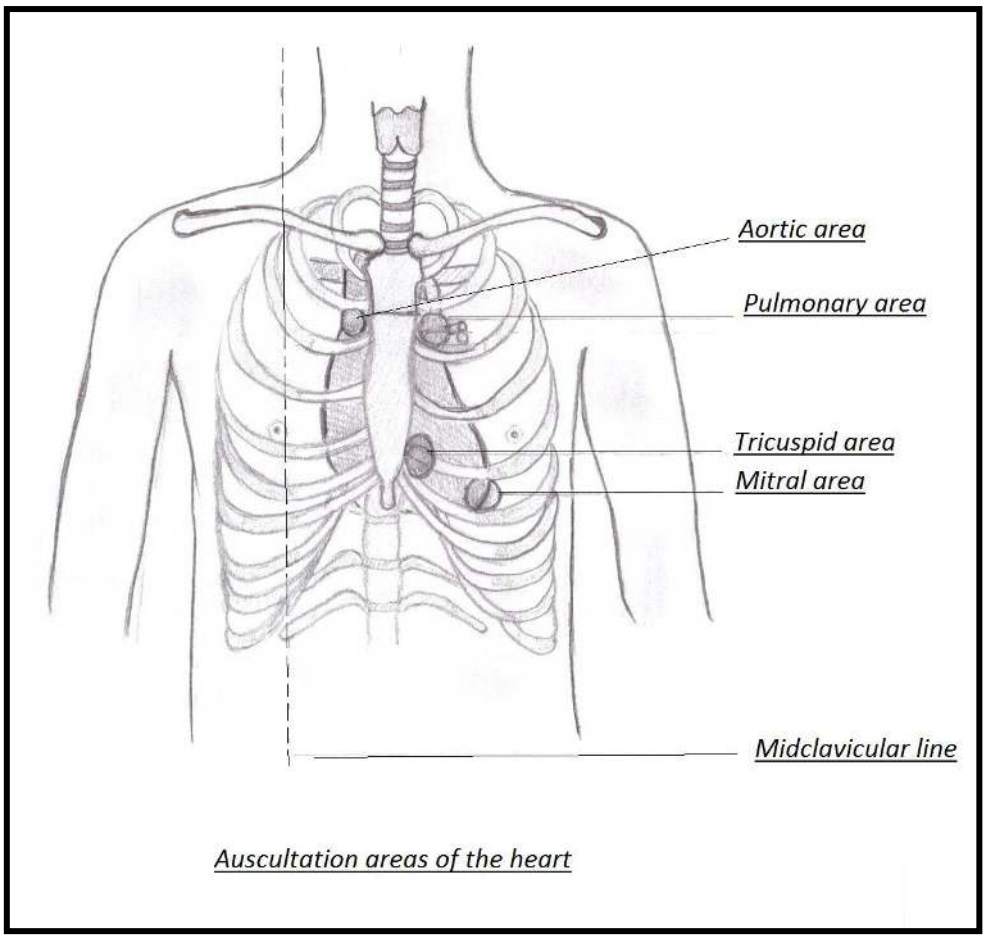
SURFACE MARKING OF AREAS OF THE HEART

Mitral area: it corresponds with the apex beat which is over the 5th intercostal space slightly medial to left mid clavicular line

Tricuspid area: this is near the lower end of left border of sternum in the 4th and 5th intercostal spaces

Pulmonary area: this is over the left second intercostal space near the left border of sternum.

Aortic area: there are 2 aortic areas. First is over the right second intercostal space near the sternum (A1) and the second is over the left third intercostal space near the sternum.



Auscultation areas of the heart

POSTURES DURING AUSCULTATION

When listening child should be calm, use both diaphragm and bell (Paediatric stethoscope is preferable), and note any variation with respiration. Patient may need to resume following three postures if possible, to best hear the different types of murmurs.

1. While patient lies flat on the bed, auscultate all the 4 areas
2. Turn the patient on his left side and auscultate at the apex with bell of stethoscope. In this posture murmur of mitral area becomes more audible.
3. Then let patient sit up and bend forward. Auscultate over aortic and pulmonary areas. Early diastolic murmur of aortic area is best heard in this posture.

Keep in mind the old adage: 'sounds first, murmurs second'. During auscultation note the followings:

- Heart rate and rhythm
- Intensity of heart sounds
- Splitting of heart sounds
- Pericardial friction rub
- Clicks and opening snaps
- Murmurs

1. HEART RATE AND RHYTHM

Two heart sounds are normally heard:

- **First heart sound** is produced by the closure of atrioventricular valves (mitral & tricuspid)

- **Second heart sound** is produced by the closure of pulmonary and aortic valves.

These two heart sounds correspond, the words "Lub" and "Dup". Now count the Lub and Dup for one minute. This will be the heart rate. Note whether rhythm is regular or irregular.

Rhythm becomes irregular in the following conditions:

- Extra systole
- Atrial flutter
- Atrial fibrillation
- Multiple ectopic beats

2. INTENSITY OF HEART SOUNDS

First heart sound

The intensity of first heart sound is increased in:

- Mitral stenosis
- Systemic hypertension
- Tachycardia

The intensity of first heart sound is decreased in:

- Rheumatic carditis
- Mitral incompetence
- 1st degree heart block

Second heart sound

Second heart sound has two components: aortic and pulmonary

Increased intensity of aortic component is seen in:

- Hypertension
- Atheroma of aorta (uncommon in children)
- Aortic aneurysm (uncommon in children)

Decreased intensity of aortic component is seen in:

- Aortic stenosis
- Aortic incompetence

Increased intensity of pulmonary component:

- Feel for palpable P2 at 2nd ICS. PA gets dilated and becomes palpable.
- Palpable pulsation on the epigastric region may be due to pulmonary hypertension.
    - Increased pulmonary blood flow may be due to PDA, ASD, and large VSD.
    - Other causes may be mitral stenosis and cor-pulmonale.

Decreased intensity of pulmonary component is seen in:

- Pulmonary stenosis
- Pulmonary incompetence
- Fallot's tetralogy

3. SPLITING OF HEART SOUNDS

Splitting of first heart sound:

First heart sound is produced by the closure of atrioventricular valves. This sound may normally split as mitral valve closes earlier than tricuspid valve.

Wide splitting may also occur in:

- Mitral stenosis
- Atrial septal defect.

Splitting of second heart sound:

Second heart sound is produced by closure of aortic & pulmonary valves therefore it has two components:

- Aortic (A2)
- Pulmonary (P2)

A2 is audible over whole of the precordium while P2 is audible over pulmonary area. Normally aortic valve closes earlier than pulmonary valve. A widely split and fixed S2 is found in conditions that prolong the RV ejection time or that shorten the LV ejection.

Pathological causes of splitting of 2nd heart sound are:

- Pulmonary hypertension
- ASD or partial anomalous pulmonary venous return (PAPVR) – volume overload
- Pulmonary stenosis (pressure overload)
- RBBB (a delay in electrical activation of the RV) delays the completion of RV ejection
- Mitral regurgitation (a decreased forward output seen in this condition shortens the LV ejection time, making aortic closure occur earlier than normal).

A single S2 is found in the following situations:

- When only one semilunar valve is present (aortic or pulmonary atresia)
- When the P2 is not audible (Transposition of Great Arteries (TGA), Tetralogy of Fallot (TOF), severe Pulmonary Stenosis (PS).
- When aortic closure is delayed (sever Aortic Stenosis [AS]
- When P2 occurs early (sever Pulmonary Hypertension)
- Keep in mind physiological splitting of second heart sound

Third heart sound:

Rapid ventricular filling (normal in healthy children). Childrens' hearts go faster than adults so you may not be able to listen it normally.

4. GALLOP RHYTHM

Third heart sound occurs in early diastole at the time of maximal ventricle filling. This may occur in any healthy young adult but in any other clinical setting its presence indicates abnormal ventricular filling. The most important causes of this are left ventricular failure and mitral regurgitation.

Fourth heart sound occurs when bolus of blood is delivered into the ventricle from atrial contraction. It can be caused by an increased stiffness or non-compliance of the ventricles.

When heart rate is rapid, diastole is shortened and the third and the fourth heart sounds may coincide. When this occurs the amplitude of the sound increases and is more easily detected, giving rise to a summation **gallop rhythm**, so called because it gives the auditory impression of a galloping horse. Third and fourth heart sounds may originate from either right or left ventricles. These diastolic sounds are best heard with the bell of a stethoscope and auscultation should routinely include a search of these sounds with the patient turned slightly onto the left side.

5. MURMURS

Murmurs are due to turbulence in the blood flow at or near a valve or an abnormal communication within the heart. It follows that a loud murmur may originate from a rather small defect such as ventricular septal defect. Equally a soft murmur may originate from a large abnormal orifice as in very sever aortic regurgitation.

Therefore, while it is important to note the intensity of a murmur, one should not make immediate deductions about its importance solely from its loudness. Not all murmurs are produced by a structural disorder of the heart; they may be due to abnormally rapid flow of blood through a normal valve. Such murmurs are called as flow murmurs.

When examining a murmur following points must be noted

1) Decide time of occurrence: note if it is systolic or diastolic or both. This can be made out by synchronising the murmur with carotid pulse or by apex beat.
2) Pitch and quality: high or low, harsh or blowing
3) Grade them according to the intensity of murmur:
    a. **Grading of systolic murmurs:**
        - Grade I: very faint
        - Grade II: medium intensity
        - Grade III: loud without thrill
        - Grade IV: loud with thrill
        - Grade V: very loud (stethoscope must be on the chest wall to listen it)
        - Grade VI: Murmur audible with stethoscope off the chest wall
    b. **Grading of diastolic murmurs**
        - Grade I: barely audible
        - Grade II: Faint but audible
        - Grade III: Easy to hear
        - Grade IV: loud
4) Note point of maximum intensity
5) Note the direction of propagation beyond the precordial area
6) Note the character of murmur
7) Note changes with respiration and posture
8) Then feel for a big liver (CCF) and spleen (IE)
9) Is there a thrill?

Thrill: It is purring sensation which is felt by the palpatory hand which is present in a palpable murmur at suprasternal & supraclavicular areas. It is of two types (systolic or diastolic) which can be made out by synchronising it with apex beat or carotid pulse.

Systolic: It corresponds with systolic murmurs. When apex beat strikes the palpating hand, thrill felt during this time is systolic

Diastolic: When apex beat is away from the hand, thrill felt during this time is diastolic
Same rule applies in case of **carotid pulse:** when you feel the pulse, it is systolic & when you do not feel, it is diastolic

Causes of systolic murmurs

Ejection systolic murmur	
Innocent flow murmur	Left sternal edge or Pulmonary area
Anaemia	Left sternal edge or Aortic area
ASD	Pulmonary area - (mid diastolic) Left 2nd intercostal space
Pulmonary stenosis	Pulmonary area – (can be mid diastolic in peripheral PS) Left 2nd intercostal space
Aortic stenosis or	Aortic area, Right 2nd intercostal space to carotids in AS
Bicuspid aortic valve	
Mitral valve prolapse	Apex
Pansystolic (holosystolic) murmurs	
VSD	Left sternal edge, 4th intercostal space
Co-arctation of aorta	Left sternal edge and between scapulae
Mitral regurgitation	Mitral area - radiates to axilla
Tricuspid regurgitation	Tricuspid area

Causes of diastolic murmurs

- ASD
- VSD
- Mitral stenosis
- Aortic regurgitation

Causes of continuous or machinery murmurs

- PDA
- Coarctation of aorta

CONGENITAL DISORDERS ASSOCIATED WITH HEART DISEASE

1. Major syndromes with cardiovascular abnormalities

- **Downs:** (Trisomy 21): AVSD (30%), VSD, ECD

- **Turner's:** (XO): Coarctation of aorta, bicuspid aortic valve, aortic stenosis, hypertension, aortic dissection later in life,
- **Alagille:** peripheral pulmonary artery stenosis
- **CHARG association:** TOF, truncus arteriosus, aortic arch anomalies
- **Di-George:** interrupted aortic arch, truncus arteriosus, VSD, PDA, TOF
- **Pierre Robin:** occasional VSD, PDA

2. Intrauterine infection

- Rubella (esp. in the 1st trimester): PDA, septal defects, peripheral pulmonary valve stenosis

3. Maternal disease

- Diabetes: Infant of diabetic mother: TGA, VSD, COA, cardiomyopathy, PPHN
- Systemic lupus erythematosis: congenital heart block

4. Drugs in pregnancy

- Anticonvulsants: aortic stenosis, pulmonary stenosis, coarctation of aorta
- Foetal warfarin syndrome: TOF, VSD
- **Foetal alcohol syndrome:** VSD, PDA, ASD, TOF

Picture: Auscultation of the heart and the neck

AT THE END OF CVS EXAMINATION MAKE A REASONABLE ASSESSMENT

1. **What is the lesion?**
   Decide if
   - Congenital (usually a young child) or
   - Acquired (usually an older child)
2. **If congenital**, decide if ACHD or CCHD and offer the most likely lesion with a differential diagnosis
3. **Is there Congestive cardiac failure** (CCF)? (big heart/big liver/fast heart/fast breathing)
4. **Is there pulmonary hypertension** (PHT)? (loud P2 and evidence of RVH)
5. Is there cor-pulmonale
6. **Is there infective endocarditis** (IE)?
7. **If congenital HD**, is there a system associated?
8. **If acquired HD** (usually Rheumatic HD, sometimes CMO) is there Acute Rheumatic Fever at present?
9. **Is there growth**/development failure?

A PRACTICAL APPROACH TO AUSCULTATE A PRECORDIUM OF A CHILD (KZN DOH)

Commence auscultation at apex, with diaphragm of stethoscope then bell (for diastolic)
Work across to and up the sternal border – tricuspid, pulmonary and aortic areas

1. Listen to each component of cardiac cycle carefully
2. Note the intensities of S1, S2
3. Whether S2 splits normally with respiration
4. Listen for added sounds
5. Then for systolic and diastolic murmurs
6. Note radiation of any murmurs to axillae or carotids
7. Next sit the child up and listen to any murmur variation with this change in position
8. Listen with the child in full expiration for the subtle early diastolic murmur of aortic incompetence
9. Listen at the back for radiation of murmur and for any pulmonary adventitious sounds
10. Inspiratory crackles with left ventricular failure
11. Variable findings with coexistent chest infection in Kartagener's syndrome
12. **Lay the child down** and examine the abdomen for:
    a. Hepatomegaly – CCF
    b. Pulsatile liver – tricuspid incompetence
    c. Splenomegaly – Subacute Bacterial Endocarditis (SBE)
13. **Then feel for ankle oedema**
14. Request urine analysis for blood – SBE
15. Then temperature chart – SBE
16. If SBE does appear likely, request for an ophthalmoscope to detect Roth spots
17. Give your succinct diagnosis based on your clinical findings and only after this you request the CXR and ECG.