

# Paediatric Cardiology

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# Introduction

- Daunting topic which is very easy to get confused by
- Try and understand the basics of congenital heart defects to logically approach the problem!
- General introduction to murmurs
- Go back over the different types of heart failure
  - Clinical signs
  - Findings
  - Treatments

# Learning Objectives

- **Age related changes in heart rate and blood pressure**
  - Know approximate values for infants and toddlers
- **Innocent murmurs**
  - Definition and how to distinguish from pathological murmurs
- **Heart failure**
  - Symptoms and signs in infants and children
  - Possible causes
- **Common forms of congenital heart disease**
  - Natural history and management of:
    - Acyanotic
      - ASD, VSD, PDA, coarctation
    - Cyanotic
      - Fallots, transposition
- **Infective endocarditis**
  - Which children are at risk?
  - Preventative measures

# Age Related Changes in HR & BP

- Important to remember that:
  - Paediatric HR is much faster than adult normal
  - BP is lower

**Paediatric Normal Vital Signs**

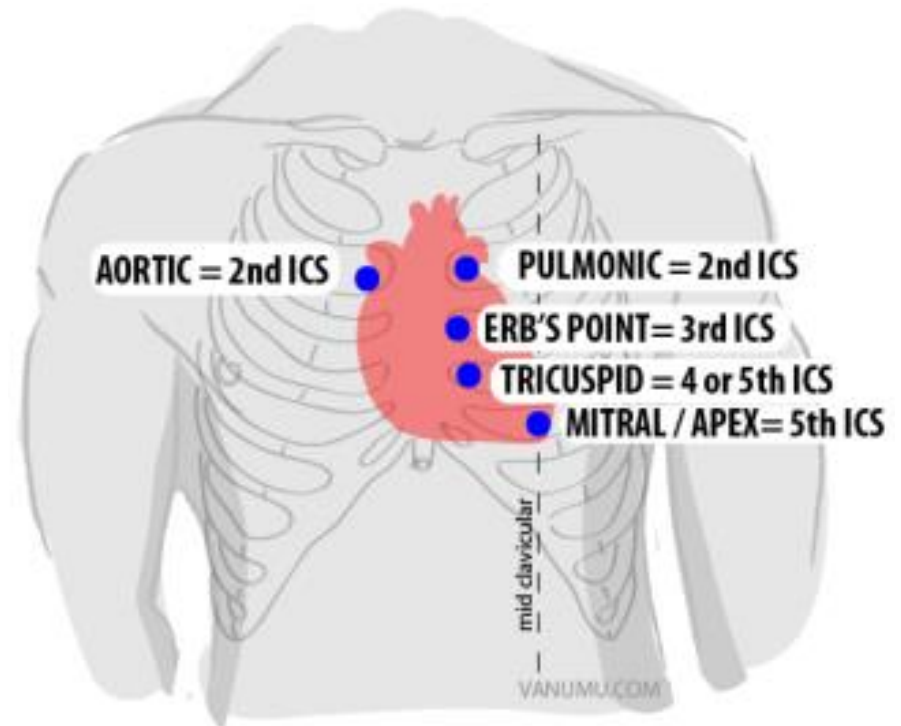
<b>Age</b>	<b>RR</b>	<b>HR</b>	<b>SBP (50<sup>th</sup> centile)</b>
<1	30-40	110-160	80-90
1-2	25-35	100-150	85-90
2-5	25-30	95-140	90-95
5-12	20-25	80-120	100-105
>12	15-20	60-100	110-120

*Source: APLS guidelines*

# Murmurs Intro – Location

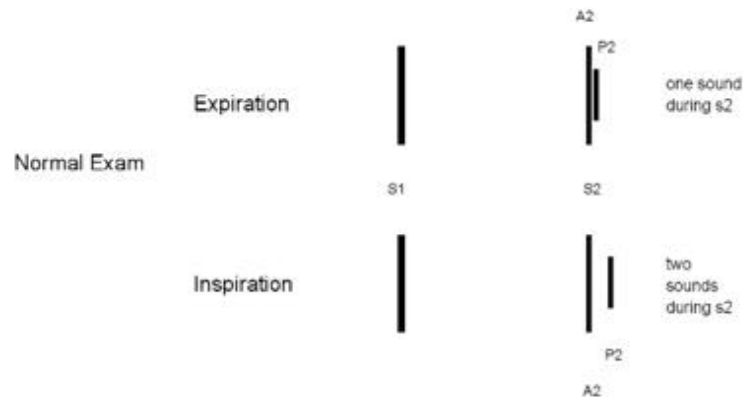
- Remember that “All Physicians Take Money” to have some logic to approaching where the murmurs will be heard loudest

- **Discuss Erb’s point**



# Murmurs Intro – Heart Sounds

- Heart sounds are known as S1 and S2. Additional sounds are S3 and S4.
- S1 >> mitral (M1) and tricuspid (T1) components
- **S2 >> aortic (A2) and pulmonary (P2) components**
  
- S2 splitting is physiological during inspiration
- Inspiration causes thorax pressure to fall, increasing venous return to RA
- Opens the pulmonary valve for longer, “splitting” S2 –heard in pulmonic region
- **Pathological splitting of S2 is due to increased loading on the R side**



# Murmurs Intro – Innocent

- Occur in 80% of normal children at some point in childhood
- May be exacerbated by febrile illness
- No associated symptoms
  - No breathlessness, cyanosis, no Hx of fainting
- Normal pulses
  
- Simple version: *murmurs are innocent*
  - asymptomatic
  - Soft blowing murmur
  - Systolic murmur only
  - left sternal edge

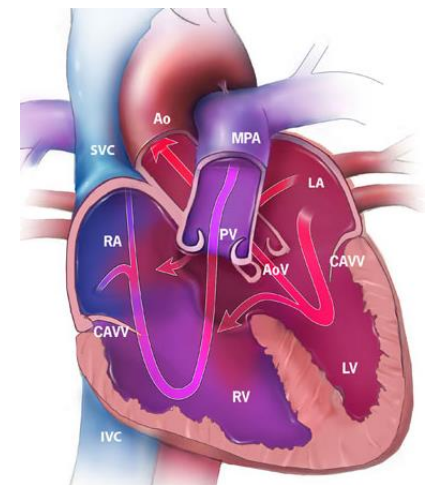
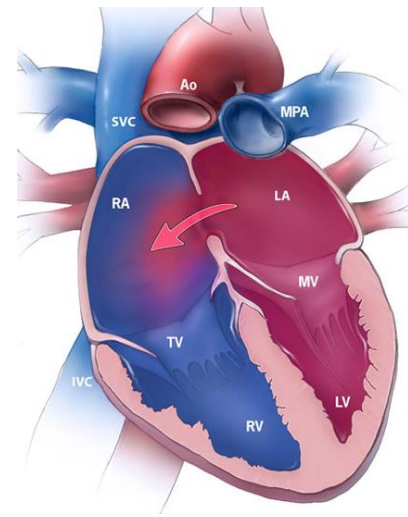
# Heart Failure

- Heart is no longer adequately perfusing the tissues
- Diverse presentation:
  - Spectrum from severely ill new-born requiring ICU
  - Asymptomatic child with murmur
- Infants:
  - Central cyanosis
  - HF symptoms: breathlessness, sweating, fatigue on feeding, poor weight gain, circulatory collapse with hypotension and acidosis
- Children:
  - Palpitations, dizziness/syncope on exertion, exercise limitation, chest pain (very rarely)



# Acyanotic HF: ASD, AVSD

- Atrial septal defect
  - Ostium secundum defect
  - More common
- Atrio-ventricular septal defect
  - Ostium primum defect
  - Associated with Down's syndrome
- Usually asymptomatic in childhood
- May develop HF symptoms



# Acyanotic HF: ASD, AVSD

- Clinical features
  - Palpitations, RV heave
- MURMURS:
  - (1) Diastolic flow murmur across tricuspid valve (increased volume in RA)
  - (2) Ejection systolic murmur at upper left sternal edge (pulmonic region – RV)
  - (3) Fixed and widely split S2 (increased volume in RV)
  - **AVSD, (4) apical pansystolic murmur**
- ECG:
  - ASD
    - RV volume overload: RSR in V1, right axis deviation
    - RA enlargement: Tall peaked P waves
    - **Right BBB**
  - AVSD
    - RV hypertrophy / **right BBB**
    - **LV hypertrophy**
    - **1<sup>st</sup> degree heart block**

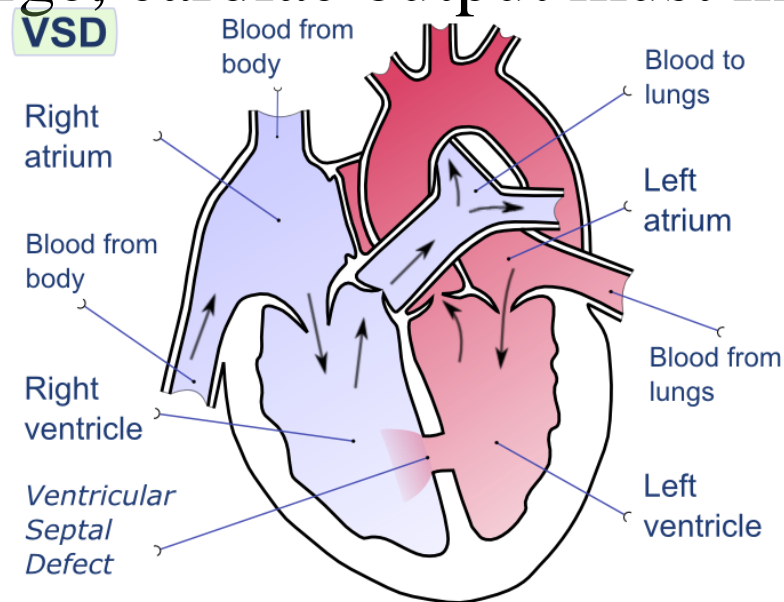
# Acyanotic HF: ASD, AVSD

- CXR (both):
  - RA and RV enlargement
  - Prominent pulmonary trunk
  - Increased pulmonary vascular markings
- Mx:
  - ASD:
    - 80% of small defects Dx in infancy close spontaneously by 18 months
    - RV volume-loading necessitates closure with a transcatheter device
  - AVSD:
    - Requires elective surgical repair between 2 and 5 years

# Acyanotic HF: VSD

- VSD

- Flow of blood through ventricular septum at **lower L sternal edge**
- When large, cardiac output must increase



# Acyanotic HF: VSD

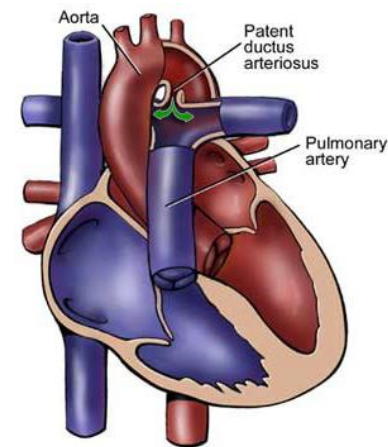
- Clinical features:
  - Small – Asymptomatic
  - Moderate/Large – full HF symptoms
- MURMURS
- Small:
  - Grade 1-4/6 pansystolic murmur at LLSE
  - Palpable thrill
- Moderate/Large:
  - Blowing, pansystolic murmur at lower left sternal edge
  - Apical, mid-diastolic, low-pitched rumble due to increased flow across mitral valve
  - **N.B. S2 is NOT split**

# Acyanotic HF: VSD

- ECG:
  - Biventricular hypertrophy
  - Notched/peaked P waves (think atrial hypertrophy)
- CXR:
  - Cardiomegaly
  - Pulmonary plethora
- Mx:
- Small – significant % close spontaneously in first 2 years
- Medical:
  - Control HF, prevention of pulmonary vascular disease, maintenance of normal growth
- Surgical indications:
  - Failure of medical treatment, large defect in infant aged 6-12 months with reversible pulmonary hypertension, aortic regurgitation

# Acyanotic HF: Patent Ductus Arteriosus

- Increased flow from the aorta to the pulmonary artery
- Clinical features:
  - Small: Asymptomatic
  - Large: Recurrent LRTIs, failure to thrive, eventual HF, endarteritis risk
  - Exertional dyspnoea
  - Bounding peripheral pulses
  - Significant shunt may cause pulmonary hypertension
- MURMURS
  - Continuous machinery murmur below left clavicle



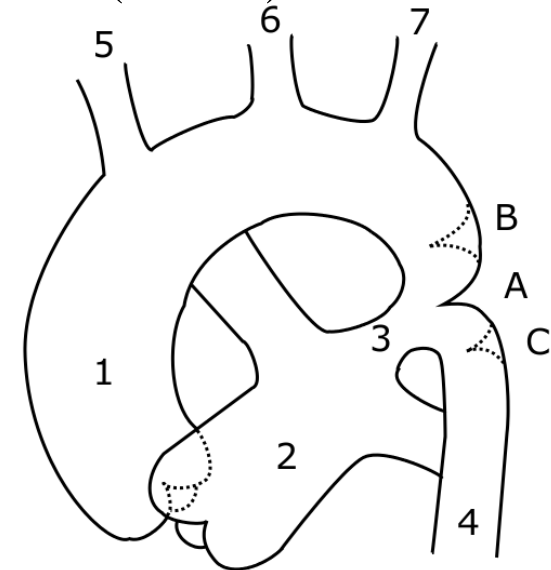
# Acyanotic HF: Patent Ductus Arteriosus

- ECG:
  - Left ventricular hypertrophy
- CXR:
  - Cardiomegaly
  - Pulmonary plethora
- Mx:
- Small: may close spontaneously
- Medical:
  - Prostaglandin synthetase inhibitors (ibuprofen, aspirin), HF Mx
- Surgical:
  - Ligation / transcatheter occlusion



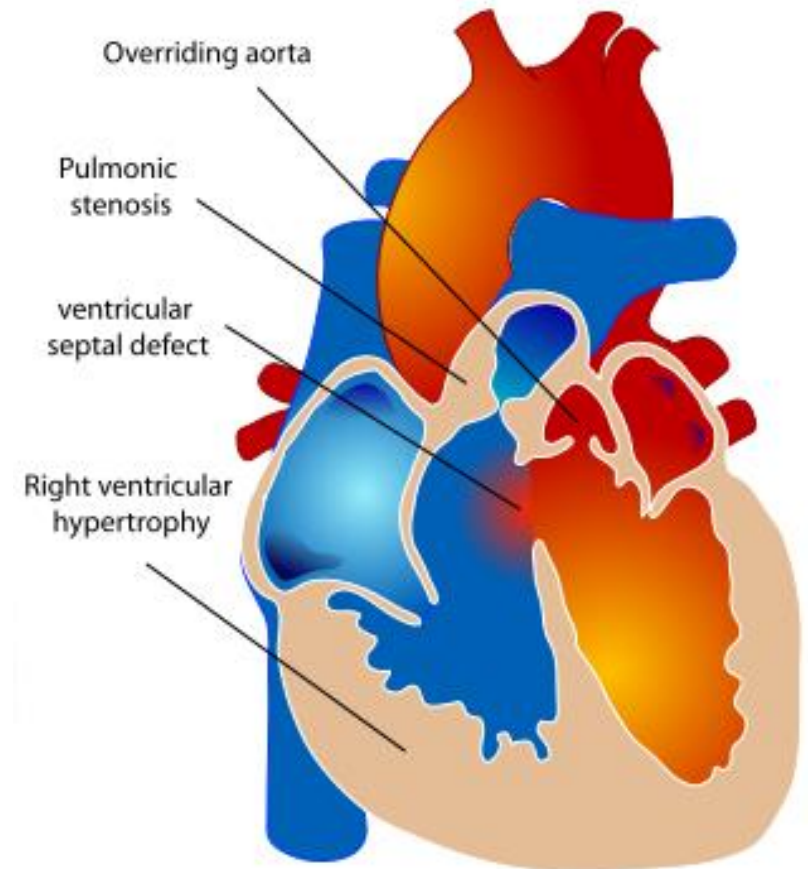
# Acyanotic HF: Coarctation of Aorta

- Different for sick newborn / well child
- Clinical features:
  - Presentation may be abrupt and acute
    - Ductal closure precipitates circulatory collapse
    - Blockage proximal to duct (B), RV can supply blood to lower limbs
    - Duct closure can also worsen the coarctation itself (A or C)
  - Reduced / absent lower extremity pulses
  - BP discrepancy upper and lower limbs
- **NO MURMURS**



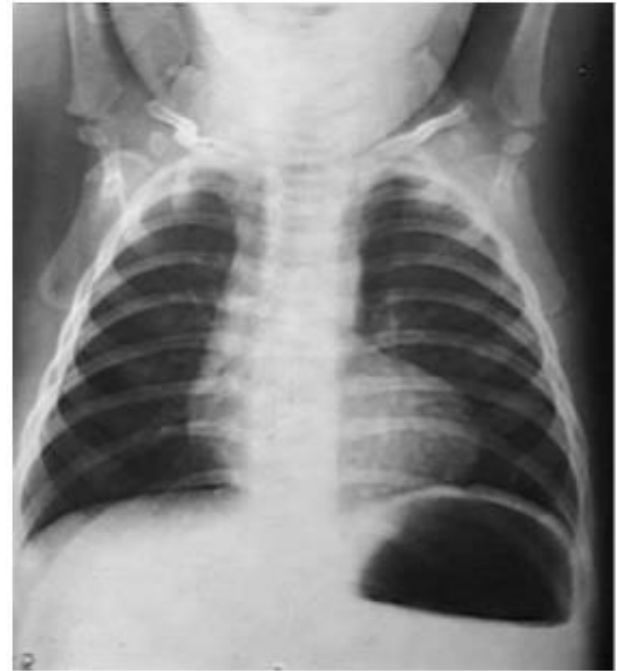
# Cyanotic HF: Tetralogy of Fallot

- VSD
  - Overriding aorta
  - **RV outflow tract obstruction**
  - RV hypertrophy
- Clinical features:
    - Severe cyanosis
      - May lead to MI, CVAs
    - Clubbing
    - Squatting on exercise
  - Ejection systolic murmur
    - ULSE, pulmonic region



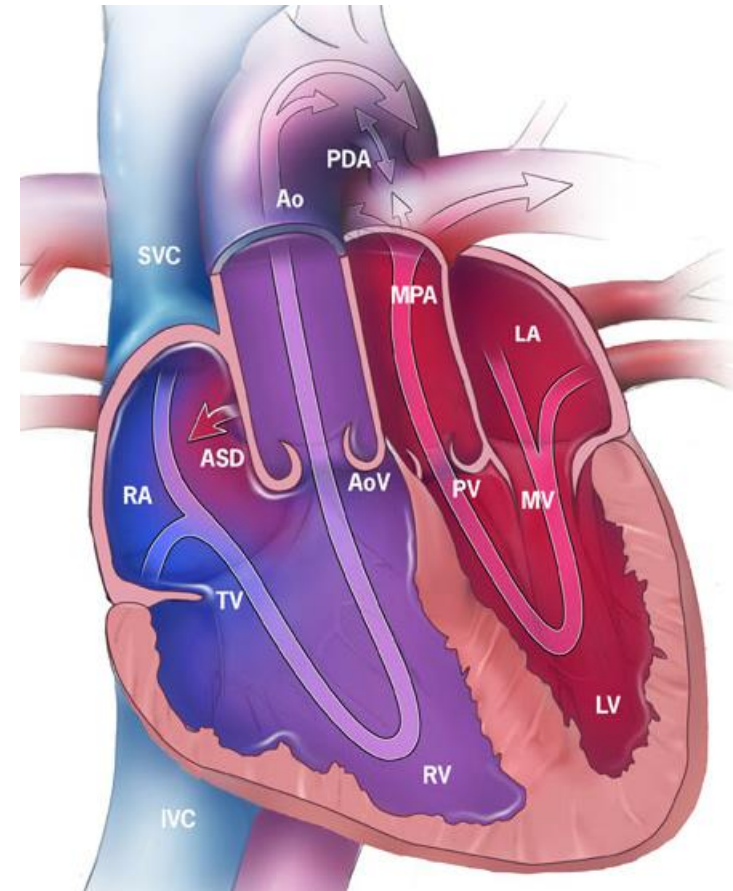
# Cyanotic HF: Tetralogy of Fallot

- ECG
  - Normal at birth
  - RV hypertrophy when older
- CXR
  - **Relatively small, “boot-shaped” heart**
  - Pulmonary artery “bay”
  - Oligaemic lung fields (reduced vessels)
- Mx
- Surgical:
  - Neonates: Shunt from subclavian to pulmonary artery
  - 6 months of age: close VSD, relieve RV obstruction
- Hypercyanotic spells:
  - Sedation, analgesia, IV beta blocker, fluids, HCO<sub>3</sub><sup>-</sup>



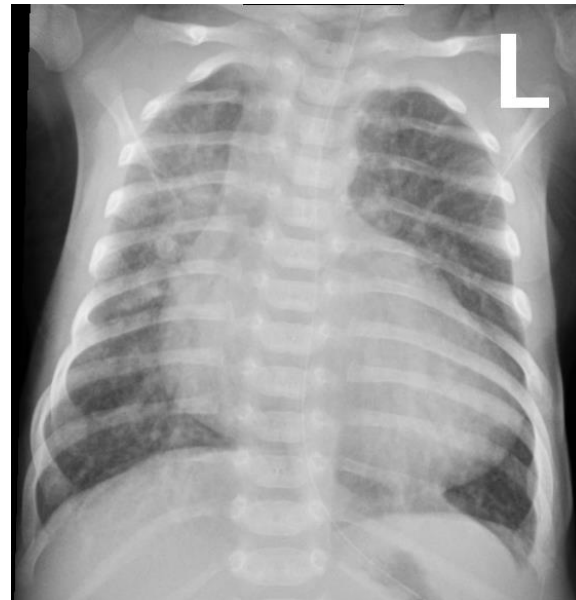
# Cyanotic HF: Transposition of Great Arteries

- Coexistent ASD/VSD/PDA allows compatibility with life
- Clinical features:
  - Severe cyanosis
  - Spontaneous PDA closure reduces mixing
- MURMURS
- **S2 single and loud**
- VSD / PDA murmur



# Cyanotic HF: Transposition of Great Arteries

- ECG:
  - Normal
- CXR:
  - “Egg on side”
  - Pulmonary plethora
- Mx:
- Medical:
  - Prostaglandin infusion – keep the PDA open
- Surgical:
  - Balloon atrial septostomy to produce ASD
  - Arterial switch procedure in neonatal period



# Conclusion

- Keep calm!
- Work through the steps methodically
- Remember the basics of murmurs before tackling the question
- Remember the difference between acyanotic and cyanotic conditions

# Flow List

- Is there a murmur?
  - No? Coarctation of aorta
- Is the murmur continuous?
  - Yes? Patent ductus arteriosus
- How is S2 described?
  - Fixed & split? R heart loading, ASD or AVSD
  - Single S2? Transposition of great arteries
  - No? VSD or Tetralogy of Fallot
- Differentiate VSD/ToF
  - Cyanosis v acyanosis
  - CXR – cardiomegaly v small “boot shaped” heart
  - ECG – A & V hypertrophy v no change / RV hypertrophy

	Murmur type	Place	Other weird sounds	CXR	ECG	Mx
Still's	Soft, mid-systole	Left sternal border	-	Normal	Normal	None
Venous hum	Soft, throughout cardiac cycle	Beneath clavicles, bilateral	-	Normal	Normal	None
Neck bruit	Soft, ejection systolic	Above clavicle	-	Normal	Normal	None
ASD	Ejection systolic 2 or 3/6	Upper left sternal edge	Fixed and widely split 2 <sup>nd</sup> heart sound	Cardio-megaly + enlarged pulm arteries + increased pulm vascular markings	Right axis deviation (due to RV hypertrophy) + RSR in V1 (RBBB)	If RV dilation  Cardiac catheterisation 3-5 years
Small VSD	Loud, pansystolic	Lower left sternal edge	Quiet pulm 2 <sup>nd</sup> sound	Normal	Normal	None
Large VSD (=/+ than aortic valve)	Mid-diastolic murmur	Apical	May be soft pansystolic murmur + loud pulm 2 <sup>nd</sup> sound	Cardio-megaly + enlarged pulm arteries + increased pulm vascular markings + pulm oedema	Bi-ventricular hypertrophy (by 2 months) + upright T wave in V1 (if RV hypertrophy due to pulm hypertension)	Diuretics (captopril) and calories Surgery at 3-6 months
AVSD	Pansystolic murmur	Apical		If large: cardiomegaly + increased pulmonary markings	Superior QRS axis (negative AVF)	Surgical 3 years



	Murmur type	Place	Other weird sounds	CXR	ECG	Mx
<b>PDA</b>	Continuous (machinery) murmur	Beneath left clavicle	Bounding pulse	Normal (or may look like a large VSD)	Normal (or may look like a large VSD)	Cardiac catheter coil or occlusion at 1 year Surgical ligation (Prem: indomethacin / ibuprofen)
<b>Coarctation</b>	None	None	None	Cardio-megaly	Normal	Maintain duct patency (PG) Surgery ASAP
<b>Tetralogy</b>	Loud 3 to 6/6 harsh ejection systolic murmur	Left sternal edge		Small heart + uptilted apex (boot-shaped) + pulmonary artery bay (concavity) on left heart border + decreased pulm vasculature markings	RV hypertrophy (upright T wave in V1) develops with age	Definitive treatment at 6 months (close VSD, relieve RV outflow obstruction)  If cyanosed infant, may need shunt between subclavian and pulmonary arteries
<b>Transposition</b>	Usually no murmur (may be systolic murmur)	Normal	Loud and single 2 <sup>nd</sup> heart sound	Egg on its side cardiac shadow + increased pulmonary vascular markings	Normal	Maintain duct patency (PG) or balloon atrial septoplasty Surgery in first few days of life

# MCQs

- Q1) A previously well 3-day-old becomes unresponsive and dusky on the neonatal unit. A CXR shows an “egg on side” appearance of the heart. Which of the following 3 are correct?
  - A) There may be a machinery murmur below the left clavicle
  - B) ECG will show RV hypertrophy
  - C) There is a loud, single second heart sound
  - D) There is a ejection systolic murmur at the ULSE
  - E) Give an immediate prostaglandin infusion

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# MCQs

- Q2) A 2-year old child is brought to the GP by his mother after having problems feeding, and not “putting on as much weight as his sister did”. Which of the 3 below are true of a ventricular septal defect?
  - A) Fixed, split second heart sound
  - B) Pansystolic murmur heard at the LLSE
  - C) Tricuspid diastolic murmur
  - D) Physiological splitting of S2
  - E) May require HF medication for feeding problems

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  - Cyanosis v acyanosis
  - CXR – cardiomegaly v small “boot shaped” heart
  - ECG – A & V hypertrophy v no change / RV hypertrophy

# MCQs

- Q3) On a routine baby check, you notice that a 48 hour old baby has absent femoral pulses. Which three of these is correct?
  - A) There is a loud, late systolic murmur at the upper left sternal edge
  - B) Blood pressure may be higher in the right arm than the right leg
  - C) Closure of the patent ductus arteriosus may cause circulatory collapse
  - D) The patient may appear to have peripheral cyanosis
  - E) There are no murmurs present