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Acute Care
Pediatric Nurse Practitioner
Review Course 2020

Cardiac

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Cardiac

Objectives:

1. Review common presentations of acquired cardiac diseases in children including hypertension, cardiomyopathy and Pericarditis.
2. Identify congenital cardiac defects by cyanotic or acyanotic lesion, presenting symptoms, typical management and surgical interventions performed.

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Cardiac

Objectives:

3. Review common cardiac diagnostic modalities used.
4. Discuss common cardiac dysrhythmias and management strategies.
5. Differentiate clinical findings of innocent and malignant cardiac murmurs.

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Hypertension

Hypertension: Blood pressure consistently above 95th % for age, gender, height, measured on 3 separate occasions

1. **Essential**: multifactorial, genetic, familial, environmental, dietary factors
2. **Secondary**: More common in kids. Usually renal vascular in origin (60%), can be systemic vascular, genetic/metabolic disorder or endocrine disorder.
3. Other: adrenal gland, OSA, stress, anxiety, coarctation, endocrine disorders, pregnancy, metabolic syndrome.

Hypertension Diagnosis

- **Labs:** CBC, Urinalysis, Culture, Uric acid, Electrolytes (BUN, creatinine), Fasting Lipid panel and Hepatic profile
- **Diagnostics:** Renal ultrasound, Echocardiography(LVH), 12 Lead EKG, Eye/retinal exam
- Utilize National High Blood Pressure Education Program (NHBPEP)
- Correct cuff size, 4 extremity with pulse checks

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Hypertension Management

- **Pre-hypertensive:** Counsel, follow-up
- **Stage 1**: diet, exercise, weight loss, low salt diet
- **Stage 2**: -Diuretics-may be primary therapy, thiazides most useful to lower B/P.

-ACE inhibitors-dilates vessels, decreases resistance, in volume depletion get hyperkalemia, cough. **"Prils"**

-Ca channel blocker-dilate, reduce resistance, arrhythmogenic, may get dizzy, fatigue, edema. Good in asthma. **"Pines"**

-Beta blockers-Blocks SNS, careful in diabetes, asthma, heart block, may get orthostatic hypotension.

-Vasodilators-bad side effects, use if failing other therapy

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Hypertensive Emergencies

- **Management**: IV anti-hypertensives: esmolol, labetolol, nicardipine and or hydralazine.
- Clear goals! No more than 25%-33% goal reduction over first 12hrs, total correction over 48-72hrs
- Not trying for normotensive
- Monitor for PRES/hypertensive encephalopathy
- Treat underlying disease!

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Syncope

- Female preponderance, more common >10yrs of age
- Mostly Benign 75% due to vasovagal, 25% due to migraines, cardiac disease
- Precipitated by dehydration and prolonged standing, may get LOC
- **Cardiac**-arrythmias or outflow tract obstruction-cerebral hypoperfusion
- Non-cardiac-Seizures/migraines-vasospasm
- Diagnostics:EKG, Holter, EEG, tilt-table, echo
- Management: fluid and salt intake, ICD, seizure management, avoid diuretics, elastic hose
- LOC> 1 minute more likely severe etiology**

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Describing Murmurs

The Approach

- Must describe the murmur by using systematic approach

1. Intensity (grading system)
2. Timing: Systolic or diastolic
3. Location
4. Radiation/transmission
5. Quality

Murmur Intensity or Grading

- Grade I-Faintest murmur auscultated
- Grade II-Murmur is faint but easily identified
- Grade III-Moderately loud
- Grade IV- Loud murmur with a **thrill**
- Grade V-Loud, but need stethoscope to hear
- Grade VI- Can be heard without stethoscope

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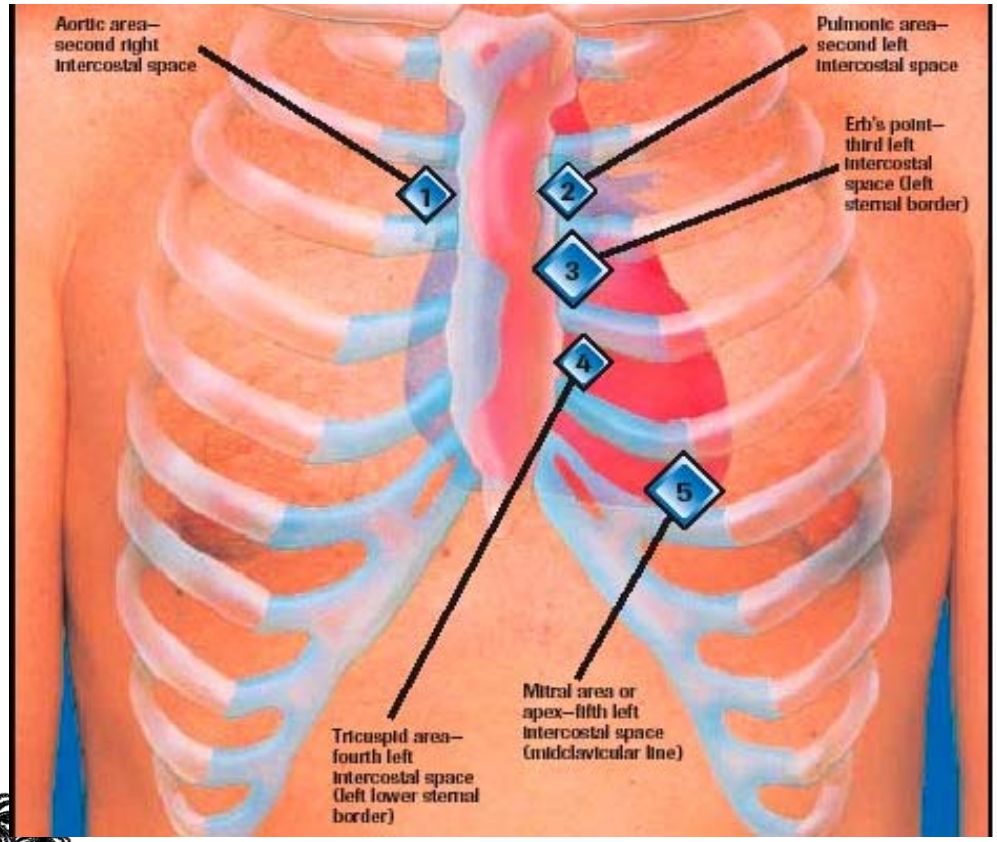
Location, Location, Location!



APT M or apex

1. **A**-Aortic at right 2nd ICS
2. **P**-Pulmonic at left 2nd ICS
3. Erb's point at left 3rd ICS on the left-hear S2 the best
4. **T**- Tricuspid left 4th ICS
5. **M-**Mitral or Apex- 5th ICS

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Pathologic Murmur

- Holosystolic
- Diastolic
- >grade 3 or with a click
- increases in intensity with standing
- Harsh in nature.
- Co-existing conditions or genetic disorders may predispose.

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Innocent Murmurs

- Arise from structures without cardiovascular abnormalities
- We need to know because…80% of children have innocent murmurs of one type or another during childhood
- Accentuated by high output states- fever, illness or anemia

7 S's of Innocent murmurs

- Small
- Single
- Short
- Sensitive
- Soft
- Sweet (not harsh)
- Systolic

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Still's Murmur

- Most common murmur
- Low frequency (use bell side), heard best at mid-left sternal border when the patient is supine. Midsystolic, grade 2-3-no thrill or click. Vibratory or twangy in sound
- Becomes quieter or disappears with upright positioning and when bell pressed firmly down or with valsalva
- Becomes louder with illness, excitement, anemia, or exercise
- Most common in children 3-6 years of age

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Pulmonary Ejection Murmur

- Commonly seen in 8-14 y/o children
- Heard at left upper sternal border, midsystolic and has a grating sound without radiation
- Usually grade 1-3/6
- No thrill, click
- Exaggerated by pectus excavatum, kyphoscoliosis, or straight back

Peripheral Pulmonic Stenosis (PPS)

- Commonly present in newborns
- Increased incidence in pre-term infant
- Disappears by 3- 6months of age
- Audible at LUSB
- Grade 1-2/6
- Transmits to the right and left chest, axillae, and the back
- Caused by turbulent flow through relatively hypoplastic PA branch that is getting increased blood after the ductus closes

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Venous Hum

- Seen commonly in kids 3-6 years of age
- Originates from turbulent jugular venous flow
- Continuous murmur where diastolic component is louder than the systolic
- Loudest in the infraclavicular and supraclavicular areas
- Heard only in the upright position, disappears in the supine position and can be completely obliterated by rotating the head to the side or occluding the neck veins

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Carotid Bruit

- AKA- Supraclavicular systolic murmur.
- Early systolic ejection murmur best heard over Supraclavicular fossa or over the carotid arteries.
- Grade 2-3/6
- Rarely associated with a palpable thrill
- Any age child

Acquired Heart Disease

- **Kawasaki Disease**: Acute systemic inflammatory vasculitis of unknown origin, may be viral? Acute and sub-acute phases. Leading cause of acquired heart disease. Covered in ID.

- **Rheumatic Fever**: Collagen vascular disease of connective tissue resulting in vasculitis. May lead to Mitral valve disease.

Acquired Heart Disease

- **Cardiomyopathy**: Acute or chronic disease of the myocardium of unknown cause, probable sequelae of a viral disease

- **Long QT syndrome**: Congenital disorder with prolongation of the QT interval and a propensity to ventricular tachyarrhythmias, which may lead to syncope, cardiac arrest, or sudden death

Rheumatic Fever

- Collagen vascular disease of connective tissue that results in vasculitis that occurs 2-4 weeks following Group A Strep pharyngitis
- Symptoms: Arthritis, carditis, chorea, erythema marginatum, and subcutaneous nodule
- Valve damage can be progressive and chronic.
- Who? Children from 5-15 y/o

Diagnosis-Jones Criteria
2 major or 1 major & 2 minor

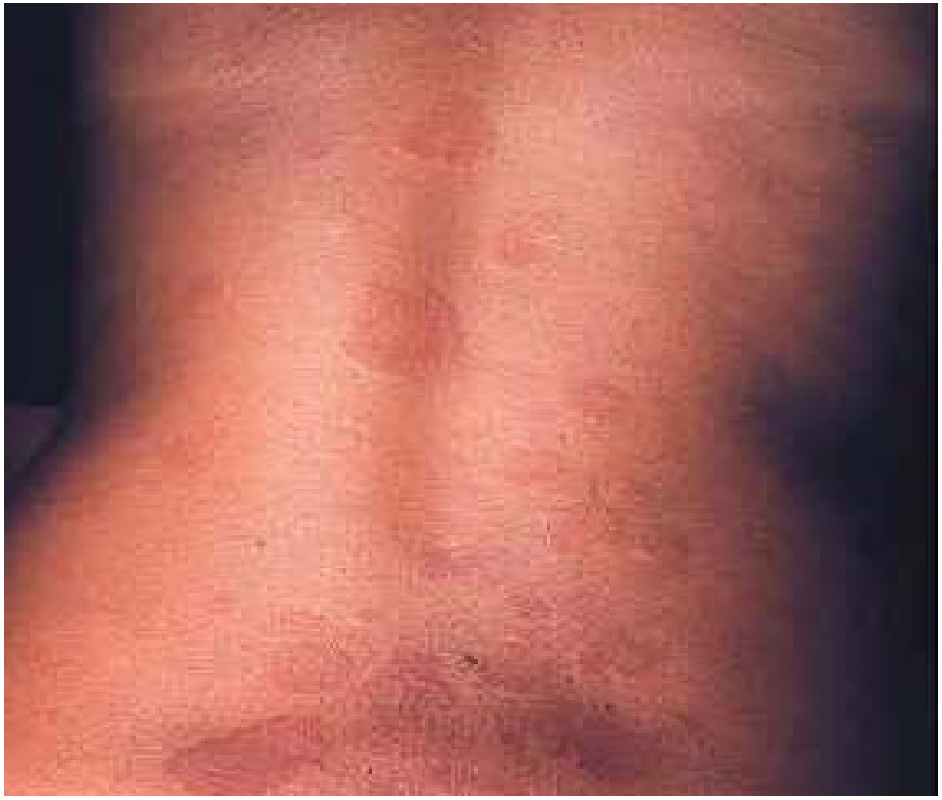
Major

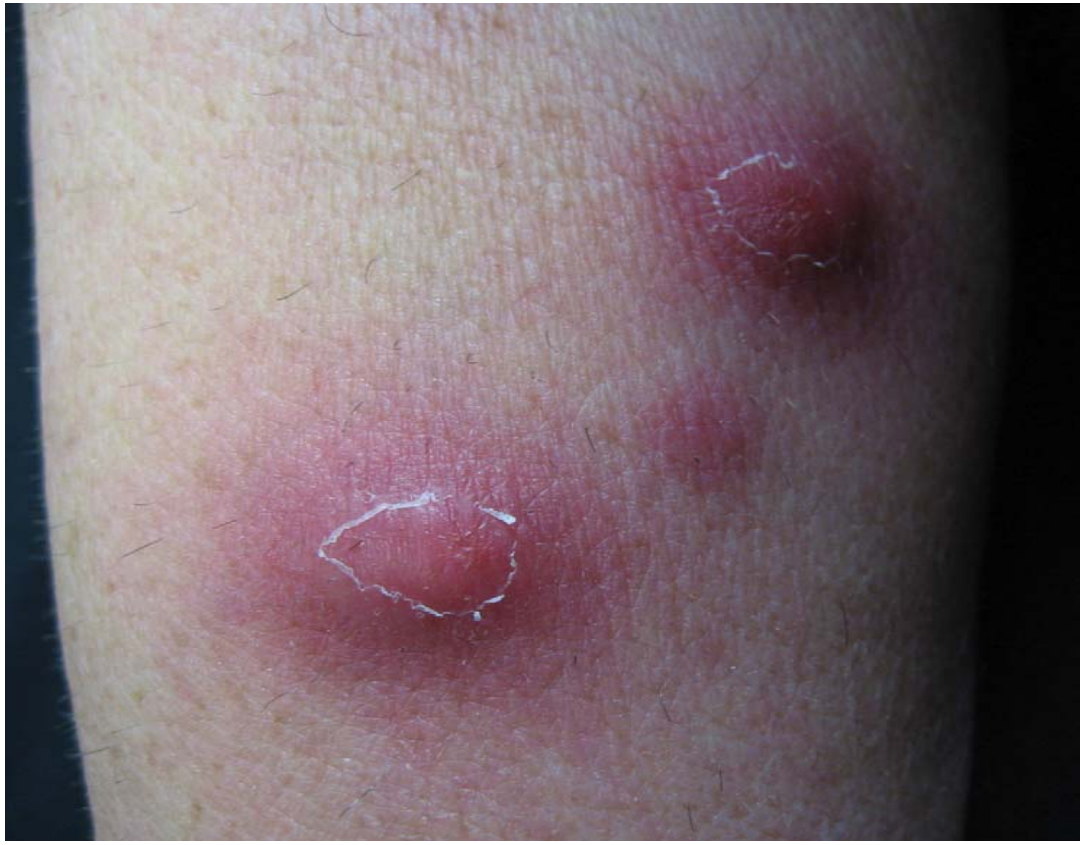
- Migratory arthritis
- Carditis and valvulitis
- CNS involvement-chorea
- Erythema marginatum
- Subcutaneous Nodule

Minor

- Arthralgia
- Fever
- Elevated acute phase reactants (ESR, CRP)
- Prolonged PR interval

Erythema Marginatum & Subcutaneous Nodules





Management

- Acute Phase: penicillin
- Aspirin therapy, bed rest until fever and symptoms resolve
- Cardiology and ID Consults
- Prevention!
- PCN prophylaxis

Long QT Syndrome

Usually not diagnosed until child/adolescent has a cardiac event, including syncope or cardiac arrest. Relatives of patients who have died of sudden death require genetic evaluation.

- Treatment is with beta blockers.
- Implantable cardioverter/defibrillator/Ablation can provide cure.
- Avoid medications that will prolong QT

https://www.sads.org.uk/drugs-to-avoid/

Cardiomyopathies

- Acute or chronic sequelae of of a typical viral disease
- 3 Types: Dilated (most common), Hypertrophic, and Restrictive
- Symptoms: SOB, CHF, fatigue, lethargy, exercise intolerance, decreased appetite.
- Echo: **Decreased CO and global function**
- EKG-sinus tachy, Prolonged PR, ST-T wave changes, hypertrophy

Cardiomyopathies: Common Causes

- Infectious-bacterial, fungal, protozoal, ricketsial
- Endocrine/Genetic/Meatbolic: hypo/hyperthyroid, excessive catecholamine (pheochromocytoma), diabetes, glycogen storage disease, mucopolysachridosis
- **Echo**-most important tool for dx and follow up, often trend BNP's

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Cardiomyopathies

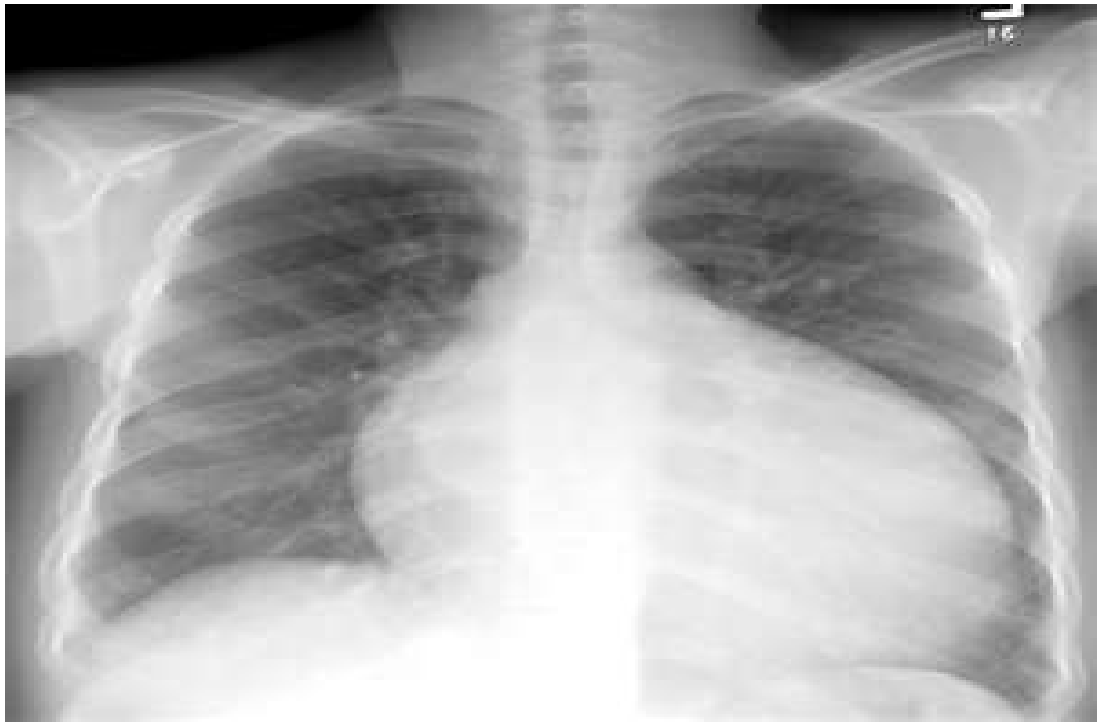
CXR: cardiomegaly, enlarged L atrial shadow, pulmonary edema

Evaluation should include anatomic abnormalities, metabolic, and infectious etiologies.

- Genetic if skeletal deformities noted, short stature or dysmorphic.
- Tissue Bx skeletal, cardiac, liver and skin.

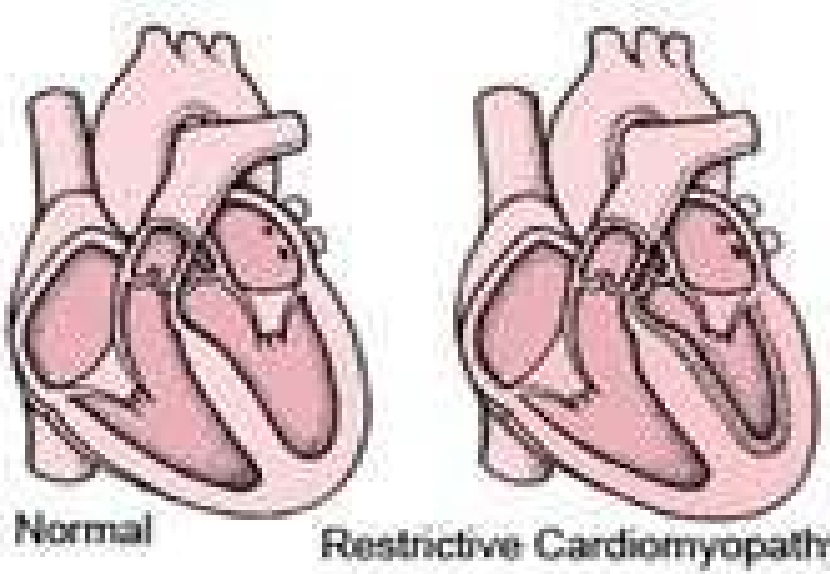
Dilated

- Systolic dysfunction
- Often asymptomatic
- LA/LV affected, chambers dilated with decreased contractility, very poor function
- Beta blockers useful



Restrictive

- Most deadly, least common
- Atrial dysfunction as large amount of blood is not able to leave ventricle
- Diastolic dysfunction
- Must think constrictive pericardidtis



In restrictive cardiomyopathy, the walls of the ventricles become stiff, but not necessarily thickened.

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Hypertrophic Obstructive Cardiomyopathy

- 50% familial, autosomal dominance
- Acute decompensation, usually with sports or activities
- Syncope rare but malignant
- Goal: Improve diastolic dysfunction
- Use: Beta blockers, avoid catecholimines
- Dual chamber pacing
- Surgery: Myotomy or myomectomy

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Management

Stable: Ace inhibitors/beta blockers to decrease LV stress

Acute: Increase CO with ino/lusitropes, vasodilators, and diuretics

- Pre-load dependent volume restriction
- IVIG, antivirals, VAD, ECMO, and heart transplant.
- Treat arrhythmias- Amiodarone is the treatment of choice

Clear as mud?

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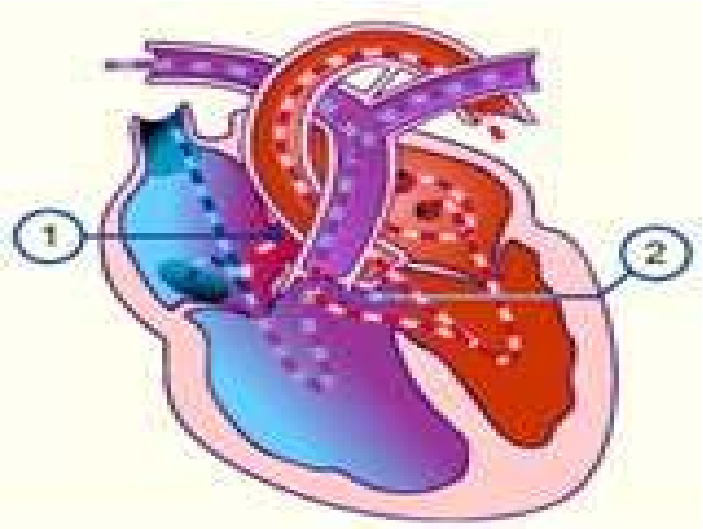
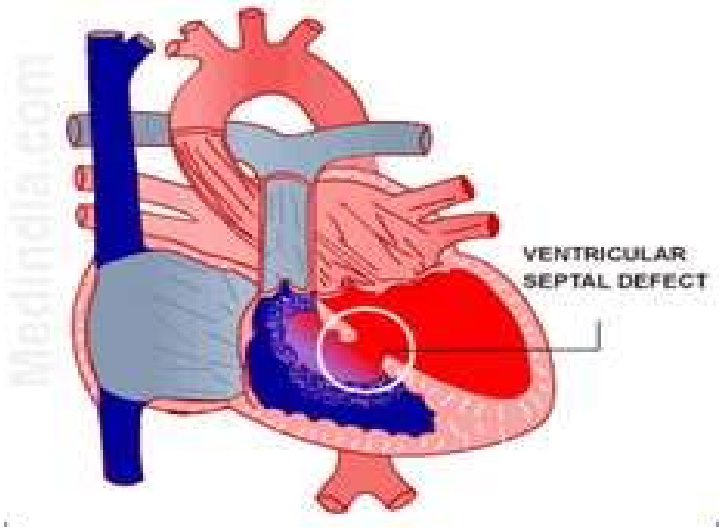
Acyanotic Defects

- Defects where blood flows left to right





VSD

- Most common of all congenital heart defects
- Accounts for 15-20% of all defects
- Hallmark-**Regurgitant systolic murmur** at the LLSB-depends on the severity of defect
- Usually holosystolic or less than holosystolic
- A thrill may be palpable at lower left sternal border
- CHF and pulmonary hypertension with large defects

ASD

- Compromises 5-10% of all defects but often exists as part of other defects
- Typically female and slender
- Hallmark-widely split **fixed S2** grade 2-3/6 at LUSB.
- SEM across Pulmonary valve
- May have mid-diastolic rumble r/t tricuspid stenosis.
- Often asymptomatic and have spontaneous closure (40%)
- Many have a device closure
- Routine monitoring via ECHO, RVH noted

AV Canal

- 2% of all defects, associated with Trisomy 21
- Failure of the endocardial cushion to develop normally
- **3 components:** ASD, inlet VSD, abnormal formation of the AV valves with left to right shunting
- Symptoms depend on type and configuration. Common: Tachypnea, poor weight gain, signs of CHF
- Systolic regurgitant murmur 3-4/6 at LLSB
- Echocardiogram, CXR
- Control CHF, encourage weight gain: surgical correction by 6 months of age
- Post-op arrhymias, mitral valve regurgitation

PDA

- Occurs in 5-10% of all CHD
- Common in pre-term infants
- CHF-Tachycardia and tachypnea noted
- Grade 1-4/6 **continuous machinery** like murmur audible at the left infraclavicular area or upper left sternal border
- Systolic thrill at the upper left sternal border with hyperactive precordium, bounding pulses, and wide pulse pressure
- Unrepaired, can result in pulmonary vascular obstructive disease, Cor pulmonale or parenchymal lung injury disease
- Surgically ligated or coil occlusion

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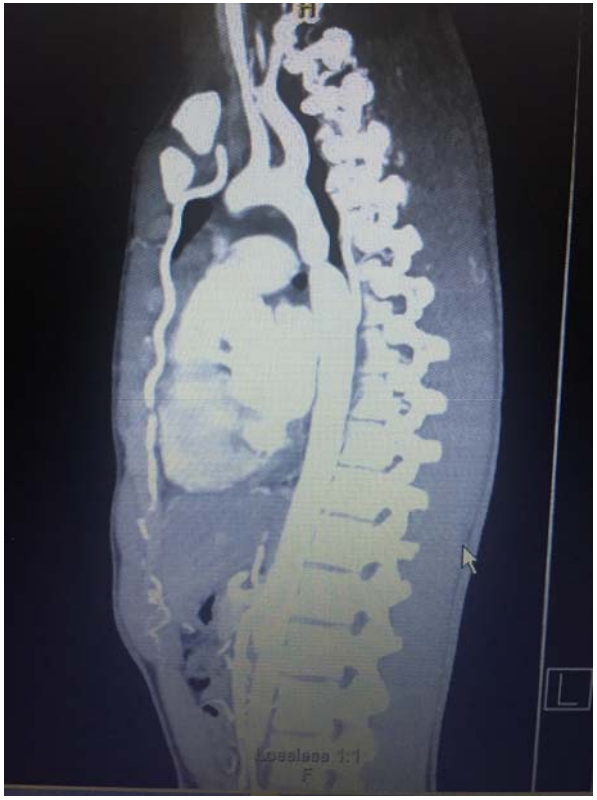
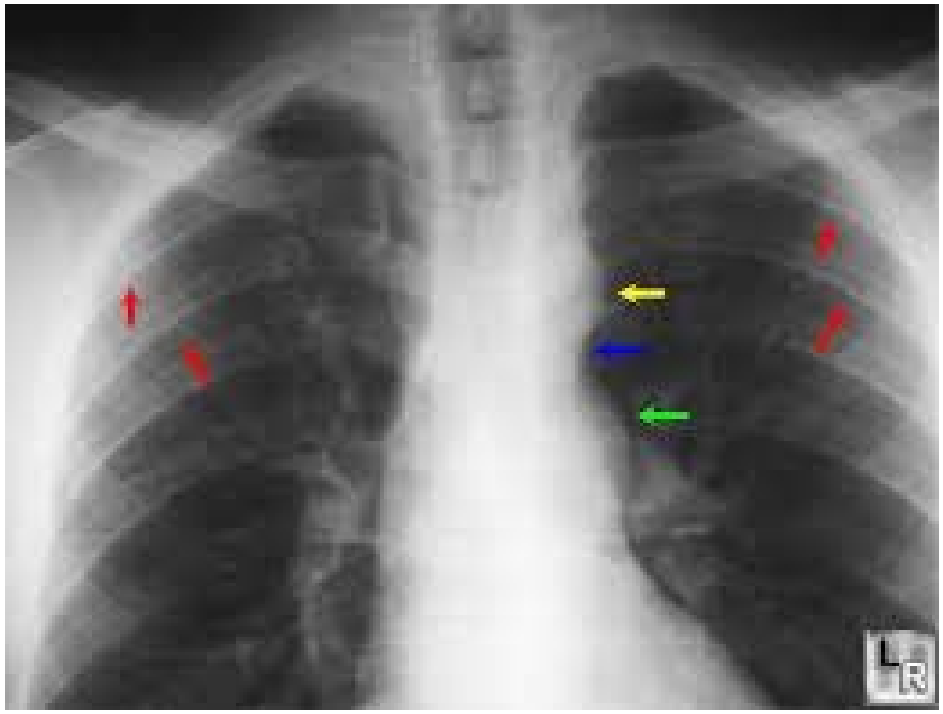
Coarctation of the Aorta

- 8-10% of all CHD
- Narrowing of the aortic arch causing decreased flow
- **Symptoms**: upper extremity hypertension, absent or weak pulses in LE, Pulmonary edema in neonate with LV failure, cardiogenic shock, risk for intracranial hemorrhage(10% untreated adults), Brachial femoral pulse lag.
- Systemic hypertension/asymptomatic murmur in older child, any child with repaired PDA at risk later in life
- May hear ejection click from bicuspid aortic valve
- CXR with 3 sign, rib notching, 4 extremity blood pressure
- Echo/EKG - MRI definitive
- Surgical repair with re-anastomosis or balloon stent placement

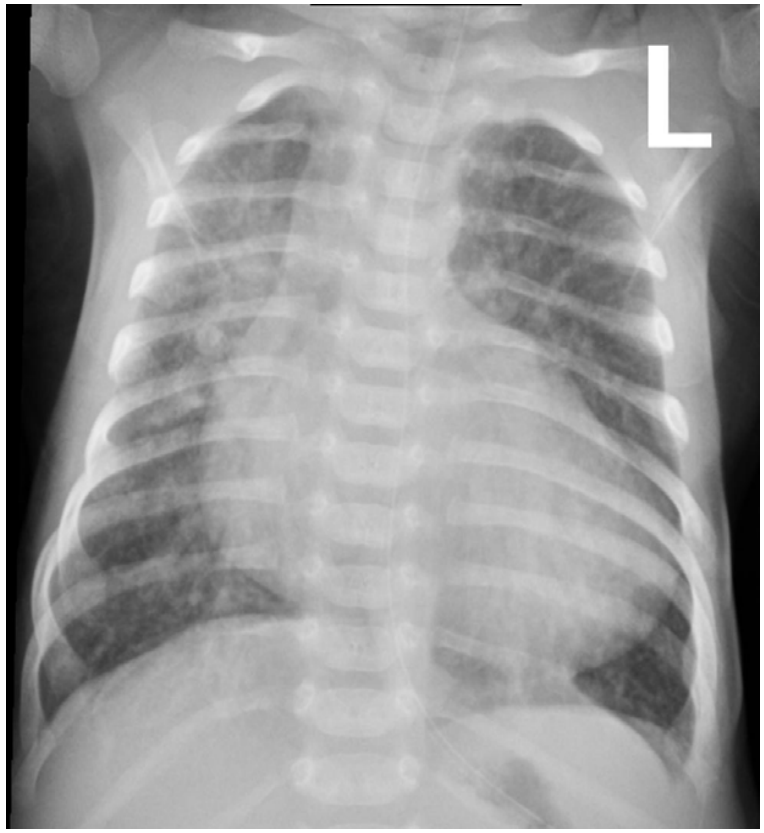
Coarctation of the Aorta





CHF

- Volume or pressure overload leading to poor cardiac output.
- **Symptoms**: crackles, respiratory distress, tachycardia, diaphoresis, hepatomegaly, FTT, cardiomegaly, exercise intolerance, decreased urine output with edema.
- **Diagnostics**: CXR, echo, MRI, CT, cardiac cath



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CHF

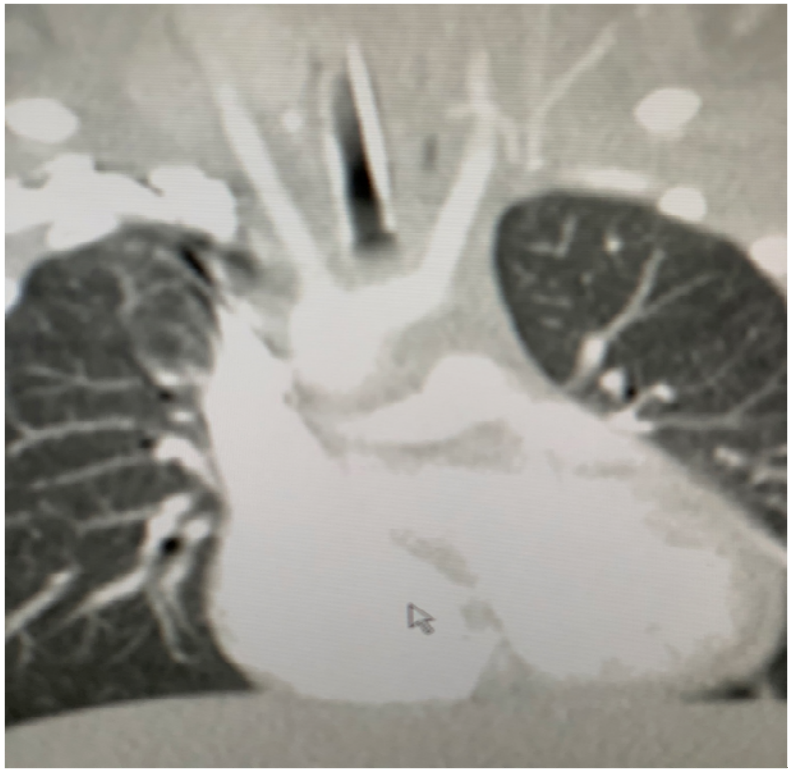
- **Management:**

-Optimize volume status: Diuretics (lasix, chlorothiazide), Aldactone for remodeling, fluid restrictions.

-Cardiac contractility: digoxin, afterload reduction (enalapril, milrinone), vasodilators.

- When Inotropic support needed-stop beta blockers!
- Maximize nutrition

Vascular Rings and Slings



- Ring- Congenital vascular anomaly where trachea and esophagus are surrounded by vascular structures or the aortic arch creating compression.
- Slings-LPA arises from proximal right PA and passes left between trachea and esophagus-causes severe tracheal compression creating an oval appearance to it.
- -DX: Barium swallow most reliable. CT if unable to determine. Surgery once diagnosed.

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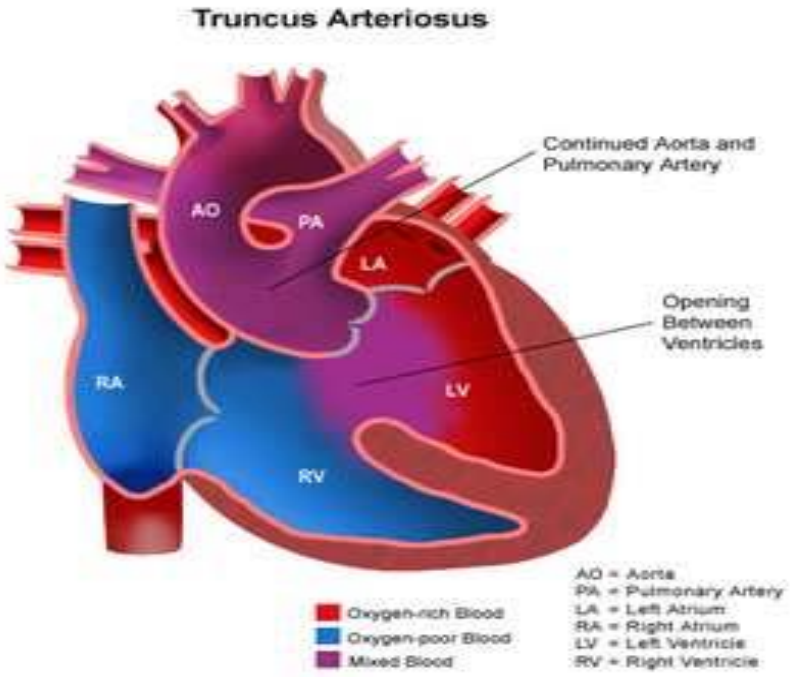
Cyanotic Defects
Right to Left Shunting



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Tetralogy of Fallot

- 6-10% of all CHD
- Typical 4 findings. where degree of cyanosis depends on degree of RVOT obstruction/pulmonary stenosis

1. VSD
2. RVOT obstruction
3. Overriding Aorta
4. RVH

CXR-Boot shaped heart

Holosystolic murmur at LSB-radiates to the back

Hypercyanotic Event

- **Hypercyanotic event**-hyperpnea and agitation-medical emergency, results from lack of pre-load and extreme right to left shunting. Treat by increasing SVR, decreasing impedence to pulmonary blood flow and reversing acidosis.

1. Oxygen-pulmonary vasodilator
2. Morphine-sedation
3. Bicarb-alkalosis-pulm vasodilator
4. Phenylephrine-selectively increases SVR, knee to chest

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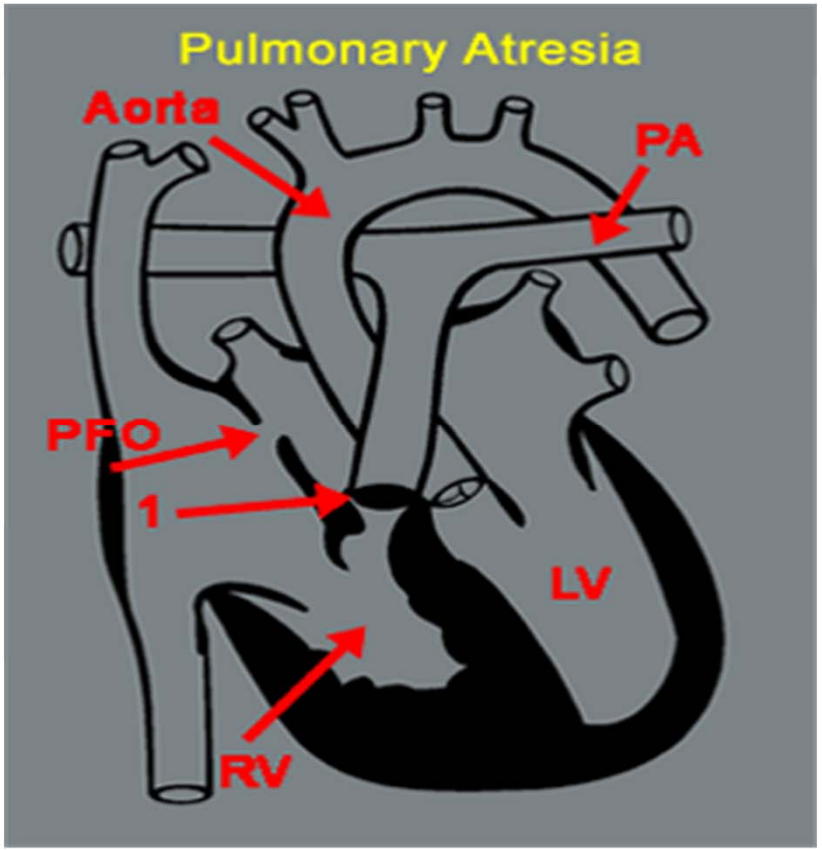
Pulmonary Atresia

- Rare only 1-3% of all defects
- Degree of cyanosis depends on presence/degree of tricuspid regurgitation
- Cyanosis with tachypnea at birth, needs PGE, BT shunt
- Hyperdynamic apical impulse with single S1, S2



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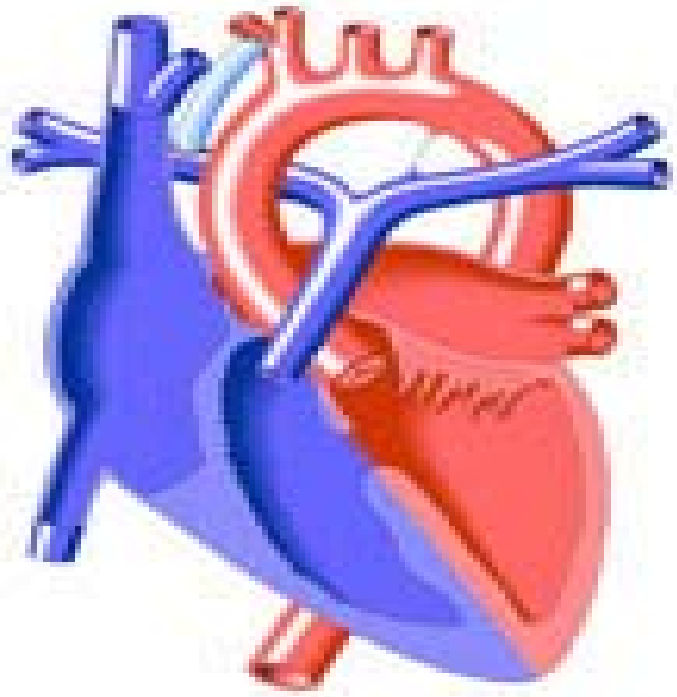
Tricuspid Atresia

- Complete lack of tricuspid valve leads to no communication between the RA and RV
- 3 types based on relationship of great vessels
- Restrictive ASD-needs atrial septostomy-will be ductal dependent.
- Elevated PVR and varying degrees of pulmonary blood flow will guide surgical interventions
- 3 staged surgical repair

Flow Control: Blalock-Taussig Shunt (BT)

Used: To increase pulmonary blood flow in ductal dependent lesions. Basically an artificial PDA

- Usually kept small-3.5mm
- Placed to connect the subclavian or carotid artery to the PA to allow blood flow to the branch pulmonary arteries and lungs.
- Anticoagulants and good hydration for patency, shunt murmur should be able to be auscultated.



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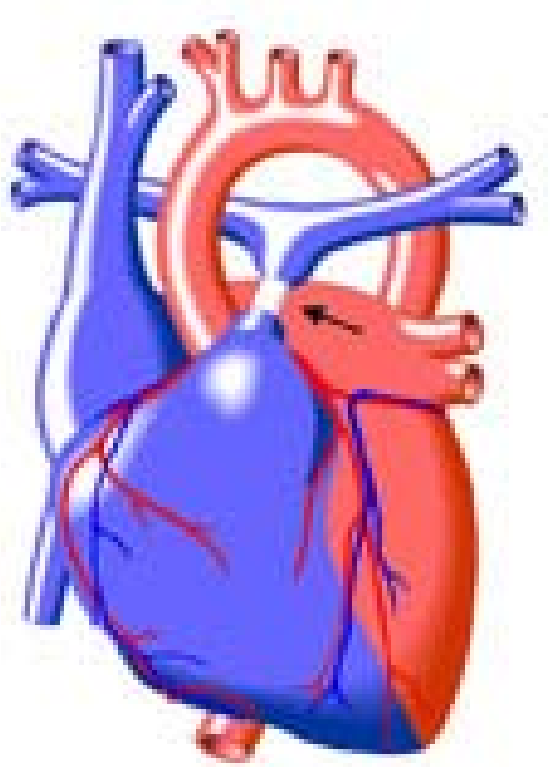
Flow Control- PA Band

Pulmonary-Artery Band

- Used: When unrestrictive pulmonary blood flow is present, limits the flow by cinching down the PA
- Prevents pulmonary over-circulation, helps promote systemic blood flow. Balance the Qp to Qs ratio.



Transposition of the Great Vessels(TGA)

- Most common Cyanotic defect in newborns
- Aorta arises from the RV and the PA arises from the LV
- Desaturated blood returns from the body to the RA and goes out to the body
- Vital organs have low perfusion
- Well oxygenated blood returns from the LA/LV to the PA
- Creates a parallel circulation that is incompatible with life.
- No murmur, single S2, unless +VSD

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TGA

- If no intra-atrial or ventricular opening, need to create an ASD, PFO not large enough
- Emergent balloon septostomy and prostaglandins as child is ductal dependent
- Treatment is an arterial switch procedure-involves moving the **coronary arteries**

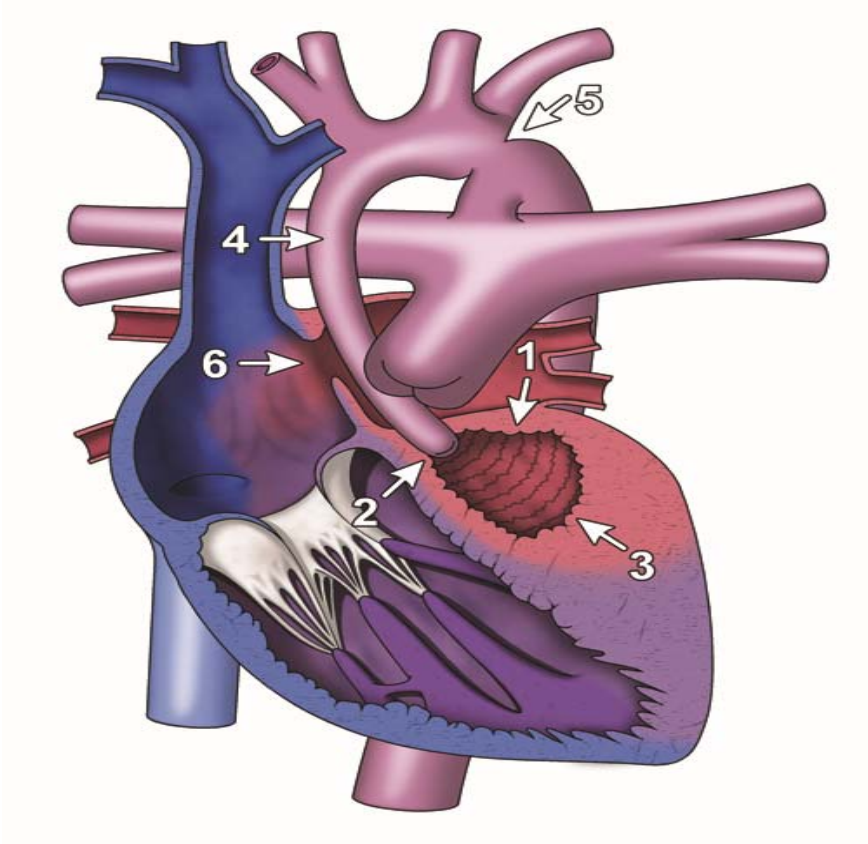
-Need LV support post-op

TAPVR

- **Obstructive** type is emergency surgery for **atrial septostomy**
- Drainage of pulmonary veins into systemic venous structure or RA
- Snowman sign on CXR
- Frequent pulmonary infections with mild cyanosis, could have pulmonary edema, poor growth
- Surgical repair by 2-3 years of age

Hypoplastic Left Heart Syndrome(HLHS)

- 7-9% of all CHD
- Variable murmur, but accounts for 25% of all cardiac deaths before 7 days of life if not diagnosed in utero
- Presents with: shock, respiratory distress, may have early heart failure.
- single S2 at LSB



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Ductal dependent lesion

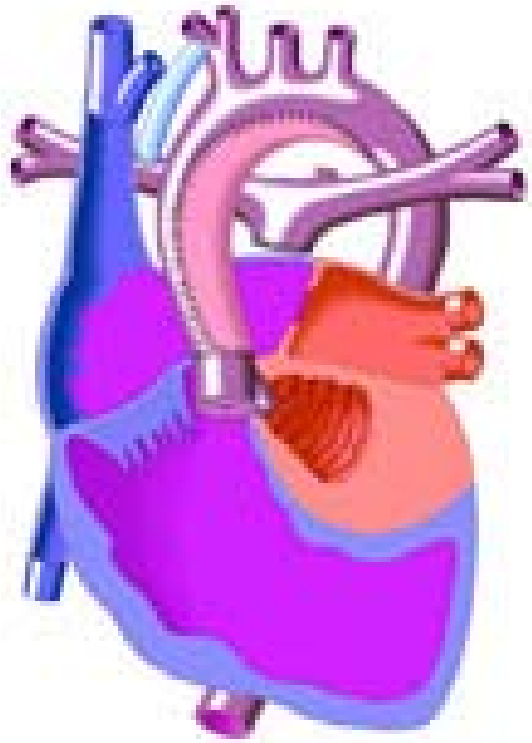
- When the systemic or pulmonary circulation is dependent on the PDA to provide mixed blood for circulation. (HLHS, TGA, Pulm atresia, Coarc, critical AS, IAA) The ductus closes-immediate decompensation, death if undiagnosed and ductus not opened.
- Open ductus with prostaglandin (PGE1) infusion-side effects-apnea, hypotension, decreased platelet aggregation activity
- Staged Palliative Surgery may be needed

1. Norwood/Sano
2. Bidirectional Glenn
3. Fontan

Stage 1: Norwood Procedure

- BT shunt created from subclavian or carotid artery to the PA to allow blood flow to the branch pulmonary arteries and lungs for better pulmonary blood flow.

- Neo-Aorta is constructed from the root of the PA and the ascending aorta.



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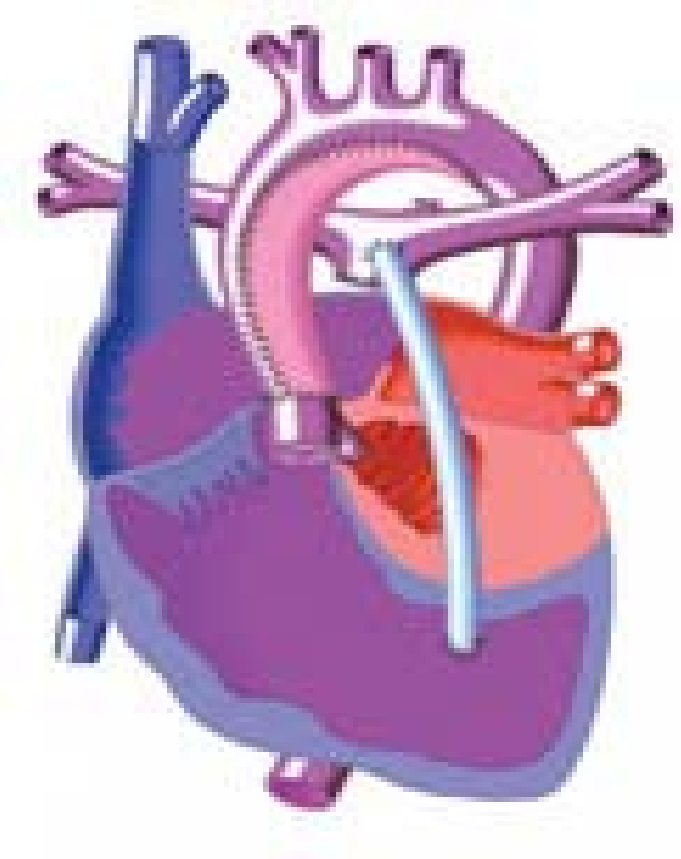
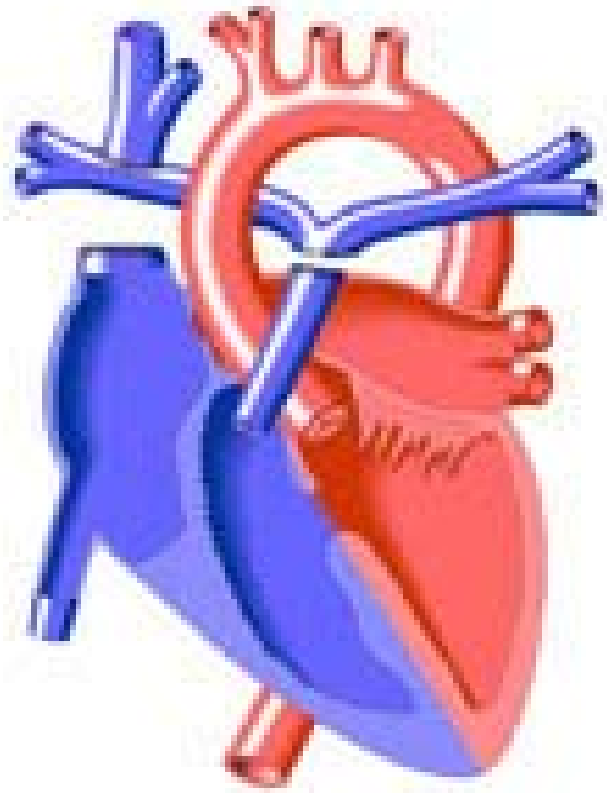
Stage 1:Sano Modification

- Create systemic perfusion via shunt from RV to systemic circulation via a PA conduit (instead of the BT shunt).
- Neo-Aorta construction is the same as Norwood
- Goal: prevent diastolic runoff of systemic blood into PA- better coronary perfusion.



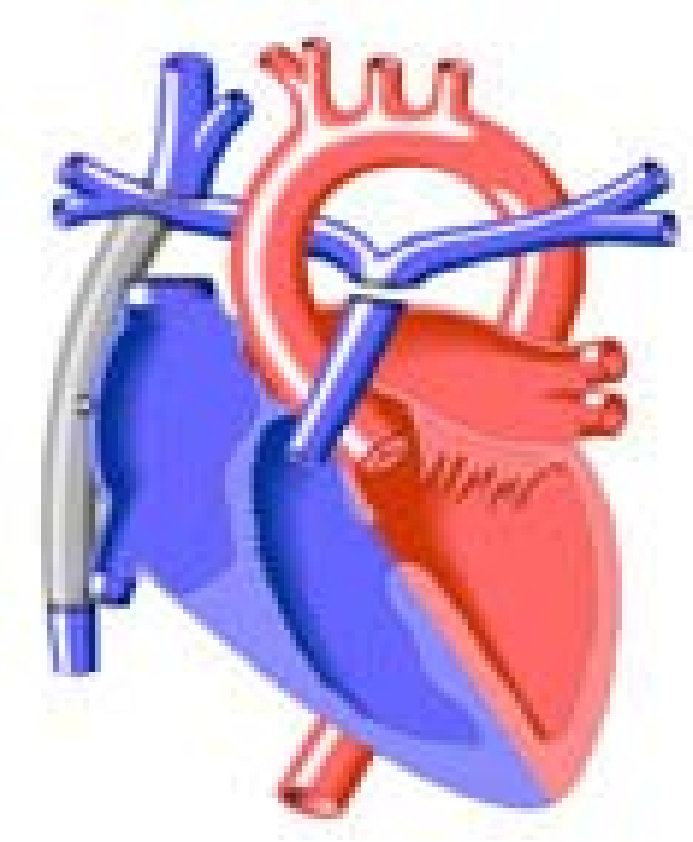
Stage 2: Bidirectional Glenn

- Decrease volume load on RV by performing anastomosis between SVC and the PA.
- Creates passive, parallel blood flow
- Goal: off load the ventricle.



Stage 3: Fontan

- Definitive repair-Separate the pulmonary and systemic systems by baffling the IVC to the PA and providing a extracardiac conduit with a fenestration or pop-off for the RA
- Transition from parallel blood flow to series



Valvular Stenosis

Mitral Stenosis

- Most commonly caused by Rheumatic Fever
- Fatigue, SOB, LA enlargement, hemoptysis
- May get atrial fib, pulmonary edema, blood clots, pulm HTN, pulm edema
- Presents with frequent pulmonary infections
- Grade 1-4 Apical murmur

Aortic Stenosis

- Sub-valvular or above
- Symptoms depend on severity of obstruction
- Mild-well tolerated
- Moderate-LVH/failure
- Severe- not enough CO to support life
- CHF, harsh loud mid-systolic murmur at LSB that radiates to neck

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Cardiac Transplant

- Donor heart is transplanted into similar aged recipient in end stage heart failure when all medical and surgical options have failed.
- One-third of all transplants are done on infants under one year of age due to **congenital defects**.
- In older children, over half of transplants occur secondary to **cardiomyopathy**
- Children present with symptoms of **heart failure**, unresponsive to therapy. May need inotropic or pulmonary support. Malignant arrhythmias and complete deterioration of ventricular function may be present

Cardiac Transplant

- **Diagnostic Evaluation**: Cardiac catheterization is done to assess hemodynamics, anatomy, and PVR
- Possible additional evaluation may include: echocardiogram, EKG, MRI/MRA, and exercise stress testing
- End organ function are assessed by labs for kidney, liver and pulmonary function and lipid profile
- Immunologic and infectious labs must also be sent to test for CMV, EBV, HSV, HIV, Varicella, toxoplasmosis, hepatitis, tuberculosis, and viral serologies
- HLA typing, PRA, and isohemagglutinins titers are also needed
- CBC and coagulation panel

Cardiac Transplant

- Families also endure psychosocial and financial evaluation to ensure they are able to withstand the rigors of post-transplant life
- Post-op Management: The first 72 hours post-transplant remain the most critical. The primary goals are to maintain coronary perfusion, systemic blood pressure, and adequate cardiac output while initiating immunosuppression
- The early reasons for failure remain primary graft failure and right heart failure that is associated with elevated PVR

Cardiogenic Shock

- Heart is unable to meet demands of the body, leads to low cardiac output state.
- Poor systolic function leads to poor CO and diminished blood flow. Heart rate and stroke volume will compensate to increase CO but eventually compensation fails leads to hypotension.
- Types: Ingestion/toxidromes, CHD, arrhythmias, trauma, metabolic derangements
- PE findings: cool extremities, poor to absent pulses, pallor, hepatomegaly, AMS, lactic acidosis, oliguria, tachycardia, tachypnea
- Management: ABC's, cautious fluid administration, Inotropic support with vasopressors. Correct derangements as able.

ECMO

- Short term severe respiratory and or cardiac support in a reversible condition after maximal medical management has failed.
- Can be venoarterial(biventricular and pulmonary support) or venovenous(respiratory only).
- Deoxygenated anti-coagulated blood from venous catheter drains out to pump and oxygenator and returns oxygenated blood to the child.

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Myocarditis

- **Myocarditis**: Serious, acute infection/ inflammation of the myocardium usually from viral infection-appear ill.
- Sudden cardiac failure with murmur, gallop or arrythmia with sinus tachycardia.
- Diagnosis: Elevated troponin, BNP

Dx: gold standard is biopsy, MRI gaining popularity .

-supportive care: digoxin, ace inhibitors, diuretics, IVIG

Heart Failure-ECMO,VAD

Pericarditis

- **Pericarditis**: Inflammation of the pericardium of the heart.
  - Symptoms: fever, tachypnea, tachycardia, friction rub-may present with tamponade sx.
  - Diagnosis: CXR-cardiomegaly, EKG-ST elevation, PR depression
  - Emergent pericardiocentesis and antibiotics for 3-4 weeks for presumed Staph and Hflu until sample can be obtained.

Endocarditis

- **Endocarditis**: acute septic presentation
- Symptoms: Fever, murmur, embolic phenomenon, myalgias, malaise, petechiae, vasculitis, Osler nodes
- Diagnosis: Duke Criteria:2 major, 1major + 2minor, 5minor.
- Need Echo/TEE, PICC placement
- Treatment: 4-6 weeks antibiotics-most common staph and strep.
- Strep- PCN, rocephin or vanco, Enterococci-ampicillin, Staph aureus-nafcillin
  - Surgery for abcesses, significant emboli, new heart block, CHF
  - Need to ensure prophylaxis

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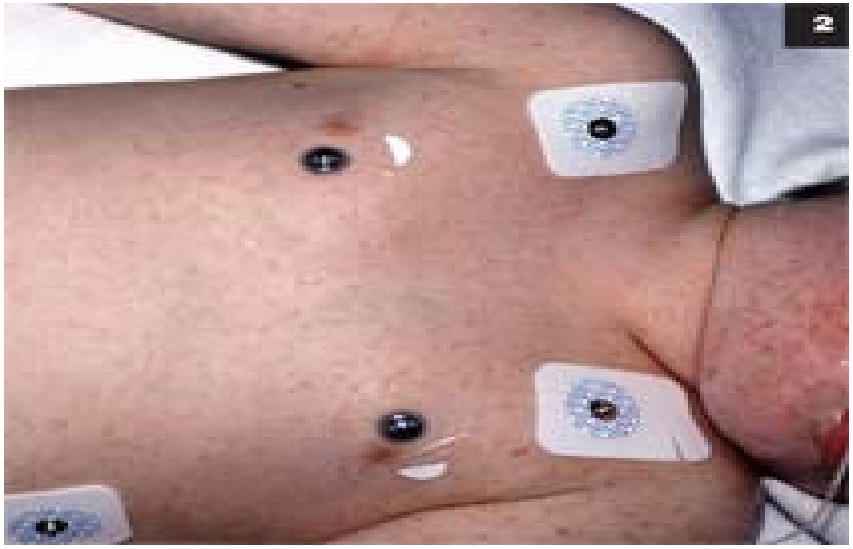
Symptoms

Petechiae



Osler Node

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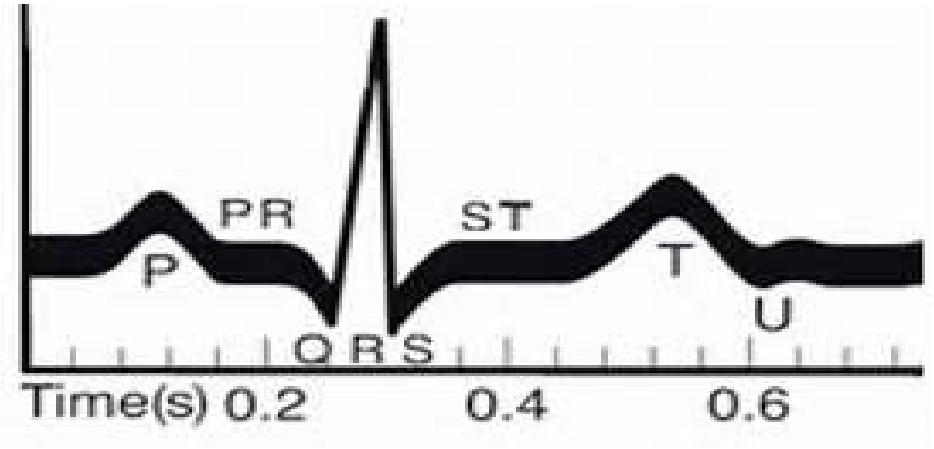
Mitral Valve Vegetation

Diagnsotics: EKG

- All findings are age dependent
- Used to diagnose rhythm disturbances
- Systematic approach to view the electrical forces in the heart by vectors
- **Limb** leads provide frontal direction
- **Precordial** leads provide information on right to left and anterior-posterior

EKG: Normal Tracing

- Important to recognize normal vs abnormal
- Rate, timing, rhythm
- Calculate intervals, segments and amplitude of waves
- Ectopy, hypertrophy, conduction disorders
- Medication and electrolyte affects



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Diagnostics: Echo

- Non-invasive with either M-Mode or 2 dimensional Views.
- **Indications**: Suspected congenital or acquired heart disease or arrhythmias.
- Can be done Transthoracic or Esophageal(TEE)

- TEE echo gives better pictures of Aorta, PA, valves of the heart, atria, atrial septum and LA appendage

Echo Views

M-Mode

- Dimension of chambers, vessel, thickness of walls and septum
- LV Systolic function
- Motion of valves and septum
- Detects pericardial fluid

2-Dimensional

- Uses 4 views-parasternal long and short axis, apical 4 chamber, subcostal and suprasternal notch position
- Rule out congenital defects and evaluate before or after interventions
- Doppler combines structure with blood flow

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Hemodynamic Monitoring

CVP

- Normal-2-6mmHg-reflects amount blood returning to the right side of the heart.
- Read at level of heart at end expiration
- High: TR, TS, high IT pressures, heart failure
- Low: hypovolemia, anaphylaxis, distributive shock

PA Pressures

- Normal- <30 mm Hg
- Mean Normal-<25 mmHg
- PVR-Normal 1 Wood unit
- PVR-determined by cross-section of small arteries and arterioles. Other factors: viscosity, mass of lungs, stenosis of vessels, compression of vessels.

$$P = F \times R$$

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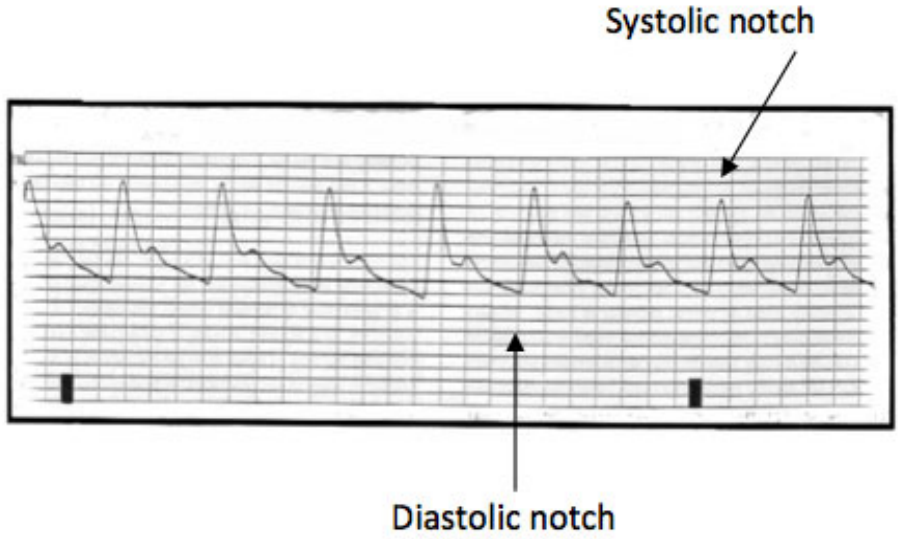
Arterial Blood Pressure Monitoring

- Normal for age
- Waveform can be dampened or peaked
- Wide: PDA, vasodilation, anemia
- Narrow: cardiac tamponade, dehydration, status asthmaticus



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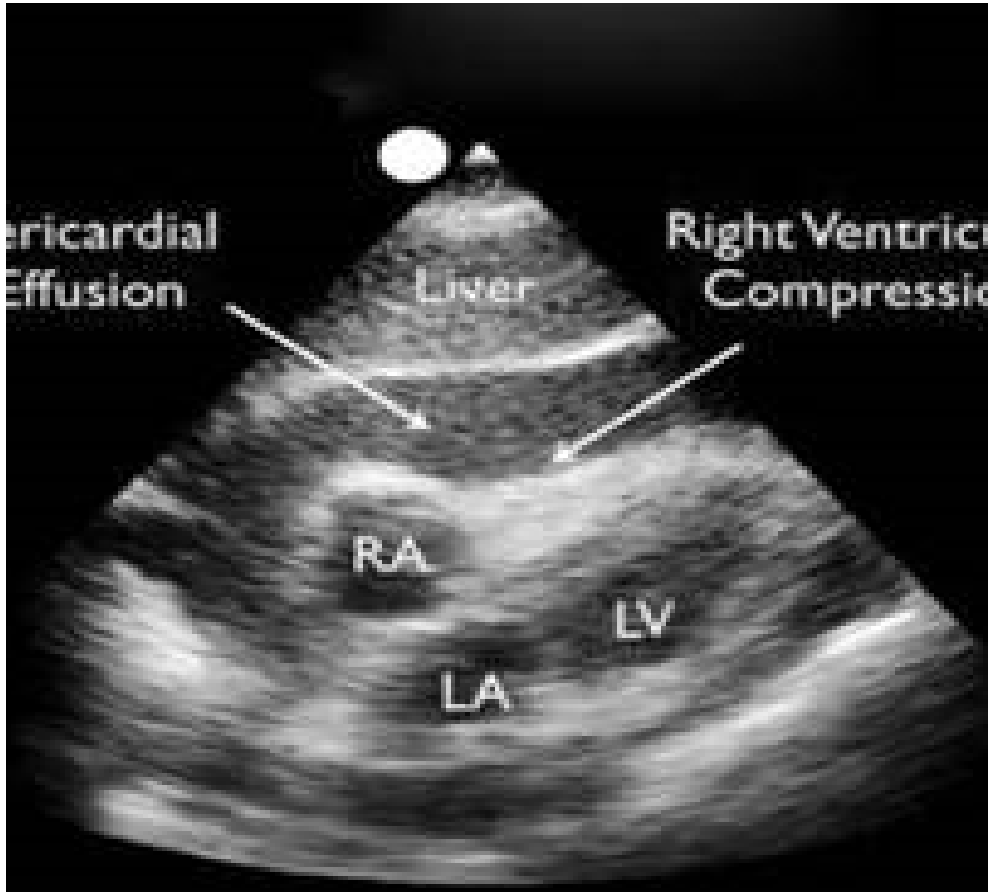
Post Operative Emergencies: Cardiac Tamponade

1. **Cardiac Tamponade**: cardiac compression occurring when blood or fluid builds up in the space between the myocardium and the pericardium.

Symptoms: Friction rub, narrow pulse pressure, obstructive shock with low CO and high SVR. Cold extremities & poor perfusion.

-Beck's Triad-JVD, muffled heart sounds, hypotension

-**Intervention**: Pericardial thoracentesis with ultrasound guidance under sedation.



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Post Operative Emergencies: Dysrhythmias-SVT

2. **Dysrhythmias-** JET, SVT (all tachy-arrythmias) bradycardia

SVT: Narrow complex tachycardia with abnormal P-wave morphology that occurs above bundle of His

-Infant with pallor, diaphoresis, poor feeding and irritability.

-Older kids with chest pain, palpitations, SOB and dizziness. Can tolerate for some period of time.

Stable: Valsalva, vagal maneuvers

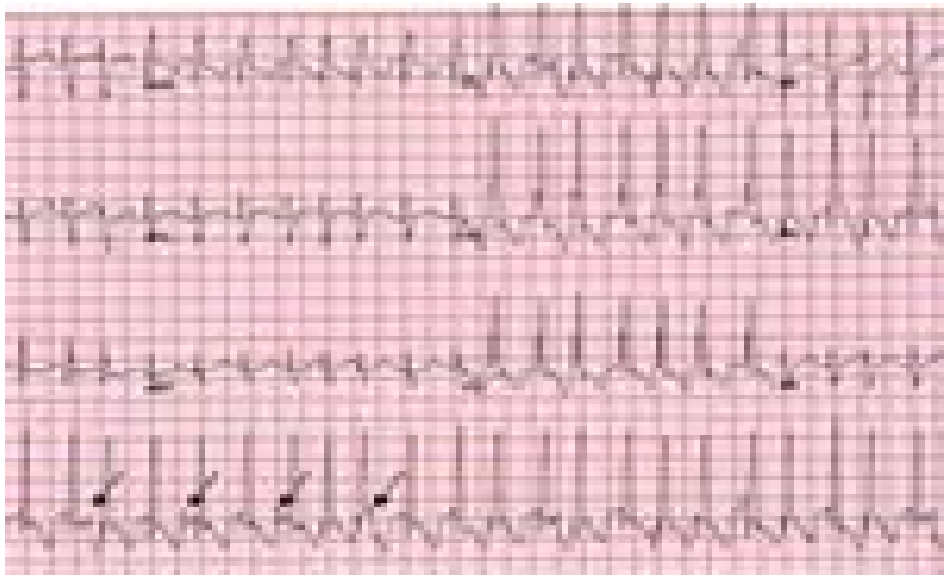
Unstable: Synchronized cardioversion 0.5-1j/kg

Adenosine 0.1mg/kg/dose

Long-term management-Digoxin, propranolol, amiodarone, possible ablation

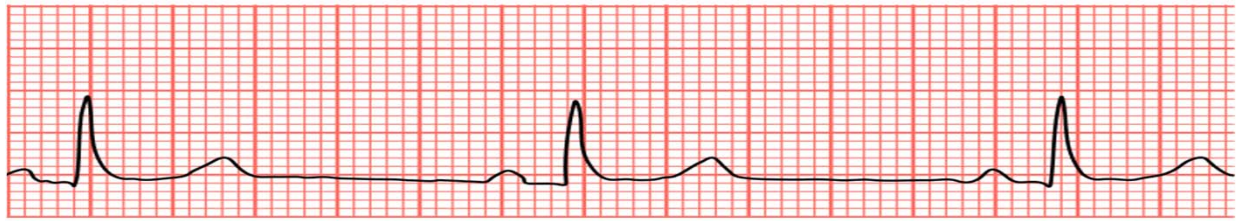
Post Operative Emergencies: Dysrhythmias-JET

- Fast narrow complex tachycardia with variable heart rates from enhanced automaticity.
- Loss of atrial filling in diastole can cause drop in CO
- Control temperature, normalize electrolytes, reduce catecholamines as able.
- Dual chamber pacing at higher rate to restore synchrony, amiodarone is first line med



Post Operative Emergencies: Dysrhythmias-Bradycardia

- Common causes
  - -High ICP
  - -Hypoxia
  - -Hypothyroidism
  - -Hyperkalemia
  - -Hypothermia
  - -Sedation, Seizures
  - -Sleep
  - -Infection
  - -Drugs-Digoxin, beta-blockers, precedex



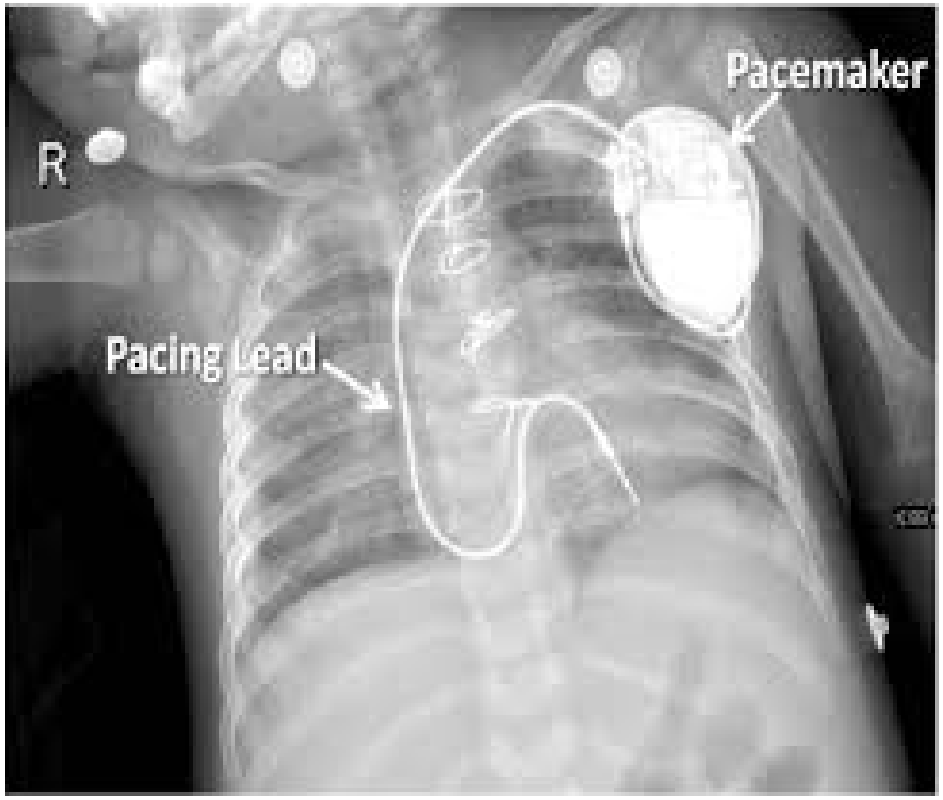
Fix Problem! Follow PALS algorithms, Consider externally pacing

Post Operative Emergencies: Bradycardia/Pacemakers

- Uses-Provides electrical stimulus to the heart when no or low intrinsic activity present. Can be single or dual chamber.
- Temporary-esophageal, epicardial, transvenous or transcutaneous.
- Permanent-Implanted, battery powered device
- Mode is dependent on intrinsic rhythm.
- Complications-Failure to capture, sense or pace and over-sensing. Infection, battery failure.

Post Operative Emergencies: Bradycardia-Pacemaker Modes

- First Letter-Chamber paced
- Second Letter-Chamber sensed
- Third Letter-Response to sensed event.
- Rate-depends on underlying rhythm



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Post Operative Emergencies: 3. Pulmonary Hypertension

- Physiologic consequences of RV pressure overload and ventricular dysfunction.
- Defined as PA pressure >25 mmHg at rest. Balance between nitric oxide(vasodilator), prostacyclin (vasodilator) and endothelin (vasoconstricts) pathways.
- **Symptoms/Physical exam:** poor feeding, tachypnea, cyanotic spells, failure to thrive, syncope, irritability, gallop rhythm, loud second heart sound, murmurs, JVD, hepatosplenomegaly, peripheral edema.
- Worsened by: acidosis, hypoxia, pain, noxious stimulus, fever
- Acute crisis: Right sided heart failure
- **Diagnostics**: Cardiac catheterization is the gold standard. Echo to screen.
- **Management**: symptom dependent: oxygen, diuretics, calcium channel blockers, prostaglandins, anticoagulation, endothelin antagonists, phosphodiesterase type 5 inhibitors (sildenafil, tadalafil), inhaled nitric oxide

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Post-op Complications

1. **Low cardiac Output Syndrome-** Predictable fall in CO after bypass at 6-18hrs. Must balance B/P and SVR.

   HR X SV =CO

2. **Postpericardiotomy syndrome**: febrile illness secondary to a cell mediated immune inflammatory reaction involving the pleura and pericardium 1-2 weeks after tissue injury to myocardium.

Symptoms: fever, pericardial effusion, fatigue, chest pain, irritability, poor PO intake. May lead to cardiac tamponade.

Diagnostics: CXR, EKG and echo

Treatment: NSAIDs-5-7days or systemic steroids for recurrent or recalcitrant cases. May need diuretics for effusion.

Post-op Complications

- 3. **Chylothorax**- Dispruption of the lymphatic system from trauma or damage. Accumulation of chylus fluid in the pleural space leading to effusion and resp distress.

Diagnosis: Milky pleural fluid tests +for chyomicrons with TG level >110mg/dl. Can get US or lateral CXR for effusions.

Treatment: Placement of thoracostomy tube to alleviate distress. Dietary restriction of fat. May take MCT formula or IL for fat source. Diuretics and octreotide used with mixed results. Pleurodesis for refractory cases.

Question

A toddler in the ED is found squatting on the floor with severe agitation and cyanosis. What treatment should be provided?

A Increase activity

B Diuretics

C Oxygen

D Move upright

Answer

A toddler in the ED is found squatting on the floor with severe agitation and cyanosis. What treatment should be provided?

C. Oxygen

Question

A 15 year old is brought emergently to the ED after collapsing at a basketball game. He was quickly revived, but is still complaining of fatigue, weakness, and mild chest pain. What diagnostic testing should be done first?

a. MRI and CBC
b. Electrolytes and EKG
c. CBC and echocardiogram
d. Electrolytes and chest x-ray

Answer

A 15 year old is brought emergently to the ED after collapsing at a basketball game. He was quickly revived, but is still complaining of fatigue, weakness, and mild chest pain. What diagnostic testing should be done first?

B. Electrolytes and EKG

Question

A 30 month old child has surgery for total anomalous pulmonary venous return and develops fever, pallor and bradycardia. What is the most likely complication?

A Pulmonary hypertension

B Postcardiotomy syndrome

C Low Cardiac output syndrome

D Sick Sinus Syndrome

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Answer

A 30 month old child has surgery for total anomalous pulmonary venous return and develops fever, pallor and bradycardia. What is the most likely complication?

B. Postcardiotomy syndrome

Question

A 10 year old arrives to the emergency department with low grade fever, lethargy and hypotension and is suspected of having myocarditis. Which cardiac test should be obtained urgently?

A. MRI
B. Enzymes
C. CT
D. Echo

Answer

A 10 year old arrives to the emergency department with low grade fever, lethargy and hypotension and is suspected of having myocarditis. Which cardiac test should be obtained urgently?

D. Echo

Question

An infant is post-op 8 hrs from TOF repair and has developed a narrow pulse pressure and cool extremities. What is the best course of action?

A Synchronized cardioversion

B Increase epinephrine drip

C Initiate antibiotics

D Pericardial thoracentesis

Answer

An infant is post-op 8 hrs from TOF repair and has developed a narrow pulse pressure and cool extremities. What is the best course of action?

D. Pericardial thoracentesis

Question?

A child is being admitted for hypertension. What is a safe strategy for blood pressure reduction?

A Return to normal B/P in 12hrs

B Reduction of B/P by 25% in 12hrs

C Return to normal B/P in 24hrs

D Reduction of B/P by 40% in 12hrs

Answer

A child is being admitted for hypertension. What is a safe strategy for blood pressure reduction?

B. Reduction of B/P by 25% in 12hrs

Question

What is the most likely diagnosis of a child who presents in atrial fibrillation with SOB, lethargy and an apical murmur grade 2/6 at the left upper heart border?

A VSD

B Aortic Stenosis

C TAPVR

D Mitral Stenosis

Answer

What is the most likely diagnosis of a child who presents in atrial fibrillation with SOB, lethargy and an apical murmur grade 2/6 at the left upper heart border?

D. Mitral Stenosis

Question

A full term newborn infant has cyanosis without respiratory disease. What cardiac lesion is suspected?

A. Atrial Septal Defect
B. Coarctation of the Aorta
C. Complete AV Canal
D. Transposition of the Great Vessels

Answer

A full term newborn infant has cyanosis without respiratory disease. What cardiac lesion is suspected?

D. Transposition of the Great Vessels

Question?

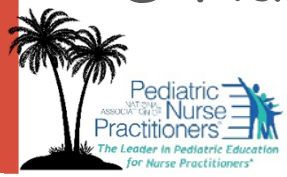
A mother of a 3-year old brings her child in for concern of a murmur heard at a well child check up. Which ausculatory finding would be most concerning?

A Twangy, mid-systolic murmur at the mid-LSB

B Continuous murmur in infra/supra-clavicular region that disappears when supine

C Early systolic murmur heard over the supraclavicular fossa

D Harsh, diastolic murmur heard best at apex



Answer

A mother of a 3-year old brings her child in for concern of a murmur heard at a well child check up. Which ausculatory finding would be most concerning?

D. Harsh, diastolic murmur heard best at apex

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Question

A slender 5 year old female presents for school check up with a widely split fixed S2. What CHD does the provider suspect?

A. Atrial Septal Defect
B. Ventricular Septal Defect
C. Coarcation of the Aorta
D. Patent Ductus Arteriosis

Answer

A slender 5 year old female presents for school check up with a widely split fixed S2. What CHD does the provider suspect?

A. Atrial Septal Defect