Cardiac Emergencies in Children

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Cardiac Emergencies in Children

- Rare
- CHD: 0.8% - 1% live births
- Congenital vs. acquired
- Symptoms are non-specific
- Surgical advances resulted in >95% survival
What to Expect?

- Congestive Heart Failure
- Cyanosis & Hypercyanotic Spells
  - Chest pain
  - Syncope
  - Dysrrhythmias
- Post cardiac surgeries
- Heart Transplant Recipients
- Cardiac trauma
Systematic Approach

. ABC’s
. History and physical examination
. Diagnostic tools
Diagnostic Tools

CXR
ECG
Blood Work (+/- ABGs)
Echocardiogram
+/- Cardiac Catheterization
Congestive Heart Failure

- The heart is unable to pump adequate blood to meet the body’s metabolic demand
- CHF
  - C.... Cardiomegaly
  - H.... Hepatomegaly
  - F.... Fast HR & RR
- Two main mechanisms:
  - Increased cardiac work
  - Impairment of myocardial contractility
Congestive Heart Failure

- Most common presentation in patients with heart disease
- CHD is the main cause in
  - 80% of younger than one year of age
  - 50% of older than 1 year of age (other 50% due to acquired heart disease)
- CHF results from **DECOMPENSATION** of:
  - Congenital Heart Disease (cyanotic & acyanotic)
    - Ductal-dependent lesions
    - Shunt lesions
  - Acquired Heart Disease
    - Myocarditis, Pericarditis, Acute Rheumatic fever, Infective Endocarditis, Kawasaki disease
**CHF. Etiologies**

### Volume Overload
- Left to Right Shunt
  - VSD, ASD, AVC, PDA
- Valvar Regurgitation
  - MR, TR, PR, AR
- Hypermetabolic State
  - (Hyperdynamic circulation)
    - Anemia, pregnancy, AVM
- Fluid Overload

### Pressure Overload
- Ventricular Outflow Obstruction
- Ventricular Inflow Obstruction
Pulmonary Vascular Resistance Changes
(at 6-8 wks)
CHF.. Etiologies

Myocardial Dysfunction
(Ventricular Contractility Impairment)

- Coronary Artery Disorders (e.g. ALCAPA)
- Inflammatory Diseases of the Myocardium
- Metabolic Alterations (Ca⁺⁺/K⁺/Glucose)
- Endocrine Disorders (Thyroid/Adrenal)
- Cardiomyopathy
  (Idiopathic/Viral/EFE/Glycogen Storage Disease)
- Hypoxemia/Acidemia (Airway Obstruction, Asphyxia)
- Dysrrhythmias (Tachycardia/Bradycardia)
CHF.. 1st Week of Life

- LVOT obstructive lesions
  - Hypoplastic Left Heart Syndrome
  - Interrupted Aortic Arch/Critical CoA
  - Critical aortic stenosis
- PDA in premature infants
- TAPVR (obstructed)
- AVMs (cerebral/hepatic)
- Cardiomyopathies
- Arrhythmias
  - Supraventricular tachycardia (SVT)
  - Complete heart block
LVOT Obstructive Lesions

- A weak pulse may not always indicate circulatory collapse
- Always check pulses from upper and lower extremities
- When in doubt, obtain four extremities BPs
CHF.. 2nd Week to Two Months

- Ductal-Dependent lesions
- Shunt lesions
  - VSD, PDA, AVC, ?? ASD
- Cyanotic lesions
  - Truncus arteriosus, TAPVR (unobstructed), D-TGA (with VSD/PS), Single ventricle, DORV
- Myopathies
- Arrhythmias
  - SVT, CAVB
- ALCAPA
# Ductal-Dependent Lesions

<table>
<thead>
<tr>
<th>Systemic Flow Dependent</th>
<th>Pulmonary Flow Dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic Stenosis (Critical/Severe)</td>
<td>Pulmonary Atresia/IVS</td>
</tr>
<tr>
<td>Hypoplastic Left Heart Syndrome</td>
<td>Pulmonary Atresia/VSD</td>
</tr>
<tr>
<td>Coarctation of the Aorta</td>
<td>Tetralogy of Fallot (severe)</td>
</tr>
<tr>
<td>Interrupted Aortic Arch</td>
<td>Pulmonary Valve Stenosis (Critical/Severe)</td>
</tr>
<tr>
<td></td>
<td>Tricuspid Valve Atresia</td>
</tr>
<tr>
<td></td>
<td>Ebstein's Malformation of the Tricuspid Valve</td>
</tr>
<tr>
<td></td>
<td>Transposition of the Great Arteries</td>
</tr>
</tbody>
</table>
Coronary from Pulmonary Artery

Anomalous Left Coronary Artery from Pulmonary Artery

“ALCAPA”
ALCAPA

- **Symptoms**: irritability, especially while feeding
- **Signs**: CHF
- **EKG findings**: Q waves in I, aVL, V4-6 (anterolateral MI)
- **Pathophysiology**:
  - After birth, the LV is perfused by the desaturated PA blood.
  - Ischemia occurs during exertion (crying, feeding), which further increases myocardial oxygen demand resulting in LV free wall (anterolateral) MI.
  - Dilation of the ventricle occurs due to chronic hypoxia
- **Treatment**: Surgery
Acute lateral infarction. ECG 1 hr after the onset of chest pain. Typical changes in the lateral chest leads (V4–V6) and the high lateral limb leads (I and aVL). Note the reciprocal changes in leads II, III and AVF. This pattern usually reflects occlusion of the circumflex coronary artery or, perhaps, a large diagonal branch of the left anterior descending coronary artery.
Myocardial Infarction...
EKG Changes & Cardiac Enzymes

Fig 1. This electrocardiogram (ECG) demonstrates the diagnostic criteria for childhood myocardial infarction (MI). Note the wide Q wave (>35 msec), ST-segment elevation (>2 mm), and prolonged QT interval.

(Troponin I level.. >2 ng/ml abnormal, >8 ng/ml poor prognosis)

Acute Myocardial Infarction in Children

Acute Myocardial Infarction in Children

**Thromboemboli**
- Coronary artery thrombosis
- Intrauterine coronary artery embolism
- Aortic thrombosis
- Mitral valve prolapse
- Lymphoma
- Sickle cell disease
- Ventricular tumor
- Disseminated intravascular coagulation
- Umbilical cord hematoma
- Hemophilia treated with unactivated prothrombin complex concentrates
- Infective endocarditis
- Thromboembolism from umbilical vein
- Thromboembolism from ductus venosus
- Thromboembolism from intrauterine renal vein thrombosis

**Mural Thickening (metabolic or intimal proliferation)**
- Progeria
- Pseudoxanthoma elasticum
- Mucopolysaccharidosis
- Fabry disease
- Alkaptonuria
- Hurler syndrome
- Birth control pills/pregnancy
- Premature atherosclerotic heart disease
- Hyperbetalipoproteinemia

**Coronary Insufficiency**
- Cardiomyopathy
- Perinatal asphyxia
- Myocarditis

**Congenital Heart Disease**
- Critical congenital aortic stenosis
- Supravalvar aortic stenosis (Williams syndrome)
- Coarctation of the aorta
- Turner syndrome
- Pulmonary atresia with intact ventricular septum
- Congenital mitral regurgitation
- Total anomalous pulmonary venous connection
- Congenital pulmonary stenosis (severe)
- Truncus arteriosus
- Hypoplastic left heart syndrome

**Other**
- Blunt chest trauma
- Erythroblastosis
- Polycythemia
**CHF.. Signs & Symptoms**

- **General**
  - Tachycardia
  - Cardiomegaly

- **Venous Congestion**
  - Left-sided
    - Tachypnea
    - Pulmonary edema
  - Right-sided
    - Hepatomegaly (jaundice)
    - JVD
    - Ascites
    - Edema

- **Diminished Output**
  - Infants
    - Irritability/lethargy
    - Poor feeding
    - Diaphoresis
    - FTT
    - Pallor
    - Cool extremities
  - Older children
    - Excessive fatigue/low energy
    - Sensation of coldness
    - Dizziness/syncope
    - FTT
CHF.. Management

- Remove underlying & precipitating cause
- Fluid & +/- salt restriction
- Decrease Preload
  - Diuretics, Venodilators (Nitroglycerine), Atrial septostomy
- Reduce Afterload
  - ACE inhibitors, PGE1, Milrinone, Nipride, Hydralazine
- Increase Contractility
  - Digoxin, Dopamine, Dobutamine, Milrinone, Epinephrine

- Beta-Blockers: Carvedilol
- Surgical intervention
- Increased Delivery
  - Increase Hemoglobin, supplemental O2, supplemental calories
- Reduce Metabolic Demand
  - ? Sedation, muscle relaxants, GA
- Mechanical Support
  - ECMO, LVAD, Balloon pump
- Other
  - IV Gamma globulin
Beware: Intravenous Lines and Cyanotic Heart Disease

Tiny air bubbles in an IV can reach the systemic circulation directly through the intracardiac shunt and cause air embolism (including stroke)
Cyanosis

- Cyanosis is due to the presence of 4-6 g or more of reduced (deoxygenated) hemoglobin in the capillary blood. (Lundsgaard and Van Slyke, 1923)
- Slight cyanosis in an infant with hemoglobin of 10 g/dl may be more ominous sign than deep cyanosis in a patient with a hemoglobin of 17 g/dl (Helen Taussig, 1947)
- Not every cyanosis is cardiac!
- Central Vs. peripheral (acrocyanosis)
Not Every Cyanosis is Cardiac!

- **Central cyanosis (reduced arterial O2 sat)**
  - Inadequate alveolar ventilation
    - CNS depression (asphyxia, narcotics)
    - Inadequate ventilatory drive (obesity, pickwickian syndrome)
    - Upper and lower airway obstruction (from any cause)
    - Parenchymal lung disease and/or ventilation-perfusion mismatch (pneumonia, atelectasis, CF, RDS, pulmonary edema, etc.)
    - Respiratory muscle weakness
  - Desaturated blood bypassing the lungs
    - Intracardiac right-to-left shunt (cyanotic CHD)
    - Intrapulmonary shunt (pulmonary AVM fistula, chronic hepatic disease resulting in multiple micro-AV fistulas in the lungs)
    - Pulmonary hypertension resulting in right-to-left shunting at the atrial, ventricular, or ductal levels (Eisenmenger’s syndrome, PPHN “PFC”)

- **Peripheral cyanosis (Increased deoxygenation in the capillaries)**
  - Circulatory shock
  - CHF
  - Acrocyanosis of newborns

- **Abnormal hemoglobin (regardless the degree of oxygenation)**
  - Methemoglobinemia (well water ingestion, aniline dye, congenital form)
  - Carbon monoxide poisoning
The 5 T's

- Tetralogy of Fallot \((TOF)\)
- Complete transposition of the great arteries \((D-TGA)\)
- Persistent truncus arteriosus \((Tr\ A)\)
- Total anomalous pulmonary venous connection \((TAPVC)\)
- Tricuspid atresia \((TA)\) “Tingle" (single) ventricle
  - Single-ventricle lesions:
    - Hypoplastic left heart syndrome (HLHS)
    - Hypoplastic right heart syndrome (PA/TA)
    - Ebstein’s anomaly of the tricuspid valve (when severe)
    - Double-inlet left ventricle (DILV)
Workup Cyanosis

- **Initiate work-up:**
  - Four extremities BPs
  - Oximetry (pre/postductal)
  - Hyperoxia test
  - CXR +/- EKG
  - ABGs

- **Initiate therapy:**
  - Don’t hesitate to start Prostaglandin (**0.0125-0.1 mcg/kg/min**)
  - Avoid O2 unless necessary (**Keep O2 sats > 75% unless associated acidosis**)  

- Always, when in doubt, call your cardiologist!
Work Up Cyanosis

- **Hyperoxia test**
  - pO2 > 150 mm Hg -------- most likely respiratory
  - pO2 < 40 mm Hg -------- most likely cardiac
  - pO2 40-150 mm Hg ---- either possible

- **Always obtain ABG/Oximetry from two areas:**
  - Preductal (right arm, ear, radial artery)
  - Postductal (umbilical artery or feet)
Work Up Cyanosis

**Differential Cyanosis**
Preductal 10% higher than postductal (pink upper and blue lower part of the body)
- PPHN
- Left heart obstructive lesions (severe AS, IAA, COA) with R→L ductal shunt

**Reverse Differential Cyanosis**
Postductal 10% higher than preductal (blue upper and pink lower part of the body)
- D-TGA+PDA+PPHN
- D-TGA+PDA+COA/IAA
Prostaglandin E1 (PGE1)

- “Any infant in the first week of life with decreased perfusion, hypotension, or acidosis should be considered a candidate for PGE1 administration” Rosen
- **Dose:** 0.0125-0.1 mcg/kg/min
- **Calculation:**
  - Supplied as 1.0 ml = 500 mcg
  - Use 0.6 ml (300 mcg) added to 100 ml
- **Infusion rate:** Infuse at rate in mL/h = infant wt (kg)
- **Side effects:** apnea, hypotension, rash, diarrhea, jitteriness/seizures, fever, plts inhibition

**Note: Oxygen can be bad ???**
(May cause PDA closure and pulmonary vessels dilation worsening CHF)
Hypercyanotic Spells

- Life-threatening events as a result of imbalance between pulmonary and systemic vascular resistance leading to reduced pulmonary blood flow and increased right to left shunting across a VSD
- Peak incidence: 2-4 months of age
- Not restricted to patients with TOF, but may occur in severe PS with VSD, and Tricuspid Atresia with a restrictive VSD
- Mechanism: ? multifactorial (infandibular spasm & ↓ SVR)
- Rare due to early surgical intervention
Hypercyanotic Spells

- Most spells are self-limited and last only minutes
- Sudden onset of the followings:
  - Hyperpnea (rapid and deep respiration)
  - Irritability and prolonged crying
  - Increase cyanosis
  - Limpness, seizure activity
  - Coma/Death
  - *Decrease intensity of the murmur on auscultation*
Tetralogy of Fallot

- Large malalignment VSD
- Overriding aorta
- Pulmonic stenosis
  - Subvalvar "infandibular"
  - Valvar
  - supravalvar
- RVH
Children with Tetralogy of Fallot exhibit bluish skin during episodes of crying or feeding.

"Tet spell"

Imbalance between pulmonary and systemic vascular resistance that favors decreased pulmonary flow and increased right-to-left shunting across the VSD into the aorta.
**Pathophysiology and Precipitating Factors of Hypermotic Spells**

- **Precipitating factors:**
  - Decreased pulmonary flow and increase right-to-left shunt
  - Hypoxemia and acidosis
  - Increase cyanosis
  - Increasing pulmonary vascular resistance

**Precipitating factors:**
- Dehydration, fever, tachypnea, tachycardia, anxiety, exercise, injury or pain, drugs (systemic vasodilators)
TET Spell Management

- Calm child, knee-chest position & O2
  - Morphine IM/SQ
  - IV access and hydrate
    - Meds:
      - Phenylephrine/Propranolol/Esmolol
  - Correct acidosis/anemia
    - General anesthesia
    - Surgical intervention
TET Spell Management - details

- Calm the child & Knee-chest position (↑ SVR)
- Avoid inotropes (Digoxin, Dopamine, or Dobutamine) and diuretics
- **Oxygen** (↑ SVR and ↓ PVR)
- **Morphine** 0.1- 0.2 mg/Kg SQ (↓ sympathetic tone, ↓ oxygen consumption, suppresses the respiratory center and abolishes hyperpnea) or **Ketamine** 1-3 mg/Kg IM (sedates and ↑ SVR)
- IVF boluses and correct anemia
- **Phenylephrine** (Neo-Synephrine): alpha 1 agonist which causes vasoconstriction then ↑ SVR
  - Bolus: 0.1 mg/Kg IM, SQ, or IV
  - Followed by continuous IV infusion: 0.1- 0.5 mcg/Kg/min
- Beta-blockers (↓ oxygen consumption, may ↓ infandibular spasm by decreasing myocardial contractility)
  - **Esmolol** load 500 mcg/Kg over 1 min (then infuse 50-1000 mcg/Kg/min) or
  - **Propranolol** 0.05-0.25 mg/Kg IV over 5 min
- Correct acidosis with bicarbonate (1-2 mEq/Kg/dose IV)
- General anesthesia
- Surgical intervention (a spell → surgery)
Chest Pain

- Very common in children 6-16 years of age
- Usually **Non-cardiac**
- **History and physical examination** are often sufficient to exclude significant heart disease
- Cardiac causes account for < 4% of the cases
- Reassurance is all that is needed in most cases
Common Causes of Chest Pain

- Idiopathic 12-45%
- Costochondritis 9-22%
- Musculoskeletal 21%
- Respiratory 15-21%
- Psychogenic 5-9%
- Gastrointestinal 4-7%
- Cardiac 0-4%
- Others 9-21%
# Chest Pain: Cardiac or Not

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cardiac</th>
<th>Non-cardiac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>midsternal</td>
<td>anywhere</td>
</tr>
<tr>
<td>Quality</td>
<td>Pressure/crush</td>
<td>Sharp/burn</td>
</tr>
<tr>
<td>Activity</td>
<td>Worsens it</td>
<td>+/- change</td>
</tr>
<tr>
<td>Duration</td>
<td>Until resting</td>
<td>Secs/mins</td>
</tr>
<tr>
<td>Radiation</td>
<td>Shoulder/arm</td>
<td>none</td>
</tr>
</tbody>
</table>
**Chest Pain... Cardiac or Not**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cardiac</th>
<th>Non-cardiac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathing</td>
<td>No change</td>
<td>+/-</td>
</tr>
<tr>
<td>Dir. Pressure</td>
<td>No change</td>
<td>+/-</td>
</tr>
<tr>
<td>Dyspnea ?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dizziness ?</td>
<td>May be</td>
<td>No</td>
</tr>
<tr>
<td>With food</td>
<td>No</td>
<td>May be</td>
</tr>
</tbody>
</table>
Chest Pain.. Cardiac Causes

- **Structural abnormalities**
  - LVOT obstructive lesions: IHSS/HOCM, AS, Sub AS
  - Congenital coronary artery anomalies: LAD from RCA, RCA from left sinus, ALCAPA
  - ? MVP

- **Acquired myopericardial disease**
  - Pericarditis/myocarditis
  - Coronary disease (Kawasaki disease, cocaine abuse “coronary vasospasm”)

- **Arrhythmias**
Congenital Coronary Arteries Anomalies

RCA from left sinus

Normal

LCA from right sinus
Kawasaki Disease
Hypertrophic Cardiomyopathy

- MV
- SEP TUM
- LV

- VS
- 3cm
- Ao
- PW
- LA
- LV
Syncope

- A sudden transient loss of consciousness and postural tone as a result of decreased cerebral perfusion
- Common in children and adolescents
- Estimated that 15% of children have a syncopal episode between the ages of 8-18 years
- Causes: Neurocardiogenic, non-cardiac, and cardiac
Syncope.. Differential Diagnosis

- **Neurocardiogenic/vasovagal syncope “Simple faint”:**
  - Due to loss of resistance in peripheral circulation
  - Provoked by emotional factors
  - Most common form of syncope (~80%)
  - Positive family history (33%)

- **Orthostatic:**
  - Excessive and prolonged fall in BP and HR with sudden positional change

- **Cardiac:** Due to loss of cardiac output from cardiac disease

- **Respiratory:** Cough, hyperventilation, or breath holding

- **Neurologic:** Seizure

- **Metabolic:** Anemia and hypoglycemia
Syncope.. When to be Concerned

- Syncope with activity
- Associated sensation of palpitations
- Pathologic murmur on examination
- Recurrent episodes
- Younger children (< 6 years of age)
- Family history of:
  - Sudden death < 40 years
  - QT prolongation
  - Cardiomyopathy
Cardiac Causes of Syncope

- **Obstructed Outflows**
  - Aortic Stenosis
  - Hypertrophic Cardiomyopathy
  - Severe pulmonic stenosis

- **Myocardial Dysfunction**
  - Dilated Cardiomyopathy
  - Anomalous Coronary Artery

- **Arrhythmias**
  - Ventricular Tachycardia
  - Supraventricular Tachycardia
    - Wolff-Parkinson-White Syndrome (WPW)
  - Long QT Syndrome (LQTS)
  - High-grade AV Block
Diagnostic Tools
Kawasaki Disease

KD: Diagnostic Criteria

- Fever for 5+ days and 4 of the 5 criteria:
  1. Bilateral non-purulent limbic sparing conjunctival injection
  2. Mucous membrane changes: Injected pharynx, fissured lips, strawberry tongue
  3. Extremity changes: Edema, induration, erythema, desquamation
  4. Polymorphous rash
  5. Cervical adenopathy (>1.5 cm), unilateral
Acute Rheumatic Fever.. Revised Jones Criteria
Infected Endocarditis

A clinical diagnosis associated with culture proven bacteremia
Clubbing

Janeway lesions

Osler node

Splinter hemorrhage
Pericarditis

- Idiopathic, presumed viral
- Purulent (bacterial)
- Autoimmune (JRA, SLE)
- Uremia
- Neoplastic disease
- Post pericadiotomy syndrome
Myocarditis

An inflammation of the myocardium associated with myocellular necrosis

- **Microbial etiologies**
  - Viral: Enteroviruses (Coxsackie Group B, Echovirus, Poliovirus, Adenovirus, Mumps, EBV, CMV, HIV)
  - Others: Mycoplasma, bacterial, rickettsial, fungal or parasitic organism.

- **Other causes: Autoimmune**
  - ARF, Kawasaki’s Disease, JRA, and SLE
Myocarditis

Onset may be abrupt, with sudden cardiovascular collapse and death within hours. However, the development of CHF may be more gradual

- **Clinical features**
  - Fever, fatigue, malaise, dyspnea, tachypnea, CP, CHF, pulmonary edema, occasionally shock,
  - Mottled and weak peripheral pulses, muffled heart sounds, tachycardia, gallop rhythm
  - **Neonates (appear septic)**
    - Feeding difficulties, listlessness, hepatomegaly

- **Lab features**
- **CXR:** cardiomegaly & increased PVMs
  - CK-MB, Troponin I, ESR, WBC elevation
  - EKG: Sinus tachycardia, ST segment flattening, T wave inversion, low QRS voltage, PVCs, tachyarrhythmias/heart block.
  - ECHO: LV dilation, valvular regurgitation, poor contractility

- **Therapy**
  - Supportive, inotropic support and afterload reduction, IVIG
Dilated (Congestive) Cardiomyopathy

- Idiopathic
- Genetic: Carnitine deficiency, Freidrich’s ataxia
- Ischemic: ALCAPA, KD, DM, Cocaine
- Toxins: Anthracyclines, alcohol, Methamphetamine
- Infections: Myocarditis (viral), HIV, Severe sepsis
- Nutritional: Severe iron def., Thiamine def
- Arrhythmias: SVT, VT, CAVB
Cardiac Dysrrhythmias

- Hemodynamic assessment is more important than accurate diagnosis of the arrhythmia
- Remember your ABC's
- Always keep in mind drug ingestion in a previously healthy child
- Myocarditis
- Electrolytes imbalance
Electrocardiogram
Palpitations

- My heart is:
  - Racing
  - Skipping a beat
  - Pounding

- Associated symptoms
  - Like a switch (ON/OFF)
  - Color changes (pallor)
  - Diaphoresis
  - Dizziness/syncope

- Symptoms on exertion or at rest
## Palpitations in Children with Normal Heart

<table>
<thead>
<tr>
<th>Question</th>
<th>Probable SVT</th>
<th>Non pathologic</th>
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</thead>
<tbody>
<tr>
<td>How many times?</td>
<td>Several times</td>
<td>once</td>
</tr>
<tr>
<td>How often?</td>
<td>monthly</td>
<td>daily</td>
</tr>
<tr>
<td>Duration</td>
<td>5-30 minutes</td>
<td>Seconds</td>
</tr>
<tr>
<td>Circumstances</td>
<td>Anytime (watching TV)</td>
<td>After exercise, at night</td>
</tr>
<tr>
<td>Appearance</td>
<td>Pale, sweaty</td>
<td>Red</td>
</tr>
<tr>
<td>Relieving factors</td>
<td>Gag, swallow, vomit</td>
<td>Rest</td>
</tr>
<tr>
<td>Location</td>
<td>Chest, neck</td>
<td>Chest</td>
</tr>
</tbody>
</table>
Cardiac Dysrrhythmias

- Too fast
- Too slow
- Irregular
- Pulseless
- Others:
  - LQTS
  - WPW
SVT

AVNRT

Accessory Pathway
Supraventricular Tachycardia (SVT)

- Symptoms: (depend on duration)
  - Infants.. excessive fussiness, pallor, CHF, or even shock
  - Older children.. palpitations, CP, dizziness/syncope
- EKG: HR, HR variability and P-waves
- Narrow QRS-Complex
- Fixed heart rate >220 bpm (no fluctuation)
- Respond to vagal stimulation
- Ice on the face (Crushed ice in a plastic bag for 30 seconds “diving reflex”)
- Adenosine (0.05-0.1mg/kg IV push)
- Synchronized cardioversion 0.5-1 J/Kg (if hemodynamically unstable)
Narrow QRS-Complex Tachycardia

Search for the P-waves
Wolff-Parkinson-White Syndrome
Wide QRS-Complex Tachycardia
Atrial Flutter
Bradyarrhythmias
Bradyarrhythmias
Premature Atrial Contractions (PACs)
Premature Ventricular Contractions (PVCs)
Normal Values of QTc:
Infants up to 6 months old <0.45 seconds, Children <0.44 seconds, Adolescents and Adults <0.42 seconds
LQTS with Torsade de Pointes
Common Cardiac Medications and their Side Effects

- **Digoxin**: (obtain level 6 hrs after the dose or just prior next dose “0.8-2.0”) anorexia, vomiting, listlessness/irritability, prolonged PR interval or heart block, or any type of arrhythmias

- **Furosemide**: dehydration, hypokalemia, vomiting (ileus), oliguria, anorexia

- **Spironolactone**: hyperkalemia (rare)

- **ACE inhibitors**: hypotension and dizziness

- **Beta-Blockers**: hypotension and dizziness

- **Drug interactions**
Baby in Shock.. Don’t Forget

- CHF
- Critical CoA/IAA
- SVT
Post Cardiac Surgeries

- Early
  - Postpericardiotomy syndrome
  - Dysrrhythmia
  - CHF
  - Technical (shunt blockage)
  - Pleural effusion

- Late
Post operative Fever

- Could be simple
- **BUT** always keep in mind:
  - Postpericardiotomy syndrome (within 1-8 weeks)
  - Infective Endocarditis
  - Atelectasis
  - Other infections
Postpericardiotomy Syndrome

- Fever + Non-specific symptoms
- pericardial rubs on auscultation if not large
- Diagnosis:
  - CXR ... cardiomegaly
  - Echocardiogram ... pericardial effusion
- Treatment:
  - Anti-inflammatory agents (ASA, Ibuprofen, Prednisone)
  - Pericardiocentesis
Pericardial Tamponade

- Pallor, hypotension (pulsus paradoxicus)
- Tachycardia
- Hepatomegaly
- Thready pulses
- Jugular venous distension
BT Shunt

Blalock-Taussig Shunt

The left subclavian artery is divided and connected to the left pulmonary artery. This allows blood to flow to the lungs to receive oxygen.

Modified Blalock-Taussig

The Blalock-Taussig operation diverts blood from a branch of the aorta to the pulmonary artery. This allows blood to flow to the lungs to receive oxygen.
Blalock-Taussig (BT) Shunt

- Avoid hypotension or dehydration
  - Diminished shunt flow
  - Reduced oxygen saturation
  - Shunt occlusion
- Absence of a continuous murmur suggests compromised shunt flow
- When administering IV fluids, avoid intravenous air
Fontan/TCPC

- Venous return flow directly to the pulmonary artery
- CVP of 9-18 mm Hg required for adequate pulmonary flow
- Avoid dehydration and hypotension
  - Cardiac under filling
  - Diminished cardiac output
- Expect atrial tachy/bradyarrhythmias
- Pleural effusion
- Protein losing enteropathy (PLE)
Post Heart Transplant

- Approximately, 300 pediatric heart transplantation are performed each year
- Five-year survival rates approach 70%
  - High index of suspicion
- Potentially serious problems may appear to have benign presentations
- Always communicate with transplant team!
Graft rejection (common in the first three months)
- May be silent.
- May be non-specific: fever, Flu-like symptoms, GI symptoms (Abd pain & vomiting may be classic signs of rejection)

Infections: PCP (rare), CMV, Herpes, Varicella.

Post transplant coronary artery disease (C/O CP)

Side effects of immunosuppressive medications

Drug-drug interactions (beware of Cytochrome P450 metabolism): e.g. Erythromycin increases Cyclosporine level 2-3X (OK Abx: Amoxicillin, Augmentin & ? Biaxin)

Neoplasm in the transplant recipient (~10%): e.g. lymphoma
Post Heart Transplant.. Problems

- Always draw trough levels of Cyclosporine or Tacrolimus (Prograf). The exception is Sirolimus (Rapamune) which is given once daily - usually at noon) and needs a 20 hour trough
- Order all drug levels stat (might take up to 5 days for results if send routinely)
- The therapeutic drug level will vary depending on time the patient is post transplant, the patient’s history, associated renal dysfunction, and the transplant center
Post Heart Transplant... Problems

- CMV infection may present as low WBC, fever, malaise, pharyngitis or GI symptoms - Check CMV quantitative DNA PCR. Start antiviral treatment if confirmed ASAP (normal level <200)

- EBV post transplant lymphoma may present with cough, fever, abdominal pain, lymphadenopathy or many other non-specific symptoms. Check an EBV quantitative DNA PCR if there is no obvious source for symptoms (normal level <200)
Cardiac Trauma

- Wide spectrum of injuries:
  - Myocardial contusion/concussion, ventricular laceration, and valvular disruption

- Wide spectrum of presentations:
  - Hemodynamically stable
  - Cardiogenic shock
  - Serious dysrrhythmias
Commotio Cordis
(Cardiac Concussion Syndrome)

- Follows blunt nonpenetrating trauma to the chest (e.g. in baseball or hockey players from a sudden precordial impact with a puck or baseball)
- No identifiable cardiac trauma (contusion, hematoma, lacerated coronary artery)
- May result in cardiac arrest and sudden death
- Death results from ventricular fibrillation
- Resistant to resuscitative efforts
- May benefit from precordial thump and AED
Thank You