PEDIATRIC CARDIOLOGY

Nursing 210

Extrauterine Transition

Umbilical cord clamped and respirations initiated, increased PaO2 levels cause:

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**Cardiac Defects**
- 8% of newborns are born with a congenital cardiovascular abnormality
- The rate is higher for preterm infants
- The usual cause of congenital heart disease is the failure of a heart structure to progress beyond an early stage of embryonic development.

**Cardiac defects cont...**
- Maternal rubella is associated with defects such as patent ductus arteriosus, pulmonary or aortic stenosis, atrial septal defect and ventricular septal defect.
- If a parent has any of these defects, then the incidences of it occurring in their children is 10% to 15%.

**Ventricular septal defect (VSD)**
- The most common defect is ventricular septal defect (VSD). Accounts for approximately 25% of all congenital heart disease.
- Abnormal opening between the right and left ventricles. Blood shunts from left to right.
- Increase pulmonary blood involves blood flow from the left side of the heart (under greater pressure) to the right side of the body.

**Ventricular septal defect (VSD) cont...**
- Blood shunts into the pulmonary circulation instead of the aorta to the body.
- Shunting causes right ventricular hypertrophy and increase pulmonary artery pressure.

**Assessment of VSD**
- A ventricular septal defect may not be evident at birth.
- At 4 to 8 weeks the child will have a loud systolic murmur. Especially at the left sternal border at the third or fourth interspace.
- A thrill maybe palpable.
- Diagnosis can be made by MRI or echocardiography.
Assessment of VSD con...

- An echocardiography will reveal right ventricular hypertrophy and possibly pulmonary dilatation from increased blood flow.
- Echocardiography is ultrasound cardiography which has become the primary diagnostic test for heart disease.
- Echocardiography is high frequency sound waves directed toward the heart. These waves can be used to locate and study movements and dimension of cardiac structure.

Management of VSD

- 60% of the VSD close spontaneously during the first year of life.
- Cardiac catherization can be used to close the defect.
- Open heart surgery is required for large defects. A silastic or dacron patch is placed over the defect and tissue grows across the patch.
- Post-op monitor for dysrhythmias is necessary because of edema of the septum may interfere with conduction.

Atrial septal defect (ASD)

- An atrial septal defect is an abnormal communication between the two atria.
- Blood flow is from left to right (oxygenated to deoxygenated) because of the stronger contraction of the left ventricle.
- The increase volume in the right result in ventricular hypertrophy and increased pulmonary blood flow.

Assessment of (ASD)

- A harsh systolic murmur is heard over the second or third interspace (pulmonic area).
- Murmur is produced by the extra amount of blood crossing the pulmonic valve.
- The extra volume of blood causes the pulmonic valve to close consistently later than the aortic valve producing a split 2nd heart sound (fixed splitting)
- A fixed split 2nd heart sound is diagnostic of atrial septal defect.
Assessment of (ASD) cont...

- Echocardiography with Doppler will reveal the enlarged right side of the heart and the increased pulmonary circulation.
- Cardiac catheterization will reveal the separation in the atrial septum and the increased oxygen saturation in the right atrium.

Management of ASD

- Without surgery the child is a risk for infections endocarditis and eventual heart failure.
- Management is by open heart surgery or interventional cardiac catheterization.
- In surgery, after a cardiopulmonary bypass, the edges of the opening are approximated and sutured.

Management of ASD cont...

- If the defect is large, a silastic or dacron patch is sutured in place to occlude the space.
- Post-op the child is observed for dysrhythmias.
- Dysrhythmias can result from edema of the atria which can interfere with SA node function.

Patent ductus arteriosus

- Failure of the fetal ductus arteriosus (the artery connecting the aorta and the pulmonary artery) to close with the first weeks of life.
- Connection between the pulmonary artery and the aorta should close at birth with the 1st breath.
- Complete closure may take up to 3 months

Patent ductus arteriosus cont...

- Failure of the ductus to close causes blood under high pressure in the aorta (oxygenated) to be shunted into the pulmonary artery (deoxygenated).
- The shunted blood goes to the lungs, to the left atrium, to the left ventricle and out to the aorta, thus repeating circulation of the same blood.

Patent ductus arteriosus cont...

- This cause the right ventricle to hypertrophy and increases the pressure in the pulmonary circulation from the extra blood being recirculated.
Assessment of PDA

- A characteristic machinery-like murmur is present in the upper left sternal border or under the left clavicle in older children
- The child may be asymptomatic or shows signs of CHF
- A widened pulse pressure (the difference between systolic and diastolic pressure) and bounding pulse are present
- A cardiac catheterization is generally necessary for diagnosis but may be used to rule out other abnormalities.

Management of PDA

- The ductus arteriosus remains open during fetal life because of stimulation of prostaglandins (particularly PGE1) from placenta and the low oxygen (PO2) level of fetal blood.
- After birth prostaglandin levels fall and oxygen levels increase which stimulates the ductus arteriosus to close.
- Medical management include administration of oral or IV Indomethacin (a prostaglandin inhibitor)
- Prostaglandin inhibitor stimulates closer

Management of PDA cont...

- If medical management fails to bring about closure of the ductus arteriosus, the defect can be ligated surgically.
- A thoracoscopy is performed and a clip is placed on the ductus.
- Without the surgery the child is at risk from heart failure from increased amount of blood pouring back into the pulmonary artery
- Also infectious endocarditis can develop.

Aortic stenosis

- Stenosis of the aortic valve prevents blood from passing freely from the left ventricle of the heart into the aorta.
- This results in hypertrophy of the left ventricle.
- It results in back pressure in the pulmonary vein and subsequent pulmonary edema.
- Aortic stenosis accounts for about 5% of congenital cardiac abnormalities.
Assessment of aortic stenosis

- The child may be free of symptoms
- Child may exhibit a systolic ejection murmur heard best in the right 2nd interspace (aortic space)
- A thrill may be felt at the suprasternal notch.
- If severe, decreased cardiac output evidenced by faint pulse, hypotension, tachycardia, and poor feeding may be present.

Assessment of aortic stenosis cont...

- When the child is active, he or she may develop chest pain.
- Sudden death can occur when the amount of oxygen needed by the heart muscle on exertion far exceeds what is available because of the aortic stenosis.
- Echocardiography will reveal left ventricular hypertrophy.
- Cardiac catheterization can further reveal the degree of the stenosis.

Management of aortic stenosis

- Management includes balloon angioplasty or surgical repair, dividing the stenotic valve or replacing the valve with an artificial valve.
- Types of valves are porcine (pig) and the prosthetic valve
- If a prosthetic is used the patient will need anticoagulation or antiplatelet therapy.
- Also antibody prophylaxis is necessary to prevent thrombus formation on the valve.

Coarctation of the aorta

- Coarctation of the aorta is a narrowing of the lumen of the aorta due to constricting bands
- Two locations are common
  1) infantile or preductal type, which is a constriction between the subclavian artery and ductus arteriosus.
  2) postductal type which is a constriction distal to the ductus arteriosus.

Coarctation of the aorta cont...

- The narrowed aorta produce an increase pressure proximal to coarctation and decrease pressure distal
- The increased pressure in the subclavian artery produces a high blood pressure
- Patient experiences headaches, vertigo, epistaxis and possible CVA.
Assessment of coarctation of the aorta

- Slight or absence of femoral pulse (check newborn femoral pulse)
- Children with obstruction proximal to left subclavian. Check for absent of brachial pulse.
- Child will experience leg pain on exertion. Due to diminished blood supply to lower extremities.
- Blood pressure can be 20 mmHg higher in the arms than the legs (normally legs are higher)

Assessment of coarctation of the aorta cont...

- X-ray will reveal left ventricular enlargement.
- A soft moderate load systolic murmur will be heard at the base of the heart.

Management of coarctation of aorta

- Intervention is usually surgical removal of the narrowed portion with end to end anastomose
- A graft of transplanted subclavian artery may be necessary if the narrowed section is extensive.

Tetralogy of Fallot (TOF)

- Tetralogy of Fallot includes four defects:
- Ventricular septal defects (VSD)
- Pulmonic stenosis (PS)
- Overriding aorta
- Right ventricular hypertrophy

Tetralogy of fallot cont...

- If pulmonary vascular resistance is higher than systemic resistance, the shunt is from right to left.
- If the systemic resistance is higher than pulmonary resistance, the shunt is left to right.
Assessment of TOF

- Infants may be acutely cyanotic at birth or may have mild cyanosis that progresses over the first year of life as the Pulmonic Stenosis worsens.
- A characteristic murmur is present.
- Acute episodes of cyanosis and hypoxia (hypercyanotic spells)

Assessment of TOF cont...

- Hypercyanotic spells called Blue spells or Tet spells occur when the infant’s oxygen requirements exceed the blood supply.
- This usually happens during crying or after feeding

Assessment of TOF cont...

- Children with increasing cyanosis, there may be clubbing of the fingers, squatting and poor growth.

Congestive Heart Failure

- Congenital heart defects are most common causes of CHF in children
- Defects with left to right shunts impose a volume load
- Cardiomyopathy: Diseases of the heart muscle resulting in poor pump function

management

- Surgical treatment for complete repair is usually performed in the first year of life.
- It involves closure of the VSD and resection of the stenosis with a pericardial patch to the right ventricular outflow tract.
- Surgery requires a median sternotomy and cardiopulmonary bypass.
## Patho of CHF

- Increase Afterload (Increase Pressure)
- Increase Preload (Left to right shunt)
- Decrease Contractility (Cardiomyopathy)
- Increase Filling
- Increase Ventricular Dilation
- Decrease Contractility/Decrease Cardiac Output

## Nursing Factors

- Factors are conditions that either add to or subtract from a problem.
- Assessment of heart disease in children begins with a thorough history and physical assessment.
- Most cardiovascular disorders in children occur as a result of congenital anomaly.

## Nursing Factors cont..

- All children with heart disorders have increased risk of poor tissue perfusion which may affect growth and development.

## Nursing Factors cont..

- Heart disease is becoming increasingly recognized because of prenatal ultrasound which show poor heart action or a distended heart.
- The newborn heart rates are too rapid to hear extra sounds of abnormal circulation.
- Infants with heart disease generally have tachycardia, tachypnea, poor feeding (because of rapid breathing and the need to rest during feeding), and they also tire easily.

## Nursing Factors cont..

- Children with congenital heart disease often prefer the knee-chest position and older children prefer the squat position.
- These positions are preferred because it traps blood in lower extremities which allows the child to oxygenate the blood supply in the upper body more fully and easier.
- Children with left to right shunts tend to perspire excessively because of sympathetic nerve stimulation.

## Nursing Factors cont..

- Edema is a late sign with periorbital edema occurring first.
- Cyanosis occurs if a shunt allows deoxygenated blood to enter the arterial system such infants generally fail to thrive and are below normal weight and height.
Nursing Factors cont.,

- Children with Coarctation of the aorta have high blood pressure in the head and upper extremities.
- They have a history of nose bleeds, headaches and
- Low blood pressure in the lower extremities and leg pain on running or exercise of lower extremities.

Nursing Factors cont.,

- Inspect toes and fingers for clubbing and for color.
- Press of the finger nail, it should blanch white and then quickly pinken in the child with good oxygenation.
- Blenching > 5 seconds indicates poor circulation
- A ruby complexion appears in children with heart disease because of the over production of RBCs to better oxygenate body cells

Nursing Factors cont.,

- Watch for signs that the heart is an ineffective pump such as
- Lethargy
- Rapid respiration
- Abnormal body postures

Nursing Factors cont.,

- Tachycardia is a pulse rate more than 160 bpm in an infant.
- Tachycardia is a pulse rate more than 100 bpm in a 3 year old.
- An increase in pulse rate over these standards needs further investigation.
- Tachycardia is significant if it persists during sleep or none excitement.

Nursing Factors cont.,

- Because a major part of the physical assessment will include inspection, palpation, and auscultation of the chest for heart function.
- It is important that the child be relaxed and not crying.
- Provide a toy, age appropriate or bottle if hungry to distract the child
- Playing with child before the exam may be helpful.

Nursing Factors cont.,

- Inspect the child for cyanosis
- Check the mouth for cyanosis which can be recognized in the newborn in the tongue and mucous membranes
- After birth check for acrocyanosis, Acrocyanosis lasting more than 20 minutes after birth suggest cardiopulmonary dysfunction.
### Nursing Factors cont..

- Increase cyanosis with crying suggest cardiac dysfunction.
- Decreased cyanosis with crying suggest pulmonary dysfunction.
- This is because crying deepens respiration.
- Hgb below 4 to 6 gms/100 ml may not show cyanosis. Severe anemia masks cyanosis.

### Laboratory tests

- Children with heart disease usually have a number of blood tests done to help diagnosis the condition.
- Hemoglobin are done to assess the rate of erythrocyte production.
- Hemoglobin increases as the body attempts to produce oxygen carrying red cells.

### Quiz

- Why have baby food manufactures taken sodium and monosodium glutamate from infant foods?
  - To encourage a diet low in sodium for life and to prevent development of hypertensive disease.

### Quiz

- Why is fat not restricted in infants diets?
  - Need the calories and fat is needed for brain growth.

### Quiz

- What about fat for school age children?
  - Should reduce fat intake to 30% of total calories.
  - Children with cholesterolemia higher than 170 mg/dl should receive dietary counseling and should be instructed in a regular exercise program.

### Quiz

- Should a baby with heart disease be allowed to cry?
  - Not for long periods. Because it increases metabolism and decreases oxygen and causes poor tissue perfusion.
Quiz

- If an infant's cyanosis increases with crying he probably has a ___ condition
  - Heart
- If an infant's cyanosis decreases with crying he probably has a ___ condition
  - Pulmonary

Quiz

- A ruby complexion of an infant indicates ___
  - Over production of RBC to better oxygenate the body cells.
  - Would a child with severe anemia have cyanosis?
  - Probable not because of decreased oxygen to cells. Would be pale.

Quiz

- Children with cardiac problems normally have ___
  - Tachycardia, tachypnea, difficulty feeding, an fatigue easily.
- How much activity should be allowed a child with a cardiac condition?
  - No roughhousing, running or games of chasing. Don't exceed tolerance.

Quiz

- What signs of respiratory distress should monitor the child with a cardiac problem for?
  - Knee chest position. Traps blood lower extremities, allowing better oxygenation of blood in the upper body.
  - Child with right to left shunt tend to perspire excessively because of sympathetic nerve stimulation.

Quiz

- A noninvasive procedure for analyzing cardiac structure and motion is ___
  - Echocardiography
- Which fetal organ is essentially bypassed by the fetal circulation?
  - Lungs

Quiz

- The primary causes for CHF are ___
  - Volume overload, pressure overload, and decreased contractility.
  - A 4 month old developed sudden gains weight, dependent edema and distended neck veins. These are symptoms of ___
  - Systemic venous congestion
A 4 month old develops dyspnea, nasal flaring, and cyanosis which is relieved by oxygen. These symptoms indicate ____. 
- Pulmonary congestion

The nurse should withhold digoxin for a 2 month old infant, if the pulse is above ___.
- 100

The antidote for digoxin toxicity is ___.
- Digibind

Stenosis of the ___ causes cyanosis in the patient with Tetralogy of Fallot.
- Pulmonary artery

The child with cyanotic heart disease develops clubbing of fingernails because of ___.
- Peripheral hypoxemia