Circulatory Changes at Birth

- When the umbilical cord is clamped, the blood supply from the placenta is cut off, and oxygenation must then take place in the infant's lungs.
- As the lungs expand with air, the pulmonary artery pressure decreases and circulation to the lungs increases.
Circulatory Changes at Birth

Structural Changes

- **Ductus venosus**: after the umbilical cord is severed, flow through the ductus venosus decreases and eventually ceases; it constricts within 3-7 days.

Foramen ovale

- Functional closure of this valve-like opening occurs when pressure in the left atrium exceeds pressure in the right.
- Closure occurs within the first weeks after birth.

Ductus arteriosus

- Increase in aortic blood flow increases aortic pressure and decreases right-to-left shunt through the ductus arteriosus.
- Functional closure occurs when this constriction causes cessation of blood flow, usually 24 hours after birth.
- Anatomic closure by 1-3 weeks.
Abnormal Circulatory Patterns After Birth

- Normal blood flow may be disrupted as a result of abnormal openings between the pulmonary and systemic circulations.
- Any time there is a defect, blood will go from high to low pressure.

Shunting

- Normally pressure is higher in the systemic circulation, so blood will be shunted from systemic to pulmonary
  - Left to right shunt
- With an obstruction to pulmonary blood flow, as well as an opening between ventricles, the blood flow may be right to left
Symptoms

- Feeding problems: fatigue, irritability, tachypnea, profuse sweating, reflux
- Failure to thrive, poor weight gain
- Respiratory difficulties: tachypnea, difficulty breathing, frequent respiratory infections, periods of anoxia, nasal flaring, retractions

Symptoms

- Activity intolerance: restlessness, lethargy
- Color changes: pallor, cyanosis, clubbing of digits
- Hematologic: polycythemia
- Organ enlargement: liver, spleen, heart

Figure 43-6

Clawing of the fingers is one manifestation of a cyanotic defect in an older child.
Diagnostics
- Chest x-ray
- Cardiac fluoroscopy
- Echocardiogram
- Electrocardiogram
- Hematologic testing
- Cardiac catheterization

Cardiac Catheterization
- Catheter threaded into right side of the heart since septal defects permit entry into the left side.
- Nursing care – pretest
  - Preparation teaching done on child’s developmental level
  - Administer medications as ordered

youtube podcast-video
Cardiac Catheterization
http://www.youtube.com/watch?v=P-Ow9ISODLY
Cardiac Catheterization

Nursing care – posttest
- Check extremity distal to catheterization site for color, temperature, capillary refill
- Keep extremity distal to the catheterization site extended
- Check pressure dressing over site for bleeding
- Monitor heart rate for bradycardia, tachycardia and dysrhythmia

Cardiac Catheterization

Nursing – posttest
- Monitor for temperature elevation due to physiologic dehydration (NPO, contrast media)
- Monitor urine output and blood pressure

Congestive Heart Failure

Reflects the heart’s inability to meet the metabolic demands of the body
- Usually due to a surgically correctable structural abnormality of the heart that results in increased blood volume and pressure
Assessment - CHF
- Tachycardia, gallop, cardiomegaly, ↓peripheral pulses, mottling
- Tachypnea, retractions, grunting, nasal flaring, cough, cyanosis, orthopnea
- Hepatomegaly, edema, decreased urine output
- Failure to thrive, decreased exercise tolerance

Nursing Interventions - CHF
- Decrease energy expenditure
  - Frequent rest periods
  - Small, frequent feedings
  - Minimize crying
  - Prevent cold stress
- Provide nutrition
  - Use soft nipple
  - Gavage feeding if needed

Nursing Interventions - CHF
- Monitor fluid status
  - I & O, specific gravity
  - Daily weight
- Provide adequate rest, position for comfort
- Prevent infections
- Promote growth & development
- Reduce respiratory distress
**Digoxin**

- Check dosage with another RN
- Give 1 hour before feeding or 2 hours after feeding
- Give at 12 hour intervals (BID)
- Take apical pulse for 1 minute
  - Hold if HR <90 in infants or <70 in children
- Monitor serum potassium levels
- Monitor for toxicity: vomiting, nausea, bradycardia, lethargy

**CONGENITAL HEART DEFECTS**

![Diagram of congenital heart defects]

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Classification

**Acynotic heart defects**
- Oxygenated blood is shunted from the systemic to pulmonary circulation (left-to-right shunt) and blood leaving the aorta is completely oxygenated

**Cyanotic heart defects**
- Unoxygenated blood is shunted from the right to the left side of the heart where it mixes with oxygenated blood

**Atrial Septal Defect (ASD)**
- Abnormal opening in the septum between left and right atria
  - Left-to-right shunt
  - Symptoms include: decreased exercise tolerance, dyspnea, and systolic ejection murmur heard best in upper left sternal border
  - Surgical correction at 2-4 years of age
**Ventricular Septal Defect (VSD)**

- Opening in the septum between ventricles, causing a left-to-right shunt
  - Symptoms include: tachycardia, dyspnea, increased respiratory effort, fatigue, frequent respiratory infections, systolic murmur heard best at lower left sternal border
  - Surgical correction if child’s shunt is persistent
Patent Ductus Arteriosus (PDA)
- Allows oxygenated blood pumped into the aorta from the left ventricle to return to the lungs
- Large PDAs cause excess blood in the lungs and volume overload, leading to CHF
- Machinery-type murmur
- Treatment
  - Indomethacin
  - Surgical ligation if necessary

Coarctation of the Aorta
- Narrowing of the aorta usually just beyond the subclavian artery
- Causes a significant decrease in blood flow to abdomen and legs, with majority of blood shunted to head and arms
Symptoms/Treatment

- Blood pressure higher in arms than legs
- Warm upper body, cool lower body
- Decreased peripheral pulses in lower extremities
- Headaches
- Nosebleeds
- Predisposition to strokes
- Angioplasty or surgery

Figure 43-3
Post-op cardiac surgery

A child with atrial septal defect (atrial septic defect). Surgery is performed with this type of defect to prevent pulmonary vascular obstructive disease.
Tetralogy of Fallot (TOF)

- Most common cyanotic heart defect
- Four components:
  - Pulmonary stenosis
  - VSD
  - Overriding aorta
    - Aorta sits near core of the heart over the VSD and therefore receives blood from both ventricles
  - Right ventricular hypertrophy

TOF

- Right-to-left shunting
- Decreased blood flow to the lungs; mixture of unoxygenated blood going to aorta causes cyanosis and dyspnea
- Symptoms: activity intolerance, irritability, failure to thrive, polycythemia, harsh systolic murmur best heard along the left sternal border and hypercyanotic (tet spells)
- Treatment: Surgical repair
Hypercyanotic (Tet) Spells

- Hypoxic episodes
- Symptoms include: cyanosis, tachypnea, altered LOC, may progress to seizures, CVA, death
- May be precipitated by crying, feeding, defecation, pain
- Treatment: oxygen, knee-chest position, morphine

Transposition of the Great Vessels

- Aorta arises from right ventricle; pulmonary artery arises from left ventricle
- Oxygenated blood circulates through left side of the heart to lungs and back to the left side, unoxgenated blood enters right atrium from body, goes to right ventricle, and back out to the body without being oxygenated
Transposition

- Child cannot live without a communication between atria or ventricles
- Palliative treatment: balloon septostomy to create ASD
- When child old enough the defect will be repaired

Assessment - Cyanotic

- Cyanosis
- Clubbing of digits
- Increased RBCs
- FTT, exercise intolerance
- ↑ HR, RR, dyspnea
- Poor feeding, weak cry
- Squatting (helps to ↓ blood flow to extremities & to keep oxygenated blood for brain & trunk)
- Risk for left-sided failure, clots
Nursing Interventions

- Do not interfere if child is squatting
- Organize care to decrease child’s energy expenditure
- Administer oxygen as needed
- Meet needs quickly; prevent crying
- Use soft nipples to decrease energy of sucking

Acquired Heart Disease

- Rheumatic Fever
- Kawasaki Disease

Rheumatic Fever (RF)

- An inflammatory disorder that may involve the heart, joints, connective tissue, and the CNS
- Thought to be an autoimmune disorder
  - Preceded by an infection of group A beta-hemolytic streptococcus
- Prognosis depends on degree of heart damage
Management - RF

- Drug Therapy
  - Penicillin, erythromycin
  - Salicylates
  - Steroids
- Decrease cardiac workload
  - Bed rest until lab studies return to normal

Assessment - RF

- Major Symptoms (Jones’ Criteria)
  - Carditis
    - Aschoff nodules (areas of inflammation & degeneration around heart valves, pericardium, myocardium)
    - Valvular insufficiency (mitral/aortic)
    - Cardiomegaly
    - Shortness of breath, edema, hepatomegaly

- Polyarthritis
  - Migratory
  - Most common in large joints which become red and swollen, painful

- Chorea (St. Vitus dance)
  - CNS disorder characterized by abrupt, purposeless, involuntary muscular movements
Assessment - RF

Major Symptoms (Jones’ Criteria)

- Subcutaneous nodules
  - Usually a sign of severe disease
  - Occur with active carditis
  - Firm, non-tender nodes on bony prominence of joints
- Erythema marginatum
  - Transient, nonpuritic rash

Assessment - RF

Minor symptoms

- History of RF, fever
- Recent strep infection
- Diagnostic tests
  - Elevated ESR
  - Positive ASO titer
  - Changes on ECG

Nursing Interventions

Carditis

- Administer Penicillin as ordered
  - Use prophylactically
  - Promote bed rest

Arthritis

- Aspirin as ordered
- Change position in bed frequently
Nursing Interventions

- Corea
  - Decrease stimulation
  - Provide safe environment

- Nodules and Rash: none

- Alleviate child’s anxiety about the ability of heart to continue to function

- Minimize boredom

Nursing Interventions

- Provide client teaching and discharge planning concerning:
  - Adaptation of home environment to promote bed rest
  - Importance of prophylactic regimen
  - Avoidance of reinfections
  - Diet modifications
  - Home-bound education

Kawasaki Disease

- An acute systemic inflammatory disease
- A multisystem disorder involving vasculitis (inflammation of the inner lining of the arteries and veins)
- Also called mucocutaneous lymph node syndrome
- In the United States Kawasaki is the most common cause of acquired heart disease in children
- Unknown cause
Stages of Kawasaki Disease

**Acute:** (days 1-10)
- Abrupt onset of fever, lasting more than 5 days & unresponsive to antipyretics
- Conjunctival hyperemia
- Red throat
- Swollen hands & feet
- Cervical node enlargement
- Child is VERY irritable

**Subacute** (days 10-25)
- Cracking lips and fissures
- Desquamation of skin on tips of fingers and toes
- Arthritis & joint pain
- Cardiac disease

**Convalescent** (days 26-40)
- Drop in ESR, diminishing signs of illness

Nursing Interventions

- Administer aspirin 80-100 mg/kg/day as ordered while temperature is elevated Q. 6 hours
- Administer IV gamma globulin (IVIG) to reduce risk of coronary artery lesions and aneurysms
- Provide comfort
Nursing Interventions

- Provide client teaching and discharge planning concerning:
  - Safe administration of aspirin therapy
  - Skin care
  - Monitoring of temperature
  - Call MD if child refuses to walk
  - Signs and symptoms of cardiac disease

Thinking Critically: The infant with VSD

Brenda, who is one month old, was diagnosed with a venti-arterial septal defect (VSD) at birth. Her parents were just beginning to accept that she had a heart defect that might require surgical repair when signs of respiratory distress and difficulty in feeding developed.

Brenda's mother had been alerted to watch for these signs as a possible indication of congestive heart failure. Brenda was quickly hospitalized so her congestive heart failure could be treated with digoxin, diuretics (Lasix), and intravenous fluids. She was also core-warmed to counteract the weight she had gained due to fluid retention.

Corrective surgery was performed to place a patch over the septal opening. Brenda was cared for in the intensive care unit before being transferred to another unit.

- Why did Brenda develop congestive heart failure?
- Why was corrective surgery performed so early?
- Is Brenda at risk to develop postoperative heart failure after having had corrective surgery?
- What teaching and support do Brenda's parents need to care for her at home after the heart surgery?
Answer:
Congestive heart failure is a result of the heart's inability to adequately pump blood to the systemic circulation and in the case of a VSD, there is an additional outflow from the right ventricle to the left ventricle causing left to right shunting and a volume overload. Congestive heart failure occurs, it puts the child at additional risk for bacterial endocarditis and pulmonary vascular obstruction disease. A complication of this surgery is a residual VSD, although not common, this should still be discussed with the family members. If the VSD is fully committed, however, there should be no risk of other heart problems, including CHE. Brandi's parents will need instruction, both verbal and written, on medications, antibiotic use, diet, and symptoms of infection, activity, when to seek medical care, and follow-up appointments with the cardiologist and/or cardiac surgeons. Depending on how well the family is adjusting to the information will determine if home health care should be an option.