N433 Infant, Child, and Adolescent Health
Growth and Development: Adolescent
Week 6
Text: Pediatric Nursing-Critical Components of Nursing Care, 3rd Edition, F.A. Davis (Advantage)
(Reviewed/Updated 9/2024)

#1. **Rudd and Kocisko: Ch. 13, ATI Ch. 20 & 43**

#2. **Objectives**

#3. ****Review normal heart flow from Patho ****

HEART ANATOMY AND PHYSIOLOGY
The heart is in the center of the chest and is about the size of a child's fist. Heart rate varies with the age of the child from 60 to 160 beats/min (bpm); the child's heart pumps as hard as an adult's heart.

Heart Valves
• Four valves: The atrioventricular (AV), tricuspid (three-leafed) valve, bicuspid (two-leafed) valve, the aortic and pulmonic valves.

Heart Vessels
• The vena cavae, pulmonary artery, pulmonary vein, and the aorta.

Normal Blood Flow
Review Figure 13-4 on pg. 252 in your textbook for normal blood flow.

Cardiac Output
Cardiac output is calculated by multiplying stroke volume by heart rate (measured in L/min).

Stroke Volume
Stroke volume is the amount of blood pumped out of the left ventricle per minute, which is altered by the size of the heart and the heart rate.

Electrical Conduction
The conduction of the electrical impulses through the heart results in an electrical discharge across the myocardium and is measured by an electrocardiogram (ECG). **Review Figure 13-6 on pgs. 254-255 for a review of components of EKG .**

Fetal Circulation
• Before birth, 90% of blood bypasses the lungs; the placenta is an organ of respiration **(Fig. 13–7).**
• Oxygenated blood is returned via the umbilical vein to the inferior vena cava and right atrium.
• Oxygenated blood crosses from the right atrium to the left atrium via the patent foramen ovale (PFO) and is pumped by the left ventricle.
• Deoxygenated blood flows from the superior vena cava to the right atrium and then to the right ventricle, the pulmonary artery, the patent ductus arteriosus (PDA), and the aorta.
• Upon birth and first breath, the foramen ovale and ductus arteriosus close.

#4.

Heart defects are classified as either congenital or acquired.

Congenital heart defects are genetic, meaning the child is born with the disorder. These defects affect 6 to 8 in 1,000 live births, or 40,000 live births per year (CDC, 2020a; Tsuda, 2016; U.S. Library of Medicine, 2017).

Acquired heart disease can occur in the normal heart or in the heart with a congenital defect.

• Increased pulmonary blood flow—abnormal connection through the septa or the great vessels; increased blood volume on right side of heart with increased pulmonary blood flow and decreased systemic blood flow
• PDA
• Atrial septal defects (ASDs)
• Ventricular septal defects (VSDs)
• Decreased pulmonary blood flow—pulmonary blood flow is obstructed within the right ventricular outflow; desaturated blood shunts from right to left across an ASD or VSD into systemic circulation, and the neonate is likely desaturated and cyanotic
• Tetralogy of Fallot (TOF)
• Tricuspid atresia
• Eisenmenger's syndrome

#5.

General History

• Comprehensive history and physical examination
• Detailed family history, including history of congenital heart disease or genetic disorders
• Prenatal history, including rapid or slow heart rate in utero, diabetes, or lupus
• Detailed history of exposure to infections, exposure to environmental teratogens such as alcohol, cocaine, phenytoin, or lithium
• Gestational age at birth
• Feeding history, weight gain
• Diaphoresis
• Attainment of developmental milestones
• Respiratory status
• Pain
  • Chest pain is a rare symptom in the pediatric cardiac client.
  • Myocardial infarction (MI) resulting in aneurysms can occur in disease processes such as Kawasaki disease.
  • Chest pain is often the result of other conditions, such as costochondritis, musculoskeletal discomforts, skin conditions, or pleural pain.

Possible Indicators of Heart Disease in Children

• Failure to thrive (FTT)
• Small for gestational age

• Poor weight gain
• Clubbing and erythema in fingers and toes **(Fig. 13–8)**
• Polycythemia = increased risk of stroke

Respiratory System

• Close evaluation of the respiratory rate and evidence of retractions is important in assessing whether the child has a primary respiratory disorder or cardiac disease.
• Shallow, rapid respirations with a rate more than 60 breaths per minute in a content infant are abnormal and need to be investigated because this may indicate a left-to-right shifting of blood in the heart (Slodki et al, 2016).
• Children with congenital heart disease often have respiratory tract infections, resulting in dyspnea with activity and fatigue (Tsuda, 2016).

Cardiovascular System

See **Table 13-3 on pg. 260 for cardiac assessment techniques.**

Pulses

• Pulse volume is rated from 0 to 4: 0 = absent, 1+ = weak, 2+ = average, 3+ = strong, 4+ = bounding.
• When normal, usually easy to feel in a child.
• Average heart rate for infants is 160 beats/min, preschool children 120 beats/min, and adolescents 100 beats/min.

Blood Pressure

• Use a nonthreatening approach; the child may sit on the parent's lap depending on age.
• In newborns, the mean arterial pressure is measured in millimeters of mercury (mm Hg) and is usually the newborn's completed age in weeks. BP is not a routine part of the neonatal assessment in the normal newborn (Durham & Chapman, 2019). If necessary, the BP is taken on either the arm or leg. Normal BPs range from 50 to 75 mm Hg systolic and 30 to 45 mm Hg diastolic in the neonate (Durham & Chapman, 2019).
• In older children, the minimum systolic BP is 70 mm Hg + (2 × age in years).
• Wide pulse pressures—diastolic pressures are low, with a wide gap between diastolic and systolic pressures; indicative of such processes as PDA.
• Poor cardiac output will result in a low systolic BP with a high diastolic pressure, creating a narrow pulse pressure.

Color

• Cyanosis is always an abnormal finding. Cyanosis is also influenced by anemia (low hematocrit) or polycythemia (high hematocrit).
• Central cyanosis, seen by bluish discoloration of mucous membranes, tongue, circumoral, or core body, is caused by problems with the heart or lungs.
• Shock can be seen with a prolonged capillary refill time, and pallor is associated with poor perfusion (AAP, 2017).
• Pulse oximeter readings of 78% or lower with normal hemoglobin levels will result in outward signs of cyanosis (AAP, 2017).

• Anemia may not show cyanosis because of decreased levels of hemoglobin; polycythemia may show cyanosis with a smaller amount of deoxygenated hemoglobin.
• Quiet pericardium combined with cyanosis is often an indicator of congenital heart disease (Altman, 2017).

Auscultation

• Heart sounds
  • S1 (lub sound) is heard at the fourth or fifth intercostal space at the midclavicular line—closure of the mitral (heard at apex of heart) and tricuspid valve (heard at left sternal border).
  • S2 (dub sound) is heard at the closure of the pulmonic and aortic valves. May be split. Single S2 is the result of absent flow or obstruction in flow to aortic or pulmonic valves.
  • S3, S4 gallop—considered normal before the age of 20 years (Altman, 2017).
• Point of maximum impulse—area of most intense pulsation heard by a stethoscope
  • In children younger than 7, located at left midclavicular line and fourth intercostal space
  • In children older than 7, located along the left sternal border in the fifth intercostal space
• Innocent murmurs (e.g., systolic, vibratory, musical) are present in many children **(Table 13-4)** because of thin chest walls in the child and hyperactive heart sounds (Shea, 2016)

#6.

Diagnostic Tests

Chest X-Ray

Chest x-rays, including anteroposterior and lateral views

Blood Gases

• Metabolic acidosis shows as a decrease in pH and an increase in base excess.
• In cardiac disease, the partial pressure of carbon dioxide is generally within normal ranges.

Electrocardiogram

• Useful to determine conduction issues
• Needs to be evaluated by a cardiologist

Echocardiogram

• Ultrasound of the heart
• Noninvasive test that indicates structure, size, flow patterns, function, and the blood vessels attached to the heart

Angiography

• Visualizes the structure and function of the ventricles
• Dye injected via a catheter

Cardiac Catheterization

Nurses must provide caregiver education about the procedure, in which small catheters or small, flexible tubes are inserted through small incisions in the neck or groin and threaded to the heart. These small tubes allow for blood samples to be taken, x-rays (fluoroscopy) to be done, and small instruments to be carried to the heart if repairs are needed. **Review Clinical Judgment box on pg. 263 regarding "Nursing Care During Cardiac Catheterization".**

Biopsy of the Myocardium
- Frequent in heart transplants
- Monitors for rejection

Pulmonary Artery Banding
- Palliative measure to decrease pulmonary blood flow
- Prevents pulmonary hypertrophy and pulmonary hypertension
- Precursor to cardiac surgery, such as in large VSDs

Caregiver Education
- The nurse should discuss limitations in physical activity for the pediatric cardiology client with the physician, child, and caregiver.
- Emotional support may be required, as the child may feel different from peers because of frequent hospitalizations; this may result in feelings of isolation, sadness, or abnormality.
- The nurse should provide education to the child and caregiver about the need for follow-up by a cardiologist for the rest of the child's life.
- The need to transition to an adult cardiologist should be discussed with teens. Endocarditis prevention is necessary for some children before many dental or medical procedures.
- Teen girls should be counseled by nurses and physicians related to birth control, because certain congenital heart defects can predispose a teen to higher risks from birth control pills and intrauterine devices. People with certain congenital heart defects may be at a higher risk of having children with congenital heart defects.

#7.

Congenital heart defects that increase blood flow to the lungs, often resulting in pulmonary edema and pulmonary hypertension, include PDA, ASD, and VSD.
These disorders are called Acyanotic disorders.
Most common heart defects.

Left side of heart pressure becomes greater than Right

Left → Right shunting

May develop heart failure because of increased blood flow to the lungs

May develop right ventricular hypertrophy

May exhibit tachypnea or tachycardia
Sodium and fluid retention may occur
Higher risk for pulmonary infections
May get pulmonary vasoconstriction and pulmonary hypertension over time

#8.

The ductus arteriosus connects the aorta to the pulmonary artery outside of the heart. Left-to-right shunting occurs through the duct that will then connect the pulmonary artery (nonoxygenated blood) with the aorta (oxygenated blood).

Most ducts close nearly 100% within 72 hours with full-term infants, and the incidence of them staying open or opening increases as the gestational age of the infant decreases (Prescott & Keim-Malpass, 2017).

In preterm infants, 10% of infants born between 30 and 37 weeks' gestation and 80% of preterm infants between 25 and 28 weeks remain open after 4 days of life (Benitz, 2016).
Increase in oxygen levels causes muscular constriction around the ducts (Prescott & Keim-Malpass, 2017).

Assessment
PDA may be indicated by:
- Heart murmur—systolic murmur, mid- to lower-left sternal border, washing machine sound
- Some infants will have no murmur
- "Wet-sounding" breath sounds known as *crackles*

Diagnostic Tests
- Wide pulse pressures—low diastolic pressures
- Increased vascular markings on the chest x-ray are a late sign of an enlarged heart
- Poor oxygen saturation
- Bounding pulses
- Enlarged heart
- An echocardiogram will show increased enlargement of left heart chambers

Nursing Interventions
- Provide postoperative care after coil embolization or ligation.

• Decrease work of breathing by providing frequent rest periods that maximize oxygen delivery to the tissues.
• Do not cluster care, as increased oxygen demand can occur during the clustering.
• Administer digoxin (Lanoxin) as ordered.
• Monitor urine output.
• Monitor laboratory tests for thrombocytopenia.
• Monitor daily weights.

Medical Management
Medical management includes using NSAIDs that inhibit cyclooxygenase-1 (COX-1) or COX-2.
Surgical Management
• Ligation of the duct through a posterior-lateral thoracotomy for infants requiring increasing respiratory or cardiovascular support
• A stainless-steel coil occlusion of the PDA is also used through cardiac catheterization
Child and Caregiver Education
• Closely monitor oral intake.
• Closely monitor diapers for urine output.
• Monitor for signs and symptoms of irritability and/or lethargy.
• Keep cardiology appointments.
• Continue diuretics.

#9.

ASDs occur between the right and left atrium when the two septal walls fail to form **(Fig. 13–11)**. The septal walls normally close between weeks 4 and 8 of fetal development, but may remain open up to 1 year (Scannell & Ruggiero, 2021). This defect allows more blood to flow into the right side of the heart from the left atrium, increasing pulmonary blood flow to the lungs through a hole in the atria. **This defect may result in pulmonary hypertension with right atrial enlargement that can cause right ventricular hypertrophy.**
Assessment
• Heart murmur known as *ejection systolic murmur* because of blood being forced through pulmonary valve
• Atrial dysrhythmias
• Higher incidence of emboli
• Recurrent respiratory infections
• Tires easily with playing
• Poor feeding
Diagnostic Tests
• Echocardiogram shows enlargement of right atrium and right ventricle.
• ECG shows thickening of the heart muscle.
• Chest x-ray shows enlargement of the heart and an increase in blood flow to the lungs.
Medical Management

• Administer medications, such as digoxin and diuretics, to decrease the load on the right side of the heart.
• Surgical closure may increase the incidence of pulmonary hypertension, resulting in dysrhythmias, and surgical clients may experience a greater mortality risk.
• Provide pain medications as ordered to decrease oxygen consumption.

Surgical Repair
• Closure with cardiac catheterization—transseptal closure across the defect with transthoracic echocardiography
• Surgical repair can also be performed by patching with the child's own tissue, bovine tissue, or artificial structures

Nursing Interventions
• Monitor feeding tolerance; offer small, frequent feedings with infants and small children.
• Monitor for signs and symptoms of CHF.
• Monitor for increased work of breathing, grunting, retractions, and flaring.
• Monitor growth patterns.

Caregiver Education
• Educate on care of the child after cardiac catheterization, which includes monitoring for bleeding at the catheter insertion site.
• Surgical closures with a patch may result in arrhythmias.
• Monitor for increase in temperature and changes in color of catheterized extremity.
• The child may need to be prescribed blood thinners for several months after the procedure.
• Educate on risk for embolization because of dislodgement of the patch.
• The child may need antibiotics for dental work after treatment (Nishimura et al, 2017).

#10.

VSD is the most common overall congenital heart disease **(Fig. 13–12)**. **This defect forms at weeks 4 to 8 of fetal development (**Scannell & Ruggiero, 2021). The degree of clinical presentation depends on the size of the defect, with up to 75% of small defects closing spontaneously (AHA, 2016f).

Assessment
• Often asymptomatic or with a heart murmur
• Shortness of breath
• Feeding difficulties
• Murmur
• Systolic thrill in lower left sternal border
• FTT
• Recurrent respiratory infections (Scannell & Ruggiero, 2021)

Diagnostic Testing
• Echocardiogram—large left atrium

- Chest x-ray—cardiomegaly of left heart and increased pulmonary vascularity
- Cardiac catheterization

Surgical Repair

Occurs through suturing if the defect is small or patching through a surgical sternotomy. The defect is repaired within the first 6 to 12 months of life and when the infant weighs more than 2000 g. Complications from the surgery can include dysrhythmias.

Nursing Interventions

- Same as for ASD

Caregiver Education

- Similar to that for ASD
- Manage postoperative care

#11.

Occurs with some obstruction of blood flow to the lungs

Pressure in right side of heart increases & becomes greater than the left side

Right → Left shunting

Cyanosis, may appear "dusky"

Deoxygenated blood mixes with oxygenated blood

#12.

TOF is the third most common lesion, classified as a nonductal cyanotic heart defect **(Fig. 13–13)** (Centers for Disease Control and Prevention [CDC], 2016c). This defect is associated with 22 deletion chromosome disorders such as DiGeorge's and Down's syndromes. TOF occurs more

frequently in males than in females (CDC, 2016c). This type of cyanotic heart disease comprises four separate defects:
• VSD between right and left ventricles
• Obstructive right ventricular outflow—PS or obstruction
• Overriding aorta lies directly over the VSD and takes blood from both the right and left ventricles; permits oxygenated blood to rest of body
• Secondary thickening of right ventricle (right ventricular hypertrophy) because of restrictive outflow

Assessment
• Right-to-left shunting
• "Tet" spells—sudden, marked increase in cyanosis; syncope; can lead to hypoxic brain injury and death ***Review Clinical Judgment box on pg. 267 in your textbook regarding "Tet Spells".**
• Increased cyanosis with irritability and crying
• Increased irritability because of lack of oxygen
• Clubbing of fingers
• Poor growth in response to chronic lack of oxygen

Clinical Indicators
The following clinical indicators may be present at birth or within the first year of life:
• PDA causes increased blood flow to lungs
• Profound cyanosis is rare
• Heart murmur may be soft to loud
• Failure to gain weight
• Fainting
• Dyspnea on exertion
• Polycythemia
• Boot-shaped heart, right ventricular hypertrophy, and small pulmonary artery
• As PDA closes, cyanosis increases
• Degree of cyanosis is dependent on restriction of blood flow to lungs

Nursing Interventions
• Improve oxygenation through clustering care to allow adequate rest periods. The nurse should continue sedative or morphine sulfate to decrease agitation and prevent inconsolable crying, which will decrease pulmonary blood flow and increase the incidence of tet spells. The nurse should maintain fluid balance to prevent fluid overload, which increases the workload on the heart.
• Provide oxygen to reduce pulmonary vasoconstriction, but note that this will not improve oxygen saturation or alleviate the cyanosis.

• The nurse should maintain vasopressors to increase systemic vascular resistance and prostaglandin E1 drip as ordered to keep the PDA open **(Table 13-5).**
• The nurse should prepare the family for the possibility of multiple surgeries, beginning with a VSD patch and resection to alleviate the PS, and the possibility of additional procedures such as a modified Blalock–Taussig procedure if the infant has severe PS or PA.

Caregiver Education
• Teach the family to calm the infant by holding the infant over the caregiver's shoulders with the child's knees drawn up toward the chest. This will increase the blood flow to the lungs.
• Support the family in asking questions related to physical activity restrictions and pharmacological regimen.
• Support the caregiver's access to a pediatric cardiologist for the child's lifelong care.

Mixed blood is low in oxygen & is pumped via the systemic circulation to the body tissues

Compensation of low blood oxygen levels stimulates the kidneys to produce erythropoietin that stimulates the bone marrow to produce more RBCs → polycythemia

#13.

Tricuspid atresia is a heart condition in which the tricuspid valve is either defective or missing **(Fig. 13–14).**

Assessment
• Cyanosis
• Shortness of breath
• Delayed growth and poor weight gain
• Murmur caused by ASD that is usually present
• Often associated with PS
• Clubbing of fingertips in older children

Diagnostic Tests
• Echocardiogram
• ECG
• Chest x-ray
• Cardiac catheterization

Nursing Interventions

• Prepare child for surgery.
• Prepare family for a series of corrective surgeries. Tricuspid atresia requires emergency interventions for survival of the infant. The nurse needs to sustain prostaglandin E1 administration to maintain blood flow to the lungs, and then a balloon septostomy is performed. Eventually, stage II surgery is the Glenn stage, with stage III surgery known as the Fontan procedure (Scannell & Ruggiero, 2021).
• Prepare family for possibility of heart transplant procedure if needed.

Caregiver Education

• Counsel family that child will need lifelong cardiology care.
• Inform caregivers that further surgeries may be required.
• The child will need to transition to an adult cardiologist.
• Monitor for signs and symptoms of fluid retention, fast heart rate, and chronic diarrhea.
• Monitor for signs of shortness of breath, bluish skin color, or slow growth (Scannell & Ruggiero, 2021).

#14.
Eisenmenger's syndrome occurs with a PDA, VSD, or ASD **(Fig. 13–15)** as a result of a hole in the atria (ASD), where high pressures push nonoxygenated blood from the right atrium into the left atrium because of right ventricular hypertrophy, or as a result of a hole in the ventricles (VSD), which pushes nonoxygenated blood into the left ventricle, bypassing the lungs.

Assessment

• Shortness of breath
• Fatigue
• Chest pain
• Cyanosis
• Increased red blood cell production

Diagnostic Tests

• Echocardiogram
• Chest x-ray

Nursing Interventions

• Monitor the child's BP and administer hypertensive medications, anticoagulants, and antidysrhythmics.
• Maintain pulmonary vascular dilation.
• Prepare child and family for bypass (extracorporeal membrane oxygenation [ECMO]).

Caregiver Education

• Provide teaching related to treatment issues, such as bypass information.
• Prepare child/caregiver for possible transfer to another facility for bypass treatment.
• The child can have sponge baths but should not take long showers or be submerged in a tub or pool for several weeks after surgery. Children can resume normal activities except for rough or vigorous play. The family should be counseled to notify the surgeon if their child develops a fever; has chest pain, difficulty breathing, or redness; swelling; or excessive drainage of any color from the incision site. The family must be counseled that they will need follow-up visits with their surgeon and cardiologist.

#15. Question

#16.

Acquired congenital heart defects can occur during childhood. Although acquired heart disease is more common in adults, **heart disease can develop in children as a complication of conditions such as rheumatic fever and Kawasaki disease**.

#17.

Cardiomyopathy is a chronic progressive disease that occurs within the heart muscle itself (primary or a genetic defect) or as a result of another disease or toxin that affects all organs, including the heart, such as infections, low blood flow to the heart, decreased oxygen levels, or high BP (AHA, 2017).
• There are three types of cardiomyopathy: **dilated, hypertrophic, and restrictive.**
• **Dilated** or congested—enlarged heart, weak and ineffective pump
    • Most common form
    • Develop heart failure
    • Blood clots because of slow blood flow
    • Dysrhythmias
• **Hypertrophic**—most common inherited heart defect in the absence of other cardiac disease with left ventricle enlarged; found in infants of diabetic mothers and Noonan's and Pompe's syndromes (AHA, 2017)
    • Enlarged heart
    • Diastolic dysfunction
    • Exercise intolerance
    • Fainting
    • Leaking valves caused by increase septal and ventricle muscle
• **Restrictive**—heart muscle becomes rigid and fails to relax; rarest type
    • Diastolic dysfunction
    • Fatigue
    • Shortness of breath

Assessment

- CHF
- Sweating with feedings
- Dizziness
- Weight loss
- Murmur—gallop
- Hepatomegaly with venous congestion
- Fatigue
- Frequent colds, pneumonia
- Dysrhythmias

Diagnostic Tests

- Murmur
- Chest x-ray shows thickening of the cardiac musculature and enlargement
- ECG indicates the degree of enlargement
- Echocardiogram reveals right- or left-sided enlargement
- Cardiac catheterization
- Cardiac dysrhythmias

Nursing Interventions

During the acute phase, nursing interventions include:

- The nurse should continue IV fluids, endotracheal intubation, ventilator, ECMO/artificial heart–lung machine, diuretics, and anticoagulation therapy (AHA, 2016e).
- ACE inhibitors have positive inotropic properties and are used because they inhibit the chemical angiotensin, which constricts arteries (AHA, 2016e). These ACE inhibitors may have to be taken for the rest of the child's life.
- Beta blocker therapy, calcium channel blockers, and nutritional supplementation with carnitine may also be warranted.
- Provide valve replacement therapy postoperatively.
- Provide heart transplant care if warranted.

Caregiver Education

- Aimed at the intensive care necessary for a child with a life-threatening condition
- Possible terminal status of the child
- Frequent echocardiograms to monitor size and function of the heart
- Psychological and physical preparation
- Activity restrictions to prevent overstimulation of the heart
- Allow the child to discuss feelings, such as concerning the restriction of activity in the previously active child
- Encourage participation in cardiomyopathy programs (Ooi, 2016)

• Anticipatory grieving of the parents is expected in this life-threatening situation

#18.

With CHF, the heart cannot supply enough oxygenated blood to meet the metabolic needs of the body tissues either at rest or work (Scannell & Ruggiero, 2021). The heart may fail with high afterloads (COA, AS), valvular regurgitation, or impaired myocardial contractility, as in cardiomyopathy.
• Right-sided heart failure—right ventricle cannot pump blood into the pulmonary artery, resulting in increased pressure in the right atrium and the systemic venous system.
• Left-sided heart failure—blood is backed into the left atrium and the pulmonary veins, resulting in increased lung congestion.

Assessment

• Edema of the face, hands, and feet or weight gain
• Cardiac enlargement
• Gallop rhythm, changes in heart rate
• Tachycardia
• When completing four limb blood pressures, the blood pressure will be higher in the arms than in the legs
• Cyanosis
• Tachypnea
• Shortness of breath
• Crackles
• Fatigue
• Poor appetite
• Poor growth, FTT
• Sweating with minimal activity

Diagnostic Tests

• History and physical examination
• Chest x-ray indicates an enlarged heart, increase in pulmonary vascularity, and edema
• Echocardiogram defines anatomy and physiology
• ECG indicates an enlarged atrium
• Urine and blood tests
• Evaluate blood gas, anemia, and electrolyte balance

Nursing Interventions

• Maintain oxygenation by elevating the head of the bed.
• Decrease oxygen consumption by minimizing stimulation and decrease work of breathing.
• Monitor intake and output daily weights at the same time, with the same scale and same clothes.
• Monitor breath sounds.

• Provide supplemental oxygen.
• Cluster care to decrease oxygen consumption.
• Use high-caloric formula or medium-chain triglycerides, which enhance the calories without providing additional fluid volume.
• Administer pharmacological therapy—Lanoxin therapy, diuretic therapy, and inotropic agents—to maximize cardiac output and eliminate excess fluid. ****Review Clinical Judgment box on pg. 277 regarding "Digoxin".**

Caregiver Education

• Surgery may need to be performed to correct congenital heart defects.
• Provide discharge instructions on observation for tachypnea and increased work of breathing.
• Maintain diuretics as ordered **(Table 13-6). Review Table 13-6 on pg. 278 in your textbook.**
• Avoid high-salt-content foods.
• Monitor weight: same scale, same time of day, same clothes.
• Elevate the head of the bed.
• Provide frequent rest periods by clustering care.

#19.

Hyperlipidemia, in which blood has high concentrations of low-density lipoprotein (LDL) and low concentrations of high-density lipoprotein, is a high-risk factor for cardiovascular disease.
• Comorbid with high BP, type 1 or 2 diabetes, smoking, overweight, and inactivity.
• National Cholesterol Education Program (NCEP) guidelines indicate that if the pediatric client's LDLs are greater than or equal to 130 mg/dL, the client has an increased risk for complications resulting from hyperlipidemia (Rohrs, 2019).
• **The National Heart, Lung, and Blood Institute recommends screening children ages 9 to 11 and 17 to 21 regardless of family history or risk factors for high cholesterol or premature cardiac disease (**Rohrs, 2019).
• Dietary and behavioral changes are necessary for long-term benefits in reduction of cholesterol and prevention of complications.
• Dietary recommendations will only decrease the cholesterol levels by a small percentage.
• Controllable factors need to be addressed throughout life: weight, smoking, hypertension, and inactivity.
• Noncontrollable factors are hereditary factors that significantly affect the incidence of hyperlipidemia.
• Treatment is aimed at controlling manageable factors and the use of statins and niacin for hereditary factors.

Pediatric hypertension is now a common occurrence and is a common cause of morbidity and mortality in the pediatric population.

The AHA (2016a) recommends that children older than 3 years have yearly BP measurements. BP is dependent on the child's age, gender, and weight.
• Systolic BP in infants is between 70 and 90 mm Hg; adolescents reach adult levels.

- Routine monitoring should begin around age 3 years.
- Diagnosis of hypertension is not made from one reading.
- **Hypertension is diagnosed when BP is more than 95% for age, weight, height, and sex** (Rodriquez-Cruz, 2017).
- Primary hypertension—child is usually younger than 10. This is a disease of exclusion.
- Secondary hypertension—daytime diastolic BP elevations and nighttime BP elevations. May indicate renal or organ involvement.
- Risk factors include genetic causes, obesity, and secondary hypertension issues related to renal perfusion or structural anomalies.

Nursing Interventions

- Aim is for reduction of the BP to less than 95% and resolution of end-organ dysfunction.
- Encourage routine exercise.
- Encourage weight loss if indicated.
- Educate the child/caregiver on healthy meal choices with lower intake of salt, saturated fat, trans fatty acids, cholesterol, and carbohydrates and increased dietary fiber intake.
- Emergency treatment of acute hypertension is the administration of labetalol (0.1 mg/kg) (Vallerand et al, 2021).
- Chronic hypertension is usually treated with ACE inhibitors.

#20.

Rheumatic heart disease is systemic inflammatory disease that occurs in response to a group A beta-hemolytic streptococcal infection, such as strep throat, rheumatic fever, or scarlet fever, that starts in the throat. Left untreated or partially treated, infection spreads into the bloodstream, usually 2 to 3 weeks after the onset of illness (Scannell & Ruggiero, 2021).

Assessment

- Abdominal pain
- Nosebleeds
- Chest pain and heart palpitations
- Waking from sleep with the need to sit or stand up (paroxysmal nocturnal dyspnea)
- Jones criteria—first established in 1944 and continually updated. States that there must be two major criteria or one major and two minor criteria present with a streptococcal infection (Gewitz et al, 2015; Special Writing Group of the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease of the Council on Cardiovascular Disease in the Young of the American Heart Association, 1992). Revised Jones criteria are as follows:
- Major criteria include symptoms such as polyarthritis, carditis, subcutaneous nodules, nonpruritic ring rash on the trunk or arms, and subcutaneous nodules (Gewitz et al, 2015; Special Writing Group of the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease of the Council on Cardiovascular Disease in the Young of the American Heart Association, 1992).

• Minor criteria include a history of rheumatic heart disease, increase in C-reactive protein, fever greater than or equal to 101.3°F (38.5°C), and evidence of heart block (Gewitz et al, 2015; Special Writing Group of the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease of the Council on Cardiovascular Disease in the Young of the American Heart Association, 1992; Chin 2017).
• Physical assessment

Diagnostic Tests

• Blood tests for the presence of exposure to strep infection (ASO)
• ECG
• Echocardiogram
• Enlarged heart and CHF per chest x-ray

Nursing Interventions

• Maintain administration of inflammatory medications and antibiotics.
• Prepare child for admission to hospital and/or surgery.
• Provide detailed education to family regarding prevention, treatment, and recurrence of symptoms.

Caregiver Education

• Educate families on the screening of school-age children for sore throats.
• Educate families on the need for completion of antibiotic regimen or prophylaxis as ordered.
• Prepare caregiver for possible hospitalization or heart valve surgery.
• Encourage regular checkups with cardiologist.
• Encourage immunizations and the annual flu shot.
• Provide education related to prophylaxis antibiotic therapy for dental work.

#21.

Subacute bacterial endocarditis results from a bacterial infection or the introduction of an infective agent through any invasive procedure such as surgery or through a dental cleaning (Scannell & Ruggiero, 2021).The endocardium of the heart becomes inflamed with *Viridans streptococcus*, *Streptococcus mutans*, *Streptococcus sanguis*, or *Staphylococcus*. Bacteria or fungi that have entered the body through the mouth, respiratory system, or bloodstream invade and attach themselves to damaged areas of the endocardium that allow the bacteria to easily attach and multiply. Healthy hearts do not develop endocarditis, but those children with damaged heart valves or heart disease are more susceptible (Friedewald, 2016). Endocarditis can be life-threatening.

Assessment

• Vague symptoms such as low-grade fever; a high fever indicates an acute illness

• Fatigue
• Cough
• Heart murmur
• Chills
• Shortness of breath
• Joint pain
• Loss of appetite and weight loss
• Flank pain
• Petechiae

Diagnostic Tests

• History and physical examination
• Can mimic other infections
• Blood cultures

Assessment Findings

• Roth spots—round or oval white spots sometimes seen in the retina in the early stages
• Janeway lesions—flat, painless, red to bluish red spots on palms and soles of feet (Friedewald, 2016)
• Osler nodes—painful, red, raised lesions on the palms and soles because of immune complex (Friedewald, 2016); Osler and Roth spots arise because of immune-mediated vasculitis (Brusch, 2016)
• Splinter hemorrhages—black or brown lines under the nails (Friedewald, 2016)
• Complete blood cell count
• Echocardiogram
• Transesophageal echocardiogram—to assess valvular function or vegetation growth

Nursing Interventions

• If untreated, can lead to bacterial or fungi clumps that can break off and travel to the lungs, brain, kidneys, or other organs.
• Monitor for stroke volume or poor pumping action.
• Maintain intensive antibiotic therapy.
• Monitor for fluid imbalances caused by nausea, vomiting, and diarrhea from antibiotics.
• Monitor for CHF symptoms such as shortness of breath, poor weight gain, and edema.
• Monitor for valve failures and cardiac failure.
• Monitor for septic emboli to the lungs.
• Prepare the child for transplanted valves.

Caregiver Education

• High-risk children with past valve damage, repairs, or defects are at an increased risk and may be treated with prophylactic antibiotics.

• Prepare caregiver for possibility of surgery for valvular replacement.
• Maintain dental health through regular checkups starting as soon as the child's teeth erupt.

#22.

Kawasaki's disease, also known as *mucocutaneous lymph node syndrome,* is the leading cause of acquired heart disease in children in the developed world. This multisystem disease affects the cardiovascular system and can lead to a coronary artery aneurysm (Scannell & Ruggiero, 2021). Mortality in children results from scarring, stenosis of the main coronary arteries, or MI because of coronary thrombosis.

Assessment
• **Kawasaki disease is a diagnosis of exclusion**.
• Signs and symptoms that last longer than 5 days include high fever greater than 101.3°F (38.5°C), plus a minimum of four of the clustered symptoms in Box 13-1. **Review Box 13-1 on pg. 282 in your textbook.**

Diagnostic Tests
• **Diagnosis is through exclusion because it often mimics other diseases such as scarlet fever, toxic shock syndrome, infectious mononucleosis, and mycoplasma**.
• Initial laboratory results will indicate an increased white blood cell count.
• Lymphocytosis and thrombocytosis occur.
• High fever that is not resolved with antibiotics or antipyretic therapy may develop.
• A life-threatening complication of Kawasaki's disease is the development of coronary artery aneurysms. Baseline echocardiogram 6 to 8 weeks after the onset of symptoms is used to rule out this complication.
• Complications include myocarditis, pericarditis, leaking of the valves, pericardial effusion, and CHF.
• MI occurs in 73% of children within the first year of diagnosis (Scheinfeld, 2016).
• Neurological complications can occur, as can gastrointestinal complications such as hydrops of the gallbladder (Scheinfeld, 2016).

Nursing Interventions
• Maintain anti-inflammatory medications such as high-dose salicylate therapy, which can also be continued for 6 to 8 weeks as an antiplatelet therapy.
• IV gamma globulin is given for the first 10 days after the onset of symptoms to prevent coronary aneurysms.
• Monitor the child's cardiac status closely for signs and symptoms of CHF.
• Nursing care is aimed at symptom relief.

Caregiver Education

• Encourage professional intervention in an infant or child with unresolved fever.
• Kawasaki disease is usually self-limiting.

#23.

The replacement of diseased heart with a healthy one is indicated for children who have serious heart dysfunction, congenital heart disease, or cardiomyopathy. Healthy hearts are given by organ donors or parents of critically ill children.

Diagnostic Tests
• Blood tests
• Echocardiogram
• ECG
• Cardiac catheterization

Nursing Interventions
• Provide preparation of children for surgery.
• Provide preparation of caregiver for surgery.
• Provide detailed education on medications, symptoms of rejection, and follow-up care.

Caregiver Education
• When organ is available, child will be called to hospital.
• Final blood work will be done to ensure match to organ.
• Child will go to the operating room.
• Transplant will take several hours.
• Long-term medication will be necessary for cardiac management, reduce risk for organ rejection, and decrease the load on the heart.
• Educate caregiver on antirejection drugs.

 # 24.

Cardiac dysrhythmias are problems with the rate or rhythm of the heartbeat; heart rates that are too fast or too slow affect cardiac output to the brain, heart, and other organs. **This is a medical emergency.**

Supraventricular Tachycardia
• Occurs in the atria of the heart
• Heart rate greater than 220 bpm
• Treatment
• Stimulate vagal response through nasal suctioning.
• Apply crushed ice to the forehead.

• Adenosine (Adenocard)—rapid IV push in a proximal site, repeat within 2 minutes with no response (Valleran et al, 2021).
• Older children may be asked to bear down as if having a bowel movement, which stimulates the vagus nerve to slow the heart rate.

Ventricular Tachycardia
• Occurs in the ventricles
• Loss of consciousness
• Sudden death

Torsades de Pointes
• Inherited or induced disorder of the electrical system with prolonged QT intervals
• The QT interval represents repolarization of a cardiac cell
• Affects approximately 1 in 5,000 people (Cohagan & Brandis, 2020)
• Sudden, unexpected, life-threatening type of ventricular tachycardia
• Causes include inherited factors, diarrhea, malnutrition, hypomagnesium, hypokalemia, and hypocalcemia, and it may be drug induced, such as from antiarrhythmics or some forms of antibiotic use
• Rapid decline in BP, fainting, ventricular fibrillation, and death
• Treatment includes removing the causes, such as the drugs; treating the abnormalities, such as with administration of magnesium or potassium; and unsynchronized defibrillation for ventricular fibrillation
• Implantation of a defibrillator may be needed

Bradycardia
• Conduction moves to the SA node down a specific path to reach the ventricles
• Passes through specialized conducting tissue called the *AV node*
• Sinus bradycardia is when a QRS wave follows a P wave
• Doesn't transmit = heart block or AV block
• Blocks classified by level of impairment: first-degree heart block, second-degree heart block, or third-degree (complete or AV heart block)
• Congenital, injury, or postsurgical
• A pacemaker may be necessary

Wolff–Parkinson–White Syndrome
• Electrical stimulation reaches the ventricles too soon
• Preexcitatory syndromes
• Tachycardia
• Syncope
• Chest palpitations
• Death
• Ablation with radiofrequency to treat

#25.

Shock is the inability of the body to maintain adequate blood flow and oxygen supply to the tissues needed for metabolism.
• Leading cause of childhood morbidity and mortality in the world (Pasman, 2019).
• The underlying cause is often difficult to diagnose.
• The three types of shock are hypovolemic, cardiogenic, and septic or distributive (Lee et al, 2017)
• Hypovolemic—profound dehydration or loss of blood with decrease in hemoglobin; chest x-ray shows normal heart
• Cardiogenic—damage to the heart muscle resulting in pump failure (Lee et al, 2017)
• Septic or distributive—shifting of fluids from the intravascular space to the extracellular space; caused by blood vessel dilation, often the result of sepsis
• This is a medical emergency and is fatal if not treated right away.
• Treatment depends on identified cause, fluids, blood and blood products, antibiotics, and inotropes to increase BP and delivery of oxygen to the tissues (Colleti & Werther, 2017; Lee et al, 2017).

Assessment
• Confusion or lack of alertness
• Loss of consciousness
• A sudden, rapid heartbeat
• Sweating
• Pale skin
• A weak pulse
• Rapid breathing
• Decreased or no urine output
• Cool hands and feet

Diagnostic Tests
• Monitoring of BP
• Chest x-ray
• Echocardiogram
• Arterial blood gases

Nursing Interventions
• Provide emergency interventions.

- Maintain medications, IV access, and fluids to increase volume and BP.
- Maintain oxygen supplementation.

Caregiver Education

- Provide education to call 911 for signs and symptoms of shock.
- Provide education related to intake and output of the child.
- Educate the child and family on the DASH diet, one that is rich in fruits and vegetables and has been shown to lower blood pressure, total cholesterol, and LDL.

#26. Question