AACN CCRN (Pediatric) - Quiz Questions with Answers

IA. Cardiovascular

1.

A pediatric nurse is providing discharge instructions to the caregivers of a child with Kawasaki disease (KD). Which of the following symptoms, if exhibited by the child, should warrant an immediate call to the child's pediatrician?

Fever

Joint pain

Irritability

Desquamation of the hands and feet

Correct answer: Fever

KD is microvascuitis of medium-sized muscular arteries. This rare disease causes inflammation of the blood vessels throughout the body and is likely a disease of the immune system triggered by an infectious event. It is more prevalent in children of Japanese ancestry and in those younger than 5 years of age.

Upon discharge of a child with KD, their caregivers should be instructed to check the temperature of the child every 6 hours for the first 48 hours following the last fever and then daily until the follow-up visit. A new fever could indicate a recurrent episode of KD and should warrant an immediate return to the hospital.

Irritability is a hallmark finding in a child with KD, and parents should be advised that this symptom can last for up to two months following the acute phase of the disease. Temporary joint pain and other manifestations of arthritis may occur and persist for several weeks. ROM exercises and warm baths will help reduce these symptoms and minimize discomfort. Skin peeling is an expected finding. Parents should be informed that the peeling itself is not painful, but the new skin underneath may be red and sore.

2.

What is the MOST common cause of sinus bradycardia in pediatric patients?

Hypoxia

Increased intracranial pressure (ICP)

Hypothermia

Surgical disruption of the SA node

Correct answer: Hypoxia

Sinus bradycardia is characterized by a heart rate that is low for the patient's age and clinical state, with a normal rhythm. The most common cause is hypoxia, but other causes can include increased ICP, hypothermia, use of digoxin or beta-blockers, hypothyroidism, anorexia, and surgical disruption of the SA node.

3.

What is the PRIMARY risk factor in the development of rheumatic fever?

A recent group A beta-hemolytic streptococcal (GABHS) infection

A history of a congenital heart defect

A recent diagnosis of erythema marginatum

Recent travel outside of the United States

Correct answer: A recent group A beta-hemolytic streptococcal (GABHS) infection

Rheumatic fever is an inflammatory disorder of the heart, blood vessels, and joints. A partially treated or untreated GABHS infection, otherwise known as "strep throat," can lead to rheumatic fever, as this is the most common type of bacteria causing acute rheumatic fever. With rheumatic fever, a child has an abnormal immune response to a "strep throat" infection, which causes widespread inflammation. This can lead to long-term cardiac damage, which is known as rheumatic heart disease.

Erythema marginatum is a major manifestation of acute rheumatic fever and involves a rash characterized by pink, raised, small irregular macules that are nonpruritic and appear on the trunk and limbs (not the face).

4.

A nurse is preparing to administer digoxin to a child with congestive heart failure. Nursing implications include which of the following prior to administration?

Assess apical pulse rate

Auscultate lung sounds

Check axillary temperature

Review laboratory findings for liver function

Correct answer: Assess apical pulse rate

Digoxin is used for the treatment of mild to moderate heart failure and has inotropic effects from the inhibition of the sodium-potassium pump. The nurse should assess heart rate (HR) prior to dose administration to assure the HR is greater than 60 beats per minute. In addition, assess the potassium level, watching for hypokalemia (evidenced by serum levels that fall below 3.5 mEq/L), the calcium level for hypercalcemia (evidenced by serum levels that rise above 10 mg/dL). and the magnesium level for hypomagnesia (evidenced by serum levels that fall below 1.4 mEq/L). These may aggravate digoxin cardiotoxicity, even if the digoxin level is normal (therapeutic trough range is 0.5 to 2 ng/mL).

The other choices are not necessary.

5.

A nurse is caring for an infant with tetralogy of Fallot (TOF) who is recovering from palliative surgery in which a modified Blalock-Taussig shunt procedure was performed. Which structures does this shunt connect?

Subclavian artery and ipsilateral pulmonary artery

Subclavian artery and superior vena cava

Superior vena cava and aorta

Superior vena cava and ipsilateral pulmonary artery

Correct answer: Subclavian artery and ipsilateral pulmonary artery

The modified Blalock-Taussig (B-T) shunt is one of the most common pulmonary-to-systemic shunt procedures performed in children with cyanotic heart disease as a palliative therapy before a definitive correction is performed. The B-T shunt consists of an anastomosis of the subclavian artery to the ipsilateral pulmonary artery, utilizing a GORE-TEX conduit (interposition tube) between the subclavian and pulmonary artery.

6.

A nurse is caring for a 6-year-old child on digoxin therapy for congestive heart failure. The nurse reviews the child's laboratory values and is MOST concerned with which of the following findings?

Potassium level of 3.2 mEq/L

Digoxin level of 1.2 ng/mL

Calcium level of 9.4 mg/dL

Magnesium level of 1.5 mEq/L

Correct answer: Potassium level of 3.2 mEq/L

Digoxin is used for the treatment of mild to moderate heart failure, to decrease the ventricular response rate in fast atrial arrhythmias, and to treat fetal tachycardia in the absence of hydrops. Digoxin has inotropic effects from the inhibition of the sodium-potassium pump. The nurse should assess the potassium level, watching for hypokalemia (evidenced by serum levels that fall below 3.5 mEq/L), the calcium level for hypercalcemia (evidenced by serum levels that rise above 10 mg/dL). and the magnesium level for hypomagnesia (evidenced by serum levels that fall below 1.4 mEq/L). These may aggravate digoxin cardiotoxicity, even if the digoxin level is normal (therapeutic trough range is 0.5 to 2 ng/mL).

The nurse should also assess the child's heart rate (HR) prior to each dose administered to assure a HR greater than 60 bpm.

7.

A pediatric intensive care unit (PICU) nurse is caring for a 2-month-old male with an unrepaired aortic coarctation. Which of the following assessment findings would the nurse expect for this infant?

A heaving precordium with equally diminished femoral pulses

Shortness of breath, pallor, systemic edema

Feeding intolerance, diaphoresis, and tachypnea

Decreased appetite, shortness of breath, and hepatomegaly

Correct answer: A heaving precordium with equally diminished femoral pulses

In coarctation of the aorta, a narrowed, thickened aorta causes elevation of pressure proximally and decreased pressure distally. Because of this, pulses are decreased or absent in the lower extremities prior to surgical repair. Coarctation occurs in about 8% to 10% of CHD cases and is more common in males than in females.

Other exam findings reveal a heaving precordium and a nonspecific systolic murmur at the LSB. In a child, examination finds a blood pressure differential between the upper and lower extremities, systemic hypertension, and a short systolic ejection murmur at the LSB.

Hepatomegaly, shortness of breath, pallor, and systemic edema indicate a ventricular septal defect (VSD). Feeding intolerance, diaphoresis, and tachypnea are associated with aortic stenosis. Transposition of the great arteries (TGA) reveals a patient with a decreased appetite, shortness of breath, and cyanosis.

8.

A patient with congestive heart failure (CHF) has been diagnosed with acute pulmonary edema and is being treated with morphine. Morphine is indicated in this condition to achieve which of the following desired effects?

Left ventricular preload reduction and relief of dyspnea

Chest pain relief and increased left ventricular afterload

Increased left ventricular preload, decreased pain, and anxiety reduction

Increased left ventricular preload and increased left ventricular afterload

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Correct answer: Left ventricular preload reduction and relief of dyspnea

Acute pulmonary edema is characterized by the movement of fluid into the alveoli and interstitium of the lungs (fluid in the air spaces); this is caused by the extravasation of fluid from the pulmonary vasculature. The condition can be categorized into cardiac and non-cardiac causes. Cardiogenic pulmonary edema causes include CHF, coronary artery disease (CAD), hypertension, heart valve disease, excessive IV fluid administration, and reperfusion injury after cardiovascular surgery, among others. Noncardiogenic causes include near-drowning, inhalation injury, and acute respiratory distress syndrome (ARDS).

Symptoms often include extreme dyspnea, cyanosis, tachypnea, tachycardia, diminished breath sounds, anxiety, agitation, confusion, diaphoresis, orthopnea, respiratory crackles, heart murmur, and jugular vein distention (JVD).

Morphine has been used as a treatment for acute pulmonary edema because it causes vasodilation, resulting in venous pooling and preload reduction (decreased left ventricular preload). In addition, morphine reduces dyspnea and sympathetic nervous system activity, which can greatly reduce the distress and anxiety that is associated with dyspnea.

The goal of treatment with morphine is decreased left ventricular preload and afterload (not increased), and morphine is not used for chest pain in this diagnosis.

9.

Which of the following congenital heart defects (CHD) leads to cyanosis from the mixing of systemic venous and pulmonary venous blood?

Tetrology of Fallot (TOF)

Aortic stenosis (AS)

Aortic coarctation

Patent ductus arteriosus (PDA)

Correct answer: Tetrology of Fallot (TOF)

TOF involves four classic features:

- *ventricular septal defect (VSD)*
- *pulmonary stenosis (PS)*
- *right ventricular hypertrophy*
- *overriding aorta*

It is the most common form of cyanotic CHD and accounts for as much as 10% of CHD cases. It occurs slightly more often in boys and is characterized by deoxygenated blood entering the systemic arterial circulation. Normally, blood enters the right ventricle (RV). In TOF, RV outflow obstruction causes shunting across the VSD to the aorta, mixing systemic venous and pulmonary venous return. The severity of PS determines the severity of the patient's cyanosis.

10.

What is the most commonly affected valve in rheumatic heart disease?

Mitral valve

Tricuspid valve

Pulmonary valve

Aortic valve

Correct answer: Mitral valve

Rheumatic heart disease is a postinfectious connective tissue disease caused by rheumatic fever. Group A beta-hemolytic streptococcal pharyngitis is the most common bacteria causing acute rheumatic fever, and it often affects children ages 6 to 15 years. While this disease remains common in developing countries, the incidence in the US has decreased after the introduction of antibiotics.

The streptococcal bacteria that are most often implicated in the patient's recent history of pharyngitis initiate an autoimmune process in a generally susceptible host that attacks collagen. The antibodies produced for streptococcal infections react with the host tissue, producing antibody-induced tissue damage and generally affecting the mitral valve.

11.

An infant presents to the emergency department with a heart rate of 212 beats/min. The infant is pale and sweating and is diagnosed with acute supraventricular tachycardia (SVT). The nurse should perform which of the following interventions first?

Apply a bag of ice to the face for 15 seconds

Administer propranolol

Administer IV adenosine

Apply direct current cardioversion (DCCV)

Correct answer: Apply a bag of ice to the face for 15 seconds

Vagal maneuvers are used initially for acute SVT to stop the arrhythmia. These maneuvers affect the vagus nerve, which sends signals to the AV node to control the heartbeat and ultimately can slow down the heart rate. Coldwater treatment is a type of vagal maneuver that can be performed quickly and easily for an infant as a primary measure. Applying ice to the face stimulates the vagus nerve and may immediately reverse SVT.

If ice is not successful, pharmacologic therapy with adenosine for acute termination of the episode is then utilized. Chronic therapy with propranolol is started if the SVT is recurrent, prolonged, or hemodynamically important. DC cardioversion or overdrive pacing if pacemaker wires are present is used for patients who are hemodynamically compromised.

12.

An infant with a diagnosis of Wolff-Parkinson-White syndrome (WPW) likely has which of the following associated congenital heart defects?

Ebstein's anomaly

Atrial septal defect (ASD)

Ventricular septal defect (VSD)

Truncus arteriosus

Correct answer: Ebstein's anomaly

Ebstein's anomaly is downward displacement of the posterior and septal leaflets of the tricuspid valve with an atrialized portion of the right ventricle; it is the congenital lesion most strongly associated with WPW syndrome.

As many as 20 percent of these patients have one or more accessory pathways; the majority are located in the right free wall and right posteroseptal spaces.

13.

An infant with hypoplastic left heart syndrome (HLHS) is admitted to the PICU for the first stage of surgical reconstruction. Prior to surgical repair, which of the following medications does the nurse anticipate administering to help keep the patent ductus arteriosus (PDA) open?

Prostaglandins (PGE1)

Milrinone (Primacor)

Indomethacin (Indocin)

Nitric oxide (NO)

Correct answer: Prostaglandins (PGE1)

HLHS is the most common congenital heart defect involving single-ventricle physiology. It is characterized by various levels of underdevelopment of left heart structures. A PDA and ASD (atrial septal defect) are obligatory for survival.

With HLHS, systemic venous blood returns normally to the right atrium (RA) and flows normally from the right side of the heart. Pulmonary venous blood flows across the ASD to the RA because it cannot exit the left side of the heart if mitral atresia is present. Mixing of pulmonary and systemic blood desaturates the blood. Blood shunts from right to left across the PDA to supply systemic blood flow distally and flows proximally to feed the coronary arteries.

Because of this pathology, ductal patency must be maintained with prostaglandin therapy until staged surgical reconstruction can be done.

Indomethacin promotes PDA closure. Milrinone and NO are pulmonary vasodilators and do not affect PDA.

14.

Which of the following types of pediatric heart failure (HF) is the result of inadequate filling due to ventricular restriction or noncompliance, leading to decreased cardiac output (CO) to the systemic circulation and symptoms of congestive heart failure (CHF)?

Diastolic left HF

Diastolic right HF

Systolic left HF

Systolic right HF

Correct answer: Diastolic left HF

Diastolic left HF (left ventricular diastolic dysfunction) results from the inability of the left ventricle during diastole to fill with blood adequately. This is due to ventricular restriction or noncompliance (too stiff), resulting in decreased CO to the systemic circulation and symptoms of CHF; blood backs into the lungs, causing the patient to experience shortness of breath.

Diastolic right HF (right ventricular diastolic dysfunction) is due to the inadequate filling of the right heart during diastole due to ventricular restriction or noncompliance, resulting in decreased CO to the pulmonary circulation and decreased return to the left atrium, compromising left-sided CO.

Systolic right HF (right ventricular systolic dysfunction) is the inability of the right heart to provide adequate pulmonary blood flow. This leads to increased right heart preload and systemic venous congestion.

Systolic left HF (left ventricular systolic dysfunction) is the inability of the left heart to provide adequate systemic blood flow and oxygen delivery, resulting in increased left heart preload and/or afterload. This leads to pulmonary congestion and low CO.

15.

In an infant, when does functional closure of the ductus arteriosus normally occur?

12 to 24 hours after birth

5 to 7 days after birth

Unable to determine

Within 30 days of delivery

Correct answer: 12 to 24 hours after birth

The ductus arteriosus is a structure that should be present in utero, as it permits blood flow to be diverted away from the high-resistance pulmonary circulation to the descending aorta and the low-resistance placental circulation. Patent ductus arteriosus (PDA) occurs when the vessel that normally connects the aorta and pulmonary artery in utero has failed to close at birth, which leads to a left-to-right shunting of blood. Blood flow to the lungs will be increased as a result of this abnormal shunting, which can cause pulmonary hypertension and eventually lead to left-sided heart failure (particularly if the PDA is large).

Closure normally occurs 12-24 hours after birth, which is initiated by a rise in the perivascular PO_2 and a decrease in endogenous prostaglandin (producing functional closure).

Anatomic closure occurs between 2 and 3 weeks and is produced by fibrosis of the ductal tissue with permanent sealing of the lumen to produce the ligamentum arteriosum. Following anatomic closure, the ductus cannot be reopened.

16.

What are the goals of pharmacotherapy for a child presenting in cardiogenic shock secondary to left ventricular dysfunction?

Increased contractility and reduced preload

Increased afterload and reduced preload

Increased contractility and increased peripheral vascular resistance (PVR)

Increased afterload and decreased cardiac output

Correct answer: Increased contractility and reduced preload

Myocardial dysfunction causes inadequate perfusion and leads to cardiogenic shock. Common causes include congenital heart disease (CHD), myocarditis, cardiomyopathy, sepsis, arrhythmias, drug toxicities, and damage to the heart. Cardiogenic shock is characterized by extreme tachycardia, high systemic vascular resistance (SVR), and decreased cardiac output (CO). Other symptoms besides tachycardia are increased work of breathing leading to respiratory distress, hepatomegaly, jugular vein distention (JVD), low BP with narrow pulse pressure, weak or absent peripheral pulses, delayed capillary refill with cool extremities, diaphoresis, and decreased level of consciousness (LOC).

Goals include improving oxygenation and blood flow (increasing CO) through the reduction of metabolic demand and afterload, optimization of preload, increased myocardial relaxation, and respiratory support. Preload is decreased with the use of diuretics. Inotropic agents are used to increase contractility. After the patient has been stabilized, vasodilating agents may be used to further reduce both preload and afterload.

17.

Which of the following findings indicates cardiac tamponade?

Narrow pulse pressure

Hypertension

Bradycardia

Low central venous pressure

Correct answer: Narrow pulse pressure

Cardiac tamponade can occur from a contusion or from penetrating trauma, resulting in blood or fluid accumulation in the pericardial sac. This accumulation of fluid around the heart impairs ventricular filling, reduces cardiac output (CO), and causes hypotension (not hypertension) due to decreased preload. A narrow pulse pressure is the result of increased diastolic pressure to compensate for the low CO, as the external pressure on the heart inhibits the ventricles from relaxing.

CVP is elevated in cardiac tamponade, not decreased. Tachycardia is present, not bradycardia.

18.

A nurse is caring for an infant diagnosed with transposition of the great arteries (TGA), who is scheduled to undergo surgical repair. The physician has ordered an echocardiogram to detect if any other cardiac defects exist.

Commonly associated defects include all the following, EXCEPT:

Tricuspid atresia

Atrial septal defect (ASD)

Ventricular septal defect (VSD)

Patent ductus arteriosus (PDA)

Correct answer: Tricuspid atresia

TGA is a congenital heart defect in which the pulmonary artery and aorta are switched positions: the left ventricle gives rise to the pulmonary artery, and the right ventricle gives rise to the aorta, resulting in parallel circulations. "Simple" TGA is associated with ASD, VSD, and PDA 80% of the time.

Systemic venous blood enters the right side of the heart normally but exits through the aorta, sending deoxygenated blood back to the body instead of the lungs. Pulmonary venous blood enters the left side of the heart normally but exits through the pulmonary artery, sending oxygenated blood to the lungs instead of the body.

TGA is not commonly associated with tricuspid atresia.

19.

An 11-year-old male is brought to the emergency department via ambulance after a motor vehicle accident (MVA) and requires immediate placement of a chest tube for a right pneumothorax. Once the patient has been stabilized, he is transferred to the pediatric intensive care unit (PICU). Approximately four hours later, the nurse performs another hourly assessment and suspects he is experiencing cardiac tamponade.

In addition to decreasing blood pressure, which of the following assessment findings is anticipated with this condition?

Increased central venous pressure (CVP)

Increased chest tube output

Increased cardiac contractility

Polyuria

Correct answer: Increased central venous pressure (CVP)

Cardiac tamponade can occur from a contusion or from penetrating trauma, resulting in blood or fluid accumulation in the pericardial sac. The fluid accumulation compresses the atria, causing elevated right atrial filling pressures (increased CVP), impairing ventricular filling, and reducing cardiac output (CO) and contractility. This decreased CO leads to hypoperfusion of the kidneys, resulting in a sudden decrease in urine output (oliguria). Chest tube output is decreased in cardiac tamponade.

20.

A PICU nurse is caring for a 3-year-old male who is recovering from a Fontan procedure for a diagnosis of hypoplastic left heart syndrome (HLHS). What is the primary purpose of this procedure?

To prevent ventricular hypertrophy and dysfunction from volume overload

To provide venous blood flow to the lungs and a stable form of oxygenation

To direct systemic venous return to the right ventricle

To create an unobstructed right ventricular outflow tract

Correct answer: To prevent ventricular hypertrophy and dysfunction from volume overload

The Fontan procedure is a palliative procedure used in the management of HLHS (it can also be done for tricuspid atresia and single-ventricle hearts of diagnostic categories other than HLHS). This procedure is the final stage of physiologic palliation in a three-stage surgical repair process for HLHS, with the outcome of diverting blood from the right ventricle (RV). This prevents ventricular hypertrophy and dysfunction from volume overload and optimizes long-term ventricular function. During this procedure, a baffle is placed in the right atrium to divert systemic venous return to the pulmonary artery.

The first stage of palliative reconstructive surgery for HLHS is the Norwood operation, which creates an unobstructed right ventricular outflow tract. Second-stage palliation for HLHS is with a bidirectional cavopulmonary shunt, which provides venous blood flow to the lungs and a stable form of oxygenation.

21.

Which of the following congenital heart defects is considered cyanotic heart disease?

- **Tetrology of Fallot (TOF)**
- Atrial septal defect (ASD)
- Ventricular septal defect (VSD)
- Patent ducts arteriosis (PDA)

Correct answer: Tetrology of Fallot (TOF)

TOF consists of four defects: VSD, pulmonary stenosis (PS), right ventricular hypertrophy (RVH), and an overriding aorta. It is the most common form of cyanotic congenital heart disease, accounting for as much as 10% of CHD, and it occurs slightly more often in boys.

ASD, VSD, and PDA are acyanotic heart diseases.

22.

A child is in the PICU for hypertension management. The nurse is monitoring the patient after the administration of propranolol (Inderal). Which assessment finding indicates a potential complication associated with this medication?

Audible expiratory wheezes

Blurred vision

Alterations in taste

Respiratory depression

Correct answer: Audible expiratory wheezes

Propranolol is a beta-blocker that reduces sympathetic excitation of the heart; it is used for the management of cardiac arrhythmias, myocardial infarction, tachyarrhythmias, and hypertension. Audible expiratory wheezes may indicate bronchospasm, a serious side effect of this mediation.

Other side effects include laryngospasm, bone marrow suppression, bradycardia, and hypotension.

23.

Congestive heart failure and hypoxemia are major complications associated with which of the following congenital heart defects?

Pulmonary stenosis

Mitral stenosis

Subaortic stenosis

Aortic stenosis

Correct answer: Pulmonary stenosis

Pulmonary stenosis (PS) results from an embryologic error in the formation of the pulmonary leaflets, and involves a narrowing of the pulmonary valve that causes an obstruction to blood flow from the right ventricle to the pulmonary artery, leading to right ventricular hypertrophy (RVH), congestive heart failure (CHF), and hypoxemia (manifested as cyanosis at birth), if left unrepaired.

With mitral stenosis, the component of the mitral valve is abnormal and, if left untreated, could cause pulmonary artery (PA) hypertension, elevated pulmonary vascular resistance (PVR), and right ventricular (RV) dysfunction from PVOD (pulmonary veno-occlusive disease). In addition, due to a decreased left ventricular (LV) volume load, ischemia, fibrosis, and decreased CO ensue.

Subaortic stenosis consists of a membranous diaphragm or fibrous ring encircling the LV outflow tract underneath the base of the aortic valve; complications include increasing exercise intolerance, dyspnea, fatigue, chest pain, and aortic insufficiency.

Aortic stenosis is the malformation of the aortic valve, causing obstruction to the ejection of blood from the left ventricle (LV). If severe, symptoms of circulatory shock are present at birth from obstruction to systemic blood flow.

24.

While performing a morning assessment on a newborn infant, the nurse auscultates a murmur at the left upper sternal border of the infant's chest. The nurse suspects the infant may have a patent ductus arteriosus (PDA) and reports their findings to the inpatient pediatrician.

What type of murmur is a hallmark sign of PDA?

Harsh, loud, continuous

Harsh, loud, systolic

Soft, blowing, diastolic

Soft, blowing, continuous

Correct answer: Harsh, loud, continuous

In utero, the ductus arteriosis permits blood flow to be diverted from the high-resistance pulmonary circulation to the descending aorta and the low-resistance placental circulation.

After delivery, the persistence of this normal fetal channel connecting the aorta and pulmonary artery characterizes an acyanotic cardiac lesion. The hallmark murmur heard in an infant with a PDA is a machine-like, continuous (heard both during diastole and systole) murmur that is harsh and loud. It can be heard best at the left upper sternal border of the chest.

25.

A child suspected of having aortic stenosis (AS) is admitted to the PICU for a full diagnostic work-up. Estimations of valvular gradients are used to determine the severity of the defect but may be falsely low if the patient has which condition?

A low cardiac output (CO)

A high cardiac output (CO)

Compromised left ventricular (LV) function

Associated cardiac lesions

Correct answer: A low cardiac output (CO)

AS is characterized by malformation of the aortic valve, which obstructs an ejection of blood from the LV. Associated cardiac lesions are common (PDA, VSD, or coarctation). In most cases, the aortic valve is bicuspid with a single, fused commissure and an eccentrically placed orifice.

Valvular gradients can give some estimation of the degree of stenosis. This number may be misleading in instances of low CO in which output across the valve is already diminished, producing a falsely low gradient reading.

26.

A pediatric patient is being treated for cardiogenic shock secondary to myocarditis. Which of the following statements describes this form of shock?

Cardiogenic shock leads to pulmonary and systemic congestion, resulting in pulmonary and peripheral edema and respiratory compromise.

Cardiogenic shock leads to increased preload, afterload, and contractility.

Cardiogenic shock is characterized by extreme tachycardia, low systemic vascular resistance (SVR), and decreased cardiac output (CO).

Cardiogenic shock occurs because the heart has an inadequate volume of blood to pump and insufficient oxygen-carrying capacity.

Correct answer: Cardiogenic shock leads to pulmonary and systemic congestion, resulting in pulmonary and peripheral edema and respiratory compromise.

Cardiogenic shock is the result of the heart's inability to pump enough blood to the rest of the body (i.e., inadequate perfusion due to a weakened heart muscle) resulting from myocardial dysfunction. Hypovolemic shock is due to inadequate blood volume, usually from blood loss related to trauma). Causes include congenital heart disease (CHD), myocarditis, cardiomyopathy, arrhythmias, sepsis, poisoning or drug toxicity, and myocardial injury.

Symptoms include severe tachycardia, high SVR (not low SVR), and decreased CO from the reduction in stroke volume (SV). Pulmonary congestion leads to pulmonary edema and respiratory compromise. Systemic congestion leads to effusions, ascites, and peripheral edema. Preload is variable, afterload is increased, and contractility is decreased. This causes decreased tissue perfusion and injury to the cells of the tissues/organs.

27.

A 3-month-old infant is admitted to the emergency department with suspected tricuspid atresia (TA). Which of the following findings on electrocardiogram (ECG) is indicative of this condition?

Left axis deviation

Right axis deviation

Increased right ventricular (RV) forces

Diminished left ventricular (LV) forces

Correct answer: Left axis deviation

Most forms of congenital heart disease show right axis deviation and right heart strain. With tricuspid atresia (TA), the right ventricle is bypassed, and the left ventricle ends up doing all the work. The lack of tricuspid valve formation results in the absence of blood flow from the right artery (RA) to the right ventricle (RV) and poor RV formation in utero.

ECG shows a superior and leftward QRS axis, RA enlargement, absent or diminished RV forces, and increased LV forces. Survival is contingent upon the placement of an obligatory right-to-left atrial shunt.

28.

A nurse is caring for a 6-month-old infant recovering from a ventricular septal defect (VSD) repair via cardiac catheterization. The nurse must monitor the infant closely for postoperative complications.

Which type of arrhythmia is the most common complication following this repair?

Atrioventricular (AV) heart block

Ventricular tachycardia

Premature ventricular contractions (PVCs)

Junctional rhythm

Correct answer: Atrioventricular (AV) heart block

Potential complications of VSD closure include infection, postoperative bleeding, damage to the valves of the heart (tricuspid, pulmonary, or aortic), pulmonary hypertension with poor cardiac output, AV heart block, residual VSD from unsuccessful closure, and death.

PVCs are common but benign, and ventricular tachycardia is a risk during the procedure but not postoperatively. Junctional rhythm is not common.

29.

The presence of a large, isolated patent ductus arteriosus (PDA) in which the ductus fails to close normally results in which condition?

Low diastolic pressure

High diastolic pressure

Low systolic pressure

High systolic pressure

Correct answer: Low diastolic pressure

In isolated PDA, blood shunts from left to right into the pulmonary artery (PA) and lungs. This occurs as the PVR drops and the pressure in the aorta exceeds that of the PA. Clinical presentation depends on the size and diameter of the ductus; the degree of shunting, compensatory mechanisms, and the stage of lung development.

The presence of a large PDA results in low diastolic pressure, leading to low cardiac output and poor coronary perfusion. Surgical closure is required to restore adequate diastolic pressure and myocardial perfusion.

30.

A 9-year-old male is brought to the emergency department by his mother with complaints of chest discomfort and shortness of breath with exertion. The patient's mother reports he fainted during his soccer game, which prompted her to bring him in right away. The triage nurse auscultates a harsh-sounding systolic murmur at the upper right sternal border and notes that the murmur is best heard at the second intercostal space. The patient is afebrile, and his vital signs at rest are otherwise normal.

The nurse suspects the child may have which of the following heart conditions?

Valvular aortic stenosis

Patent ductus arteriosus (PDA)

Ventricular septal defect (VSD)

Coarctation of the aorta

Correct answer: Valvular aortic stenosis

In valvular aortic stenosis (AS), the aortic valve (which separates the left ventricle and the aorta) is stenosed, leading to decreased orifice size because of the thickening and rigidity of the valve leaflets. This malformation of the aortic valve (narrowing) causes obstruction to ejection of blood from the left ventricle, occurring at the valve annulus of the LV.

Critical AS is a severe form of AS that presents at birth with symptoms of circulatory shock from obstruction to systemic blood flow, but most children with AS are asymptomatic and grow and develop normally. As symptoms occur, they usually include fatigue, exertional dyspnea, angina pectoris, and syncope. Examination reveals a systolic, harsh-sounding murmur that is best heard at the upper right sternal border, at the second intercostal space.

Associated cardiac lesions—PDA, VSD, or coarctation—are common with AS, but they are not the same. Congenital AS is a progressive lesion, and most affected children will require surgical intervention at least once to repair the stenosed aortic valve.

31.

A 7-month-old infant is admitted to the PICU with sinus tachycardia secondary to infection and subsequent dehydration The patient has a heart rate of 200 beats/min. The nurse expects which of the following findings on an electrocardiogram (ECG) tracing?

Rhythm originating in the sinoatrial (SA) node

Irregular heart rate

Prolonged pause between QRS complexes

P wave inversion

Correct answer: Rhythm originating in the SA node

Sinus tachycardia is recognized on ECG with a normal upright P wave (not inverted) preceding every QRS complex (P:QRS ratio of 1:1). The PR interval and QRS configuration are normal (there is no prolonged pause), the rhythm is regular, the heart rate is increased (can be as high as 250 bpm, overlapping with rates of supraventricular tachycardia [SVT] in neonates), and the pacemaker is coming from the SA node and not elsewhere in the atria.

Sinus tachycardia is almost always the result of an underlying condition and is rarely a primary cardiac arrhythmia. Most commonly, treating the underlying cause will resolve this condition. The heart rate is increased but regular in sinus tachycardia. If there is an inverted P wave noted on ECG, this generally indicates an ectopic atrial rhythm not originating in the SA node (non-sinus origin of the P waves).

32.

All the following are appropriate diagnostic studies for a child with suspected heart failure (HF), EXCEPT:

Holter monitoring

Electrocardiogram and echocardiogram

Cardiac catheterization

Brain natriuretic peptide (BNP) levels

Correct answer: Holter monitoring

Heart failure (HF) is a condition in which the heart is unable to provide adequate cardiac output (CO) or regional blood flow to meet the circulatory and metabolic requirements of the body. A history and a physical examination are often performed first, providing lots of clues to both the etiology and severity (presenting signs and symptoms) of HF. Diagnostic tests include chest x-ray, ECG and echocardiogram, PA catheter placement and/or cardiac catheterization, SVO_2 measurements, laboratory studies including BNP levels, and cardiac MRI.

Holter monitoring provides a 24-hour record of ECG activity (heart rate and rhythm). It is used to document arrhythmias and/or conduction disorders at rest and under stress, as well as the frequency of their occurrence. It does not aid in the diagnosis of HF.

33.

A child exhibits differing blood pressures in the upper and lower extremities, systemic hypertension, and a short systolic ejection murmur that is best heard at the left sternal border (LSB). The pediatric nurse suspects which of the following congenital heart defects?

Coarctation of the aorta

Tetralogy of Fallot (TOF)

Ventricular septal defect (VSD)

Tricuspid atresia

Correct answer: Coarctation of the aorta

Aortic coarctation is the congenital narrowing of the aorta, the main blood vessel that carries blood from the heart to the rest of the body. This deformity results in an increased blood pressure proximally and a decreased pressure distally. Coarctation occurs in about 8%-10% of cases of congenital heart disease and is more common in boys. It is frequently associated with PDA, VSD, aortic stenosis, aortic insufficiency, bicuspid aortic valve, mitral and tricuspid valve anomalies, and DiGeorge syndrome.

Examination of the infant reveals a heaving precordium, equally diminished pulses if the ducts are still open, and a nonspecific systolic murmur at the LSB. In a child, however, there is a blood pressure differential between the upper and lower extremities, systemic hypertension, and a short systolic ejection murmur at the LSB.

TOF is an obstructive heart defect with signs and symptoms that include irritability, cyanosis, loss of consciousness, seizures, and possible cardiac arrest. A VSD may lead to heart failure due to increased energy requirements, prompting fatigue and pulmonary hypertension (caused by increased blood flow to the lungs). Tricuspid atresia occurs when the tricuspid valve fails to form, resulting in increased pulmonary blood flow with clinical manifestations of congestive heart failure and fluid overload. Survival is contingent upon the placement of an obligatory right-to-left atrial shunt.

34.

A PICU nurse is caring for an infant who has just undergone palliative surgery to repair an aortic coarctation. During the head-to-toe assessment, the nurse should expect the infant's lower extremity pulses to be which of the following?

Stronger than preoperative baseline findings

Diminished or absent

Weak and thready

Bounding

Correct answer: Stronger than preoperative baseline findings

In coarctation of the aorta, a narrowed, thickened aorta causes elevation of pressure proximally and decreased pressure distally. Because of this, pulses are decreased or absent in the lower extremities prior to surgical repair of the congenital defect (CHD). Coarctation occurs in about 8% to 10% of CHD cases and is more common in males than in females.

After surgical repair of this condition, the infant's lower extremity pulses (femoral and/or pedal) should be stronger than preoperative baseline findings due to improved blood flow to the lower body.

35.

Which of the following common pacemaker modes is indicated as an emergent treatment to establish ventricular activity when AV dissociation is present, maintaining cardiac output (CO) without an atrial kick?

VVI (ventricular demand pacing)

VOO (ventricular asynchronous pacing)

DDD (dual-chambered pacing)

AAI (atrial demand pacing)

Correct answer: VVI (ventricular demand pacing)

Pacemakers deliver an electrical stimulus to the heart to initiate depolarization and stimulate cardiac contraction. Common indications for pediatric pacemaker placement include surgically induced heart block, congenital complete heart block, SSS and other symptomatic bradyarrhythmias, long QT syndrome (LQTS), and neurocardiogenic syncope.

Ventricular demand pacing mode (VVI) prevents ventricular bradycardia and is primarily used in emergencies for patients with atrial fibrillation who have a slow ventricular response to establish ventricular activity and maintain CO. In this pacemaker mode, the ventricle is paced and sensed, and the pulse generator inhibits pacing output in response to a sensed ventricular event.

VOO pacing is indicated for asystole and is dangerous, as it can cause R-on-T with ventricular fibrillation (use DDD or VVI instead). DDD pacing is indicated for any arrhythmia without AV conduction (blocks); it should be avoided for patients with atrial fibrillation or flutter since it tracks atrial rate. AAI pacing is indicated for sinus or high-junctional bradycardias when the AV conduction system is intact.

36.

Which of the following diuretic agents, indicated in the management of pediatric heart failure (HF), has a common side effect of hyperkalemia?

Spironolactone

Furosemide

Chlorothiazide

Butemadine

Correct answer: Spironolactone

Spironolactone is a potassium-sparing diuretic. Therefore, it can increase potassium levels, causing hyperkalemia as a potential side effect. It is not a strong diuretic but can be used in the treatment of HF.

Furosemide (Lasix), chlorothiazide, and butemadine (Bumex) are all diuretic agents that have the potential for hypokalemia.

37.

An 11-year-old male is brought to the emergency department via ambulance after a motor vehicle accident (MVA) and requires immediate placement of a chest tube for a right pneumothorax. Once the patient has been stabilized, he is transferred to the pediatric intensive care unit (PICU). Approximately four hours later, the nurse performs another hourly assessment and suspects he is having cardiac tamponade.

Which of the following assessment findings is anticipated with this condition?

A sudden decrease in chest tube drainage

A sudden decrease in central venous pressure (CVP)

A widened pulse pressure

Increased cardiac output (CO)

Correct answer: A sudden decrease in chest tube drainage

Cardiac tamponade can occur from a contusion or penetrating trauma, resulting in blood or fluid accumulation in the pericardial sac. The fluid accumulation impairs ventricular filling (decreased preload), reduces CO, and causes low blood pressure.

A sudden decrease in chest tube output is the result of clotting in the tube, causing worsening systemic perfusion. A narrowed pulse pressure occurs because of the increased diastolic pressure to compensate for the low CO, and the external pressure on the heart decreases the ability of the ventricles to relax. CVP is elevated, not decreased.

38.

A pediatric nurse would NOT expect to observe pulsus paradoxus in which emergent situation?

Acute bronchitis

Pericarditis

Severe asthma

Hemorrhagic shock

Correct answer: Acute bronchitis

Usually on inspiration, the body's normal physiologic response is a drop of less than 10 mm Hg in arterial systolic pressure. Pulsus paradoxus is an exaggerated fall (>10 mm Hg) of systolic blood pressure during normal inspiratory effort. This phenomenon has been reported with cardiac tamponade, significant asthma, croup (not acute bronchitis), pericardial effusion and pericarditis, cardiomyopathy, hypovolemia, and hemorrhagic shock.

39.

In an infant with a diagnosed truncus arteriosus, which other heart defect is often present?

Ventricular septal defect (VSD)

Atrial septal defect (ASD)

Patent ductus arteriosus (PDA)

Pulmonary stenosis (PS)

Correct answer: Ventricular septal defect (VSD)

Truncus arteriosus comprises approximately 1% to 2% of all congenital cardiac defects and is characterized by a single great artery (along with one truncal valve) that connects the right and left ventricles. This structure carries blood to both the lungs and the body. In a normal heart, two separate arteries (the pulmonary artery and the aorta) exist with their own valves. The pulmonary artery carries blood from the right side of the heart to the lungs, while the aorta carries blood from the left side of the heart to the body.

A coexisting VSD is present in more than 98% of cases. The VSD will be near the truncus arteriousus, and it will allow blood to mix in the right and left ventricles and enter the truncus artery.

40.

A nurse is caring for an infant immediately following cardiac surgery to correct a congenital heart defect. Upon assessment, the nurse notes the infant's heart rate is low and alerts the physician of the abnormal finding.

What is the most likely cause of this patient's bradycardia?

Decreased ventricular compliance

Increased contractility

Decreased pulmonary vascular resistance (PVR)

Increased systemic vascular resistance (SVR)

Correct answer: Decreased ventricular compliance

Decreased cardiac output (CO) is often the cause of bradycardia in the infant following cardiac surgery. CO is a product of heart rate and stroke volume, and stroke volume is affected by preload, afterload, and contractility. Ventricular compliance is generally low immediately following cardiovascular surgery, further affecting preload, and can lead to bradycardia.

Increased SVR may be a compensatory mechanism in a low cardiac state, most likely manifesting as vasoconstriction and poor peripheral pulses. Decreased PVR and increased contractility are desired outcomes after cardiac surgery to optimize right ventricular function and CO.

41.

A nurse is caring for an infant who is scheduled to undergo surgical closure of a ventricular septal defect (VSD). This surgery will prevent which of the following problems?

Growth failure

Heart block

Ventricular dysrhythmias

Respiratory acidosis

Correct answer: Growth failure

A VSD is a hole in the septum (wall) that separates the heart's lower chambers. This defect results from imperfect embryologic formation of the septal wall and occurs when the wall between the ventricles (lower chambers) does not develop fully in utero. VSDs account for up to 20% of congenital heart defects (CHD) and are the most common CHD (excluding bicuspid aortic valve).

Infants are usually asymptomatic until 2 to 4 weeks of age, when pulmonary vascular resistance (PVR) falls, allowing shunting from the LV to the RV and creating pulmonary overcirculation. While some defects close spontaneously, the rest will need to be surgically repaired. Indications for intervention include congestive heart failure (CHF), pulmonary artery hypertension, growth failure, or evidence of left ventricular overload. Children with VSDs have increased metabolic demands and are at risk for failure to thrive.

42.

A pediatric patient is being prepped for cardiac catheterization to obtain a cardiac biopsy. Which allergies should the patient be assessed for prior to this procedure?

Iodine or shellfish

Penicillin

Opioid pain medications

Antiarrhythmic medications

Correct answer: Iodine or shellfish

Cardiac catheterization is an invasive procedure that can be used to diagnose a congenital heart defect, as well as repair certain congenital heart defects. It can also help identify rejection in a transplanted heart, aid in the diagnosis of infectious etiology or continued inflammatory response in myocarditis (both via a biopsy), and assess for cellular disease such as mitochondrial disease.

A catheter is inserted into the femoral artery and then threaded to the heart. Prior to the procedure, it is important to assess for any allergies to iodine or shellfish. If a patient has an allergy to either of these, this increases the risk of an allergic reaction to the contrast dye used in the procedure.

43.

Acute rheumatic fever (ARF) most often occurs in which age group?

6 to 15 years

2 to 5 years

13 to 18 years

Birth to 3 years

Correct answer: 6 to 15 years

Rheumatic fever most often occurs in those aged 6 to 15 years and is rare in children younger than 2 years or older than 15 years. Although the incidence in the United States has decreased after the introduction of antibiotics, it remains common in developing countries. It is caused by group A beta-hemolytic streptococcal pharyngitis (strep throat infection) that was either not properly treated or left untreated and can lead to rheumatic heart disease.

Early diagnosis and treatment (with antibiotics) are essential for preventing rheumatic fever.

44.

Which of the following findings on an electrocardiogram (ECG) is associated with first-degree AV block?

Prolonged PR interval

Irregular R-R interval

Abnormal QRS complex

More P waves than QRS complexes

Correct answer: Prolonged PR interval

Heart block is characterized by first-, second-, or third-degree blocks, depending on the extent of electrical signal damage. First-degree AV block occurs when there is a delay in transmission of the intra-atrial impulse; the impulse still reaches the ventricles but moves more slowly than normal through the AV node. This is the mildest form of heart block and is associated with rheumatic fever, CHD, injury to the AV node, certain cardiac drugs or cardiac surgery, hypoxemia, certain electrolyte imbalances, and ischemia of the conduction system.

The patient may not exhibit any clinical symptoms of first-degree heart block, and this condition may only be found on a routine ECG tracing. Findings include a regular heart rate and rhythm, a P wave for every QRS complex, regular P-P and R-R intervals, and a prolonged PR interval for age and heart rate. Management involves monitoring the patient, as first-degree blocks may progress to second- or third-degree AV blocks. Treatment is needed only if the cause is drug toxicity.

45.

A pediatric intensive care unit (PICU) nurse is caring for a 6-week-old infant with an unrepaired ventricular septal defect (VSD). Which of the following assessment findings would the nurse expect for this infant?

Shortness of breath, pallor, systemic edema, and hepatomegaly

Palpable brachial pulses but lower extremity pulses not palpable, and extremities cool to the touch

Feeding intolerance, diaphoresis, tachypnea, acrocyanosis, and lethargy

Decreased appetite, shortness of breath, and cyanosis

Correct answer: Shortness of breath, pallor, systemic edema, and hepatomegaly

A VSD is a birth defect characterized by an opening (or hole) in the septal wall, allowing communication between the right and left ventricles. VSDs account for up to 20% of all congenital heart defects and are more common in girls. Children are usually asymptomatic until at least 2 to 4 weeks of age when PVR falls. This drop in PVR allows shunting from the LV to the RV and creates pulmonary overcirculation. Signs and symptoms include shortness of breath, pallor, hepatomegaly, and systemic edema.

Coarctation of the aorta manifests with decreased or absent pulses in the lower extremities, as well as cool lower extremities. Feeding intolerance, diaphoresis, tachypnea, acrocyanosis, and lethargy are associated with aortic stenosis. Transposition of the great arteries (TGA) reveals a patient with a decreased appetite, shortness of breath, and cyanosis.

46.

Which of the following signs is indicative of patent ductus arteriosus (PDA) in a newborn?

Bounding peripheral pulses

Narrow pulse pressure

Profound cyanosis

Clubbed fingers and toes

Correct answer: Bounding peripheral pulses

Assessment findings of a newborn with PDA reveal a machine-like continuous murmur that is heard best at the left upper sternal border. Poor feeding, irritability, tachypnea, tachycardia, and poor weight gain are often present. The pulse pressure is wide (not narrow), and peripheral pulses may be strong and collapse suddenly because of low diastolic pressure resulting from ductal shunting of blood into the low-pressure pulmonary artery. This is referred to as a water-hammer pulse.

No cyanosis or clubbing of the digits is present in PDA.

47.

Tetrology of Fallot (TOF) is a congenital heart condition often requiring surgical intervention in the first year of life to correct the structural defects. Which of the following is present with TOF?

Right ventricular hypertrophy

Coarctation of the aorta

Transposition of the great arteries

Patent ductus arteriosis (PDA)

Correct answer: Right ventricular hypertrophy

TOF is the most common form of cyanotic congenital heart disease (CHD) and accounts for as much as 10% of CHD. The four components of TOF are:

- *an overriding of the ascending aorta*
- *ventricular septal defect (VSD)*
- *pulmonary stenosis*
- *hypertrophy of the right ventricle*

Total surgical repair of TOF is not usually carried out in the neonatal period. Surgery (intracardiac repair) is usually performed electively within the first year of life via closure of the VSD with a patch and eliminating the pulmonary stenosis by resection; in addition, the pulmonary outflow tract may be enlarged by a patch. If surgical intervention in infancy is warranted due to severe hypoxia, a systemic-to-pulmonary shunt (Blalock-Taussig shunt) is performed to provide adequate pulmonary blood flow until a complete surgical repair is done at a later date.

48.

An infant with unrepaired hypoplastic left heart syndrome (HLHS) experiences episodes of hypoxia secondary to oxygen desaturation. Why does desaturation happen in this context?

Pulmonary and systemic venous blood mix together

Ventricular size is decreased

Pulmonary vascular resistance (PVR) is decreased

Systemic vascular resistance (SVR) is decreased

Correct answer: Pulmonary and systemic blood mix together

HLHS is the most common type of single-ventricle physiology characterized by various levels of underdevelopment of left heart structures. The left-sided valves may be small or atretic, the left ventricle cavity may be absent or hypoplastic, and the ascending aorta could be tiny to normal-sized. In all cases of HLHS, the left-sided structures fail to form normally and are not large enough to function as systemic ventricles and valves. An atrial septal defect (ASD) may or may not be present, but both a patent ductus arteriosus (PDA) and ASD are obligatory for survival and are considered part of the complex.

Systemic venous blood returns normally to the right atrium (RA) and flows normally from the right side of the heart. Pulmonary venous blood flows across the ASD to the RA because it cannot exit the left side of the heart if mitral atresia is present. Mixing in the RA desaturates the blood, resulting in tachypnea, dyspnea, grunting, cool and poorly perfused extremities, lethargy, and pallor or gray color.

PVR is initially elevated, placing the infant at risk for pulmonary over-circulation. A hypoplastic (or absent) left ventricle causes decreased systemic vascular blood flow (not "desaturation").

49.

The Jones criteria are used for the diagnosis of acute rheumatic fever. Using these criteria, which of the following signs and symptoms must a child exhibit to warrant a diagnosis?

Carditis and chorea

Polyarthritis and fever

Previous rheumatic fever diagnosis, elevated erythrocyte sedimentation rate (ESR), and elevated C-reactive protein (CRP)

Erythema marginatum and positive rapid streptococcal antigen test

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Correct answer: Carditis and chorea

Using the Jones criteria, the patient needs two major or one major and two minor manifestations to make the diagnosis of rheumatic fever.

Major manifestations include:

- *carditis*
- *polyarthritis*
- *chorea*
- *erythema marginatum*
- *subcutaneous nodules*

Minor manifestations include:

- *clinical findings: arthralgia, fever, previous rheumatic fever*
- *laboratory findings: Elevated acute phase reactants (ESR, CRP, white blood cell count)*
- *prolonged PR interval*

Supporting evidence or antecedent group A streptococcal infections

- *positive throat culture*
- *positive rapid streptococcal antigen test*
- *elevated or increasing streptococcal antibody titer*

Carditis and chorea are two major manifestations; if present, they would indicate a diagnosis of rheumatic fever in a child.

50.

A nurse is caring for an infant with DiGeorge syndrome and associated coarctation of the aorta. Surgical intervention is scheduled for closure of the patient's ventricular septal defect (VSD) and aortic arch reconstruction. Which interventions are necessary for this patient before the OR?

Send type and screen for blood for the OR and ensure the blood bank is aware the infant meets the criteria for irradiated blood products

Ensure an MRI of the head has been completed and is in the patient's chart

Place a consult with craniofacial surgery for discussion of cleft palate

Perform a newborn screen and a newborn hearing screen prior to any surgical procedure

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Correct answer: Send type and screen for blood for the OR and ensure the blood bank is aware the infant meets the criteria for irradiated blood products

Surgical repair of aortic coarctation is accomplished via thoracotomy with one of the several methods. Sternotomy and cardiopulmonary bypass are used if complete arch reconstruction is required or associated lesions are to be repaired (i.e., VSD). Blood is required when bypass is used in infants. Because patients with DiGeorge syndrome are at risk for immune deficiency, irradiated blood products should be used to avoid graft-versus-host reactions.

A head MRI is not indicated at this point but may be necessary if there are neurologic complications postoperatively. A craniofacial surgery consult will be obtained after the initial phase of illness to plan treatment and management for cleft lip and palate. The newborn screen is performed at 24 hours of age, and a hearing screen will not be performed until the infant is no longer requiring oxygen.

51.

An infant diagnosed with an atrial septal defect (ASD) presents with a grade IV systolic ejection murmur that is heard well in all positions. Which of the following is characteristic of this type of murmur?

A palpable thrill

Increased blood flow through the aortic valve

Murmur heard throughout systole

Murmur heard when the stethoscope is partly off the chest

Correct answer: A palpable thrill

Systolic ejection murmurs are heard between S_1 and S_2 (early, mid, or late) when blood flows through the semilunar valves; the intensity increases, then decreases (known as crescendo-decrescendo). In an ASD, blood is shunted from the higher-pressure left side of the heart to the lower-pressure right side, resulting in RV volume and pressure overload with RA and RV dilation.

Auscultation reveals a systolic ejection murmur at the LSB from increased blood flowing through the pulmonic valve (not the aortic valve). The murmur is wide and fixed with a split S_2. A diastolic murmur may also be present from the large volume flowing across the tricuspid valve.

Murmurs are graded from a barely audible (using a stethoscope) grade I murmur to a grade VI murmer (which is so loud it can be heard without a stethoscope). A grade IV murmur is heard well in all positions (using a stethoscope), and a palpable thrill is present. Grade V murmurs can be heard with the stethoscope partly off the chest. Murmurs heard throughout systole are referred to as holosystolic murmurs.

52.

In what phase of Kawasaki disease will a child manifest red lips, tongue, palms, and soles?

Acute phase

Subacute phase

Convalescent phase

Refractory phase

Correct answer: Acute phase

Kawasaki disease is the systemic inflammation of the blood vessels in the body (vasculitis). Early fever and multisystem vasculitis (particularly in the coronary arteries) are followed by pancarditis with inflammation of the conduction system, myocardium, pericardium, and endocardium. The cause of this disease is unknown. However, it is possibly due to an exaggerated immune response to an infection in a susceptible child.

There are three phases of this disease; the acute phase, subacute phase, and convalescent phase. The acute phase (days 1-10) presents with a high fever, conjunctivitis, indurative edema, diffuse red-purple discoloration of the palms/soles, a strawberry tongue, reddened fissured lips, skin rash, and cervical lymph node enlargement.

The refractory phase is a stage of shock and is not associated with Kawasaki disease.

53.

The nurse is caring for an infant with a diagnosis of transposition of the great arteries (TGA), who is scheduled for surgical repair. Which surgical treatment option provides a permanent solution to TGA and is usually performed within the first 2 weeks after birth?

Arterial switch procedure

Complete repair with a patch

Balloon atrial septostomy

Norwood operation

Correct answer: Arterial switch procedure

TGA is a congenital heart defect in which the pulmonary artery and aorta are switched positions: the left ventricle gives rise to the pulmonary artery, and the right ventricle gives rise to the aorta, resulting in parallel circulations. Systemic venous blood enters the right side of the heart normally but exits through the aorta, sending deoxygenated blood back to the body instead of the lungs. Pulmonary venous blood enters the left side of the heart normally but exits through the pulmonary artery, sending oxygenated blood to the lungs instead of the body.

Repair via arterial switch is permanent and should be performed by 2 weeks of age to avoid CHF and early development of PVOD. Balloon atrial septostomy is a temporary treatment option that expands the ASD and improves the oxygenation of the blood. Complete repair with a patch is a treatment option for tetralogy of Fallot (TOF). The Norwood operation is palliative reconstructive surgery for hypoplastic left heart syndrome (HLHS).

54.

A child with diastolic left heart failure (HF) secondary to pediatric cardiomyopathy has developed pulmonary edema. When a nurse performs this patient's head-to-toe assessment, which of the following signs and symptoms would be an expected finding?

Tachypnea and tachycardia

Machine-like murmur

Muffled heart sounds

Jaundice

Correct answer: Tachypnea and tachycardia

Cardiomyopathy is myocardial dysfunction associated with mechanical and/or electrical problems with ventricular dilation or hypertrophy. Symptoms of cardiomyopathy reflect the variable degrees of HF. Tachycardia, tachypnea, increased work of breathing, diaphoresis, loss of appetite, feeding intolerance, poor weight gain, abdominal pain, and exercise intolerance are often seen.

A machine-like murmur is not associated with congestive heart failure (CHF). Jaundice is the result of liver dysfunction and subsequently elevated bilirubin levels. Muffled heart sounds are indicative of cardiac tamponade.

55.

Acute rheumatic fever (ARF) can cause which of the following electrocardiogram (ECG) abnormalities?

Prolonged PR interval

Sinus tachycardia

Widening QRS complexes

Flattening, broadening, and near-disappearance of P waves

Correct answer: Prolonged PR interval

Rheumatic fever is an inflammatory disorder of the heart, blood vessels, and joints. A partially treated or untreated GABHS infection in a susceptible child, otherwise known as "strep throat," can lead to an abnormal immune response, which causes widespread inflammation within the body. This can provoke long-term cardiac damage, which is known as rheumatic heart disease.

Laboratory studies will reveal a positive throat culture for group A streptococci; increased white blood cells (WBCs), sedimentation rate (ESR), and C-reactive protein (CRP); and elevated antistreptolysin O antibody titer. An ECG often shows a prolonged PR interval, indicating first-degree AV block, diffuse ST-T wave changes, and/or T-wave inversion.

56.

What are the PRIMARY medications used to treat Kawasaki disease?

Intravenous immunoglobulin (IVIG) and aspirin

Intravenous (IV) antibiotics and diuretics

Intravenous (IV) vasopressin and respiratory treatments with inhaled albuterol and Pulmicort

Intravenous corticosteroids and Ofirmev

Correct answer: Intravenous immunoglobulin (IVIG) and aspirin

Kawasaki disease is the systemic inflammation of the blood vessels in the body (vasculitis). Early fever and multisystem vasculitis (particularly in the coronary arteries) are followed by pancarditis with inflammation of the conduction system, myocardium, pericardium, and endocardium. The cause of this disease is unknown. However, it is possibly due to an exaggerated immune response to an infection in a susceptible child.

Goals and patient management target reducing the risk of coronary artery aneurysm formation and preventing emboli from elevated platelet counts. Anti-inflammatory agents will reduce inflammation and decrease the incidence of coronary abnormalities. High-dose aspirin therapy with IVIG is used for treatment. Repeat doses of IVIG or pulse steroids are used if treatment fails and symptoms persist.

57.

Murmurs are heard because of turbulent blood flow through an abnormal opening or obstructed area of the heart. Upon asculatation, the nurse notes a grade 2 systolic murmur in a patient. Which of the following is characteristic of this type of murmur?

Just easily audible, not heard in all positions

Heard well in all positions

Associated with a thrill

Loud, heard with stethoscope partly off the chest

Correct answer: Just easily audible, not heard in all positions

Systolic murmurs are heard when blood flows through the semilunar valves. The intensity of systolic murmurs is based on a 6-point scale:

- *Grade I: Barely audible (faint), not heard in all positions*
- *Grade II: Just easily audible, not heard in all positions*
- *Grade III: Heard well in all positions*
- *Grade IV: Heard well with a palpable thrill*
- *Grade V: Louder, can be heard with stethoscope partly off the chest*
- *Grade VI: Loudest, audible without a stethoscope*

58.

A pediatric patient is prescribed digoxin (Lanoxin) for heart failure. The nurse knows that toxicity is usually seen at levels greater than what value?

2 ng/mL

3 ng/mL

4 ng/mL

1 ng/mL

Correct answer: 2 ng/mL

Digoxin is commonly used for the treatment of mild to moderate heart failure in pediatric patients. The toxic effects of digoxin are exacerbations of therapeutic effects (dysrhythmias, bradycardia, and heart block). Clinical effects of acute overdose occur in the gastrointestinal and cardiovascular systems, consisting of nausea, vomiting, hypotension, bradycardia, and dysrhythmias. Digoxin immune Fab (Digibind) is the antidote to digoxin and can be used in acute and symptomatic digoxin toxicity.

A toxic dose can be estimated by history, but laboratory evaluation of serum levels and careful evaluation of the patient are critical components to avoiding overdose. The therapeutic trough range is 0.5 to 2 ng/mL, and toxicity is usually seen at levels above 2 ng/mL (although toxicity can occur within this range, too).

59.

A nurse is caring for a 2-year-old toddler who just underwent a diagnostic cardiac catheterization via the right groin. As part of the head-to-toe assessment, the nurse checks bilateral pedal pulses frequently to monitor for which complication?

Thrombosis

Hemorrhage

Stroke

Cardiac tamponade

Correct answer: Thrombosis

Caring for a child post-cardiac catheterization includes checking bilateral pedal pulses to ensure they are present and equal; a loss of pulse or a decrease in pulse strength could indicate the formation of a potential blood clot (arterial or venous thrombosis).

Hemorrhage, stroke, and cardiac tamponade are also all potential complications of cardiac catheterization, but they are not monitored with a pulse assessment.

60.

A nurse is caring for a pediatric patient who begins to manifest signs of compensated shock. Which of the following assessment findings would the nurse anticipate?

Cool, clammy skin

Jaundice

Hypotension

Petechiae and ecchymosis

Correct answer: Cool, clammy skin

Compensated shock is characterized by normal systolic blood pressure with clinical evidence of inadequate tissue perfusion. Cool, clammy skin is a response of the sympathetic nervous system causing vasoconstriction as a "fight or flight" mechanism. This is one of several compensatory mechanisms used by the body to maintain adequate oxygen delivery. Other signs of compensated shock include tachycardia, an increase in systemic vascular resistance (SVR), increased contractility of the heart muscle, and increased venous smooth muscle tone (increasing venous return to the heart and augmenting preload).

Jaundice, hypotension, petechiae, and ecchymosis are all signs of decompensated shock, when physiologic attempts to maintain systolic blood pressure, tissue perfusion, and oxygen delivery fail. Jaundice occurs when the liver is no longer able to filter and metabolize waste products, leading to an increase in bilirubin. Clotting factors are activated in uncompensated shock, which causes petechiae and ecchymosis. Hypotension results when perfusion can no longer be maintained.

61.

A nurse is caring for an infant who is in the PICU recovering from a ventricular septal defect (VSD) repair via cardiac catheterization. What is the MOST common type of cardiac arrhythmia that could occur as a complication following VSD repair?

Heart block

Premature ventricular contractions (PVCs)

Supraventricular tachycardia (SVT)

Atrial fibrillation (A-fib)

Correct answer: Heart block

Potential complications of VSD closure include infection, postoperative bleeding, damage to the valves of the heart (tricuspid, pulmonary, or aortic), pulmonary hypertension with poor cardiac output, AV heart block, residual VSD from unsuccessful closure, and death. Repair before the patient is 2 years of age permits normalization of growth and reversal of any related developmental delays.

PVCs are common but benign, and SVT is a risk during the procedure but not postoperatively. A-fib is not common.

62.

A 6-year-old male presents to the emergency department with signs and symptoms of acute digoxin toxicity. The patient's mother reports that her son is taking digoxin for heart failure and has been taking it as prescribed.

Which of the following is a cardinal manifestation of digoxin toxicity?

Severe bradycardia

Headache

Hypertension

Respiratory distress

Correct answer: Severe bradycardia

Digoxin is commonly used for the treatment of mild to moderate heart failure. The toxic effects of digoxin are exacerbations of therapeutic effects. Clinical effects of acute overdose occur in the gastrointestinal and cardiovascular systems (e.g., nausea, vomiting, hypotension, bradycardia, and dysrhythmias). Digoxin immune Fab (Digibind) is the antidote to digoxin and can be used in acute and symptomatic digoxin toxicity.

It is vital to educate the caregivers to assess the patient's heart rate prior to every dose administration to ensure it is greater than 60 beats per minute. In addition, the patient should receive frequent laboratory evaluations of serum levels, and the caregivers should be taught signs of digoxin toxicity (poor feeding or appetite, nausea, vomiting, and visual changes). Toxicity can occur even if the patient is within the therapeutic range.

63.

A pediatric nurse is educating the parents of a child with pulmonary stenosis about the pathophysiology of this condition. The nurse should explain that this disorder involves which of the following?

Obstruction to blood flow from the right ventricle to the pulmonary artery

Obstruction of blood flow from the left ventricle to the pulmonary artery

Absence of blood flow from the right atrium to the right ventricle

Restriction of blood flow from the left atrium to the left ventricle

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Correct answer: Obstruction to blood flow from the right ventricle to the pulmonary artery

Pulmonary stenosis (PS) involves a narrowed pulmonary valve obstructing flow from the right ventricle to the pulmonary artery, resulting in right ventricular hypertrophy. This defect involves a stiff pulmonic valve, further contributing to the obstruction of blood flow. PS is most often a congenital heart defect, resulting from an embryologic error in the formation of pulmonary leaflets.

In noncritical PS, conservative management and monitoring are recommended. Intervention is required for moderate or greater PS, with balloon valvuloplasty as the currently accepted treatment modality, providing excellent short- and long-term results.

Tricuspid atresia involves an absence of blood flow from the RA to the RV, due to a lack of tricuspid valve formation. Survival of this condition is contingent upon the placement of an obligatory right-to-left atrial shunt. Mitral stenosis (not pulmonary stenosis) involves narrowing of the mitral valve orifice, restricting blood flow from the LA to the LV.

64.

A pediatric nurse would expect a full-term, 5-day-old infant with a patent ductus arteriosus (PDA) to present with which of the following clinical manifestations?

Cardiomegaly and widening pulse pressure

Decreased pulmonary vascularity and hypertension

Narrowed pulse pressure and hypotension

Increased pulmonary vascularity and narrowed pulse pressure

Correct answer: Cardiomegaly and widening pulse pressure

In utero, the ductus arteriosus permits blood flow to be diverted from the high-resistance pulmonary circulation to the descending aorta and the low-resistance placental circulation. Closure of this structure normally occurs from contraction of the medial smooth muscle in the wall of the ductus arteriosus during the first 12 to 24 hours after birth, which is initiated by a rise in the perivascular PO_2 and a decrease in endogenous prostaglandin (producing functional closure).

In the case of PDA, where the ductus fails to close normally, blood shunts from left to right into the pulmonary artery (PA) and lungs. This occurs as the PVR drops and the pressure in the aorta exceeds that of the PA. Pulmonary blood flow increases, thus increasing venous return to the left ventricle. Left artery and left ventricle volume overload and congestive heart failure ensue. This causes cardiomegaly. The increased flow and pressure on the pulmonary circulation changes the pulmonary vasculature, resulting in hypertension and increased pulmonary vasculature resistance.

Examination of the infant reveals a machine-like continuous murmur auscultated at the left upper sternal border. Poor feeding, irritability, tachycardia, tachypnea, and slow weight gain are often present. The pulse pressure is wide, and peripheral pulses are bounding.

65.

Stroke volume (SV) is the amount of ventricular volume pumped during each systolic cardiac contraction. SV is affected by which of the following factors?

Preload, afterload, contractility

Preload, cardiac index, contractility

Heart rate (HR), afterload, contractility

Preload, pulmonary capillary wedge pressure, contractility

Correct answer: Preload, afterload, contractility

Cardiac output (CO) is the amount of blood being pumped by the heart to the tissues and is measured in liters per minute. It is determined by multiplying SV and HR. The cardiac index, equal to CO divided by body surface area (BSA), is used for children because of the potential variation in CO by body size. SV is affected by preload (the amount the ventricle stretches at the end of diastole), afterload (pressure that the heart needs to exert to eject blood during ventricular contraction), and contractility (strength and efficiency of contraction).

66.

A nurse is preparing a child for cardiac catheterization. Which of the following is an early and common complication of this procedure?

Arrhythmia from catheter manipulation

Allergic reaction to contrast dye

Perforation of the heart, valves, or vessels

Infection

Correct answer: Arrhythmia from catheter manipulation

While all the choices are potential complications of cardiac catheterization, cardiac arrhythmias secondary to catheter manipulation during the procedure are the most common (and early) complications of this procedure. These are generally sporadic and transient, resolving without treatment. In rare cases, more serious arrhythmias may develop.

67.

Which of the following is the MOST likely cause of obstructive shock in a pediatric patient?

Tension pneumothorax

Hemorrhage

Sepsis

Spinal injury

Correct answer: Tension pneumothorax

Obstructive shock is a condition in which there is a physical (mechanical) obstruction in the flow of blood, leading to impaired cardiac output (CO) because blood cannot get to where it needs to go. Causes include cardiac tamponade, tension pneumothorax, ductal-dependent congenital heart lesions, and massive pulmonary embolism. The obstruction causes low CO, decreased tissue perfusion, and increased systemic vascular resistance (SVR). The patient may initially appear to be in hypovolemic shock, but a thorough assessment will reveal pulmonary and/or systemic venous congestion.

Hemorrhage leads to hypovolemic shock. Sepsis is a cause of cardiogenic shock. Neurogenic shock is a type of distributive shock and is caused by a head or spinal injury.

68.

A 6-year-old male presents to the emergency department with signs and symptoms of acute digoxin toxicity. The mother reports that her son is taking digoxin for heart failure and has been taking it as prescribed.

Which of the following signs and symptoms would NOT be indicative of digoxin toxicity?

Respiratory distress

Severe bradycardia

Nausea and vomiting

Hypotension

Correct answer: Respiratory distress

Digoxin is used for the treatment of mild to moderate heart failure, to decrease the ventricular response rate in fast atrial arrhythmias, and to treat fetal tachycardia in the absence of hydrops fetalis. The toxic effects of digoxin are exacerbations of therapeutic effects. Clinical effects of acute overdose occur in the gastrointestinal and cardiovascular systems (e.g., nausea, vomiting, hypotension, bradycardia, and dysrhythmias). Digoxin immune Fab (Digibind) is the antidote to digoxin and can be used in acute and symptomatic digoxin toxicity.

It is vital to educate the caregivers to assess the patient's heart rate prior to every dose administration to ensure the heart rate is greater than 60 beats per minute. In addition, the patient should receive frequent laboratory evaluations of serum levels, and the caregivers should be taught signs of digoxin toxicity (poor feeding or appetite, nausea, vomiting, and visual changes). It is possible for toxicity to occur even if the patient is within the therapeutic range.

Respiratory distress is not a clinical manifestation of acute digoxin toxicity.

69.

You are caring for a newborn who has just been diagnosed with truncus arteriosus and are educating the parents about this condition. Which statement, if made by the mother, demonstrates she understood your teaching about this condition?

"My baby's heart shares a single great artery that arises from both ventricles."

"My baby has a bluish discoloration of the skin, which is referred to as cyanosis. This is an expected finding with truncus arteriosus and is not concerning."

"The left side of my baby's heart is not fully developed."

"The positions of the great arteries of my baby's heart are reversed."

Correct answer: "My baby's heart shares a single great artery that arises from both ventricles."

Truncus arteriosus is a congenital heart defect characterized by one great artery arising from both the left and right ventricles (connecting the ventricles), overriding a ventricular septal defect (VSD). A coexisting VSD is present in more than 98% of cases. In a normal heart, there should be two separate arteries (pulmonary artery and aorta) with their own valves (instead of one truncal valve). This condition makes up 1% to 2% of all cardiac defects. These infants may present with cyanosis at birth, but this finding varies in intensity according to the amount of pulmonary blood flow.

Hypoplastic left heart syndrome (HLHS) is a congenital heart defect in which the left side of the heart is underdeveloped. Transposition of the great vessels is a congenital heart defect in which the great arteries are reversed (i.e., the pulmonary artery arises from the left ventricle and the aorta from the right ventricle).

70.

An infant is diagnosed with Wolff-Parkinson-White (WPW) syndrome and is admitted to the PICU for treatment and management. Which ECG finding is expected?

Episodes of supraventricular tachycardia (SVT)

Prolonged PR interval

Narrow QRS complex

Ventricular fibrillation (V-fib)

Correct answer: Episodes of supraventricular tachycardia (SVT)

WPW syndrome is a congenital cardiac preexcitation syndrome involving an accessory connection that is evident on resting ECG, involving electrical activity conduction that is faster than the AV node; SVTs may occur at any age secondary to reentry pathways. Frequent tachycardia occurs in infancy with decreased episodes in early childhood followed by resumption of symptoms at puberty.

ECG features include regular rhythm, episodes of SVT, a short PR interval, a wide QRS complex, and the presence of a delta wave. Atrial fibrillation (not V-fib) occurs in 10 to 30 percent of persons with WPW syndrome.

IB. Respiratory

71.

What is considered to be the gold standard for the diagnosis of pulmonary hypertension (PH)?

Cardiac catheterization

Echocardiogram

Computed tomography (CT) scan of the chest

Cardiac magnetic resonance imaging (MRI)

Correct answer: Cardiac catheterization

Performing a right cardiac catheterization is the gold standard for the diagnosis of PH; a catheter is used to measure the pressure in the heart and lungs. However, it is not always necessary during the initial evaluation. Because it is an invasive procedure that carries risks, the test is sometimes deferred until the initiation of targeted PH therapy is under consideration.

An echocardiogram is a part of the initial evaluation in PH; a CT scan of the chest may yield valuable information on disease pathogenesis. Cardiac MRI remains the gold standard for assessing the right ventricle and may be used as additional testing if needed to better evaluate cardiac and pulmonary function, assess the patient's functional capacity, and identify the underlying etiology of PH if a cause is not identified in the initial evaluation.

72.

An 11-year-old child is admitted to the emergency department for the treatment of an acute asthma exacerbation. Albuterol, a beta-adrenergic agonist, is administered initially. What action does the medication demonstrate?

Dilating the bronchioles

Reducing bronchial hyperresponsiveness

Reducing the amount of mucus produced by the airways

Blocking inflammatory and bronchospasm effects

Correct answer: Dilating the bronchioles

Beta-adrenergic agonists, such as albuterol, are considered essential bronchodilator drugs in the treatment of acute asthma exacerbations and for the prevention of exercise-induced bronchospasm (EIB). They work by binding with the beta receptors on the smooth muscle of the airways, allowing the smooth muscle to relax, resulting in easier breathing.

Corticosteroids are anti-inflammatory drugs used as first-line treatment to reverse airflow obstruction, control symptoms, and reduce bronchial hyperresponsiveness in chronic asthma. Anticholinergics may also be used for the relief of acute bronchospasm; they are helpful in acute, severe asthma when used in conjunction with beta-agonists and also work by reducing the amount of mucus produced by the airways. Leukotriene modifiers work by blocking inflammatory and bronchospasm effects; these are used for long-term asthma control.

73.

Positive end-expiratory pressure (PEEP) levels that are too high in an intubated and mechanically ventilated child can cause which of the following complications?

Decreased cardiac output (CO)

Decreased afterload

Decreased lung compliance

Decreased intrathoracic pressure

Correct answer: Decreased cardiac output (CO)

Optimal PEEP improves CO by decreasing left ventricular transmural pressure and decreasing afterload, making the ejection of blood from the left ventricle easier.

Decreased CO caused by compression of the great vessels secondary to elevated intrathoracic pressures (most often from high levels of PEEP) is a potential complication of mechanical ventilation. This can be remedied with adequate volume (preload) expansion.

74.

A 2-year-old male is admitted to the emergency department with a suspected pneumothorax after a motor vehicle accident. The child presents in severe respiratory distress, showing distended neck veins on physical assessment and a displaced trachea.

Which of the following x-ray findings would confirm the presence of a pneumothorax?

Unilateral hyperlucency

Increased pulmonary vascular markings

Narrow intercostal spaces

Decreased lucency

Correct answer: Unilateral hyperlucency

Children with significant intrathoracic injuries may not have suggestive external evidence of these injuries. Therefore, radiographic evaluation of the chest is standard in thoracic trauma cases. Pediatric nurses should observe for chest-wall ecchymosis, bruising, abrasions, a sensation of crepitus, point tenderness over a rib, or a displaced trachea.

A sharp edge sign, in which the cardiac border and the diaphragm are seen in sharp contrast, is an x-ray finding of a pneumothorax (the most common air leak). Other findings of pneumothorax include unilateral hyperlucency (blackness indicating air), an overall increase in size, a flattened diaphragm on the affected side, widened intercostal spaces, and decreased or absent pulmonary vascular markings.

A tension pneumothorax results in mediastinal shifts with decreased volume, increased opacity of the opposite lung, and deviation of the heart and trachea to the opposite side (shifted away from the side of the pneumothorax). If a tension pneumothorax is left untreated, the underlying lung will collapse.

75.

A nurse is providing care to an intubated and mechanically ventilated child for the treatment and management of pediatric acute respiratory distress syndrome (PARDS). The child's respiratory function has continued to deteriorate over the past 24 hours, and the physician has ordered arterial blood gases (ABGs) for reassessment.

The ABG results that are expected with this diagnosis will correlate with which of the following acid-base imbalances?

Respiratory acidosis

Respiratory alkalosis

Metabolic alkalosis

Metabolic acidosis

Correct answer: Respiratory acidosis

ARDS is respiratory failure due to diffuse alveolar-capillary membrane injury, causing permeability or elevated protein pulmonary edema. Management may include high positive end-expiratory pressure (PEEP) with low tidal volume, high-frequency oscillation ventilation (HFOV), permissive hypercapnia, and hemodynamic monitoring.

Respiratory acidosis occurs in later stages of PARDS when CO_2 levels rise high enough to lower the serum pH below 7.35. Increased CO_2 can be the result of CNS depression, intrinsic airway disease, chest wall instability, a compromised diaphragm, compromised upper airway muscle function, or alveolar disease.

76.

For an infant with suspected pulmonary hypertension (PH), which symptoms would likely accompany this condition?

Tachypnea, tachycardia, and failure to thrive

Exertional dyspnea, chest pain, and syncope

Tachycardia, dyspnea, and loss of vision

Bradycardia, clubbing, and cyanosis

Correct answer: Tachypnea, tachycardia, and failure to thrive

PH is a disease characterized by elevated pulmonary artery pressure (PAP), which can result in right ventricular (RV) failure. In children, PH is most commonly associated with underlying cardiac or lung disease (e.g., bronchopulmonary dysplasia), but may also be idiopathic or familial.

The presenting symptoms in children with PH are highly variable. In infants, the presentation involves signs of low cardiac output (e.g., tachypnea, tachycardia, poor appetite, failure to thrive, lethargy, diaphoresis, and irritability).

Cyanosis may be present with exertion due to right-to-left shunting through a patent foramen ovale (PFO) or congenital heart disease (CHD). The most common presenting symptoms in older children include exertional dyspnea and chest pain. Children without adequate shunting may develop syncope (fainting) due to the inability to achieve an adequate CO with exertion. Clubbing may manifest in a child with underlying lung disease.

77.

A 7-year-old female patient is admitted to the emergency department after suffering second-degree burns and inhalation injury from a house fire. A nurse is preparing to transfer this patient to a burn center and, while reviewing her current laboratory values, notes a carboxyhemoglobin level of 16%.

Which of the following signs and symptoms is NOT associated with this carboxyhemoglobin level?

Syncope

Headache

Confusion

Mild dyspnea

Correct answer: Syncope

Carbon monoxide toxicity secondary to smoke inhalation is evaluated by measuring the patient's arterial carboxyhemoglobin level. Elevated levels serve as indirect evidence for exposure to combustible products, and multiple signs and symptoms have been associated with these levels.

The normal value is 0%-5%. A patient with a carboxyhemoglobin level of 15%-20% will generally exhibit headaches, mild dyspnea, and confusion. If levels rise above 20% and up to 40%, the patient will often be disoriented, fatigued, and nauseous and may exhibit fainting spells (syncope). Levels greater than 50% will leave a patient comatose with seizure activity, respiratory failure, and even death.

78.

What is the most common chronic disease of childhood?

Asthma

Type 1 diabetes mellitus (T1DM)

Obesity

Attention deficit hyperactivity disorder (ADHD)

Correct answer: Asthma

Asthma prevalence, morbidity, and mortality are increasing in the United States. These increases may result from worsening air pollution, poor access to medical care, and underdiagnosis or undertreatment.

Asthma is the most common chronic disease of childhood, the primary cause of school absences, and the third leading cause of hospitalizations in children younger than the age of 15 years.

79.

What is the MOST common cause of true nasal obstruction in a newborn?

Choanal atresia

Septal deviation

Pyriform aperture stenosis

Turbinate hypertrophy

Correct answer: Choanal atresia

Choanal atresia is a congenital disorder that can be unilateral or bilateral, in which the nasal choanae (openings that connect the nasal cavity with the nasopharynx) are occluded by soft tissue, bone, or a combination of both. It is the most common cause of true nasal obstruction. Because newborns are obligate nasal breathers, it can be an acute otolaryngologic emergency if bilateral occlusion is present. Intubation or an oral airway may be necessary in severe cases pending surgical intervention to open the bony membrane that is blocking the airway.

The other choices are differential diagnoses.

80.

A 4-year-old male is admitted to the pediatric intensive care unit (PICU) after a near-drowning accident. His respiratory function has been steadily deteriorating over the last 12 hours, despite noninvasive positive-pressure ventilation (NPPV).

Which of the following findings on chest radiographs is indicative of pediatric acute respiratory distress syndrome (PARDS)?

Bilateral white-out infiltrates

Heart enlargement with bilateral upper lobe infiltrates

Infiltrates on the bilateral lower lobes

Normal chest radiograph

Correct answer: Bilateral white-out infiltrates

Chest imaging findings of new pronounced, bilateral white-out infiltrates, consistent with acute pulmonary parenchyma disease, are necessary to diagnose PARDS.

81.

A 10-month-old infant is brought into the emergency department via ambulance and stops breathing. The nurse confirms the infant still has a pulse by checking the brachial artery in the infant's upper arm. The nurse ensures the infant is positioned correctly and immediately begins CPR.

When two rescuers are performing CPR, what technique should be used for compressions?

Two thumbs on the sternum with hands encircling the chest to deliver compressions

Two hands on the sternum using the heel of the hands to deliver compressions

Two fingers on the sternum to deliver compressions

One hand on the sternum using the heel of the hand to deliver compressions

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Correct answer: Two thumbs on the sternum with hands encircling the chest to deliver compressions

External chest compressions consist of serial, rhythmic compressions of the chest to maintain circulation to the vital organs until the infant begins spontaneously breathing again or advanced life support can be initiated.

For an infant, the fingers should be placed at a point on the lower sternum just below the intersection of the sternum and an imaginary line drawn between the nipples. Lone rescuers should use two fingers on the sternum to deliver compressions. When two rescuers are present, the two-thumb encircling hands technique may be used.

82.

A 2-year-old male presents to the emergency department with symptoms indicative of acute epiglottitis. The child is intubated for airway management and admitted to the pediatric intensive care unit (PICU). The nurse caring for the child would NOT expect orders to administer which treatment?

Racemic epinephrine

Parenteral antibiotics

Antipyretics

Corticosteroids

Correct answer: Racemic epinephrine

Acute epiglottitis is a life-threatening medical emergency in which the epiglottis swells due to a bacterial infection, and the airway is compromised. Signs and symptoms include an abrupt onset of a high fever, a sore throat, dysphagia, drooling, a muffled voice, and stridor. Airway management with the placement of an endotracheal tube (ETT) is generally indicated, along with parenteral antibiotics (ceftriaxone, cefotaxime, or a combination of ampicillin and sulbactam, pending culture and susceptibility reports). Antibiotics should be given for 7 to 10 days. Antipyretics for fevers and comfort with intravenous fluids are also given; corticosteroids should be administered to reduce edema during the early treatment phase.

Racemic epinephrine is indicated for the treatment of acute laryngotracheobronchitis (LTB), not for acute epiglottitis. Croup is the general medical term that refers to this inflammatory process.

83.

An 18-month-old male is brought to the emergency department by his mother with a sudden onset of choking, gagging, and coughing. The patient is afebrile and has a pulse of 125/min and a respiratory rate of 42/min. The nurse auscultates decreased breath sounds over the right lower lung field.

What is the next step in the evaluation of this child?

Plain neck and chest radiographs

Lateral soft tissue radiograph of the neck

Finger sweep

Indirect laryngoscopy

Correct answer: Plain neck and chest radiographs

Foreign-body aspiration is a common cause of accidental death in infants and children. The initial episode is frequently associated with choking and coughing. Examination findings may be normal or nonspecific, such as decreased air entry, wheezing, rhonchi, or inspiratory stridor. The right bronchus is more often the site of the foreign body than the left, and thus decreased breath sounds may be heard over the right lung field.

After a thorough history and physical exam, plain neck and chest radiographs should be obtained. Approximately 10% of aspirated foreign bodies are radiopaque, making the diagnosis a simple one. Unfortunately, the majority of foreign bodies are not obvious, and changes are seen secondary to obstruction of the airway by the object. Anteroposterior and lateral views of the neck and chest may show signs of a partially obliterated tracheobronchial air column.

However, chest radiography alone does not diagnose the condition; a final diagnosis is only achieved at the time of bronchoscopic evaluation.

84.

An infant is being treated with inhaled nitric oxide (iNO) for hypoxic respiratory failure secondary to pulmonary hypertension. The nurse should be aware of which of the following potential side effects while providing care to an infant receiving iNO therapy?

Methemoglobinemia

Rebound pulmonary hypertension

Significant GI distress

Hepatic dysfunction

Correct answer: Methemoglobinemia

Nitric oxide (NO) is an inhaled pulmonary vasodilator. A potential side effect of iNO is methemoglobinemia, which can reduce the oxygen-carrying capacity of the hemoglobin. For this reason, weaning the patient as quickly as possible is vital. Methemoglobin levels should be closely monitored while the child is receiving iNO therapy.

Use iNO with caution in patients with left-sided obstructive heart lesions. Rebound pulmonary hypertension may occur with discontinuation; do not abruptly discontinue but rather wean the patient. GI distress and hepatic dysfunction are not considered to be side effects of iNO.

85.

An 11-month-old male is brought to the emergency department by his parents, who state the infant was playing on the floor when he started to cough and choke. The coughing has gotten worse, and the child is starting to have trouble breathing.

Based on this data, what is the most likely cause of the child's symptoms?

Foreign body aspiration

Upper respiratory tract infection

Exposure to allergens (e.g., dust, pollen, pet dander)

Anaphylactic reaction to a food

Correct answer: Foreign body aspiration

A leading cause of accidental death in toddlers is foreign body aspiration, occurring when a foreign object like a nut, coin, or small toy gets lodged in the airway. Mobile infants and toddlers are at an increased risk, as they are inherently curious and tend to place objects into their mouths when exploring the world around them. In addition, children younger than 2 do not yet have molars, so they are unable to grind their food into smaller, more manageable pieces.

The initial episode is frequently associated with choking and coughing, and examination findings may be normal or reveal nonspecific signs, such as decreased air entry, wheezing, rhonchi, or inspiratory stridor. Treatment depends on the cause and location of the obstruction and is primarily focused on maintaining adequate ventilation; oxygen is administered if necessary.

While the other choices are possibilities to be ruled out, the most likely answer in this scenario is a foreign body aspiration.

86.

A 4-year-old female presents to the emergency department via ambulance with severe wheezing and cyanosis. She is pale and restless. Her respiratory rate is 40 breaths per minute, her heart rate is 155 beats per minute, and her oxygen saturation is 89%. The mother reports the child has been experiencing a prolonged asthma attack and is not responding to her usual asthma treatments.

What is this patient likely experiencing?

Status asthmaticus

Anaphylaxis

Reactive airway disease

Congestive heart failure (CHF)

Correct answer: Status asthmaticus

Status asthmatics is one of the most common causes of emergency room encounters in the United States. This condition is characterized by impending respiratory failure from a severe asthma attack that is unresponsive to routine therapy, thus necessitating hospitalization. The child presents with severe wheezing, is usually pale and restless, and is sometimes cyanotic. Respiratory rate and heart rate are elevated, and a pulsus paradoxus of >15 mm Hg may be noted. Dehydration, vomiting, and abdominal pain with distention are common manifestations.

Status asthmaticus can be misdiagnosed when wheezing occurs from an acute cause other than asthma. The child in this scenario has a diagnosis of asthma, and the mother has already reported a prolonged asthma attack that has been unresponsive to usual treatments. This rules out other causes of wheezing (including anaphylaxis and CHF). Reactive airway disease generally precedes a formal diagnosis of asthma.

87.

Which of the following infectious causes of stridor has a viral etiology with an allergic component?

Acute spasmodic laryngitis

Acute bacterial tracheitis

Acute epiglottitis

Acute laryngotracheobronchitis (LTB)

Correct answer: Acute spasmodic laryngitis

Acute spasmodic laryngitis is distinct from laryngitis and LTB. It is characterized by recurrent paroxysmal attacks of laryngeal obstruction that happen specifically at night. The child feels well the following day. This condition is viral, and some children may be predisposed to it; allergies or hypersensitivities may be implicated in some cases. Management is the same as for infectious croup.

Acute epiglottitis and acute bacterial tracheitis are both caused by bacterial infections. Croup, or acute laryngotracheobronchitis, is viral but is not associated with allergies or hypersensitivities.

88.

Which of the following conditions may result in difficulty weaning an infant from mechanical ventilation?

Patent ductus arteriosus (PDA)

Respiratory distress syndrome (RDS)

Transient tachypnea of the newborn (TTN)

Meconium aspiration syndrome (MAS)

Correct answer: Patent ductus arteriosus (PDA)

A left-to-right shunt via the PDA results in blood flow from the aorta into the pulmonary artery and lungs, thus increasing pulmonary blood flow. The increased pulmonary artery pressure and increased left ventricular pressure and volume lead to pulmonary edema and bilateral congestive heart failure, limiting the physiologic ability to wean successfully from the ventilator. The PDA will often present clinically in 4 to 7 days after birth with an inability to wean from the ventilator or a need for increased ventilatory and oxygen support.

89.

A pediatric nurse is caring for a child with epiglottitis and is providing education to the child's parents. What is the most common cause of epiglottitis?

Haemophilus influenzae type b (Hib)

Respiratory syncytial virus (RSV)

Streptococcus pyogenes

Influenza virus

Correct answer: Haemophilus influenzae type b (Hib)

Epiglottitis is a life-threatening condition in which the epiglottis swells and obstructs airflow into the lungs. It is a rapidly progressive infection requiring prompt medical attention. The organism most often responsible for epiglottitis is Haemophilus influenza type b (Hib); caregivers should be taught that the Hib vaccine can be given as a preventative measure. This vaccine is administered in a four-dose series at 2, 4, 6, and 12-15 months.

Other less common infectious organisms include Streptococcus pyogenes, Streptococcus pneumoniae, or Staphylococcus aureus. RSV and the influenza virus do not cause epiglottitis.

90.

Which of the following factors will negatively impact the oxyhemoglobin dissociation curve by causing a shift to the left?

Hypocapnia

Acidosis

Hyperthermia

Increased $PaCO_2$

Correct answer: Hypocapnia

The oxyhemoglobin dissociation curve is a graph (S-shaped curve) representing hemoglobin's affinity for oxygen. The partial pressure of oxygen (PaO_2) is on the x-axis and oxygen saturation (% hemoglobin saturation) is on the y-axis.

A left shift represents hemoglobin with more affinity for oxygen; factors shifting the curve to the left include alkalosis, hypocapnia (decreased $PaCO_2$), and hypothermia.

A shift to the right reflects hemoglobin with less affinity for oxygen; factors shifting the curve to the right include acidosis, fever (hyperthermia), and hypercapnia (increased $PaCO_2$).

91.

A 2-year-old male is brought to the emergency department by his mother with a sudden onset of choking, gagging, and coughing. The patient has a pulse of 125/min and a respiratory rate of 34/min. The nurse auscultates decreased breath sounds over the right upper lung field.

What other immediate physical finding correlates with a diagnosis of partial laryngeal foreign body obstruction?

Inspiratory stridor

Fever

Aphonia

Crackles

Correct answer: Inspiratory stridor

Foreign body aspiration is a common cause of accidental death in infants and children. The initial episode is frequently associated with choking and coughing. Examination findings may be normal or nonspecific, such as decreased air entry, wheezing, rhonchi, or inspiratory stridor. The right bronchus is more often the site of the foreign body than the left, and thus decreased breath sounds may be heard over the right lung field.

Patients who present with laryngeal foreign bodies develop stridor, dyspnea, cyanosis, coughing, and voice change (not an inability to speak). Patients with bronchial foreign bodies manifest with cough, asymmetric breath sounds, wheezing, and dyspnea.

A fever may develop later (not immediately) if the partial obstruction is not resolved. Cyanosis will get progressively worse if the larynx becomes completely blocked or if the child aspirates the foreign body deeper into the lungs. Crackles are not heard in a partial foreign body obstruction.

92.

A 10-month-old infant is brought into the emergency department via ambulance and stops breathing. The nurse confirms the infant still has a pulse by checking the brachial artery in the infant's upper arm. The nurse ensures the infant's airway is open and immediately begins CPR.

When two rescuers are performing CPR, what is the ratio of compressions to breaths for an infant patient?

15 compressions to 2 breaths

15 compressions to 1 breath

30 compressions to 2 breaths

30 compressions to 1 breath

Correct answer: 15 compressions to 2 breaths

Infants and children typically go into cardiac arrest only after they have experienced respiratory failure; prolonged hypoxemia from inadequate oxygenation, ventilation, and circulation will lead to cardiac arrest. Respiratory arrest in the pediatric population is associated with a higher survival rate than cardiac arrest.

If an infant stops breathing and still has a pulse (brachial pulse should be checked for infants, and carotid or femoral pulses should be checked for children older than 1 year), rescuers should initiate CPR with the CAB (compressions, airway, and breathing) sequence. Conventional CPR, using chest compressions with rescue breaths, should be provided.

When two rescuers are present, 15 compressions to 2 breaths (15:2) should be instituted, and the patient should be reassessed for a pulse every 2 minutes of CPR. When one rescuer is present, the ratio of compressions to breaths is 30:2.

93.

A nurse is caring for an intubated, mechanically ventilated child. The child suddenly becomes notably pale and has diminished peripheral pulses. Hemodynamic monitoring reveals decreased oxygenation.

What is the priority nursing action in this scenario?

Call the physician and prepare for needle decompression

Administer IV sedatives and neuromuscular blocking agents

Administer an IV bolus of normal saline

Prepare the patient for chest radiographs

Correct answer: Call the physician and prepare for needle decompression

Air leak syndromes (e.g., pneumothorax, pneumomediastinum, pneumopericardium, and pneumoperitoneum) are complications of mechanical ventilation as a result of large tidal volumes and/or high pressure. The physician should be immediately notified in this scenario, and the nurse should prepare for needle decompression. A chest x-ray will be indicated after the procedure to verify the resolution of the pneumothorax.

Administering sedation and neuromuscular blocking agents is indicated in the diagnosis of pulmonary hypertension. A fluid bolus would be necessary in the case of hypotension.

94.

A child presents to the emergency department with abrupt-onset, large-volume hemoptysis secondary to right lower lobe pneumonia that the patient has been battling for approximately two weeks. The child does not have any underlying pulmonary, cardiac, hematologic, or neoplastic disease but is coughing up significant amounts of blood. The child requires airway stabilization with intubation and mechanical ventilation, and the emergency team is preparing for a blood transfusion.

Which of the following tests, if ordered by the physician, is diagnostic of pulmonary hemorrhage?

Sputum or gastric aspirate revealing hemosiderin in the lung

Hematocrit, reticulocyte count, and stool sample for occult blood

Culture of bronchoalveolar lavage (BAL) samples via bronchoscopy

Chest radiographs in at least two views to detect the site and extent of bleeding

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Correct answer: Sputum or gastric aspirate revealing hemosiderin in the lung

Infection is the most common cause of hemoptysis in children without underlying disease. It can be caused by any pneumonia or lung abscess, tuberculosis, or aspergilloma. Influenza virus may present with significant bleeding, and infections with relatively common community-acquired organisms such as Staphylococcus, Streptococcus, Klebsiella, and Pseudomonas can also cause hemoptysis.

Initial management for patients with large-volume hemoptysis includes airway stabilization and prevention of further bleeding. Once the patient is stable, laboratory work is performed (acute hemorrhage is accompanied by a drop in hematocrit, an increase in reticulocyte count, and a stool positive for occult blood). Chest radiography may indicate the site and extent of the bleeding, and culturing of BAL samples for bacteria, viruses, and fungi will help exclude infectious processes.

The diagnosis of pulmonary hemorrhage is most readily confirmed with the detection of hemosiderin-laden macrophages in sputum or gastric aspirate using Prussian blue staining.

95.

What is the MOST common complication of endotracheal intubation in a child?

Intubating the right mainstream bronchus

Perforating the trachea

Intubating the esophagus

Dental damage

Correct answer: Intubating the right mainstream bronchus

The most common complication of endotracheal intubation is inadvertent intubation of the right mainstem bronchus (if the tube is placed too deep) or dislodgment of the endotracheal tube (ETT) into the right mainstream bronchus if the child is positioned for procedures or transported within the facility. When this situation arises, chest expansion may not be equal, and breath sounds are absent or diminished in the left side of the chest. Pulse oximetry readings may be low, and ventilation may be difficult.

Prompt recognition of this complication is essential; it is corrected by withdrawing the ETT until equal breath sounds and equal chest movement are observed. It is important to document ETT placement measurement at the nose or lip once intubation is established.

96.

Functions of surfactant include all the following, EXCEPT:

Vasodilating the pulmonary vasculature

Preventing lung collapse during exhalation

Optimizing lung compliance

Defending against microorganisms

Correct answer: Vasodilating the pulmonary vasculature

Surfactant is a substance produced by type II alveolar epithelial cells in the lungs, consisting of proteins and lipids. It prevents alveolar collapse at end exhalation, lessens the work of breathing, optimizes lung compliance and surface area for gas exchange and ventilation-perfusion (V/Q) matching, protects the lung epithelium, and facilitates clearance of foreign substances. It also prevents capillary leakage of fluid into the alveoli and defends against microorganisms.

Premature infants have decreased levels of surfactant, which leads to respiratory distress syndrome (RDS). This often necessitates the administration of exogenous surfactant replacement therapy to increase lung compliance. Surfactant is not a vasodilator.

97.

Pediatric acute respiratory distress syndrome (PARDS) is characterized by which of the following?

Increased airway resistance

Increased lung compliance

Increased chest wall compliance

Decreased airway resistance

Correct answer: Increased airway resistance

ARDS in children is different than ARDS in adults. Pediatric ARDS occurs when fluid fills the lungs due to an infection or injury, causing increased airway resistance. This prevents air from filling the lungs efficiently and deprives the body of oxygen.

When lungs are inflamed and filled with fluid, they become stiff and unable to expand properly when breathing (decreased lung and chest wall compliance). Oxygen saturation levels decline rapidly, and other organs are at risk of failure. These patients need ventilatory support and management to allow the lungs to heal.

98.

An infant receiving mechanical ventilation is suddenly deteriorating. The nurse auscultates the infant's chest and notes air entry over the left upper abdominal quadrant. What does this finding indicate?

The esophagus has been intubated

The endotracheal tube (ETT) is too high in the trachea

The endotracheal tube (ETT) is too low in the trachea and is likely down the right mainstem bronchus

This is an expected finding and indicates correct tube positioning

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Correct answer: The esophagus has been intubated

Auscultating an infant's chest for the quality of breath sounds is an important tool when assessing an infant's condition, especially if they are deteriorating. If an infant is not improving with manual ventilation, there is likely a problem with the ETT (it is most likely malpositioned).

Air entry heard over the left upper abdominal quadrant (stomach) indicates the esophagus is intubated. The ETT will need to be repositioned or replaced. If the ETT is too high, there will be diminished air entry heard over the chest upon auscultation. If the ETT is too low, the nurse would expect to hear unequal air entry. If it is down the right mainstream bronchus, the right chest will be better aerated than the left chest.

99.

A nurse is caring for a child who is intubated and mechanically ventilated. The ventilator's FiO2 parameter is set at 50. What does this mean?

The child is using 50% oxygen

The child is breathing 50 mL of air with each breath

The oxygen flow rate for this child is 5 L/min

The child is breathing at a rate of 50 breaths per minute (bpm)

Correct answer: The child is using 50% oxygen

The FiO2 describes the percentage of inspired oxygen that the patient receives through the ventilator. This amount can be increased based on the child's response. Room air is 21% FiO2, so this patient is requiring more oxygen (at 50%) via the ventilator than is in room air.