Blood Supply to the Lungs

The pulmonary arteries transport deoxygenated blood (seen in blue) from the heart to the lungs, where it becomes oxygenated (indicated in red). This blood is then returned to the heart via the pulmonary veins. Inset—Capillaries in the lung tissue facilitate the exchange of respiratory gases between the alveoli and the red blood cells, resulting in pulmonary respiration.


seconds, a pulse rate of 160 and respirations of 52.

The parents report that the child has had a cold for the past two days. They had contacted their pediatrician, who started the baby on decongestant drops. They deny any fever.

The paramedics obtain a pertinent but brief medical history. The child apparently was the product of an uneventful pregnancy and a normal vaginal delivery. She received her first set of vaccinations the month before and has never been ill until now.

They quickly move the infant to the ambulance, where they switch from blow-by oxygen to a non-rebreather mask. They then prepare a pediatric bag-valve mask (BVM) unit and endotracheal (ET) tube. They place a pulse oximeter probe on the baby's heel and note oxygen saturation of 88 percent at 100% oxygen. The paramedics relay their patient report to medical control, which orders administration of nebulized albuterol through the mask and immediate transport. Transit time to the local children's hospital is approximately 10 minutes.

On arrival at the hospital, the infant begins to look better. Her respiratory rate is down to 44/min., and her oxygen saturation is up to 93 percent. The baby is re-evaluated by the emergency department staff. A chest X-ray reveals a bilateral bronchopneumonia pattern, and her blood count is found to be consistent with that of a viral illness. Laboratory analysis of a nasal washing is positive for respiratory syncytial virus (RSV).

The baby is diagnosed with RSV bronchiolitis and is admitted to the hospital. She is started on the antiviral drug ribavirin (Virazole), and breathing treatments with albuterol are continued. By the second hospital day, the child is much improved. She continues to do well and is discharged four days after admission.

Discussion

Infants and children are apt to develop respiratory problems for several reasons. First, the pediatric airway is smaller and thus more susceptible to swelling and foreign body obstruction than the adult airway; in children, even a slight reduction in the airway diameter can cause a dramatic decrease in airflow.

Second, in younger children, the immune system is still relatively imma-
Glossary of Terms

Atopic—Pertaining to atopy, a clinical hypersensitivity state, or allergy, with a hereditary predisposition.

Grunting—The noise caused by premature glottic closure during early expiration. It helps maintain increased airway pressure and alveolar expansion.

Hypoxemia—Insufficient oxygenation of the blood.

Rales—An abnormal sound heard on auscultation of the chest, produced by passage of air through bronchi that contain secretions or exudate or that are constricted by spasm or a thickening of their walls. May be heard on inspiration or expiration.

Respiratory Syncytial Virus—A major cause of lower respiratory tract disease in infancy and childhood, RSV affects the bronchiole lining.

Retractions—Visible indentations of the soft tissue covering the chest wall that indicate increased respiratory effort. Retractions may be seen directly above the sternum and clavicles (suprasternal), between the ribs (intercostal), below the lower costal margin of the rib cage (subcostal) or just below the xiphoid process (substernal).

Stridor—A harsh, high-pitched sound (similar to the sound of wind blowing) heard during respiration that is caused by obstruction of air passages.

Surfactant—An agent, such as oils and various forms of detergents, that lowers surface tension.

Tachypnea—Pertaining to tachypnea, which is an abnormal rapidity of respiration.

Tracheal Deviation—Movement of the trachea and mediastinum toward one side or the other due to hyperexpansion or collapse of a lung.

Tracheal Tugging—Pulsation of the larynx or downward pull of the trachea.

Transthracheal Ventilation—Method of mechanical ventilation in which a stream of oxygen is administered via a needle cricothyotomy.

Wheezing—Production of whistling sounds during difficult breathing.

ture and is often unable to mount a rapid and effective response to the multitude of viruses and bacteria that can cause respiratory infections. In fact, the average infant and young child will have six to seven upper respiratory infections per year (as opposed to the three to four per year in the adult). Third, the oxygen consumption rate of children is nearly double that of an adult. Thus, infants and children develop hypoxemia far more rapidly than their adult counterparts.

In addition to the routine respiratory infections found in children, serious respiratory emergencies also can occur during childhood. These include asthma, croup, epiglottitis, bronchiolitis, pneumonia and foreign body aspiration. All of these conditions warrant immediate intervention by EMS personnel.

Anatomy and Physiology
Understanding the anatomy and physiology of the respiratory system is essential to pediatric respiratory care, as is understanding what respiration actually is.

For purposes of study, the respiratory system is typically divided into upper and lower airways. The upper airway extends from the mouth and nose to the larynx, while the lower airway consists of those structures below the larynx.

The upper airway is responsible for warming and humidifying incoming air. It is also effective in air purification; dust and other particulate matter are trapped on the mucous membranes that line the upper airway and are eliminated, usually through swallowing. In addition, the mucous membranes contain a special antibody, called immunoglobulin A (IgA), which aids the body in fighting and preventing respiratory infections.

As air enters the upper airway through the mouth and nose, it passes through the larynx and into the trachea and lower airway. The trachea divides into the right mainstem bronchus, which is almost straight, and the left mainstem bronchus, which angles more acutely to the left. The mainstem bronchi then divide into the secondary bronchi, which ultimately divide into the bronchioles, or the small airways. These bronchioles contain smooth muscle which can contract or relax, changing the diameter of the airway.

After approximately 22 more divisions, the bronchioles become respiratory bronchioles, which contain only muscular connective tissue and have a limited ability to effect gas exchange. The respiratory bronchioles then divide into the alveolar ducts, which terminate in the alveolar sacs.

Blood is supplied to the lungs through two systems: the pulmonary arteries and veins, and the bronchial arteries and veins (see Figure 1). The pulmonary arteries transport deoxygenated blood from the heart to the lungs for oxygenation, and oxygenated blood is then transported from the lungs back to the heart via the pulmonary veins. (The lung tissue itself receives little of its blood supply from the pulmonary arteries and veins, relying instead on bronchial arteries that branch from the aorta to provide most of the blood supply.) The bronchial veins return blood from the lungs to the superior vena cava.

Respiration is the exchange of gases between a living organism and its environment. Pulmonary respiration occurs in the lungs when the respiratory gases are exchanged between the alveoli and the red blood cells via the pulmonary capillary membranes (see Figure 1 inset). Limited gas exchange also may occur in the alveolar ducts and respiratory bronchioles. The alveoli are kept expanded and more accessible to gas exchange through the presence of an important chemical called surfactant, which tends to decrease the surface tension of the alveoli, avoiding collapse.

Cellular respiration, on the other hand, occurs in the peripheral capillaries and is the exchange of the respiratory gases between the red blood cells and the various tissues.

Anatomical Differences in Children
The child's airway is anatomically different from the adult's (see Figure 2). For example, as a rule, the structures of a child's airway are proportionately smaller and more flexible than those of an adult—
with the exception of the tongue, which is larger in relation to the oropharynx. Also, the larynx is situated higher and in a more anterior position in the neck; the epiglottis (which protects the trachea during swallowing) is more floppy and narrow; the trachea is shorter and narrower; and the tracheal cartilage is more elastic than in the adult. Finally, unlike the adult, whose glottic opening is the narrowest part of the airway, the narrowest part of the child’s upper airway is at the cricoid cartilage.3

The Dyspneic Child

Children are susceptible to many of the respiratory problems that occur in adults, as well as several problems unique to children. The presence of such a problem should be identified in the primary assessment and treated appropriately.

By their very nature, most respiratory problems result in dyspnea, or difficulty breathing. No matter what the cause of the dyspnea, all levels of EMS providers must be prepared to assist children suffering from this disorder.

Assessment

The primary assessment in dyspneic children should be slightly modified from that of an adult to include a rapid cardiopulmonary assessment (RCA). This determines whether the child has a respiratory or circulatory problem that may lead to cardiopulmonary arrest.3

The first step of the RCA is to evaluate airway patency, employing the standard evaluation technique of look, listen and feel. Then, after evaluating and determining airway patency, caregivers must decide whether the airway requires head positioning, suctioning or airway adjuncts, or is unmaintainable. If the latter is the case, they may need to employ special techniques, such as foreign body removal or ET intubation.

After ensuring airway patency, providers should turn their attention to the patient’s breathing. The respiratory rate should be the first to be noted, as an increased respiratory rate is often the first manifestation of respiratory distress in children. Although this rate varies depending on the age of the child, any child with a rate of 60 breaths per minute or more is in respiratory distress (see Table 1 for normal vital sign ranges by age). However, it is important not to be lulled into a false sense of security by a decreasing respiratory rate. This is not necessarily a sign of improvement and could indicate that the child is tiring.

Next, breath sounds should be briefly evaluated. Stridor or wheezing, if present, indicate potential respiratory compromise and warrant further evaluation. It is also important to note how hard the child is working to breathe. Increased respiratory effort as evidenced by nasal flaring, inter-costal retractions or grunting indicate respiratory distress and pending respiratory failure.

Last, the child’s skin color (e.g., cyanosis, or blueness of the skin) can be a helpful indicator of the child’s condition. Again, however, it is important not to rely on this, as cyanosis is a late sign of respiratory failure.

The final component of the RCA is circulation. The first step here is to quickly determine the heart rate; any tachycardia in a child warrants further evaluation to determine the cause. Next, providers should evaluate end-organ perfusion, which is the best indicator of circulation in children.

The easiest method of evaluating end-organ perfusion is by determining capillary refill time. Capillary refill time is normally two seconds or less and can be evaluated by compressing and releasing a capillary bed, such as that under a fingernail. Once pressure is released, color should return to the capillary bed in two seconds or less. Any increase in capillary refill time indicates circulatory compromise.

Mental status is another indicator of perfusion. As blood flow to the brain diminishes, the infant or child will exhibit an alteration in mental status, possibly becoming agitated or lethargic. Failure of the child to recognize the parents is often an ominous sign.

Secondary Assessment

Once the RCA is completed and any immediate problems corrected, providers should turn their attention to the secondary assessment, repeating the RCA throughout care and transport. Quick, repeated evaluations will help determine whether the child’s condition is deteriorating or improving.

The secondary assessment is basically the same for the child as for the adult, although the order in which it is completed may vary depending on the child’s age. (Sometimes it’s easier to begin at the feet and work upward in children so they are not threatened by the exam and by having a stranger touch their face.) The first step in all patients is to determine accurate vital signs, remembering that they will vary according to the child’s age.

If possible, any problems detected during the secondary assessment should be corrected and appropriate BLS or...
A child’s airway is typically smaller and more susceptible to obstruction than an adult’s.


ALS care provided as discussed with medical control. If capillary refill is slow or if the child requires fluids or medications, venous access should be established either peripherally or, if the child is less than 3 years old and critically ill and a peripheral IV cannot be obtained, via an intraosseous needle placed in the proximal tibia. (Fluids and most drugs can be administered effectively via this route.)

The secondary assessment may also include the use of pulse oximetry and cardiac monitoring, both of which play a role in pediatric care. The pulse oximeter gives a constant indicator of peripheral oxygen delivery and heart rate, and the cardiac monitor aids in ongoing monitoring of the heart rate and surveillance for cardiac dysrhythmias. However, it is important not to rely on these technologies and to remember to treat the patient—not the monitor or oximeter.

If time allows after completing the secondary assessment, providers should try to assess the family members, who will quite likely be extremely anxious. Family members should be reassured and kept abreast of the treatment. However, they should never be given too many options, as it is hard for them to make appropriate decisions in a crisis situation. If family members become hysterical, be firm with them, possibly asking them to leave the area around the child if they refuse to calm down.

Parents will occasionally be angry, mostly as a by-product of the helplessness they feel. In these cases, EMS personnel may try and redirect their anger into doing something constructive, such as holding IV bags or assisting as they can with the care of their child. Again, however, if the parents continue to be uncooperative, they should be removed from the immediate area until they are calm.

Finally, the child should be transported to a facility that is capable of providing comprehensive pediatric care. The child should be continually reassessed during transport, particularly if he or she is critically ill or injured.

Treatment

Much as with the secondary assessment, treatment of the dyspneic child follows the same priorities set forth for adult prehospital care. The airway has the highest priority, followed by respiratory support ranging from supplemental oxygen administration to mechanical ventilation. The next step is circulation. If the child is pulseless, CPR should be initiated. If the child is critically ill and ALS is available, intravenous access should be established for both fluid and medication administration. (In pediatric respiratory emergencies, bronchodilator medications may be administered by small-volume nebulizers. However, in critically ill children, medication administration may need to be intravenous.)

Pediatric Respiratory Emergencies

Pediatric respiratory emergencies that deserve special attention include foreign body aspiration, croup, epiglottitis, bronchiolitis and asthma. Children with any of these disorders can suffer respiratory arrest, mainly due to airway obstruction or exhaustion, and require immediate intervention.

Foreign Body Aspiration
Children, especially 1- to 3-year-olds, are eager to place virtually any object in their mouths. Unfortunately, they face the risk of aspirating the object, especially when they are running or falling. In addition, many children choke on or aspirate food given to them by their parents or other well-meaning adults; young children have not yet developed coordinated chewing motions in the mouth and pharynx and often cannot chew their food adequately. Common foods associated with aspiration and airway obstruction in children include chewing gum, hot dogs, grapes, peanuts and Vienna sausages.

Assessment
The child with a suspected aspirated foreign body may present in one of two ways. If the obstruction is complete, the child will not be breathing. If it is partial, the child may exhibit labored breathing, stridor, retractions, chest expansion and cyanosis.

A foreign body aspirated into the respiratory tree will often drop until it lodges in a bronchus or one of the bronchioles—large objects will lodge in the trachea or the mainstem bronchi, while the smaller objects may drop to the bronchioles. Often, the food particle will act as a one-way valve, allowing the entry of air while restricting its exit. This results in hyperexpansion, or expansion beyond normal limits, of the affected lung. Or, in severe cases, tracheal deviation away from the involved lung may occur.

Management
When confronted with a child suspected of aspirating a foreign body, providers must complete the primary survey immediately. If complete obstruction is noted, the airway should be cleared using accepted BLS techniques. If this is unsuccessful and ALS capabilities are available, the airway should be visualized using a laryngoscope. If the foreign body is seen and is readily accessible, advanced providers can try to remove it using Magill forceps. If the airway cannot be cleared by routine measures, cricothyrotomy may be indicated.

If the obstruction is partial, the child should be made comfortable and given oxygen, humidified if possible. Care should be taken to avoid agitating the child, as this may lead to complete obstruction. Also, be aware that complete obstruction may occur at any time, and ALS providers should be ready to intubate. The child should be transported to a hospital, where the foreign body can be removed with special surgical techniques.

Croup
Croup, medically referred to as laryngotracheobronchitis, is an infection of the upper airway. It is most often caused by the parainfluenza viruses and tends to occur in fall and winter in children 6 months to 4 years of age. The infection causes edema to develop beneath the larynx and glottis (subglottic edema), narrowing the airway lumen (see Figure 3a). Severe cases of croup may result in complete airway obstruction and respiratory arrest.

Assessment
The history for croup is fairly classic. The child will have a mild cold or other infection and be doing fairly well until night falls. After dark, however, a harsh, barking cough develops. The attack may subside in a few hours but can recur over several nights.

Physical examination of the child will often reveal inspiratory stridor, associated nasal flaring, tracheal tugging or retractions. In such cases, never examine the oropharynx; in the prehospital setting, it is often difficult to distinguish croup from epiglottitis, and if epiglottitis is present, examination of the oropharynx may result in laryngospasm and complete airway obstruction. If the attack of croup is severe and progressive, the child may develop restlessness, tachycardia and cyanosis. If humidified oxygen is not available, it may be helpful to finish the exam in the bathroom with the hot water running.

Management
Management of croup consists of appropriate airway maintenance, placement of the child in a position of comfort, administration of humidified oxygen by face mask and transport to the hospital. The process of transporting the child from the house to the ambulance will often allow him or her to breathe cool air which may cause a decrease in the subglottic edema, improving the child's clinical condition.

In cases of severe croup, medical control may order the administration of albuterol (Ventolin, Proventil) or racemic epinephrine (VapoNefrin). Albuterol is beta agonist bronchodilator that in croup relieves the bronchospasm associated with subglottic edema.

Racemic epinephrine is also often effective in relieving swelling in the subglottic region, but there is a significant risk of rebound swelling, usually within 12 hours, following its administration. The racemic epinephrine should be reserved for only the most severe cases, and recipients should be admitted to the hospital for continued care and observation.

Some physicians advocate the use of corticosteroids in croup because they believe these drugs shorten the course of the illness. However, the use of corticosteroids in the prehospital setting is controversial.

Epiglottitis
Epiglottitis is an acute and potentially threatening infection and inflammation
the epiglottis. Caused by a bacterial infection, usually *Haemophilus influenzae*, it is characterized by a swollen, cherry-red epiglottis and severe respiratory distress and tends to occur in children 3 to 6 years of age. However, up to 25 percent of all cases of epiglottitis occur in children less than 2 years old.

Because of the sudden onset of the illness and the rapid progression of respiratory distress and obstruction, epiglottitis is a true emergency (see Figure 3b).

**Assessment**

Epiglottitis presents in a similar fashion to croup. Often, the child will go to bed feeling relatively well, usually with what the parents consider to be a mild infection of the upper respiratory tract. Later, the child awakens with a high fever, sore throat and a brassy cough. The progression of symptoms then can be dramatic. There is often pain on swallowing, continued sore throat and high fever, shallow breathing, dyspnea, inspiratory stridor and severe drooling.

On physical examination, the child appears to be in severe distress, often assuming the “tripod position,” leaning forward on outstretched arms. Again, never attempt to visualize the airway. However, if the child is crying, providers might be able to see the tip of the red and swollen epiglottis posterior to the base of the tongue. As airway obstruction develops further, the child will exhibit retractions, nasal flaring and pulmonary hyperexpansion.

**Management**

As with other respiratory emergencies, management of epiglottitis should consist of appropriate airway maintenance, placement of the child in a position of comfort and administration of high-flow humidified oxygen by face mask. Handling and examination should be minimized to prevent agitation and crying.

There are a number of contraindicated interventions in epiglottitis: racemic epinephrine, for example, is contraindicated, as it can worsen the condition. Also, the child should not lie down, as this may cause the swollen epiglottis to fall into and completely obstruct the airway. And, although all intubation equipment should be available, including an appropriately-sized endotracheal tube, intubation is contraindicated unless complete airway obstruction occurs. In this case, *translaryngeal ventilation* may be required.

In cases of epiglottitis, the child should be transported to the hospital as quickly as possible. If total obstruction develops, attempts should be made to ventilate the patient using high pressure, which may require depressing the pop-off valve on the BVM device. Be prepared to administer CPR.*5*

**Bronchiolitis**

Wheezing in a child less than 1 year of age, especially during winter months, is frequently due to bronchiolitis. This is a respiratory infection of the medium-sized airways—the bronchioles—which occurs in early childhood. It should not be confused with bronchitis, which is an infection of the larger bronchi.

Bronchiolitis is caused by a viral infection, most commonly RSV, which affects the lining of the bronchioles.

**Assessment**

Characterized by prominent expiratory wheezing, bronchiolitis clinically resembles asthma. Thus, a history is necessary to distinguish the two. With asthma, there is often a family history of asthma or allergies, although neither will be present in the child. A low-grade fever may also be present. A major distinguishing factor is age: Asthma rarely occurs before the age of 1 year, whereas bronchiolitis is more frequent in this age group.

The physical examination should be systematic in approach, with particular attention paid to the presence of *rales* or wheezes. Also, any evidence of infection or respiratory distress should be noted.

**Prehospital Management of Suspected Bronchiolitis**

Prehospital management of suspected bronchiolitis is much the same as with asthma. The child should be placed in a semi-sitting position if old enough, and humidified oxygen should be administered by mask. Ventilations should be supported as necessary and, as with the other emergencies mentioned, intubation should be readily available. If wheezing is present, medical control may request administration of a bronchodilator, such as albuterol, by small-volume nebulizer. The cardiac rhythm should be constantly monitored, and pulse oximetry, if available, should be used continually.

**Asthma**

Asthma is a common respiratory disease that affects 10 million Americans every year. It usually occurs before the age of 10 in approximately 50 percent of all cases and before age 30 in an additional 33 percent of cases. The disease tends to run in families and is also commonly associated with *atopic* conditions, such as eczema and allergies. While death from other respiratory conditions has been steadily declining, asthma-related deaths have increased significantly in the past decade, and hospitalization of children for treatment of asthma has increased by 200 percent or more during the same interval.6

Because children can die from asthma, prompt prehospital recognition and treatment are essential.

**Assessment**

Asthma can often be differentiated from...
other pediatric respiratory illnesses by the history; in many cases, there is a prior history of asthma or reactive airway disease. The child’s medications may also be an indicator. Children with asthma often carry inhaler or take a theophylline or oral beta-agonist preparation. Children with severe asthma often have a home nebulizer unit for routine administration of bronchodilators.

On examination, the asthmatic child is usually sitting up and leaning forward and is tachypneic. Often, there is an unproductive cough, and accessory respiratory muscle usage is usually evident. Although wheezing may be heard, in a severe attack the patient may not wheeze at all—known as “silent chest.” This is an ominous finding, as it may indicate insufficient air movement due to constricted airways. Generally, there is an associated tachycardia which should be monitored, since virtually all medications used to treat asthma increase the heart rate.

Management
The primary therapeutic goal in the asthmatic patient is to correct hypoxia, reverse bronchospasm and decrease inflammation. First, it is imperative to establish an airway and administer supplemental humidified oxygen as necessary. Next, medical control may order the administration of an inhaled beta agonist. Many paramedic units have the capability of administering nebulized bronchodilator medications, such as albuterol, terbutaline or isoetharine. If your system does not have access to such drugs, consider the use of subcutaneous epinephrine to treat severe asthma.

In addition to the beta agonist, anticholinergic agents such as atropine and ipratropium (Atrovent) may be requested to relieve the bronchospasm associated with asthma. If there is a prolonged transport time, medical control may also request administration of a steroid preparation. (For more information on asthma, see “Breathe Easy: Diagnosing and Treating Asthma in the Field,” JEMS, November 1993.)

Status Asthmaticus
Status asthmaticus is defined as a severe, prolonged asthma attack that cannot be broken by repeated doses of epinephrine. This is a serious medical emergency, and prompt recognition, treatment and transport are required.

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Olien, the child suffering status asthmaticus will have a greatly distended chest from continued trapping of air. Breath sounds and even wheezing may be absent. The patient is usually exhausted, severely acidic (a symptom of exhaustion) and often dehydrated.

The management of status asthmaticus is basically the same as for asthma. However, it should be recognized that respiratory arrest is imminent and that respiratory support will be needed. ALS personnel should be prepared to intubate. Transport should be immediate, with aggressive treatment continued en route.

Because of the sudden onset of the illness and the rapid progression of respiratory distress and obstruction, epiglottitis is a true emergency.

Conclusion
Respiratory emergencies are among the most common of childhood. When responding to these calls, it is important for prehospital personnel to remember that hypoxemia secondary to respiratory failure is the leading cause of cardiac arrest in infants and children. Thus, prehospital personnel should apply the RCA to all children suffering respiratory distress to help determine whether they are at risk of deteriorating to respiratory or cardiopulmonary arrest. Remember, the key to successful management of pediatric respiratory emergencies is early recognition and prompt management.

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1. In relation to the adult airway, a child's airway is:
   a. Larger in diameter
   b. Smaller in diameter
   c. Longer in length
   d. The same size as the adult airway

2. A child's oxygen consumption rate is:
   a. Approximately double that of an adult
   b. Approximately three times that of an adult
   c. Approximately one-half that of an adult
   d. Nearly the same as an adult

3. The upper airway consists of the:
   a. Mouth and nose only
   b. Pharynx and larynx
   c. Structures below the larynx
   d. Mouth and nose and the structures above the larynx

4. The bronchioles contain ____ of the airway.
   a. Mucus membranes, diameter
   b. Mucus membranes, resistance
   c. Smooth muscle, diameter
   d. Smooth muscle, length

5. The narrowest part of the child's upper airway is:
   a. The glottic opening
   b. The criocoid cartilage
   c. The larynx
   d. The nasal passage

6. The primary assessment in a pediatric patient should include:
   a. Determining vital signs
   b. Assessing pupillary status
   c. Performing a rapid cardiopulmonary assessment (RCA)
   d. Determining body temperature

7. The first step in an RCA is:
   a. Evaluating airway patency
   b. Assessing level of consciousness
   c. Determining respiratory rate
   d. Checking capillary refill

8. Any child with a respiratory rate of ____ breaths per minute or more is in respiratory distress.
   a. 30
   b. 45
   c. 60
   d. 75

You respond to a call at a day care center for a child having difficulty breathing. On arrival, you find a 2-year-old who is cyanotic with labored breathing, sternal retractions and chest hyperinflation. On auscultation of the lungs, you note breath sounds on inspiration but diminished sounds on expiration. The day care manager states that the child had just finished eating a snack of seedless grapes when she started having difficulty breathing.

9. You suspect the child is suffering from:
   a. Complete airway obstruction
   b. Partial airway obstruction
   c. Asthma
   d. Croup

10. Appropriate treatment for this child is:
    a. Back blows and chest compressions
    b. Blind finger sweeps
    c. Placement of the child in a position of comfort, administration of oxygen and transport to a hospital
    d. Calling for ALS

11. You are assessing a 3-year-old male child who has a barking cough. His mother says he has had a mild case of the flu lately, and the cough started after he was put to bed. You immediately suspect:
    a. A nocturnal asthma attack
    b. Croup
    c. Epiglottitis
    d. Partial airway obstruction

12. When caring for a child suspected of having epiglottitis or croup, it is important not to:
    a. Attempt to visualize the airway
    b. Administer oxygen that is not humidified
    c. Place the patient in a prone position
    d. Hyperextend the head

13. An 8-month-old infant is presenting with prominent expiratory wheezing. This may indicate:
    a. Complete airway obstruction
    b. Croup
    c. Epiglottitis
    d. Bronchiolitis

14. You are on a call for a dyspneic child, and the father tells you that the child takes theophylline. You suspect the child is suffering from:
    a. An asthma attack
    b. Croup
    c. Bronchiolitis
    d. Epiglottitis

15. The primary therapeutic goal when treating an asthmatic patient is to:
    a. Reverse the bronchospasm and call the child's doctor
    b. Break up the mucous plugging
    c. Correct hypoxia, reverse the bronchospasm and decrease inflammation
    d. Control the patient's respiratory rate

Questions 16 through 20 are mandatory for paramedics. EMTs may answer the questions, but credit will not be applied to their scores.

16. An appropriate means of vascular access in a 4-year-old, critically ill patient is via:
    a. External jugular cannulation
    b. Internal jugular cannulation
    c. Intravenous needle in the proximal tibia
    d. The umbilical vein

17. Foreign bodies in the airway that can be visualized via a laryngoscope are best removed using:
    a. A rigid suction tip with high vacuum suction
    b. A suction blade
    c. The paramedic's fingers
    d. Magill forceps

18. Patients with epiglottitis should be routinely intubated in the field?
    a. True
    b. False

19. Albuterol (Ventolin) is classified as:
    a. A beta agonist bronchodilator
    b. A beta antagonist bronchodilator
    c. Sympathomimetic
    d. Sympatholytic

20. Racemic epinephrine is used only rarely in the field because of side effects, including:
    a. Extreme dryness
    b. Rebound swelling within two hours
    c. Arrhythmias during the next 12 hours
    d. Racemic epinephrine has no side effects.

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