chapter 11

Throat and Thorax Injuries

Objectives

After completing this chapter, the student will be able to do the following:

- Understand the basic anatomy of the throat and thorax.
- Understand how to prevent injuries of the throat and thorax.
- Know the care necessary to treat an injury to the throat or thorax.
- Understand the implications of illness or injury related to specific organs in the thorax.

The thorax is the part of the body between the neck and the abdomen. Compromise of the organs and passageways in the throat and thorax is life threatening. Prompt care can save an athlete's life.

ANATOMY OF THE THROAT

The throat contains the carotid arteries, jugular veins, larynx, trachea, and esophagus. Because these structures are so sensitive and vital to life, the AT must understand their purpose and location (see figure 11.1).

The **esophagus** is the passageway for food going from the mouth to the stomach. It lies in front of the cervical vertebrae and behind the trachea and larynx. The **trachea** is made up of circular rings of cartilage; it is the main trunk of the system of tubes through which air passes to and from the lungs for the exchange of oxygen and carbon dioxide. The **larynx** is the modified upper part of the trachea and contains the vocal cords.

One **carotid artery** and one **jugular vein** pass on each side of the trachea. The carotid arteries carry oxygenated blood to the brain while the jugular veins carry unoxygenated blood away from the brain. Severing one of these vessels can cause death in a short time, so protection of the neck is vital in sports such as ice hockey and field hockey.

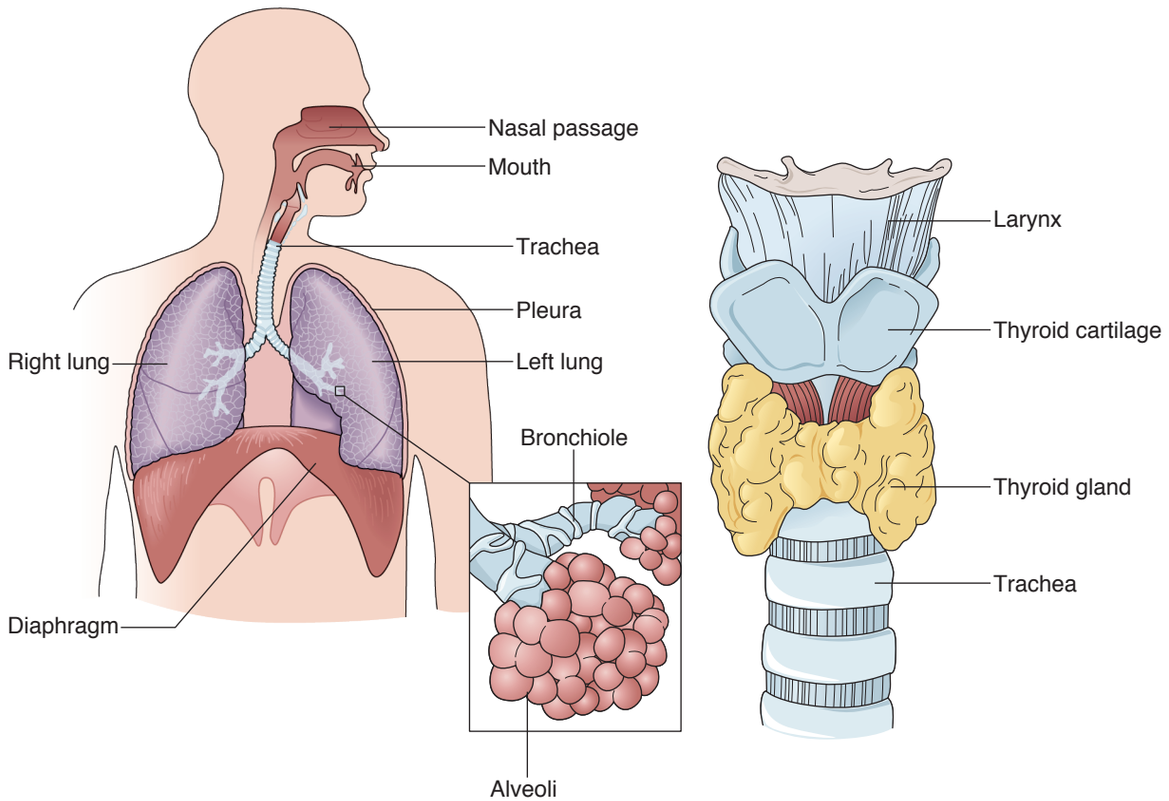

Figure 11.1 Anatomy of the thorax and throat.

ANATOMY OF THE THORAX

The bony structure of the thorax is made up of the thoracic vertebrae posteriorly, 12 ribs on each side, and the sternum anteriorly (see figure 7.3). These bones protect the sensitive organs in the thorax. The two lowest ribs do not attach to the sternum and are called *floating ribs*.

Heart and Lungs

The heart is about the size of a fist and is responsible for pumping blood to all parts of the body. The blood carries nutrients and oxygen to cells and carbon dioxide and waste products away from cells. The heart is divided into four chambers: the upper chambers, which include the left and right atria, and the lower chambers, which include the left and right **ventricles** (see figure 11.2). The ventricles are generally larger and have thicker walls than the atria because they pump the blood throughout the body. Exercising the heart muscle makes it larger and more efficient at pumping. However, an enlarged heart can also be a sign of heart disease.

The heart pumps blood to the lungs and around the body (see figure 11.3). The right **atrium** fills

FYI

Veins
Veins carry waste products and carbon dioxide back to the heart (except for the pulmonary vein, which carries oxygenated blood to the left atrium).

Arteries
Arteries carry nutrients and oxygenated blood away from the heart and throughout the body.

Oxygenated
As blood passes through the lungs, it picks up oxygen and becomes oxygenated, or oxygen rich.

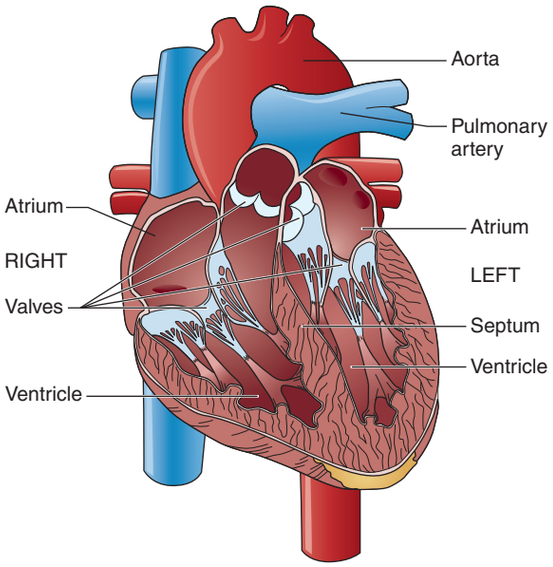

Figure 11.2 Interior of the heart.

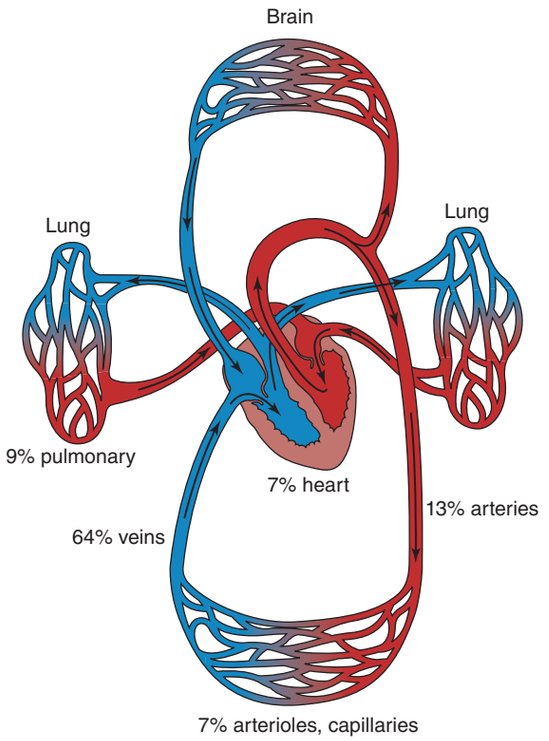

Figure 11.3 Circulation of blood through the heart and distribution to the body.

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with blood from a vein, which is carrying waste products and carbon dioxide. The right ventricle receives blood from the right atrium and pumps it to the lungs to get rid of carbon dioxide and pick up oxygen. The left atrium fills with the oxygenated blood from the lungs. The left ventricle, which is the largest chamber of the heart, receives the oxygenated blood from the left atrium and pumps it throughout the body. The main artery leaving the heart is known as the aorta. The aorta travels downward through the chest and abdomen, and other large arteries branch off to the head (carotid arteries), arms (brachial arteries), and legs (femoral arteries) (see figure 11.4). After the oxygen-rich blood has been delivered and used by the tissues, the deoxygenated blood returns to the heart through major veins (see figure 11.5).

Two electrical nodes in the right atrium begin a contraction. A slight delay in impulses conducted from the nodes through the heart allows blood to be squeezed from one chamber to another. Injured or diseased electrical nodes cause the heart to stop or to beat ineffectively.

The lungs, which are located on each side of the heart, exchange oxygen and carbon dioxide and dissipate body heat. The trachea divides into two bronchi, the bronchi further subdivide into bronchioles, and each bronchiole ends in an alveolus, an air-containing cell of the lungs (see figure 11.1). It is in the **alveoli** that the exchange of oxygen and carbon dioxide occurs. The lung tissue is divided into sections, or lobes. There are three lobes in the right lung and two lobes in the left lung. Lung capacity is hampered primarily by smoking, pollution, and lung disease. The bronchi are filled with cilia, which are small, hairlike projections that help remove foreign substances such as dust and pollen. Coughing and sneezing help to keep the trachea and bronchi clear and remove **phlegm** and allergy-causing agents.

Lung function and breathing rate are controlled by carbon dioxide receptors. When receptors register the presence of too much carbon dioxide, inhalation occurs. Exercise increases cell metabolism

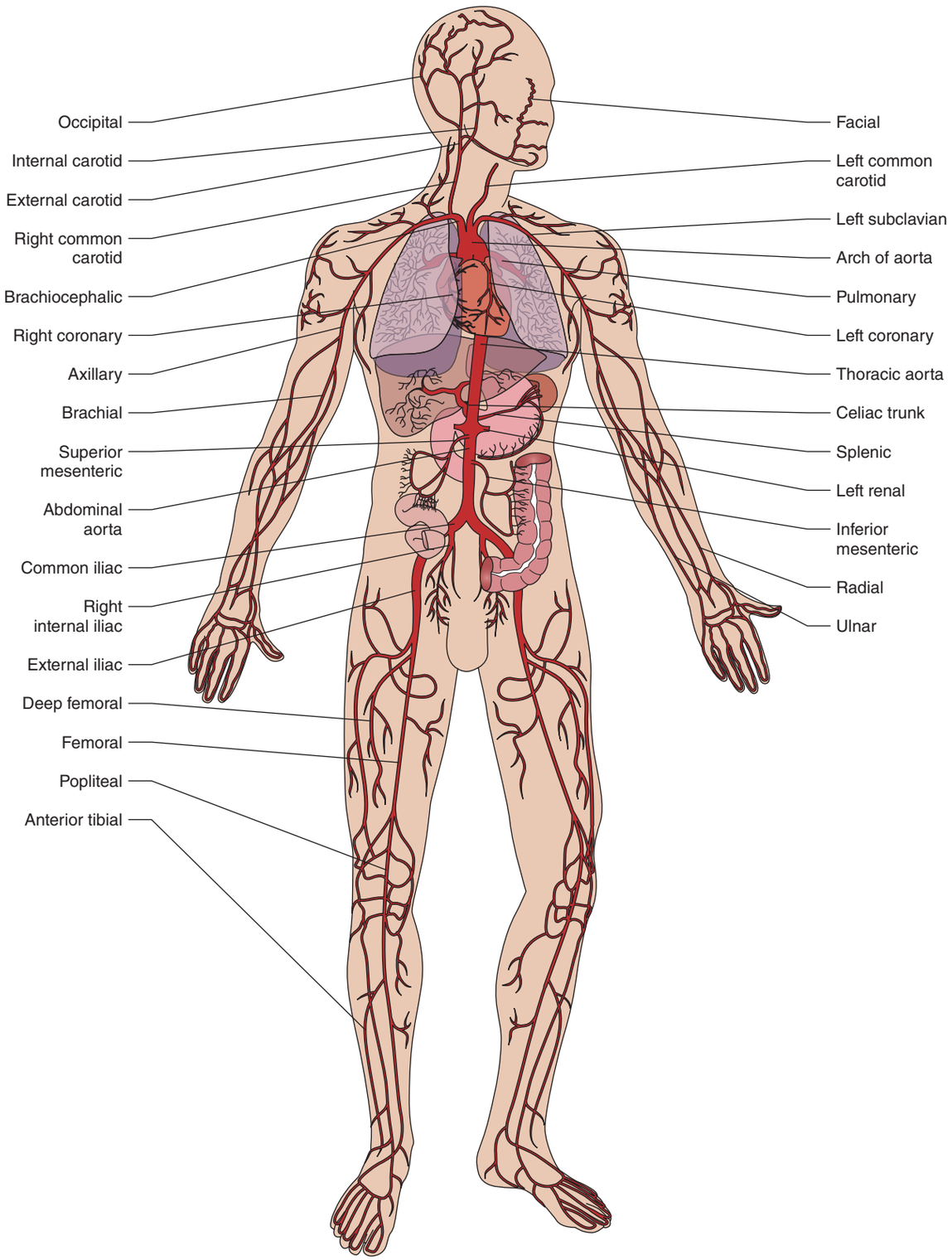

Figure 11.4 Major arteries.

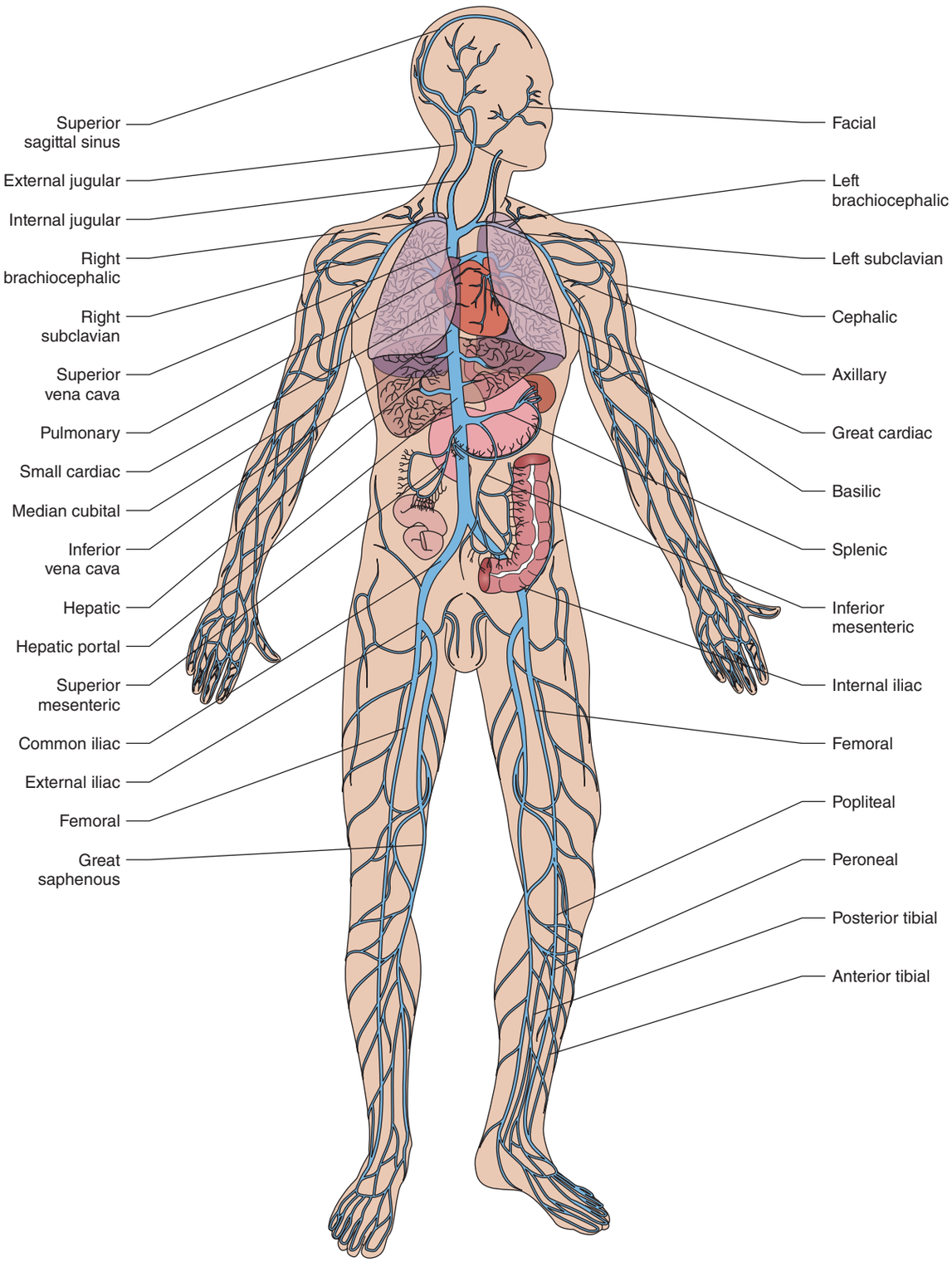

Figure 11.5 Major veins.

and causes cells to need more oxygen and eliminate more carbon dioxide. This increased cellular need increases the number of breaths per minute. Over time, the ability of the lungs to exchange air effectively increases as the athlete exercises, and the athlete's breaths become deeper and more forceful. Moreover, a conditioned athlete will return to a normal breathing rate more quickly after exercising compared with someone who is out of shape.

A thin, lubricated tissue called the *pleura* lines each half of the thorax and is folded back over the surface of the lung on the same side. The pleurae allow smooth movement of the lungs as they encounter the wall of ribs during inhalation and exhalation. There is a small space between the pleura and the lung.

Diaphragm

The **diaphragm** muscle separates the thorax and the abdominal cavity. The diaphragm contracts and pulls down to assist in inhalation and moves upward to push air out of the lungs on exhalation (see figure 11.6). The diaphragm has three openings to allow passage of the esophagus, the abdominal aorta (artery), and the inferior vena cava (vein).

PREVENTING THROAT AND THORAX INJURIES

Protective equipment and rules in athletic contests are both designed to prevent injuries to the throat and thorax because these areas contain organs that are vital to life. Thus, athletes wear throat protectors in softball, baseball, lacrosse, field hockey, and ice hockey. In field hockey, lacrosse, football, ice hockey, softball, and baseball, protective equipment—shoulder pads, chest protectors, and sternal pads—is provided for the thorax, especially for goalies. A safe distance between the boundary of a playing surface and objects such as bleachers, fences, scorers' tables, and spectators is 15 feet (4.5 m). In addition, walls, tables, and fences are often padded to prevent injury to athletes who may collide with these objects.

Many Little League softball and baseball players are required to wear chest protectors when batting because of the danger of being struck in the chest with a ball. If a ball strikes the chest just before a heartbeat is initiated, it can cause the heart to beat irregularly or even stop, which could result in death.

When buying equipment to protect an athlete in a potential life-and-death situation, get the best available. Make sure the equipment is certified and will

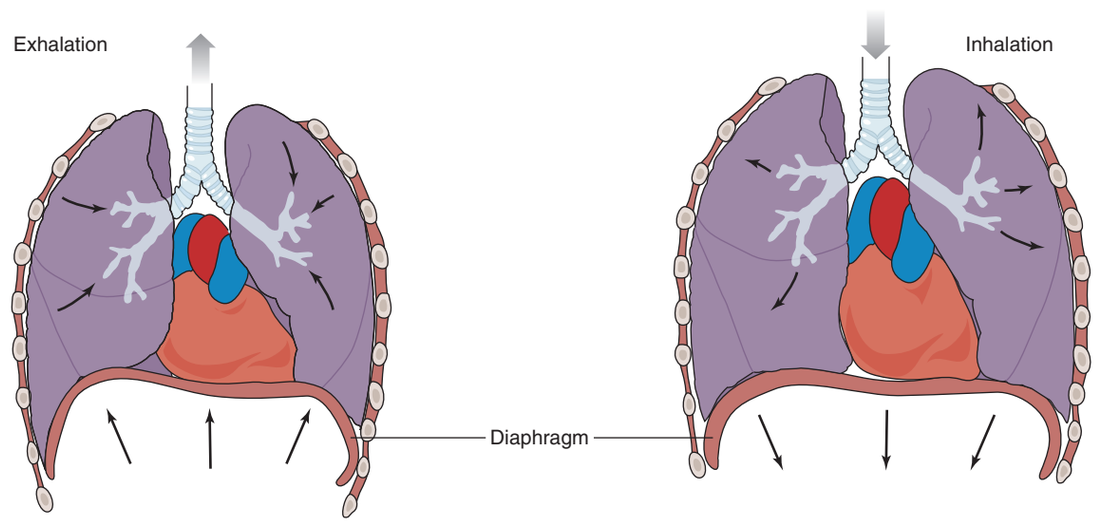

Figure 11.6 Breathing. The diaphragm moves upward during exhalation and downward during inhalation.

What Would You Do If . . .

You are proudly wearing your new student assistant's uniform of a white sweater. This is the first sweater you have received after working with the AT for two years. At the ice hockey game, the goalie suffers a lacerated vein in the neck. You are asked to assist the AT in stopping the bleeding. Blood is everywhere—it is definitely going to get on your new sweater.

do what it claims. When a baseball hits the chest of a Little Leaguer, the chest protector is supposed to absorb the force and reduce the impact on the heart. However, some of the chest protectors used by Little Leaguers are not certified and may actually increase the chance of irregular heartbeat if a ball hits the chest because they focus the impact over the heart.

TREATING THROAT INJURIES AND CONDITIONS

Throat injuries can be simple or devastating. Most of the injuries that occur to the throat are contusions caused by blows from sticks, feet, or arms. Contusions can be treated by applying ice. In any type of throat injury, the athlete will experience coughing, spitting, difficulty breathing, and pain.

Throat Laceration

A throat laceration could occur, for example, when one player's ice skate goes across another player's throat. Lacerations that are not deep can be handled with direct pressure. Deep lacerations or those that affect a jugular vein or carotid artery are medical emergencies and require immediate treatment. Apply direct pressure over the site of the laceration and treat the athlete for shock. The athlete will be placed on her side with her feet elevated. The injured side must be placed closest to the ground. Lacerations of the throat can allow oxygen into the circulatory system, which can cause an **air embolism** and sudden death. If air enters the vein or artery, it can block blood flow. Reduced blood flow causes tissue death. The air embolism gravitates toward the body part that is elevated, in this case, the feet. The vessels in the neck are large, and a massive amount of blood will be lost rapidly, so the AT must respond quickly to save the athlete's life. To review procedures for treating hemorrhages, see the Hemorrhage section in chapter 24.

Cartilage Fracture

A severe blow to the throat can result in a fracture of the circular cartilaginous rings of the trachea, which can be life threatening. The athlete will have difficulty breathing and talking, gasp for air, spit up blood, complain of pain, and be very anxious. His skin may turn a bluish color due to lack of oxygen. The AT must exercise caution when treating a cartilage fracture because the trauma also may have caused a fracture of the cervical spine. This is a medical emergency. The AT will place the athlete on a backboard for transport to the hospital and apply ice to the area to reduce swelling. Those treating the athlete must remain calm to keep the athlete calm. Keep the airway free of blood and make sure medical care is on the way.

The Real World

At an ice hockey game, a young man was trying to stop a shot on goal with a diving headfirst slide. The slap shot hit him square in the throat. It was immediately apparent that he was in life-threatening danger. The team physician and AT jumped onto the ice before play was stopped. They quickly assessed him and found he had difficulty breathing, a blue skin tone, an inability to speak, and rapid swelling over the throat. They iced his throat and put him on a backboard. His breathing was constantly monitored, and the physician was ready to make an emergency airway. Paramedics arrived and took the young man to the hospital. He recovered—with a deeper voice and partial loss of the use of his vocal cords. He now wears a throat protector, and he slides feetfirst to stop slap shots!

Lorin Cartwright, MS, ATC

TREATING THORAX INJURIES AND CONDITIONS

Many people suffer from conditions such as asthma or experience hyperventilation. Additionally, if the thorax is not adequately protected, it is vulnerable to blunt trauma that can result in fractures of the ribs or sternum. Moreover, severe trauma may cause a lung injury.

Hyperventilation

Hyperventilation is quick, deep breathing at a rate of more than 24 breaths per minute, which leads to abnormal loss of carbon dioxide from the blood. The condition can be caused by an athlete becoming too excited and beginning to breathe rapidly or by an underlying illness such as diabetes. If the athlete does not get her breathing under control, she will experience lightheadedness; numbing of the fingers, toes, and lips; and loss of consciousness. As hyperventilation continues, muscular contractions will occur in the limbs. To treat hyperventilation, the AT should talk calmly to the athlete and encourage her to control her breathing rate.

Exercise-Induced Asthma

Asthma is a chronic inflammation of the breathing passageways to the lungs. The triggers can be many, but in this instance, exercise causes the asthma attack. The bronchi spasm and narrow the breathing passageways. This narrowing causes the athlete to wheeze and struggle with taking a full breath. The feeling has been described as if one is breathing through a straw. An athlete may also experience coughing, tightness of the chest, lips turning blue, fingernails turning blue, and mucus production.

The immediate treatment is to have the athlete stop activity, sit upright, and breathe in through the nose and out through the mouth (see figure 11.7). The athlete should take the medication that has been prescribed before the attack gets worse. Breathing must be controlled even though he feels as if he is not getting enough air. Breathing in through the nose humidifies and cleans the air. Exhalations should last for a count of five. If mucus is coughed up, the athlete should lean forward and remove it. He should continue to control his breathing and to relax as much as possible. If the athlete is unable to breathe or is progressively worsening, EMS must be called and the AT must be prepared to perform CPR.

One preventive method that has been used with success is to have athletes take their medication about 20 minutes before exercise. Athletes who have a known asthma problem should be tested during their preparticipation physical with a spirometer. A spirometer is a device that measures air volume, both in and out. The spirometer measurements are recorded on the athlete's physical form. The spirometer can be used to test air volume at the time of a suspected attack; if it is less than the preparticipation amount, an asthma attack should be the diagnosis.

Jogger's Nipple

Jogger's nipple is most commonly found among male athletes. It occurs when the shirt one is wearing rubs against the nipple repetitively. It is called *jogger's nipple* because long-distance runners are the most inclined to suffer this condition. The nipple becomes irritated, sometimes to the point where application of a lubricant or bandages becomes necessary.

Prevention involves using lubricant or applying an adhesive bandage over the nipple. If the irritation does not subside with minimal treatment, a physician may have to evaluate the athlete to determine if an infection has occurred.

What Would You Do If . . .

An athlete comes off the playing field where you are standing. She is having trouble catching her breath. You ask her what happened and she says, "I just got the wind knocked out of me. I'll be fine in a minute." The minute passes, and she is still struggling to catch her breath.

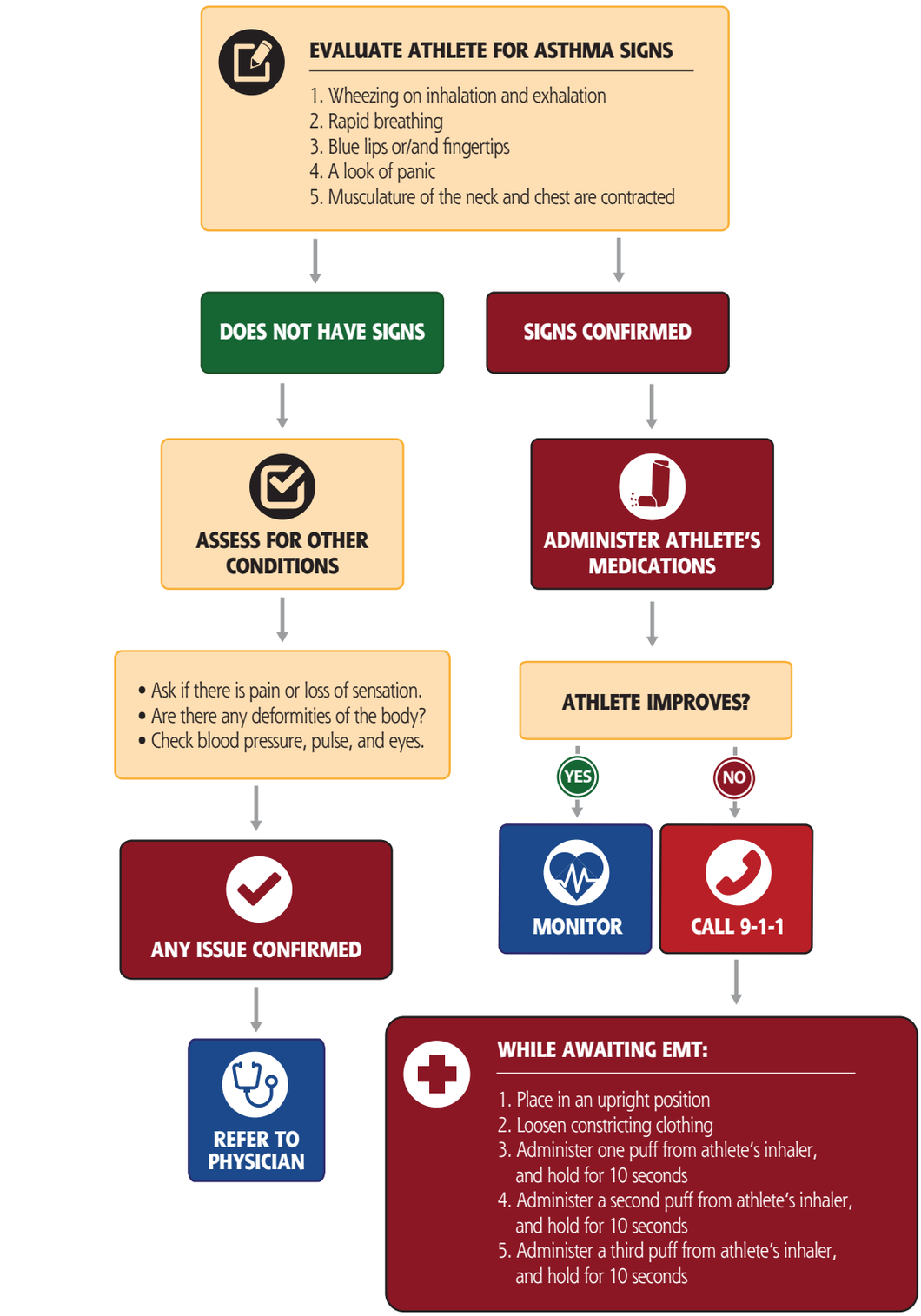

Figure 11.7 Treating an asthmatic attack.

Blow to the Solar Plexus

The typical cause of a solar plexus injury is a blow to the area of the diaphragm that hits the nerve in the solar plexus. When this occurs, the athlete will struggle to take a breath because the diaphragm spasms. After a short span of time, the diaphragm relaxes, and the person is able to breathe normally again. The AT should reassure the athlete while he recovers.

Pulmonary Contusion

A pulmonary contusion is a bruise of the lung due to impact, such as from a baseball to the chest or a tackle. The contusion results in an accumulation of blood and other fluids within the lung tissue. Unfortunately, the accumulated fluid keeps the lung from exchanging oxygen and carbon dioxide, and the larger the contusion, the more serious the injury. The athlete will have difficulty breathing and may have a bluish skin color. Application of ice may be helpful, but EMS must be called immediately.

Myocardial Contusion

When there is an impact to the chest over the heart, the heart can become bruised. In sport, a typical impact would come from a ball or a shoulder into the chest. An athlete may experience pain in the chest, especially over the sternum, and a rapid heart rate. In this instance, the injury merits calling EMS and treating the athlete for shock.

Rib Contusion

A rib contusion is caused by the same impact or compression as a rib fracture, but the force does not cause a fracture. There is pain, and signs and symptoms may be similar to those of a rib fracture. When the AT evaluates the athlete, there is pain over the site of the impact but not on compression away from the site.

Treatment involves ice application and rest. An athlete may participate as pain allows. The area may have to be padded to allow participation.

Ruptured Diaphragm

Infrequently in athletics, the diaphragm can rupture as a result of a blow to the general area of the diaphragm. The athlete will present with difficulty breathing with no real trauma to the chest. The athlete may have other internal injuries, most likely in the abdominal region. If the AT auscultates the chest, bowel sounds may be heard.

Treatment is to care for the presenting signs or symptoms. If the athlete is having difficulty breathing, elevating the head will be helpful. Treat the athlete for shock and call EMS. This injury is hard to diagnose, so if difficulty with breathing continues to be a problem, call EMS.

Sternal Fracture

Sternal fractures occur because of direct impact. Impact to the sternum that causes a fracture can be expected to also cause internal injuries, so the heart and lungs may be involved. A suspected fracture of the sternum is treated with application of ice and referral to the hospital. If the sternum is only contused from the impact, the athlete could possibly return to activity with a special sternal pad.

Rib Fracture

A rib fracture is caused by direct impact or chest compression. On rare occasions, a sudden violent muscular contraction, such as throwing a baseball, will cause a rib stress fracture. Blows to the front or back of the ribs generally do not result in inward displacement of the fractured rib. Blows to the lateral aspect, however, are more likely to lead to inward penetration, causing complications such as internal bleeding or a punctured lung.

An athlete with fractured ribs experiences pain and difficulty breathing. The pain increases with inhalation, and the athlete usually holds a hand over the injured area in an effort to support the ribs. The area may be deformed due to swelling. A key to determining if a rib is fractured or severely contused is to note whether the athlete experiences increased pain with inhalation but not exhalation. If she has pain during both inhalation and exhalation, she more likely has a contusion.

Treatment for uncomplicated rib fractures involves applying ice and sending the athlete for X-rays. The team physician will restrict the athlete's physical activity until inhalation is not painful. If the athlete participates in a contact sport, all activity should be stopped for six weeks. When he returns to competition, he should wear protective padding or equipment.

Flail Chest

Flail chest occurs when several consecutive ribs are fractured in two or more places (see figure 11.8). This injury occurs from an impact directly to the ribs. The entire fractured portion moves in and out when the athlete breathes; however, the portion moves opposite to the normal breathing pattern. Normally the chest expands and the ribs move outward during inhalation, and during exhalation the chest moves inward. With a flail chest, the fractured portion moves outward during exhalation and inward during inhalation. This movement creates extreme pain and difficulty breathing. Breathing will be painful and distressed, the athlete will be anxious, and skin tone will be bluish. The athlete should be checked for other internal injuries, especially lung contusions.

Treatment of a flail chest includes decreasing the movement of the fractured ribs. This can be accomplished by placing an object such as a sandbag or pillow over the fractured segment to keep it from moving. The athlete can be placed on her injured side as a way of controlling the movement of the flail chest, and she also should be treated for shock. This is a medical emergency and requires rapid advanced care.

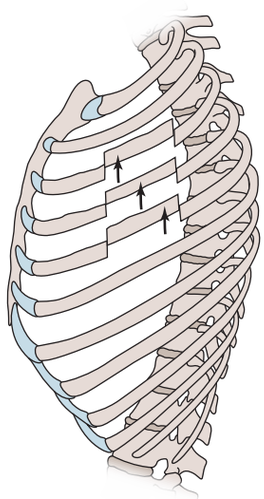

Figure 11.8 When two or more ribs are broken in two places, it makes flail chest possible—the broken section of ribs moves inward toward the heart and lungs during inhalation and outward during exhalation.

Pneumothorax

A **pneumothorax** is the presence of air in the pleural cavity, commonly known as a collapsed lung, which can occur either as a result of trauma or without trauma. A traumatic pneumothorax can occur from a rib puncturing the lung, a gunshot wound, or a severe laceration. A nontraumatic pneumothorax occurs due to a weakness of the lung tissue. When a pneumothorax occurs, the injured lung moves toward the center of the chest, which puts pressure on the heart and the other lung. Because only one lung is functioning, the athlete will experience difficulty breathing and will gasp for air. As the athlete continues to breathe, air goes through the hole in the lung and into the chest cavity, which causes the collapsed lung to compress the heart and opposite lung even further.

Spontaneous Pneumothorax

When there is an imperfection in the tissue of the lung, it can break and cause the lung to collapse, also known as a spontaneous pneumothorax. There need not be any impact or illness associated with a spontaneous pneumothorax; the athlete may have appeared healthy in the past and had no previous signs of illness. The athlete will experience difficulty with breathing, chest pain, and possibly bluish color of the skin if breathing is poor.

The athlete should be placed so that the side with the injured lung is closest to the ground. The AT will treat the athlete for shock and get him to a hospital. In general, a spontaneous pneumothorax will heal itself without surgical intervention.

Tension Pneumothorax

An athlete with a pneumothorax may develop a more serious problem called a *tension pneumothorax*. As air leaks out of the collapsed lung and into the chest cavity, it forces the lung to press against the other lung and the heart. If the AT observes the trachea deviated to the side of the throat, she should suspect tracheal shifting. As pressure builds in the chest, the trachea moves away from the side of the pneumothorax. If the trachea moves, the athlete will experience severe respiratory

distress. As more air enters the chest cavity, more pressure builds against the heart and uninjured lung. As the pressure mounts, the heart begins to labor as blood flow and breathing are impeded. Death can occur if the athlete is not treated rapidly. If the athlete has an external puncture wound, partially cover it, leaving one side unsealed. Sealing the wound entirely will prevent the inner air from escaping, worsening the tension pneumothorax.

With tension pneumothorax, the athlete will experience respiratory distress, absent breath sounds on the injured side, anxiety, and bluish skin color. His pulse will be rapid and weak, and his blood pressure will drop. As the pneumothorax worsens, tracheal deviation and neck vein distention will occur, as will bulging of the muscles between each of the ribs. The AT should place the athlete so that the side with the injured lung is closest to the ground, treat him for shock, and get him to a hospital. This injury requires a physician to insert a chest tube to allow air to escape as well as possible surgical intervention.

Sucking Chest Wound

If the wall of the chest is punctured and air from the outside is drawn noisily into the cavity, the athlete has a **sucking chest wound** (see figure 11.9). In this injury, the lung is not punctured. However, the air that is being sucked into the chest cavity applies pressure on the lungs and heart, causing distress. The athlete will have difficulty breathing, and circulation may become impaired, resulting in a bluish skin color. The athlete is best treated by sealing the wound with a cellophane wrap or a piece from a plastic bag. EMS must be called immediately.

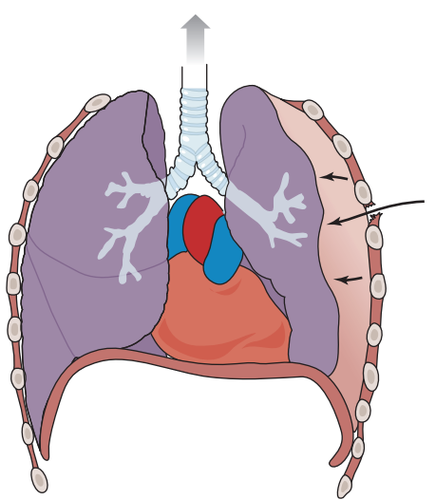

Figure 11.9 Sucking chest wound. When the chest is pierced, air can enter the chest cavity directly from the outside, which causes the lung on the same side to compress. Breathing becomes difficult.

Hemothorax

A **hemothorax** is blood in the chest cavity. The bleeding can occur from an internal injury, such as a ruptured lung or blood vessel. A hemothorax may also occur from an external wound that penetrates the chest, such as a javelin into the chest.

A hemothorax is similar to a pneumothorax in that the blood puts pressure on the heart and lungs, which decreases their ability to function normally. As blood fills the chest cavity, the athlete will have difficulty breathing, may turn blue from lack of oxygen, may become unconscious, will have a rapid weak pulse, will sweat, and will go into shock. Breath sounds may be absent on the side of the bleeding.

Bleeding into the chest cavity is serious and requires immediate care to prevent death. The AT must call for immediate transportation to the hospital and control the bleeding as best she can. The athlete may require CPR if advanced help is delayed.

Cardiac Tamponade

Blows to the thorax can affect not only the lungs but also the heart. There is a thin pericardial sac around the heart. When fluid fills the sac, it places pressure on the heart to the point where it may stop beating. An injury to the heart increases fluid in the sac. In athletics, the most likely cause is a blow to the chest.

Cardiac tamponade is a medical emergency that will cause death if not diagnosed and treated quickly. The athlete will be in shock, with all the signs and symptoms. The defining sign of cardiac tamponade is a narrowing pulse pressure, meaning the systolic and diastolic pressures come closer together after each repetitive taking of the blood pressure. EMS must be called and oxygen administered. On arrival at the emergency room, a needle will be inserted into the chest to remove the fluid.

RED FLAGS

Call 911 if any the following signs or symptoms exist with a throat or thorax injury:

- Difficulty breathing
- Wheezing
- Low blood pressure of 90/60 (National Heart, Lung, and Blood Institute n.d.c)
- Uncontrolled severe bleeding
- Rapid breathing
- Shock
- Narrow pulse pressure
- Bluish skin color
- Extreme pain
- Hearing bowel sounds in the chest
- Deformity

Dorsal Aortic Rupture

The aorta can be ruptured with a severe deceleration force to the chest over the dorsal aorta. This is most commonly seen in car accidents when the strap of the seat belt tightens rapidly during a sudden deceleration. In sport, the most common deceleration is a severe blow to the chest, such as a hit in football.

In **dorsal aortic rupture**, the aorta commonly tears away from the heart and the athlete most often bleeds to death in seconds. Those who do not die may have a partial tear and can bleed to death more slowly. They will show signs of shock and will be anxious. The deceleration, or severe blow, may be the most revealing determination of this injury. If this happens, EMS must be called and the athlete must not be moved. Movement can cause the aorta to shift, resulting in immediate death.

SUMMARY

Injuries to the throat and thorax can cause severe, permanent damage or even death. The AT must be able to evaluate injuries to the throat and thorax because prompt treatment is crucial to an athlete's survival. The history, signs, and symptoms will define the injury. Most injuries to these areas are preventable if the athlete is wearing the proper equipment. Luckily, few injuries occur in these areas, and when they do occur, most of them are not life threatening. For serious injuries, EMS is needed immediately.

KEY TERMS

Define the following terms found in this chapter:

air embolism
alveoli
atrium
cardiac tamponade
carotid artery
diaphragm
dorsal aortic rupture
esophagus
flail chest
hemothorax
hyperventilation
jugular vein
larynx
phlegm
pneumothorax
sucking chest wound
trachea
ventricle

Go online to the web resource to find quizzes, activities for reinforcement, above and beyond activities, practical skill worksheets, and chapter-specific tasks for the semester-long project.