

# Thorax & Abdominal Injuries

Sports Medicine

Name \_\_\_\_\_

Per \_\_\_\_\_ Date \_\_\_\_\_

Read Ch 11 "**Throat & Thorax injuries**" and Ch 12 "**Abdominal Injuries**" of the [Textbook Fundamentals of Athletic Training 4<sup>th</sup> edition](#) [Tan color textbook cover]. Pp.119-140.

Answer the questions below online in [Illuminate \[LHUSD Test link\]](#) [Click Link](#).

FHS - Student ID #####. Assess Code. **PE5FMBG**

You may print a copy of this assignment and answer the questions while you read, then enter your answers online.

CHECK YOUR ANSWERS - After completing the assignment online. [Log back](#) into the Assignment and see your score.

DIRECTIONS: Pick the BEST answer below.

1. Hyperventilation is
  - a. the presence of blood in the pleural cavity
  - b. the presence of air in the pleural cavity
  - c. a quick breathing rate that results in an imbalance of oxygen and carbon dioxide
  - d. a or b
2. The presence of blood in the pleural cavity is called
  - a. hemothorax
  - b. flail chest
  - c. pneumothorax
  - d. hyperventilation
3. The presence of air in the pleural cavity is called
  - a. hemothorax
  - b. flail chest
  - c. pneumothorax
  - d. hyperventilation
4. Which of these may be a sign or symptom of a cartilage fracture of the trachea?
  - a. spitting up blood
  - b. difficulty talking and breathing
  - c. pain in the throat
  - d. all of these
5. Which of these is a lower chamber of the heart?
  - a. right atrium
  - b. left atrium
  - c. right ventricle
  - d. middle ventricle
6. The passageway for air between the mouth and the lungs is the
  - a. trachea
  - b. larynx
  - c. esophagus
  - d. bronchial tube
7. The passageway for food from the mouth to the stomach is the
  - a. trachea
  - b. larynx
  - c. esophagus
  - d. bronchial tube
8. This injury occurs when several consecutive ribs are fractured in two or more places.
  - a. sternal fracture
  - b. hemothorax
  - c. flail chest
  - d. pneumothorax
  - e. hyperventilation

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9. Which of these injuries has occurred when the thin pericardial sac around the heart has filled with fluid and the pressure on the heart may stop the beating?
- a. cardiac concussion
  - b. cardiac tamponade
  - c. angina
  - d. cardiac arrest
  - e. none of these
10. Which of these is considered a life-threatening injury to the thorax?
- a. cardiac contusion
  - b. hemothorax
  - c. pneumothorax
  - d. a and b
  - e. a, b, and c
11. Which of these statements is TRUE of the trachea?
- a. It has cartilaginous rings.
  - b. It is a smooth, muscular tube.
  - c. It is used to transport food to the stomach.
  - d. It has small bronchial tubes attached directly to it.
12. Which set of ribs is considered floating ribs?
- a. the first five sets
  - b. the last five sets
  - c. the bottom two sets
  - d. the top two sets
13. Which structure contains the vocal cords?
- a. esophagus
  - b. larynx
  - c. trachea
  - d. carotid artery
14. Most injuries to the throat and thorax can be prevented with
- a. protective equipment
  - b. competitors of equal size
  - c. proper sporting techniques
  - d. better coaching
15. Injuries to the throat that involve bleeding are complicated because it is hard to protect the
- a. trachea
  - b. carotid artery
  - c. esophagus
  - d. larynx
16. A considerable risk with a rib fracture is
- a. damage to the bladder
  - b. damage to the lungs
  - c. damage to the heart
  - d. damage to the spine
17. A contusion to the sternum requires that the athletic trainer
- a. assess for ABC's
  - b. check for concussion
  - c. refer for evaluation to ensure no heart involvement
  - d. do nothing unless the athlete stops breathing
18. When an athlete experiences a laceration to the throat, it is important to immediately
- a. control bleeding and maintain airway
  - b. control bleeding only
  - c. check for blood pressure readings
  - d. perform rescue breathing

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19. Which injury will cause the air from outside the body to be drawn noisily into the chest cavity, thereby causing compression on the heart and lungs?
- a. hemothorax
  - b. pneumothorax
  - c. sucking chest wound
  - d. tension pneumothorax
20. An athlete suffering a spleen injury may have pain in the
- a. left shoulder
  - b. right shoulder
  - c. left lower quadrant
  - d. right upper quadrant
21. The appendix is located in the
- a. right upper quadrant
  - b. left upper quadrant
  - c. right lower quadrant
  - d. left lower quadrant
22. The liver is predominately located in the
- a. right upper quadrant
  - b. left upper quadrant
  - c. right lower quadrant
  - d. left lower quadrant
23. The spleen is located in the
- a. right upper quadrant
  - b. left upper quadrant
  - c. right lower quadrant
  - d. left lower quadrant
24. Which abdominal muscle is responsible for forward flexion of the trunk?
- a. external oblique
  - b. internal oblique
  - c. rectus abdominis
  - d. rectus femoris
25. A protrusion of organs through the abdominal wall is known as
- a. a side stitch
  - b. a hernia
  - c. an abdominal torsion
  - d. a rectus abdominis strain
26. Which of these abdominal injuries is most likely to cause blood in the urine?
- a. kidney contusion
  - b. abdominal muscle strain
  - c. ruptured spleen
  - d. hernia
27. A person with appendicitis will have pain in McBurney's point, which is located
- a. midway between the umbilicus and the ASIS
  - b. midway between the iliac crest and pubis
  - c. midway between the acromion and the coracoid
  - d. midway between the greater trochanter and the ischial tuberosity
28. What is the medical term for blood in the urine?
- a. hematoma
  - b. hematuria
  - c. hemaduria
  - d. hemodynamic

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29. Which of these is TRUE of a hernia?
- a. It can result from increased abdominal pressure.
  - b. It is a lump that bulges through the abdominal wall.
  - c. It is life-threatening.
  - d. It may require surgery.
  - e. a, b, and d
30. A side stitch is treated by
- a. resting and breathing slowly
  - b. calling 911
  - c. asking the athlete to relieve his bladder
  - d. having the athlete lie on the ground in fetal position
31. Which muscles of the abdomen are responsible for rotation of the trunk?
- a. rectus abdominus
  - b. obliques
  - c. traps
  - d. erector spinae
32. Which organ in the male body is responsible for adding nutrients to the seminal fluid?
- a. ovaries
  - b. prostate
  - c. seminal vesicles
  - d. a and b
  - e. b and c
33. The kidneys are responsible for maintaining the \_\_\_\_\_ balance in the body.
- a. acid-base
  - b. water-food
  - c. vitamin-mineral
  - d. blood-oxygen
34. The liver is responsible for
- a. storing vitamins
  - b. producing bile
  - c. breaking down food
  - d. a and b
35. The small intestine will refer pain to
- a. the sacrum
  - b. the ribcage and chest
  - c. the navel
  - d. the shoulder
36. Which organ is NOT part of the digestive system?
- a. small intestine
  - b. kidney
  - c. gallbladder
  - d. appendix
37. The abdominal quadrants are divided vertically by the
- a. linea blanco
  - b. linea alba
  - c. linea aspera
  - d. linea grande

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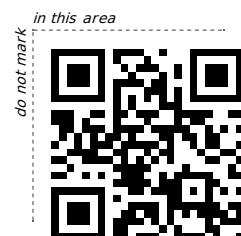
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35	A	B	C	D	
36	A	B	C	D	
37	A	B	C	D	



# 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.

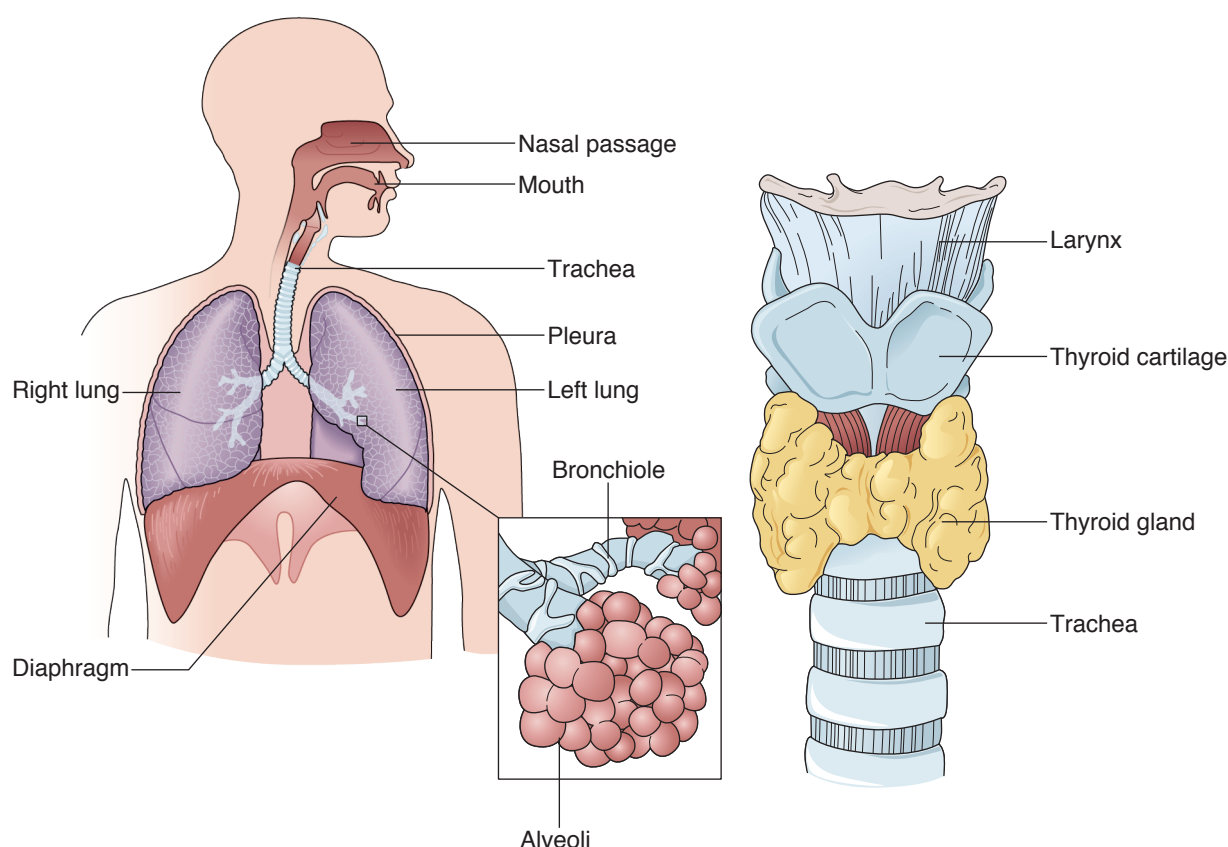
## ANATOMY OF THE THROAT

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


**FYI**

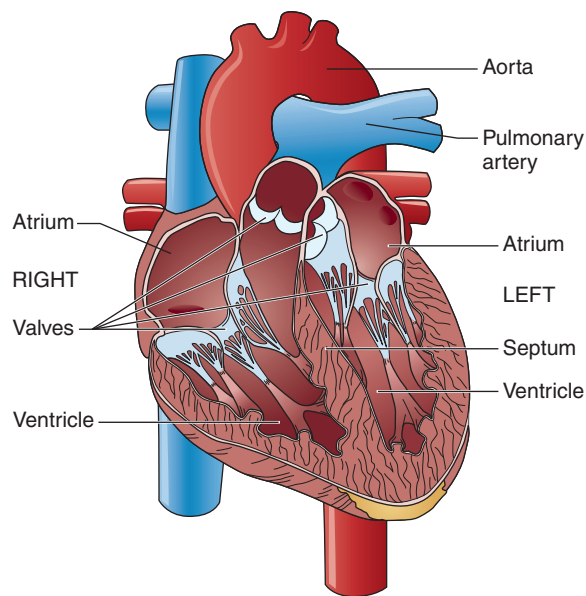
**Veins**  
Veins carry waste products and carbon dioxide back to the heart (except for the pulmonary vein, which carries oxygenated blood to the left atrium).

**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.

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

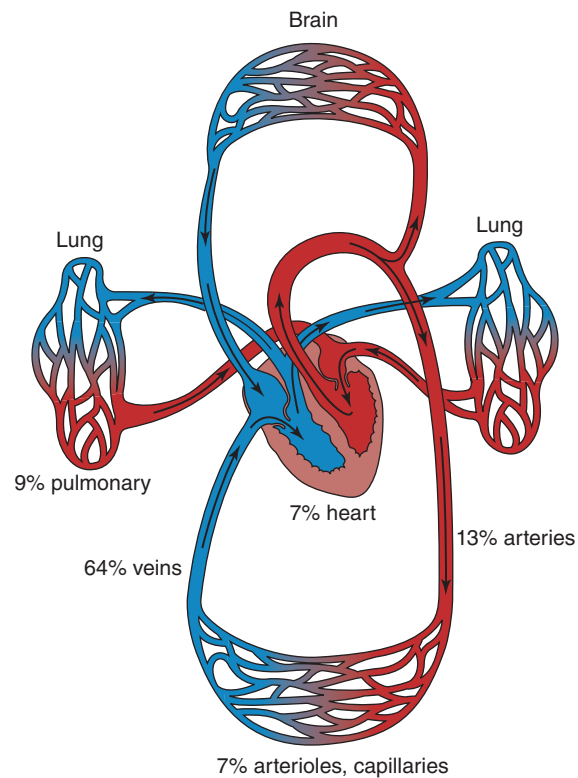


**Figure 11.2** Interior of the heart.

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



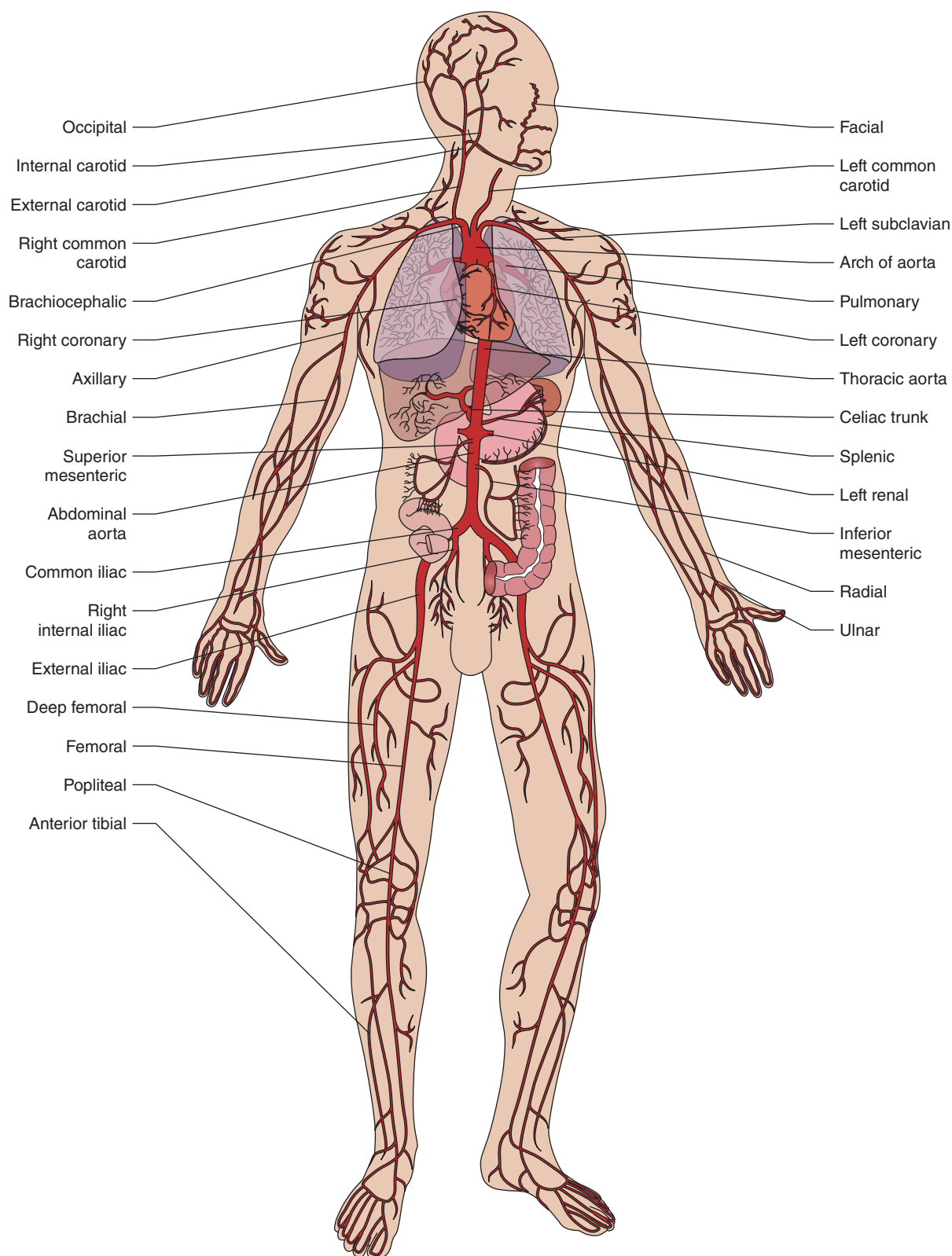
**Figure 11.3** Circulation of blood through the heart and distribution to the body.

Reprinted by permission from J. Wilmore and D. Costill, *Physiology of Sport and Exercise*, 4th ed. (Champaign, IL: Human Kinetics, 2007), 138.

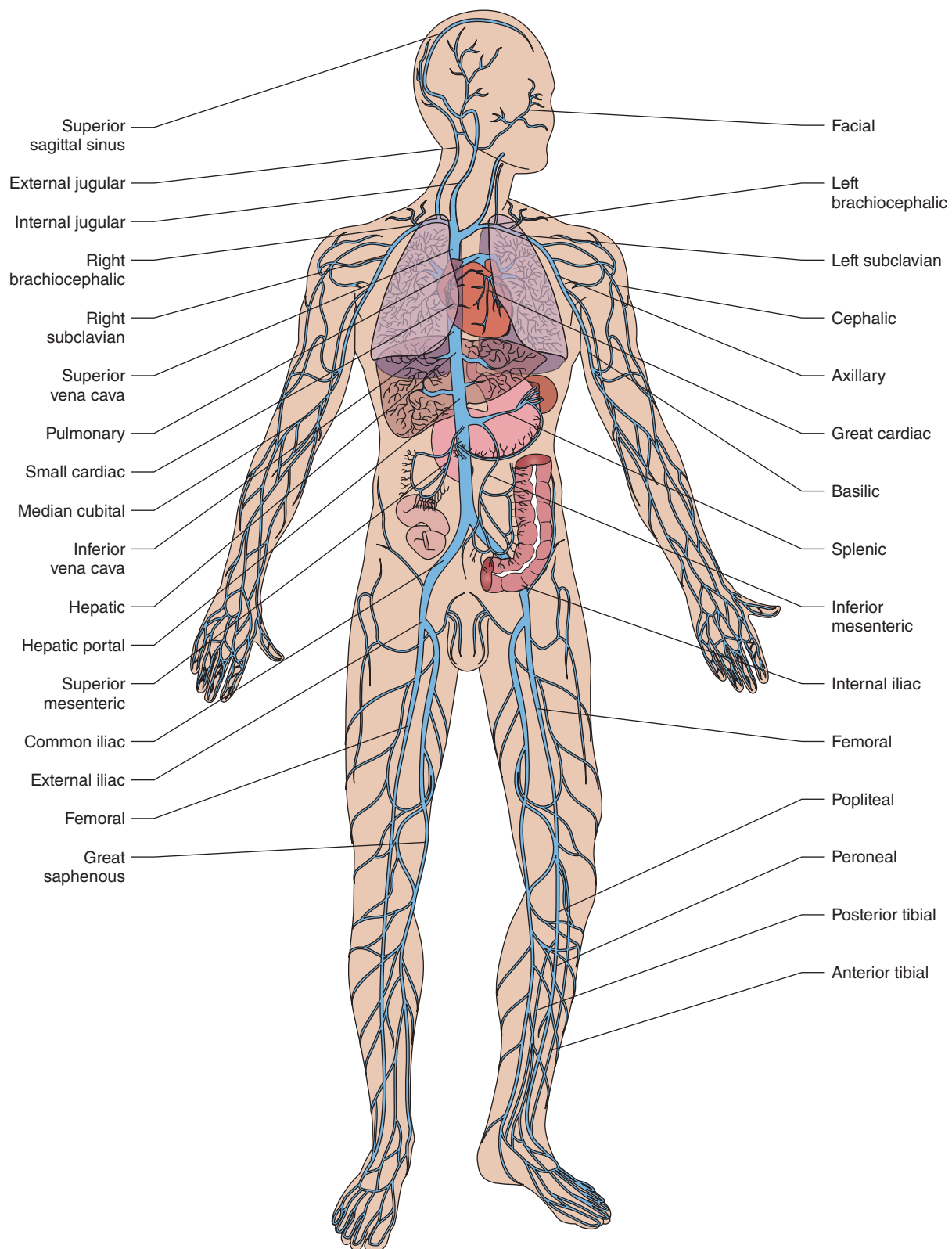
bronchi, the bronchi further subdivide into bronchioles, and each bronchiole ends in an alveolus, an air-containing cell of the lungs (see figure 11.1). It is in the **alveoli** that the exchange of oxygen and carbon dioxide occurs. The lung tissue is divided into sections, or lobes. There are three 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

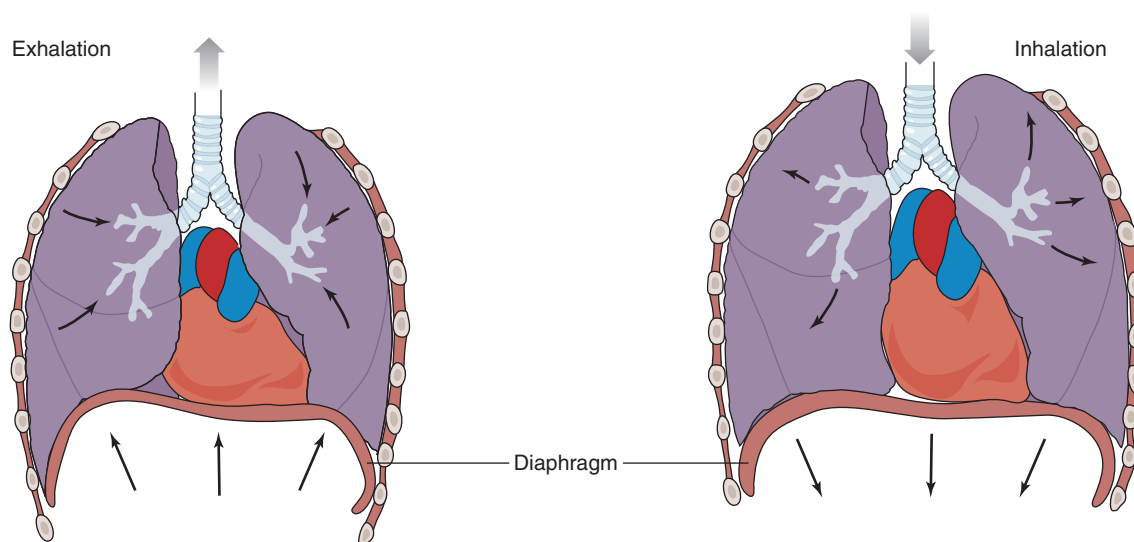
The **diaphragm** muscle separates the thorax and the abdominal cavity. The diaphragm contracts and pulls down to assist in inhalation and moves upward to push air out of the lungs on exhalation (see figure 11.6). The diaphragm has three openings to allow passage of the esophagus, the abdominal aorta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

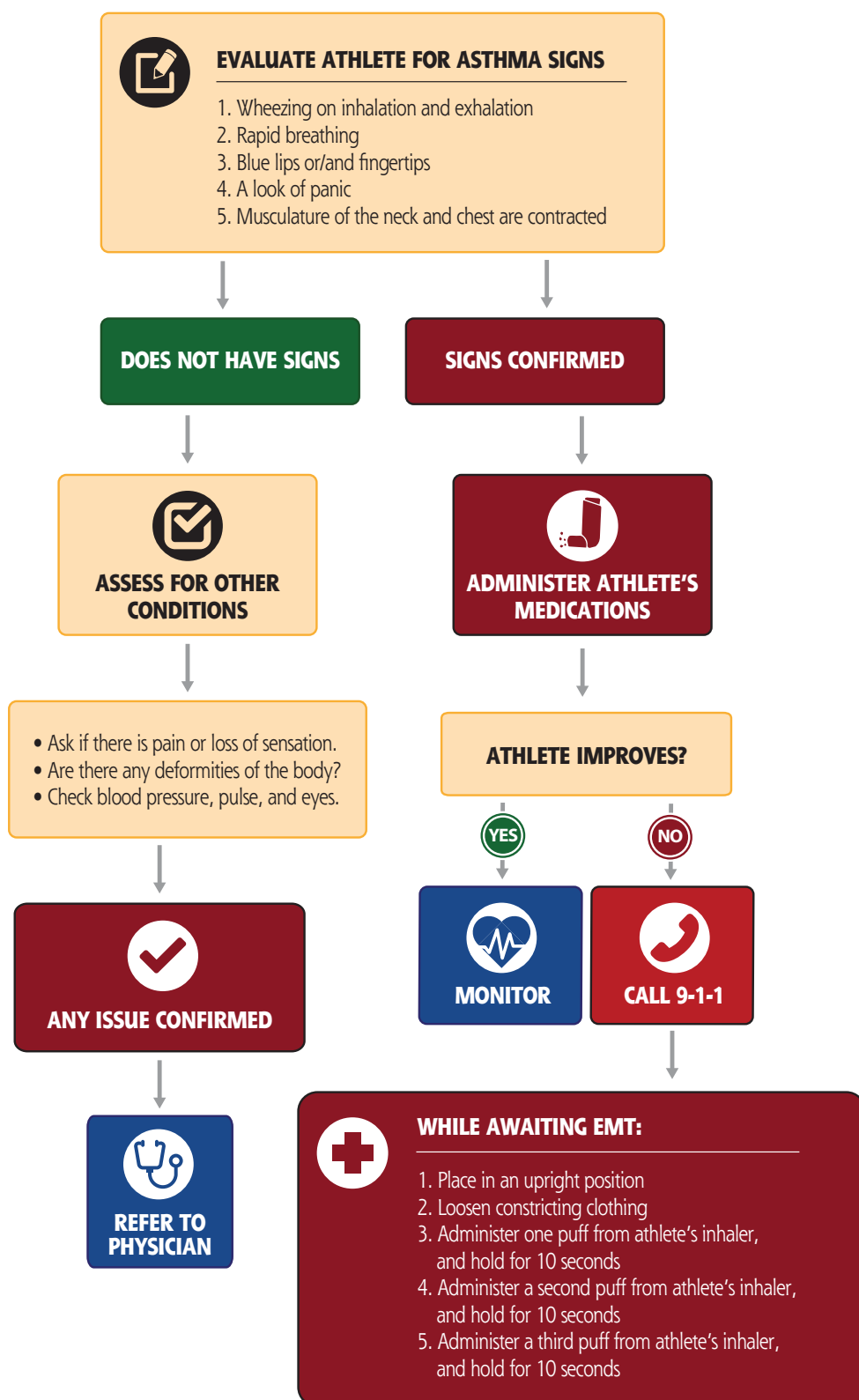
Prevention involves using lubricant or applying an adhesive bandage over the nipple. If the irritation does not subside with minimal treatment, a physician may have to evaluate the athlete to determine if an infection has occurred.



### 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.

## SUSPECTED ASTHMA ATTACK, EVALUATION BEGINS



**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.

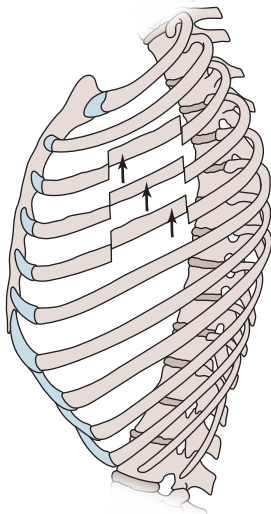
An athlete with fractured ribs experiences pain and difficulty breathing. The pain increases with inhalation, and the athlete usually holds a hand over the injured area in an effort to support the ribs. The area may be deformed due to swelling. A key to determining if a rib is fractured or severely contused 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



**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.

shock. This is a medical emergency and requires rapid advanced care.

## 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

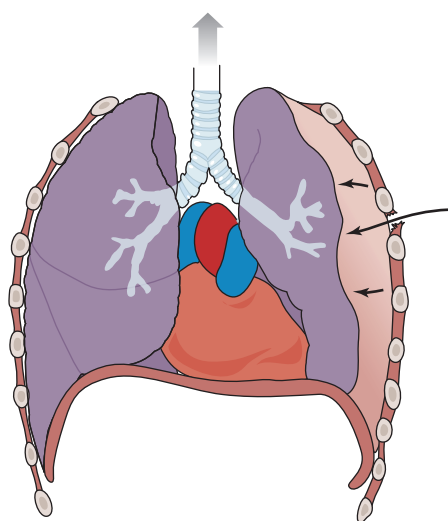


distress. As more air enters the chest cavity, more pressure builds against the heart and uninjured lung. As the pressure mounts, the heart begins to labor as blood flow and breathing are impeded. Death can occur if the athlete is not treated rapidly. If the athlete has an external puncture wound, partially 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



**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.

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.

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



# Abdominal Injuries

## Objectives

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

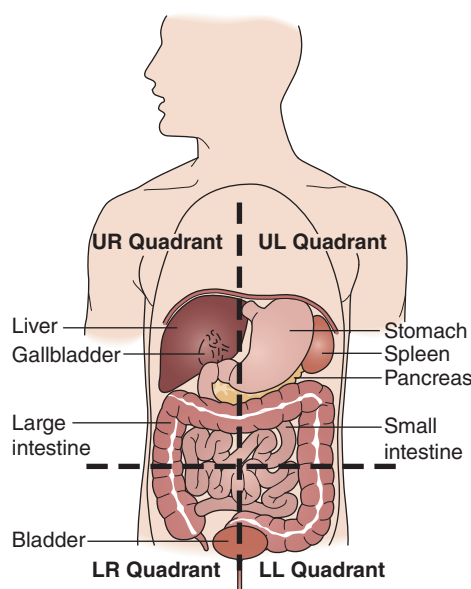
- Understand the anatomy of the abdomen.
- Understand that an abdominal organ may cause referral of pain.
- Understand the implications of illness or injury related to specific organs.
- Understand how to prevent injuries of the abdomen.
- Describe the care necessary to treat an abdominal injury.

Although abdominal organs are not generally protected in sporting activity by padding, abdominal injuries occur infrequently. A serious injury of the abdomen, however, may not become apparent for days. In this chapter, we discuss function of the abdominal organs, injury prevention, and treatment.

## ANATOMY OF THE ABDOMEN

The abdominal cavity is bounded by the lumbar spine posteriorly, the diaphragm superiorly, the abdominal musculature anteriorly, and the pelvis inferiorly. For purposes of discussion, the abdominal cavity is divided into four quadrants by an imaginary horizontal line running across the abdomen through the navel and an imaginary vertical

line running from the sternum through the navel to the area between the legs (see figure 12.1). The upper right quadrant lies just below the ribs on the athlete's right side, and it contains the liver, a portion of the pancreas, the right kidney, the gallbladder, and the large and small intestines. The upper left quadrant lies just below the ribs on the athlete's left side, and it contains the stomach, a portion of the liver, a portion of the pancreas, the left kidney, the spleen, and the large and small intestines. The lower right quadrant contains the large and small intestines, the appendix, a portion of the bladder, the uterus and right ovary (in women), and the prostate (in men). The lower left quadrant contains the large and small intestines, a portion of the bladder, the uterus and left ovary (in women), and the prostate (in men).



**Figure 12.1** The abdominal quadrants.

The abdomen contains both solid and hollow organs. Injuries to the hollow organs, such as the bladder, intestines, stomach, and appendix, rarely cause rapid death. Moreover, the hollow organs tend to move and bend away if an athlete is hit in the abdomen. Hollow organs are tubes that assist in transporting substances from one organ to another and are connected to one another by sheetlike membranes. Solid organs such as the liver, kidneys, and spleen aid in body chemistry. They can cause rapid death if injured because they have a large blood supply.

Abdominal organs can be divided into three categories: digestive organs, urinary organs, and reproductive organs. The organs included in the digestive system are the stomach, liver, pancreas, large and small intestines, appendix, spleen, and gallbladder. The organs of the urinary system are the kidneys, ureters, and bladder. Organs of the female reproductive system include the ovaries and uterus. Organs in the male reproductive system include the prostate and seminal vesicles.

The abdominal organs, when injured or diseased, will refer pain to another part of the body. The following list indicates the abdominal organ

and its **referral point** (Stanford Medicine 2016; PositiveMed 2015; Anderson and Parr 2013):

- Liver: right shoulder area and back
- Kidney: below rib cage, wrapping from back to front
- Appendix: lower right abdomen between navel and hip
- Gallbladder: just below right rib cage and possible right shoulder
- Pancreas: left shoulder and midabdominal region
- Stomach: below rib cage to chest
- Bladder: over the bladder
- Small intestine: navel
- Large intestine: sacrum
- Spleen: left shoulder and over the spleen

During an evaluation, the AT can palpate each quadrant to determine if any of the organs may have been injured. When palpating a quadrant, the AT will use the flat surface of his fingers (see figure 12.2). The AT will compress the abdomen and ask if the athlete experiences any pain. The pain can occur as the AT is compressing inward or when he releases pressure. The AT will be looking to determine if there is tightening of abdominal muscles, which is a sign of internal injury.

When the athletic trainer uses a stethoscope, he can hear sounds in each of the quadrants. The AT can hear abnormal bowel sounds or the lack of bowel sounds, an indication of injury.

## Digestive Organs

The stomach secretes gastric juices that assist in breaking down food before it enters the intestines. The liver has several functions, including the detoxification of chemicals that the body perceives as poisons, such as alcohol. The liver also stores several vitamins, produces bile, and assists with food metabolism. The gallbladder is located at the liver and is a storage tank for **bile**, which is passed into the small intestine where it assists with the digestion of fat. The pancreas produces insulin and enzymes





**Figure 12.2** Palpating the abdominal quadrant.

for digestion. The small intestine completes the digestive process of breaking down food; from here, the products of digestion are absorbed into the circulatory system. The sequential contraction and relaxation of the intestinal muscles, or peristalsis, pushes the food onward through the intestines. By the time it reaches the large intestine, the material that has not been digested or absorbed into the circulatory system is considered waste. In the large intestine, water is absorbed, leaving solid waste for excretion. The appendix is part of the large intestine and has no known function. The spleen, which is covered with a thin sheath, has numerous functions: It produces and destroys red blood cells, assists in the destruction of harmful microorganisms, and stores blood.

## Urinary Organs

The kidneys are responsible for maintaining the sensitive acid–base balance within the body. If the acid–base balance changes, the body systems begin to shut down, eventually resulting in death. The kidneys filter the blood and remove the waste products of metabolism to keep the acid–base relationship stable. If either kidney does not have adequate blood supply (whether by injury or illness), the kidney can cause hypertension from a chemical constriction of the body’s blood vessels. The ureters are tubes attached to the kidneys that transport urine to the bladder, which is the holding tank for liquid waste products.

## Reproductive Organs

In women, the ovaries produce eggs for possible fertilization and the hormone estrogen. Estrogen is the chemical that stimulates the development and maintenance of feminine characteristics. The uterus is the organ in which a fertilized egg develops. The lining of the uterus is released during a menstrual period if a fertilized egg is not present.

In men, the seminal vesicles and prostate gland are responsible for adding fluid and nutrients to seminal fluid. Men are particularly at risk of injuries to the reproductive organs because these organs are external to the pelvic and abdominal cavity. A common injury for male athletes is a testicular contusion. This injury is caused by direct impact and results in severe pain and swelling. Wearing a protective cup during contact sports such as football and an athletic supporter during other sports such as basketball can prevent testicular trauma.

## The Pelvis

The pelvis is a structure that provides a bony base and solid protection for some abdominal organs. The top edge of the pelvis is known as the iliac crest (see figure 7.3), which is the attachment point for the abdominal muscles. The pelvis in women has a larger opening and is wider than in men in order to permit childbirth.

## Abdominal Muscles

Although the liver and spleen are slightly covered by the inferior-most portion of the ribs, protection of the abdominal organs is mainly provided by the abdominal musculature and fat. The primary muscles of the abdomen are the rectus abdominis and the obliques. When well developed, the rectus abdominis gives the washboard-ripple effect to the abdomen. It attaches at the hip bones and extends to the lower ribs and sternum. The rectus abdominis is responsible for forward flexion or bending of the trunk. Each oblique muscle attaches to the lateral aspect of the lower ribs on one side of the body and runs diagonally to the hipbone. The obliques help compress the abdomen—for example, if someone threatens to hit you and you tighten your muscles,

you are contracting the obliques. Refer to chapter 7 for a review of these muscles (see figure 7.6) and the bones to which they are attached (see figure 7.3).

## PREVENTING ABDOMINAL INJURIES

Preventing injuries of the abdominal organs is essential because abdominal trauma can quickly cause death. Sport rules that require protective equipment and limited contact are designed to prevent abdominal injuries. Ice hockey goalies, for example, generally wear protective equipment for the abdomen and reproductive organs. Other players can protect themselves by tightening their abdominal muscles. Most sports do not allow tackling or checking (physically moving an athlete) from behind so that athletes can protect themselves. Boxing has a rule that says it is illegal to hit below the belt. Before games, all athletes should be reminded to empty their bladders because full bladders are more prone to rupture on impact than empty ones.

## TREATING ABDOMINAL INJURIES AND CONDITIONS

Injuries within the abdominal cavity, especially to the hollow organs, are rare. The solid organs—the liver, spleen, and kidneys—can be injured, and internal bleeding may result. The AT should assess any athlete who has received a blow to the abdominal area, especially if he has abdominal pain, signs

of shock, muscle spasms, or blood in the urine. See figure 12.3.

### Side Stitch

A side stitch refers to pain just below the ribs in the upper abdominal region. There are various theories about why this pain occurs—a lack of oxygen to the abdominal muscles, improper breathing technique, eating food just before exercising, air trapped in the abdominal organs, and muscle spasms are a few—but in general, people who are less fit tend to get more stitches. Athletes experiencing the pain of a stitch resolve it by stopping exercise or by pressing directly over the area. If an athlete believes the stitch is a result of eating, she should change her eating patterns. A muscle-spasm stitch can be resolved by raising the arm on the same side as the pain and leaning away from the painful area. Pain that does not resolve needs to be referred to a physician for further evaluation.

### Hernia

A **hernia** is a lump of tissue, usually the intestine, that bulges through a weakness in the abdominal wall. Hernias can result from increased abdominal pressure, which may occur if the athlete holds his breath while weightlifting or going to the bathroom. The lump may go away when he lies down and bulge again when he stands up or exerts abdominal pressure. In men, the intestine may go through the inguinal canal and stay in the scrotal sac. The athlete may or may not have pain. A hernia must be surgically repaired, although a truss, or strap, can be used temporarily to apply pressure to keep the bulge inside the abdomen. A truss does not work for inguinal hernias and cannot be used by athletes who participate in contact sports or sports such as weightlifting that require the exertion of internal abdominal pressure. If not treated, the bulge of tissue can get stuck in the abdominal wall or inguinal canal, which is called *strangulation*. Strangulation cuts off the blood supply to the tissue, and eventually the tissue will die. If intestinal tissue is involved, a bowel obstruction will result. The obstruction prevents the passage of waste material from the body, causing pain and illness, and must be surgically repaired.



### RED FLAGS

Call 911 if an athlete experiences any of the following:

- An injury that refers pain
- Spleen injury
- Liver injury
- Protrusion of abdominal organs
- An object penetrating the abdominal wall
- Blood in urine
- Pain when palpating abdominal quadrants
- Painful urination



## FYI

**Enzymes**

An enzyme is a protein that allows a biochemical reaction to take place at normal body temperature but is itself not changed in the reaction.

**Inguinal Canal**

The inguinal canal is a hole in the abdominal wall in the groin region.

**Mechanism of Injury**

The *mechanism of injury* refers to the way in which an injury occurs. The mechanism can be observed if one is paying attention during a practice or game or it can be explained by the athlete.

**What Would You Do If . . .**

Everyone in the locker room is gathered around an athlete who is showing off a quarter-sized bulge near his navel. He pushes on the bulge and it disappears, but when he holds his breath and bears down, the bulge reappears. Everyone laughs, and he continues showing off.

**Appendicitis**

When the appendix becomes inflamed, it causes pain between the navel and the hip, better known as **McBurney's point**. The inflammation of the appendix increases and is called *appendicitis*.

Along with significant pain, the athlete is likely to exhibit nausea, vomiting, a fever, loss of appetite, and abdominal bloating (Mayo Clinic 2018a). This athlete needs to be treated by a physician. The appendix can rupture, spewing the contents of the colon into the abdominal cavity. Surgery is urgent in this situation.

**Blunt Trauma to the Abdomen**

An athlete who receives a blow directly to the abdomen is subject to blunt force trauma. An example of blunt force is the impact of the handlebars when a bike rider crashes during a race. The blunt force can cause bruising, severe pain, difficulty standing up straight, and injury to the organs within the abdominal cavity. The athlete should be treated for shock and needs immediate medical attention. The following are specific abdominal organs that can be injured, along with their signs and symptoms.

**Pancreas Injury**

The pancreas lies just behind the stomach near the liver and the spinal column. It is prone to injury during deceleration—for example, when an athlete running with the ball hits a wall. The wall does not cause the injury, but as the pancreas shifts forward

when the rest of the body has stopped, it tears. The athlete will have pain in the middle of the abdomen to the back as well as nausea, vomiting, and signs of shock. The athlete should be referred to the hospital for additional examination—a ruptured pancreas must be surgically repaired.

**Liver Injury**

A blow to the upper right abdomen can result in a contusion or rupture of the liver. The athlete will experience pain over the area that may radiate to the right shoulder. As the athlete loses blood, she will go into shock, have a rapid, weak pulse, and experience a drop in blood pressure. She must be referred to a physician immediately. The AT should be suspicious of a liver contusion if the athlete receives any blows to the area. The athlete may die if the liver is ruptured and it goes untreated.

**Kidney Injury**

A direct blow over the kidney can cause a contusion, laceration, or rupture. The athlete will experience pain just under the posterior ribs to the side of the spine, and the pain may radiate to the bladder. Pain will increase with trunk extension and ease with knee or hip flexion. The athlete may feel nauseated and vomit. Urine may have visible blood, and the blood loss may cause the athlete to go into shock. Thus, the injury requires prompt emergency care and hospitalization. Generally, an athlete with a kidney injury is required to rest for several weeks before returning to competition. Possible complications are scarring of the kidney and hypertension.





## What Would You Do If . . .

A cross country runner reports that she has blood in her urine. She does not remember being hit over her kidney.

## Bladder Injury

A rupture of the bladder causes urine to leak into the surrounding area. The athlete may have painful urination, a contusion over the bladder, or blood in the urine. She should report any of these symptoms to the AT. In severe cases of bladder injury, athletes go into shock, causing rapid heart rate, decreased blood pressure, anxiety, and sweating. When the injury mechanism suggests a bladder injury, the athlete should be referred to a physician for immediate evaluation. The AT should instruct the athlete to look for the signs and symptoms listed previously and report problems immediately.

## Blood in Urine

Occasionally, an athlete may share that his urine is tinged pink or red. This means that there is blood in the urine. The athletic trainer's assessment will include determining if the athlete has been ill, experienced painful urination, received any impact to his abdominal organs, or done strenuous exercise. The athlete will likely be referred to a physician for evaluation. Cross country runners are prone to **hematuria** (blood in the urine) due to their strenuous exercise routine (Mayo Clinic 2017a).

## Spleen Rupture

A blow to the abdomen may injure the spleen. A spleen that is enlarged from an infection is more prone to rupture, so athletes recovering from

illnesses, especially mononucleosis, should not be allowed to play without a physician's permission. Athletes with a spleen injury will experience abdominal pain and perhaps pain in the left shoulder, which is referred to as **Kehr's sign**. The left shoulder pain is caused by internal bleeding that puts pressure on the diaphragm, which presses on a nerve, causing referred pain to the shoulder. The athlete will often indicate that she is nauseated, experiencing cramps, and weak, and she may pass out. On examination, the AT may note abdominal spasms, vomiting, rapid heart rate, decreased blood pressure, and shock. The athlete must be transported by EMS to a hospital immediately—an injured spleen is a medical emergency. A ruptured spleen can bleed severely, causing rapid blood loss and a drop in blood pressure.

An athlete with less severe spleen injuries will be hospitalized overnight for observation. A ruptured spleen must be surgically removed. Athletes who have had their spleens removed are able to play sports after total recovery. The spleen can be protected from injury through the use of padding.

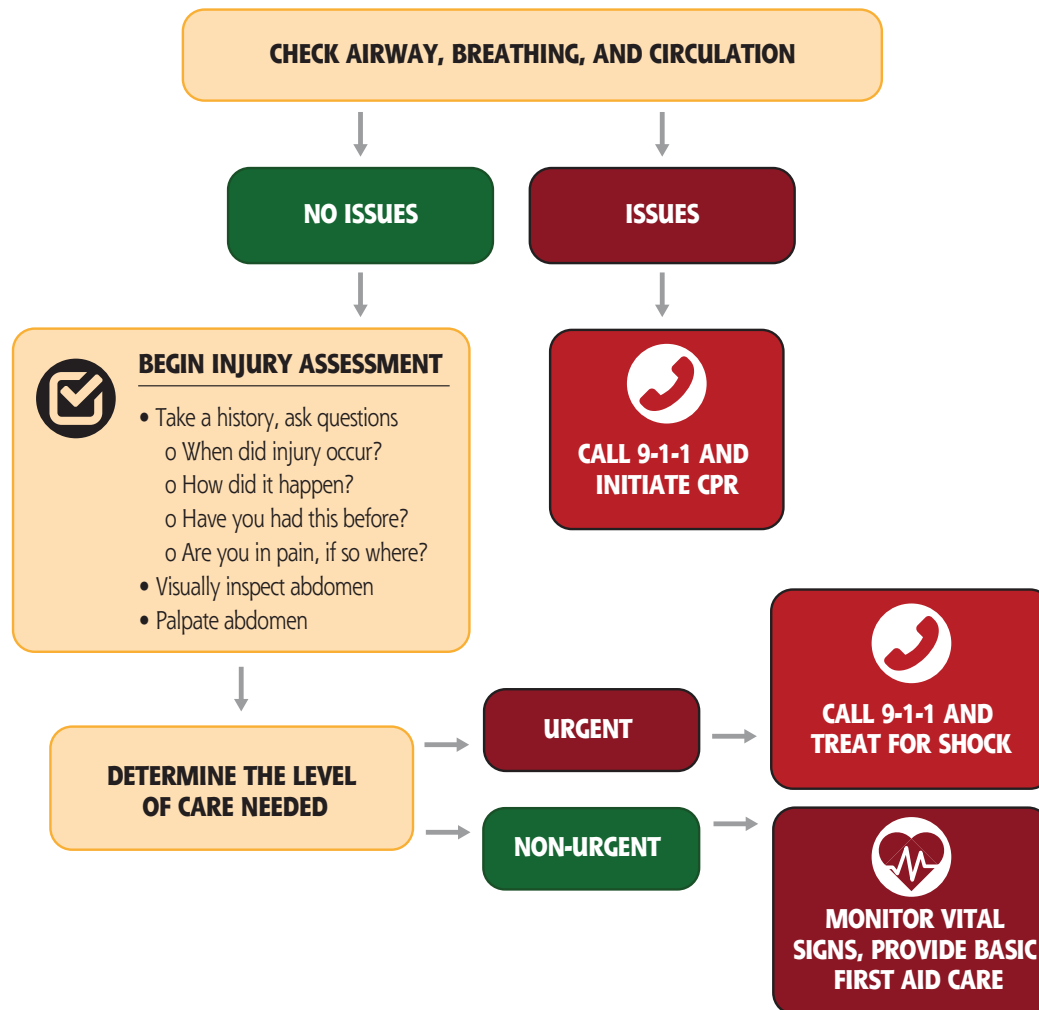


## The Real World

While I was working a summer basketball camp, one of the athletes was accidentally kneed in the abdomen. When we got to him, he complained of high pain levels in the lower abdomen off to the left side. We determined that he could move, so we helped him walk to the sideline and finished our evaluation. He exhibited tenderness over the spleen with a positive Kehr's sign. The coach encouraged the athlete to walk it off, but because a Kehr's sign most often suggests a spleen injury, I overruled him. We removed the athlete to the training room, where he began to show signs of shock. We thought his spleen must be ruptured, and we called EMS immediately. While we waited, we monitored his vital signs and treated him for shock. He showed a decreasing level of consciousness and a significant drop in blood pressure. We recorded vital signs at five-minute intervals before EMS arrived, and that cut down on time of transfer from our care to theirs. He was taken to the local hospital and was later airlifted to a larger hospital. He did have a ruptured spleen, and he was rushed into surgery. The athlete recovered fully, and the next summer he was back at the same camp.

**Alex Embry, ATC, EMT**

## ATHLETE PRESENTS WITH ABDOMINAL PAIN, SIGNS, OR SYMPTOMS



**Figure 12.3** Assessing abdominal pain.

### Penetrating Abdominal Injury

Penetrating abdominal injuries present with external bleeding and an open wound. If an object that has penetrated the abdominal wall causes a wound, the AT will not remove it. The AT will apply direct pressure around the object, stabilize it, and call 911.

Some penetrating injuries can be the result of the athlete's own anatomy, such as a fractured bone. The concern with all penetrating wounds is the possibility that the object may have injured one of the abdominal organs. Injuries to abdominal organs will require a physician's assessment, so immediate care is necessary.

## SUMMARY

Most of the organs in the abdominal region are involved in the digestive process and therefore are hollow. It is difficult to injure the hollow organs, but the solid organs of the abdomen can be seriously injured. The AT must know where the organs of the abdomen are located in order to evaluate abdominal injuries. Some serious injuries will not be immediately evident because they have delayed signs and symptoms. Athletes with abdominal injuries require immediate aid from EMS. The number of serious abdominal injuries in sport has been reduced by following rules restricting body contact and wearing required protective equipment.

## KEY TERMS

Define the following terms found in this chapter:

bile	hernia	McBurney’s point
hematuria	Kehr’s sign	referral point

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.