chapter 12

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).

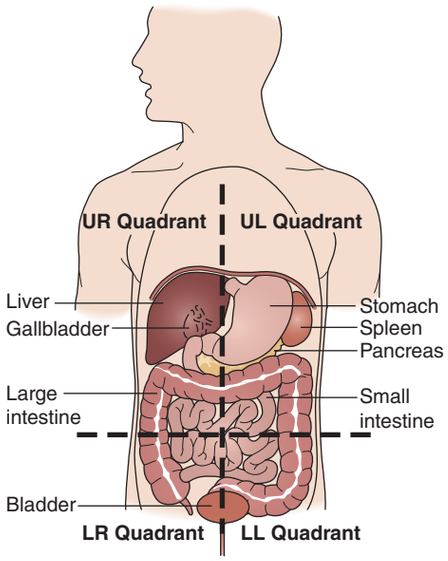

Figure 12.1 The abdominal quadrants.

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

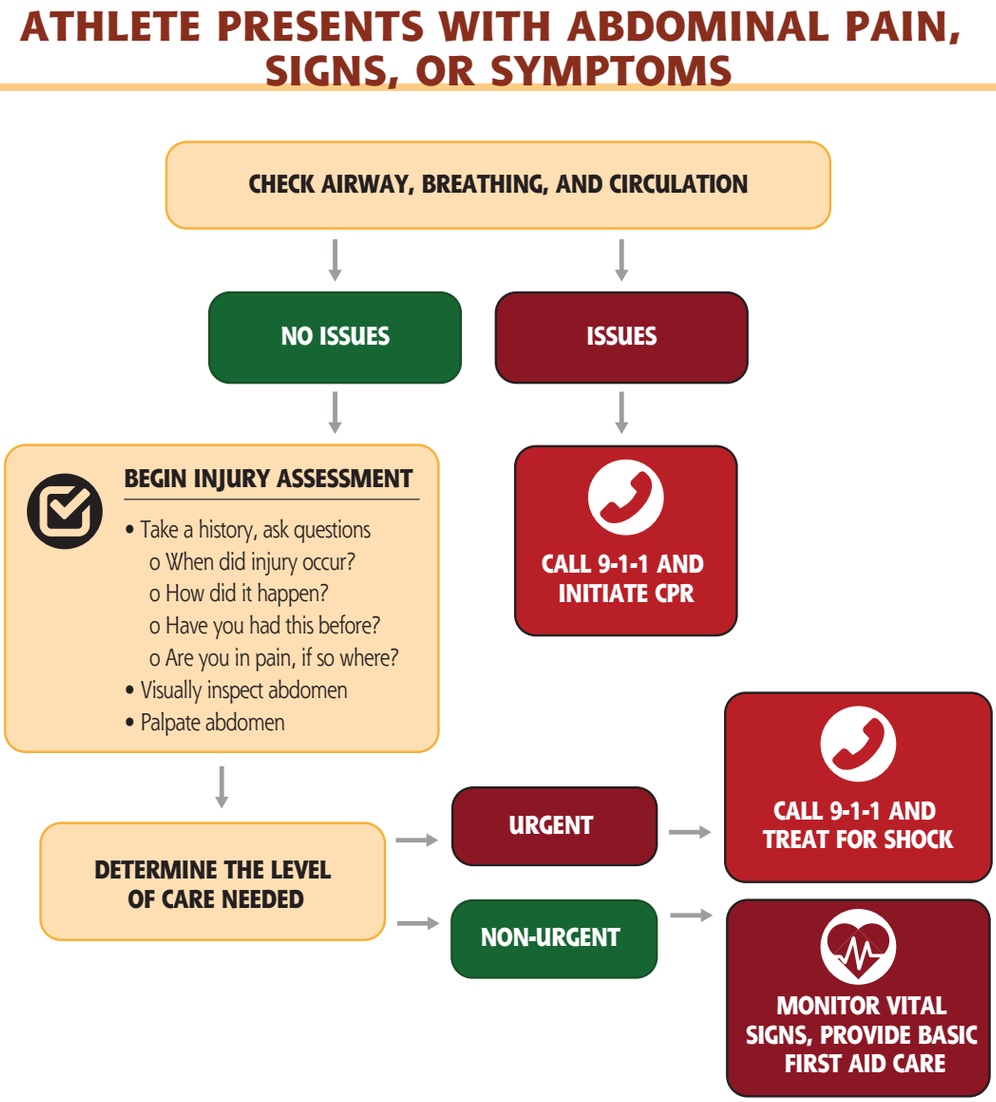

Figure 12.3 Assessing abdominal pain.

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.