Objectives
At the conclusion of this chapter you should be able to:

1. Describe the function and location of each organ in the body.
2. Describe the signs and symptoms of body cavity injuries.
3. Describe the treatment for body cavity injuries.

Case
Medic 7 is dispatched to the scene of a single-car accident. The 16 year old female driver lost control of her car and struck a tree. The vehicle sustained major damage between the headlights. The driver, the car’s lone occupant, was not restrained and no air bag was deployed. Evaluating the scene, you see the steering wheel is bent and that the patient has a large contusion on her anterior chest. It takes Rescue 1 almost 30 minutes to extricate her from the car. After extrication, you notice the patient is pale and diaphoretic with the following vital signs: heart rate, 140; blood pressure, 80 palpated; respirations, 45 and shallow. The patient is able only to moan in response to deep pain. You and your partner immobilize the patient, manage the airway and transport.

Body Cavity Trauma
The body cavity includes the thorax, abdomen, and pelvic cavity. When trauma occurs in this part of the body, it can involve the respiratory, cardiovascular, digestive, and urinary systems. Multiple systems may be involved depending on the type of injury.

Anatomy and Physiology
In order to be able to assess for trauma, you must know the function and location of each organ in the body. Trauma to a specific area of the body will most likely affect the organ within that area. Think of the body cavity as one large space that extends from the clavicles downward into the pelvis. This space is divided into two smaller cavities by the diaphragm. The diaphragm is a strong muscle that actively participates in respiration. The upper cavity is termed the thorax. The thorax contains the lungs and mediastinum. The mediastinum is a central region that houses the heart, trachea, esophagus, major blood vessels, and several nerve pathways. The lower abdominal cavity is divided into three cavities, the abdomen, the retroperitoneal space, and the pelvic cavity.

The Thorax
The thorax acts as both a container and a component of the respiratory process. The thorax houses the major functional parts of the respiratory and circulatory systems. The thorax is composed of skeletal and soft tissue. It has twelve C-shaped rib pairs, articulating directly with the vertebral column posteriorly. The sternum is located in the thoracic cavity. The upper most part of the sternum is called the manubrium.

The Mediastinum
The central region of the chest is called the mediastinum. The mediastinum houses several structures essential to body function. These include the trachea, vena cava, aorta, esophagus, and the heart. A strong, thin sac called the pericardium surrounds the heart. A small amount of fluid lays between the pericardium and the outer most cardiac tissue called the endocardium. The pericardium does not stretch. If the pericardium fills with fluid, it can inhibit cardiac filling.

The lungs fill the chest cavity on both sides of the mediastinum. Each lung has regions called lobes, the right lung has three lobes and the left has two.

Pleura
The pleural cavities are the two potential spaces on each side of the thorax which are lined by visceral pleura on the inside and parietal pleura on the outside. The cavity normally has a very small volume that is largely made up by serous fluid secreted by the pleura. The fluid acts as a lubricant between visceral and parietal layers and hold the two layers together.

The Abdomen
The diaphragm forms the upper border of the abdomen. It is a domed shaped muscle that moves up and down with each breath.

Abdominal Cavity
The lower ribs and lumbar spine as well as the muscles of the lower back make up the posterior boundary of the abdomen. Its inferior border is the pelvis. Three regions subdivide the abdomen, the abdominal space, the retroperitoneal space, and the pelvic cavity. The retroperitoneal space contains the:

- Kidneys
- Aorta
- Vena cava
- Part of the duodenum and pancreas

The organs of the abdominal cavity lack protective covering. The appendix is located in the right lower quadrant of the abdomen. The stomach is located in the left upper quadrant. The liver is located in the right upper quadrant. Bile is a by-product produced by the liver and stored in the gallbladder, which is located in the right upper quadrant just below the liver.

The Peritoneum
The peritoneum is a delicate tissue that covers the organs and the interior of the abdominal cavity. Fluid within the peritoneum allows smooth motion between the organs.

The Pelvic Cavity
The pelvic cavity contains the bladder, rectum and in the female, the reproductive organs. This cavity also houses the iliac artery and vein which supplies and returns blood from the lowest extremities. The pelvic cavity is the space from the opening of the pelvis to the pelvic floor. It is generally well protected from trauma.

Body Cavity Injuries
Injuries of the chest, abdomen, and pelvic cavity cause a serious threat to life because of the possibility of blood loss, respiratory embarrassment, and compromise of organ failure. Body cavity injuries require serious evaluation and immediate consideration when exposed to trauma.

Chest Injuries
There are two main types of chest injuries, those that compromise the movement of air and those that injure the internal structures. Internal injuries can contuse or lacerate lung or mediastinal tissue, including the great vessels, trachea, esophagus and the heart.

Rib Fractures
Simple rib fractures can affect the efficiency of respiration. The fracture of a rib is very painful and will cause the patient to limit chest expansion with each breath. This limits tidal volume and reduces the alveolar air. Your patient will not breathe deeply since the chest motion causes extreme pain. Shallow breathing results in alveolar collapse. This alveolar collapse is called atelectasis. Atelectasis results in less efficient respiration and can lead to pneumonia or other respiratory infections.

Pulmonary Contusion
Compression of the chest may contuse the lungs. Pulmonary tissue will swell and edema results. Pulmonary contusion reduces lung compliance and increases respiratory effort. It also interferes with diffusion of carbon dioxide, increasing PaCO2, and decreasing the blood's pH.

Flail Chest
If three or more ribs fracture in multiple locations, the chest area may become unstable. In flail chest, the segment moves due to the intrathoracic pressure rather than by muscular control. When the patient takes a deep breath, the intact chest wall moves outward, and the intrathoracic pressure falls. The reduced intrathoracic pressure draws the unstable segment inward. The motion of the flail segment is opposite to the rest of the chest, and is called paradoxical. Flail chest results in severe respiratory compromise because the air from beneath the segment travels to and from the good lung tissue instead of in and out of the airway. Complications of flail chest are:

- Rib displacement
- Internal Bleeding
- Air leaking into the subcutaneous tissues

Traumatic Asphyxia
This condition involves some mechanism that holds or pushes the chest wall inward. This condition can be caused by fractured ribs or a compression force injury, such as the chest hitting the steering wheel. The compression severely compromises chest expansion and results in hypoventilation. It may also tamponade intrathoracic hemorrhage and cause a backflow of venous blood in the neck and head. The usual presentation of traumatic asphyxia includes bloodshot eyes, bulging blue tongue, distended neck veins, and a cyanotic upper body. While release of the chest pressure may help the patient to breathe, it may also lead to:

- Rapid hypovolemia
- Shock
- Death

Pneumothorax
If an internal or external wound allows air, blood, or fluid to enter the area, the potential space becomes actual space. Expansion of the pleural space reduces the effective lung expansion and compromises respiration. If the pleural space expands because of air from an interior wound it is called a closed pneumothorax. If the wound is external, it is called an open pneumothorax.
**Tension Pneumothorax**
If a wound permits air to enter the pleural space it may also act as a one way valve, producing a condition called tension pneumothorax. Tension pneumothorax is a progressive pneumothorax that enlarges, builds in pressure, and begins to infringe upon the function of the opposite lung and the circulatory system. The valve allows air to enter the pleural space during inspiration. As the patient breathes out, the valve closes and air cannot exit. Pneumothorax increases the effort of respiration, pushes the mediastinum against the affected lung, retards venous return to the heart, reduces the heart’s ability to fill, and possibly kinks the vena cava where it travels through the diaphragm. The effects on the patient are extreme dyspnea and circulatory compromise. The trachea shifting from the midline is a late sign. Look for severe dyspnea, unilaterally absent or severely diminished breath sounds, subcutaneous emphysema, and signs and symptoms of shock without any apparent cause. The pleural space may also fill with fluid, most commonly blood. This is called a hemothorax. A mixed presentation of pneumothorax and hemothorax together is common.

**Cardiac Injury**
Decelerating trauma can affect structures within the mediastinum, including the heart and great vessels. Kinetic forces can contuse the heart, injuring the myocardium. The myocardial contusion can cause life-threatening dysrhythmias while in your care.

**Pericardial Tamponade**
This can occur secondary to a blunt or penetrating injury. A coronary artery may tear, allowing blood to enter the pericardial space. As the sac fills up with blood, it restricts the filling of the heart. The characteristics of tamponade are:

- Beck’s triad - Narrowing pulse pressure
- Hypotension occurs because of decreased stroke volume
- Distended jugular veins due to impaired venous return to the heart
- Muffled or distant heart sounds due to fluid in the pericardium

Pericardial tamponade will eventually stop blood flow through the heart, resulting in cardiopulmonary arrest. This condition does not respond to CPR, defibrillation, or drug therapy.

**Injuries to Other Structures in the Mediastinum**
If sudden deceleration occurs, especially if it is lateral, the heart may twist on the aorta. This movement can cause the layers of the vessel to tear, causing a ballooning of the wall known as an aneurysm. The patient may complain of a tearing sensation in the central chest or back and numbness or tingling in the upper extremity. The patient may have an absent pulse. Most of the patients who suffer from a traumatic aneurysm do not survive. Other injuries include rupture of the esophagus, or trachea, and laceration to the inferior or superior vena cava. Severe blunt abdominal trauma has been known to rupture the diaphragm and force abdominal contents into the thoracic cavity.

**Abdominal Injury**
Assessment of this area is difficult because the abdominal container is soft and pliable. It is very difficult to predict the nature and extent of injury.

**Penetrating Trauma**
Penetrating trauma to the abdomen can cause severe injury. You cannot determine the depth of a wound, its pathway, or the organs or tissues involved from an entrance wound alone.

**Evisceration**
Evisceration is the rupture or laceration of the abdominal wall that allows the abdominal contents to escape through the opening. The small bowel is the most common protruding viscera. Eviscerated organs should be covered with a moist, sterile and occlusive dressing. Follow your local protocols for eviscerated organs.

**Blunt Trauma**
Blunt trauma is responsible for several types of injuries of the abdomen. Organs may contuse, lacerate, or fracture. Hollow organs can rupture, and abdominal vasculature may tear. Hemorrhage, organ dysfunction, and destruction of the abdominal lining and organs may occur with these injuries.

The spleen is positioned in the abdomen where it is not very well protected from injury. A severe blow to the abdomen area may rupture the spleen. A ruptured spleen is a very common injury resulting from automobile accidents, altercations and sporting injuries.

**Solid Organ Injury**
During deceleration and acceleration, the posterior abdominal wall and the anterior abdominal surface may trap and compress the solid abdominal organs. Tissues are compressed which results in swelling, hemorrhage, and organ failure.

**Hollow Organ Injury**
If kinetic forces are enough, the organ may rupture and spill its contents into the abdominal cavity.

**Other Trauma Related Injuries**
Trauma or deceleration of abdominal organs may cause them to tear at their sites of attachment. Injuries involving the blood supply to any abdominal organ can result in rapid blood loss and organ failure. This is indicated by what is referred to as rebound tenderness.

Management of the patient includes:

- Stabilizing the spine
- Securing the airway
- Supporting breathing

Advanced Treatment may include:

- Intubating the patient who is unable to protect his own airway
- All trauma patients and patients who have injury to a body cavity require high flow oxygen
- If the patient shows signs of shock, begin PASG application and fluid resuscitation
- Start two large bore IV's peripherally
- Assist the infusion by using pressure infusion bags or BP cuffs
- Cardiac monitor

If the abdomen shows signs of internal hemorrhage, consider inflating the abdominal compartment of the PASG, for hemorrhage control as well as hemodynamic effect. Transport the patient with any uncorrectable breathing or airway problem, or any signs of central nervous system depression and any signs of shock.

**Soft Tissue Injury Care**

If a wound penetrates the thorax, seal it like a sucking chest wound. Do this by covering the wound with an occlusive dressing. Secure three sides of the dressing with tape, so that excessive intrathoracic pressure will escape to prevent a tension pneumothorax.

**Flail Chest Care**

You must stop the paradoxical motion and ineffective air exchange. Do this by splinting the flail with a pillow or a pad. Use positive pressure ventilation to assist the patient in breathing. This helps negate the motion of the flail segment. The positive pressure you create by squeezing the device moves the chest wall and the flail segment outward.

**Traumatic Asphyxia Care**

Transport any patient with this problem to an emergency facility immediately. Administer aggressive care during extrication and while en route. Anticipate hypovolemia as releasing the chest compression. The pressure compressing the chest and limiting the respiration may cause tamponade hemorrhage. Once you release compression, the patient may bleed internally. Initiate two IV access lines with large bore catheters and trauma tubing. Prepare two 1000-ml bag of normal saline or Lactated Ringers with pressure tubing. Prepare, apply, and inflate the PASG if needed. Give 100 % oxygen by non-rebreather or bag valve mask and be ready to intubate if the patient becomes unconscious. This patient may deteriorate rapidly.

**Tension Pneumothorax Care**

If pressure is present, relieve it quickly by needle decompression. Approximate the second or third intercostal space at the mid clavicular line. Locate the middle of the clavicle on the affected side and move the fingers down to the first or second intercostal space. Locate the intersection of the midaxillary and nipple line, and palpate the nearest intercostal groove. At either location, insert a large bore over the needle catheter just above the lower rib at a 90-degree angle. Advance the needle until you hear the sound of escaping air. Now advance the catheter and remove the needle. Secure the hub of the catheter with tape and cover it with a finger of a rubber glove. Tape the glove finger securely around the hub. Cut the fingertip to allow air to escape but not reenter. Monitor the patient frequently for redevelopment.

**Cardiac Contusion Care**

Implement cardiac protocols including:

- Oxygen
- Lidocaine
- Bretylium
- Procainamide
- Atropine

**Pericardial Tamponade Care**

Insert a large bore spinal needle into the pericardial sac and aspirate the blood that restricts cardiac filling. You must have specific training and be permitted to perform this procedure. Package the patient and transport immediately.

**Traumatic Aortic Aneurysm Care**

Rapid and gentle transport to an emergency facility should be initiated. Bouncing, sudden movement and an increase in blood pressure can cause the injury to progress or rupture. Maintain good perfusion, but treat shock conservatively. The patient should receive two large bore IV sites and two 1000-ml bags of solution.
**Impaled Object Care**
Immobilize the object just as you find it. Cover the entry wound with an occlusive dressing and a bulky dressing. Completely stabilize the object so that transporting will not cause shifting. If the object is very large, attempt to cut it. Fully immobilize the object prior to and during the attempt to shorten it.

**Abdominal Trauma Care**
Immediately transport a patient that has signs and symptoms of internal bleeding. While en route to the facility, insert two large bore catheters and start IV fluids. Apply the PASG and be ready to inflate. Evaluate vital signs frequently and any other signs indicating shock.

**Penetrating Abdominal Injury Care**
Cover the penetrating wounds of the abdominal cavity, as you would with any other open wound. If the bowel is protruding, cover the wound with a wet sterile dressing and then an occlusive dressing. If an object remains impaled in the abdomen, carefully immobilize it in place. Restrain the hands of a patient with either an evisceration or an impaled object to prevent them from manipulating the wound.

**Blunt Abdominal Injury Care**
Care for the blunt abdominal injury is basically supportive. Place the patient in the most comfortable position, usually on the side, and flex the legs. Transport the patient to a trauma center rapidly and as smoothly as possible.

**Acute Abdominal Pain**

**Gastrointestinal and Genitourinary Anatomy**
The gastrointestinal components include the mouth, pharynx, esophagus, stomach, small and large intestine, rectum, and peritoneum. The genitourinary anatomy includes the urinary system and the male and female reproductive system.

**Assessment of Acute Abdominal Pain**
After the primary survey, assessment of the abdomen should begin. Take a thorough history focused on the patient’s chief complaint. Baseline vital signs should be taken and a systemic physical exam should follow.

**History**
Use the mnemonic PQRST to help in obtaining this information.

| P | Provocative, what brought on the pain, what makes it worse or better |
| Q | Quality what does it feel like |
| R | Region where is the pain |
| S | Severity degree of pain |
| T | Time when did it begin and how long does it last |

Other elements of the patient history to include are any recent illnesses, past medical history, presence and character of penile or vaginal discharge, medication use, alcohol or other drug use, and any previous abdominal surgeries. Women should be questioned on menstrual activity and the possibility of pregnancy.

**Location and Type of Abdominal Pain**
There are three classifications of abdominal pain: visceral, somatic and referred.

**Visceral Pain**
Visceral pain is usually described by the patient as cramping or gas type pain that varies in intensity, increasing in severity and then subsiding. Visceral pain in generalized pain and is difficult to locate. Visceral pain is often associated with other symptoms of autonomic nerve involvement such as tachycardia, diaphoresis, nausea and vomiting. Common causes of visceral pain are appendicitis, pancreatitis, cholecystitis, and intestinal obstruction.

**Somatic Pain**
Somatic pain is caused by bacterial or chemical irritation of nerve fibers in the peritoneum. Somatic pain is usually constant in nature and localized to a specific area. It is described as sharp or stabbing. Patients will not move around a lot and usually lie on their back or side with the legs flexed to reduce pain. These patients also have guarding of the abdomen and rebound tenderness during an exam. Common causes of somatic pain are appendicitis and an inflamed ulcer, gallbladder or intestine.

**Referred Pain**
Referred pain is pain in a part of the body that is caused from another location but referred to a different location. This results from branches of visceral fibers that synapse in the spinal cord with the same second order neurons that receive pain fibers from the skin. When the pain fibers spread, the patient receives pain in areas distant from the original source.

**Signs and Symptoms**
Signs and Symptoms associated with abdominal pain are:

- Nausea
- Vomiting
- Anorexia
- Gastritis
- Pancreatitis
- Biliary tract disease
- High intestinal obstruction
- Diarrhea
- Inflammatory processes
- Constipation
- Dehydration, obstruction, medications
- Stool color

**Vital Signs**
Monitor the patient’s blood pressure, pulse, respirations, skin color, moisture, temperature, and turgor. If possible, check for orthostatic changes in the patient’s blood pressure by using the tilt test. The tilt test is a drop in the systolic blood pressure of 15mm Hg or an increase in the pulse rate of 15 beats per minute when a patient is moved from a supine position to a seated position. The above change in BP and HR indicate a positive test and are suggestive of hypovolemia. This is also called orthostatic vital signs.

**Physical Examination**
Examine the abdomen by inspection, auscultation, and palpation. If the patient has a life threatening emergency, examine the abdomen en route to the hospital.

**Inspection**
Initially note the position the patient is in when you arrive. Other clues to abdominal pain are skin color, facial expressions, and the presence or absence of movement. Remove the patient’s clothing so that the abdomen may be inspected. Look for bruises, scars, ascites, abdominal distention or masses.

**Auscultation**
Auscultate to determine presence of bowel sounds. Listen in all four quadrants for a minimum of 1 minute. Auscultation should always precede palpation.

**Palpation**
Gentle palpation of the abdomen should begin by saving the area of pain until last. Be alert to rigidity, tenderness, masses, and facial expressions that may provide a clue about the severity of pain. Note whether or not the abdomen is soft and palpable or rigid.

**Management of Acute Abdominal Pain**
Patients who have acute abdominal pain cannot be managed in the prehospital setting.

- Administer high flow oxygen
- Monitor vital signs
- Establish an IV
- Monitor for cardiac dysrhythmias
- Gently transport to the hospital

**Summary**
Injury to the chest and abdomen account for a high number of trauma deaths. You should have a high suspicion for injury to this region and prepare for aggressive intervention. This approach will give the best opportunity to reduce patient death and morbidity.

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References