Chapter 5

Abdominal Trauma

Göksu Afacan

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.76474

Abstract

Abdominal injuries may be life threatening and should be approached cautiously. After trauma, the abdomen may be sanctuary for occult bleeding that, if not discovered and corrected expeditiously, may lead to deleterious consequences. Patients with abdominal trauma should have rapid assessment, stabilization, and early surgical consultation to maximize the chances of a successful outcome. Deaths from abdominal trauma result principally from hemorrhage or sepsis. Most deaths from abdominal trauma are preventable. Patients at risk of abdominal injury should undergo prompt and thorough evaluation. In some cases, dramatic physical findings may be due to abdominal wall injury in the absence of intraperitoneal injury. If the results of diagnostic studies are equivocal, diagnostic laparoscopy or exploratory laparotomy should be considered, since they may be lifesaving if serious injuries are identified early.

Keywords: abdomen, trauma, surgery

Abdominal injuries may be life threatening and should be approached cautiously. After trauma, the abdomen may be sanctuary for occult bleeding that, if not discovered and corrected expeditiously, may lead to harmful consequences. Patients with abdominal trauma should have rapid assessment, stabilization, and early surgical consultation to maximize the chances of a successful outcome.

1. General evaluation

Initial management of patients with abdominal trauma is the same as for all other trauma patients. Begin with a rapid primary survey, including evaluation of the airway, breathing, circulation, disability, and exposure.

If the abdomen is the probable source of exsanguinating hemorrhage, the patient should be transferred to the operating room for immediate laparotomy. The hemodynamically stable patient can be more meticulously assessed within the framework of the secondary survey. Evaluation always includes comprehensive physical examination with pelvic and rectal examinations and may require specific laboratory and radiologic tests.

1.1. Airway

Administer high flow oxygen and intubate the patient if necessary. Maintain cervical spine immobilization until potential injury is ruled out.

1.2. Breathing

Auscultate for breathe sounds. Inspect for asymmetry of chest wall movement, open wounds, or flail segments. Palpate the chest wall carefully as palpable crepitus may indicate a pneumothorax or rib fractures. Pulse oximetry and capnography may be useful.

1.3. Circulation

Stop gross external hemorrhage with direct pressure. Assess pulses, capillary refill, and blood pressure. Obtain intravenous access with at least two large bore (≥16 gauge) catheters. If peripheral intravenous access is inadequate, place a central venous catheter.

1.4. Disability

Complete a brief and focused neurologic examination to document the patient's baseline. The examination should include an assessment of pupillary size and reactivity, a determination of the patient's Glasgow coma scale (GCS) score, and notation of any focal neurologic deficits such as unilateral weakness or poor muscle tone. Ideally, perform the examination before administering pain medications, sedatives, or paralytics.

1.5. Exposure

Completely undress the patient, although be careful to prevent or recognize and correct associated hypothermia. Begin a more thorough secondary survey, including examining all skin folds, the back, and axillae for occult penetrating injuries.

Do not remove impaled foreign bodies because they may be providing hemostasis from a vascular injury. Foreign body removal should be performed with surgical consultation in a more controlled setting.

Any penetrating injury below the nipple line warrants evaluation for intra-abdominal injury. In patients in motor vehicle collisions, look for ecchymosis or erythema in the area of clavicles

http://dx.doi.org/10.5772/intechopen.76474

or across the abdomen. The classic "seat belt sign" or linear bruising across the lower abdomen is a marker for intra-abdominal injury.

2. General examination

Examine the abdomen for tenderness, distention, rigidity, or guarding.

Evaluate the pelvis for anteroposterior or lateral instability with gentle pressure; this does not require much force and should not be repeatedly performed. Examine the genitalia and look for blood at the urethral meatus, especially in males. Perform digital rectal examination in any patient with abdominal trauma. Look for gross blood, assess sphincter tone, and note any other evidence of trauma. If blood at the urethral meatus or a high riding prostate is present, placement of a urinary catheter is contraindicated, and a retrograde urethrogram is required to evaluate for potential urethral injury.

2.1. Laboratory evaluation

Initial laboratory evaluation should include hemoglobin and hematocrit and platelet count to establish a baseline, and a blood type and screen in case transfusion of packed red cells are needed. A lactate level may be obtained and, if elevated, is an excellent indicator of shock. Base deficit is another indicator of shock. The role of amylase in abdominal trauma is uncertain. Examination of the urine may reveal gross hematuria, which suggests significant injury to the urogenital tract.

2.2. Plain radiography

Almost all major trauma patients require plain X-rays of the chest, pelvis, and cervical spine. Although rarely used today because of the ubiquity of computed tomography (CT) scanning, a one-shot intravenous pyelogram may be useful in patients with flank wounds or gross hematuria who are unable to undergo further diagnostic testing prior to operative intervention.

2.3. Ultrasonography

Ultrasonography has emerged as the primary initial diagnostic examination of the abdomen in multisystem injured blunt trauma patients. Emergency ultrasonography has been studied extensively and is rapid and accurate in the identification of intraperitoneal free fluid. Also, it is safe in special patient populations (e.g., pediatrics, obstetrics). Focused assessment with sonography for trauma (FAST) examination is a bedside test that has demonstrated good accuracy with relatively minimal operator experience. In the standard FAST examination, four areas are scanned: the right upper quadrant, the subxiphoid area, the left upper quadrant, and the pelvis. Unstable patients with a positive FAST examination should undergo urgent exploratory laparotomy [1]. Unlike CT, a FAST examination is rapid, can be performed bedside in the emergency department, and is easily repeatable [2] (**Figure 1**).

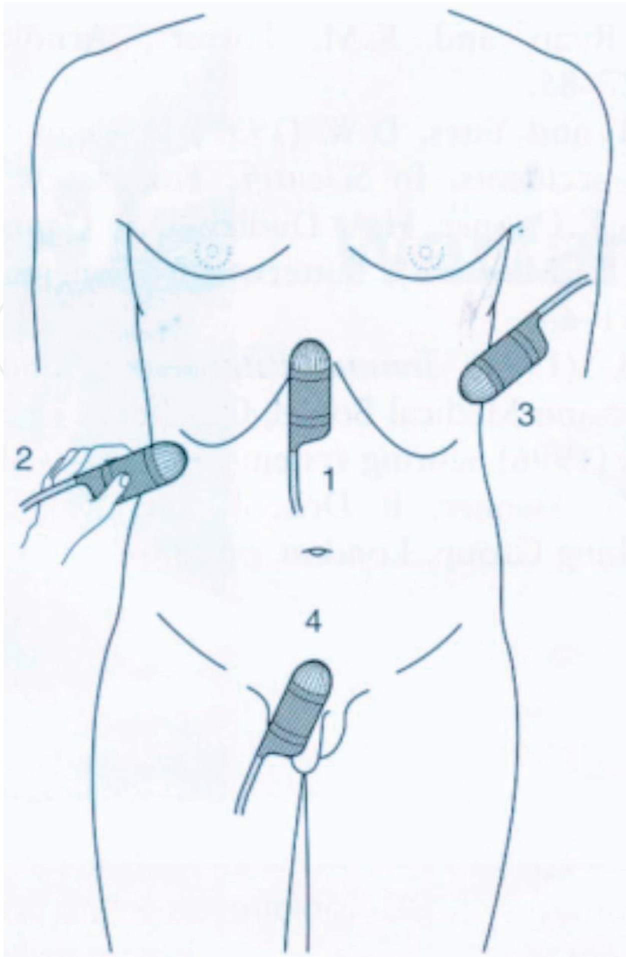

Figure 1. Transducer positions for FAST: pericardial area, right and left upper quadrants, and pelvis.

2.4. CT scanning

CT is noninvasive, qualitative, sensitive, and accurate for the diagnosis of intra-abdominal injury. Modern spiral scanners have greatly decreased the time required for obtaining high quality images. However, CT scanning remains expensive. CT scanning requires transport from the acute care area and should not be attempted in the unstable patient.

CT scanning has a primary role in defining the location and magnitude of intra-abdominal injuries related to blunt trauma. It has the advantage of detecting most retroperitoneal injuries, but it may not identify some gastrointestinal injuries. The formation provided on the magnitude of injury allows for nonoperative management of patients with solid organ injuries.

In the hemodynamically stable patient, CT scanning is an excellent diagnostic modality that is easy to perform. No diagnostic modality outperforms CT in the evaluation of intraperitoneal as well as retroperitoneal injuries (**Figure 2**).

2.5. Diagnostic peritoneal lavage

Diagnostic peritoneal lavage (DPL) is designated to detect the presence of intraperitoneal blood, although its use has decreased significantly at many centers with the use of the FAST

http://dx.doi.org/10.5772/intechopen.76474

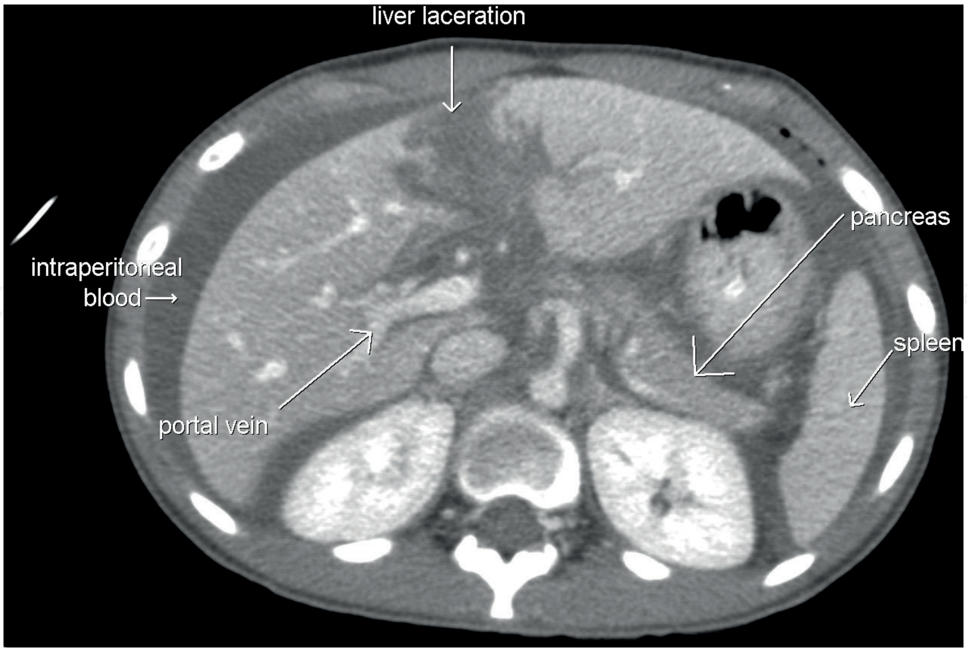

Figure 2. A CT image in blunt abdominal trauma (liver laceration and intraperitoneal blood was shown with the landmarks such as the pancreas, spleen, and portal vein).

examination. Determinations of leucocytes, particulate matter, or amylase in the lavage fluid may indicate the presence of a bowel injury. Drainage of lavage fluid from a chest tube or urinary catheter may indicate a lacerated diaphragm or bladder. Lavage can be performed easily and rapidly, with minimal cost and morbidity. It is an invasive procedure that will affect the findings on physical examination, and it should be performed by a surgeon [3].

The procedure is neither qualitative nor quantitative. It cannot identify the source of hemorrhage, and relatively small amounts of intraperitoneal bleeding may result in a positive study.

Although DPL has largely been replaced by ultrasonography, it is still used occasionally. The main concern regarding DPL is that it is overly sensitive for intra-abdominal blood, which has led to a high rate of negative or nontherapeutic laparotomies [4].

If DPL is considered, it should be performed only after consultation with the trauma surgeon, who should perform this diagnostic study in most cases (**Table 1**).

2.6. Laparoscopy

Laparoscopy has an important role in stable patients with penetrating abdominal trauma. It can quickly establish whether peritoneal penetration has occurred and thus reduce the number of negative and nontherapeutic trauma laparotomies performed [5]. Laparoscopy has also been applied safely and effectively as a screening tool in stable patients with blunt abdominal trauma [6].

The use of laparoscopy, with or without CT scanning or DPL, is being studied. It is less invasive than traditional laparotomy and may shorten hospital stays and decrease patient costs, although it requires surgical consultation [7].

Positive	
20 mL gross blood on free aspiration (10 mL in children)	
≥100,000 red cells/μL	
≥500 white cells/μL (if obtained 3 h or more after injury)	
≥175 units amylase/dL	
Bacteria on Gram-stained smear	
Bile (by inspection or chemical determination of bilirubin content)	
Food particles	
Intermediate	
Pink fluid on free aspiration	
50,000–100,000 red cells/μL in blunt trauma	
100–500 white cells/μL	
75–175 units amylase/dL	
Negative	
Clear aspirate	
≤100 white cells/μL	
≤75 units amylase/dL	

Table 1. Criteria for evaluation of peritoneal lavage fluid.

2.7. Emergency (exploratory) laparotomy

Most patients with penetrating abdominal injuries will also require laparotomy given the high incidence of intra-abdominal injury once the fascia has been violated. Hemodynamically unstable patients sustaining blunt or penetrating trauma with a positive screening test [such as focused assessment with sonography for trauma (FAST) examination or diagnostic peritoneal lavage (DPL)] require laparotomy to control hemorrhage and evaluate for intra-abdominal injuries. Also patients with obvious diaphragmatic injury noted on chest X-ray require emergency laparotomy [8].

The tree main indications for exploration of the abdomen following blunt trauma are peritonitis, unexplained hypovolemia, and the presence of other injuries known to be frequently associated with intra-abdominal injuries. Peritonitis after blunt abdominal trauma is rare but always requires exploration. Signs of peritonitis can arise from rupture of a hollow organ, such as the duodenum, bladder, intestine, or gallbladder from pancreatic injury, or occasionally from the presence of retroperitoneal blood.

Emergency abdominal exploration should be considered for patients with profound hypovolemic shock and a normal chest X-ray unless extra-abdominal blood loss is sufficient to account for the hypovolemia. In most cases a rapidly performed FAST examination or peritoneal lavage will confirm the diagnosis of intraperitoneal hemorrhage. Patients with blunt trauma and hypovolemia should be examined first for intra-abdominal bleeding even if there is no overt evidence of abdominal trauma. Hemoperitoneum may present with no

Method	Time/cost	Advantage/disadvantage
Physical examination	Quick/no cost	Useful for serial examinations, very limited by other injuries, coma, drug intoxication, poor sensitivity and specificity
Diagnostic peritoneal lavage (DPL)	Quick/inexpensive	Rapid results in unstable patient but invasive and may be overly sensitive for blood and not specific for site of injury, requires experience and may be limited if previous surgery
Focused assessment with sonography for trauma (FAST)	Quick/inexpensive	Rapid detection of intra-abdominal fluid and pericardial tamponade, may be limited by operator experience, large body habitus, subcutaneous air, poor for detection of bowel injury. Fairly sensitive but not highly specific
Helical computerized abdominal tomography (CT)	Slower/expensive	Most specific for site of injury and can evaluate retroperitoneum, very good sensitivity but may miss bowel injury, risk of reaction to contrast dye

Table 2. Comparison of diagnostic methods for abdominal trauma.

signs except hypovolemia. The abdomen may be flat and nontender. Patients whose extra-abdominal bleeding has been controlled should respond to initial fluid resuscitation with an adequate urine output and stabilization of vital signs. If hypovolemia recurs, intra-abdominal bleeding must be considered to be the cause.

Injuries frequently associated with abdominal injuries are rib fractures, pelvic fractures, abdominal wall injuries, and fractures of the thoracolumbar spine (**Table 2**).

3. Surgical consultation

Seek surgical consultation early in the management of patients with abdominal trauma, especially if the patient is hemodynamically unstable [9].

4. Fluid resuscitation

Rapid infusion of large amounts of crystalloids may disrupt the formation of the soft clot and dilute the clotting factors, leading to increased bleeding. Attempts to make the patient normotensive are not recommended. A more reasonable goal may be to obtain systolic blood pressure of 80–90 mmHg, or a mean arterial pressure of 70 mmHg. Crystalloids remain first-line fluids, followed by infusions of packed red blood cells [10].

5. Types of injuries

The distribution of blunt and penetrating injury in a given population is highly dependent upon geographic location. Blunt injuries predominate in rural areas, while penetrating injuries are more common in urban areas. The specific type of injury varies according to whether the trauma is penetrating or blunt. The mechanism of injury in blunt trauma is rapid deceleration, and noncompliant organs such as the liver, spleen, pancreas, and kidneys are at greater risk of injury due to parenchymal fracture.

Deaths from abdominal trauma result principally from hemorrhage or sepsis. Most deaths from abdominal trauma are preventable. Patients at risk of abdominal injury should undergo prompt and thorough evaluation. In some cases, dramatic physical findings may be due to abdominal wall injury in the absence of intraperitoneal injury. If the results of diagnostic studies are equivocal, diagnostic laparoscopy or exploratory laparotomy should be considered, since they may be lifesaving if serious injuries are identified early.

5.1. Penetrating trauma

Penetrating injuries may cause sepsis if they perforate a hollow viscous. Increasing abdominal tenderness demands surgical exploration. White blood cell count elevations and fever appearing several hours following injury are keys to early diagnosis.

Penetrating injuries can cause severe and early shock if they involve a major vessel or the liver. Penetrating injuries of the spleen, pancreas, or kidneys usually do not bleed massively unless a major vessel to the organ (e.g., renal artery) is damaged. Bleeding must be controlled promptly. A patient in shock with a penetrating injury of the abdomen who does not respond to 2 L of fluid resuscitation should be operated on immediately following chest X-ray [11].

The treatment of hemodynamically stable patients with penetrating injuries to the lower chest or abdomen varies. All surgeons agree that patients with signs of peritonitis or hypovolemia should undergo surgical exploration, but treatment is less certain for patients with no signs of peritonitis or sepsis who are hemodynamically stable [12].

Most stab wounds of the lower chest or abdomen should be explored, since a delay in treatment of hollow viscous perforation can result in severe sepsis. Some surgeons have recommended a selective policy in the management of these patients. When the depth of injury is in doubt, local wound exploration may rule out peritoneal penetration. Laparoscopy may ultimately have a role in the evaluation of penetrating injuries. All gunshot wounds of the lower chest and abdomen should be explored because the incidence of injury to major intra-abdominal structures is 90% in such cases [13].

5.2. Blunt trauma

Blunt abdominal trauma (BAT) comprises 75% of all blunt trauma and is the most common example of this injury. The majority occurs in motor vehicle accidents, in which rapid deceleration may propel the driver into the steering wheel, dashboard, or seatbelt causing contusions in less serious cases, or rupture of internal organs from briefly increased intraluminal pressure in the more serious, dependent on the force applied. It is important to note that initially there may be little in the way of overt clinical signs to indicate that serious internal abdominal injury has occurred, making assessment more challenging and requiring a high degree of clinical suspicion [14].

http://dx.doi.org/10.5772/intechopen.76474

There are two basic physical mechanisms at play with the potential of injury to intra-abdominal organs: compression and deceleration. The former occurs from a direct blow, such as a punch, or compression against a non-yielding object such as a seatbelt or steering column. This force may deform a hollow organ, thereby increasing its intraluminal or internal pressure, leading to rupture [15]. Deceleration, on the other hand, causes stretching and shearing at the points at which mobile structures, such as the bowel, are anchored. This can cause tearing of the mesentery of the bowel, and injury to the blood vessels that travel within the mesentery. Classic examples of these mechanisms are a hepatic tear along the ligamentum teres and injuries to the renal arteries [16].

When blunt abdominal trauma is complicated by "internal injury," the liver and spleen are most frequently involved, followed by the small intestine [17].

In rare cases, this injury has been attributed to medical techniques such as the Heimlich maneuver, attempts at cardiopulmonary resuscitation and manual thrusts to clear an airway. Although these are rare examples, it has been suggested that they are caused by applying unnecessary pressure when administering such techniques. Finally, the occurrence of splenic rupture with mild blunt abdominal trauma in those convalescing from infectious mononucleosis is well reported.

A major addition in management of blunt trauma has been the focused assessment with sonography for trauma (FAST) examination. Ultrasound has proved to be an ideal modality in the immediate evaluation of the trauma patient because it is rapid and accurate for the detection of intra-abdominal fluid or blood and is readily repeatable.

The goal of the FAST examination is the identification of abnormal collections of blood or fluid. In this regard, it obviates the need for diagnostic peritoneal cavity, but attention is directed also to the pericardium and to the pleural space.

6. Specific organ injuries

6.1. Liver injuries

Numerous methods for the definitive control of hepatic hemorrhage have been developed. Minor lacerations may be controlled by direct compression to the injury site. For similar injuries which do not respond to compression, topical hemostatic techniques have been successful. Small bleeding vessels may be controlled electrocautery. Microcrystalline collagen can be used. The powder is placed on a clean sponge and applied directly to the site. Pressure is maintained for 5–10 min. Fibrin glue has been used for both superficial and deep lacerations and appears to be an effective topical agent [18].

Suturing of the hepatic parenchyma remains an effective hemostatic technique. Although this treatment has been maligned as a cause of hepatic necrosis, hepatic sutures are often used for persistently bleeding lacerations less than 3 cm in depth. It is also an appropriate alternative for deeper lacerations if the patient will not tolerate further hemorrhage. The preferred suture is 2–0 or 0 chromic attached to a large and curved blunt needle. The large diameter of the suture helps prevent it from pulling through Glisson's capsule [19].

Most sources of venous hemorrhage within the liver can be managed with parenchymal sutures, and even injuries of the retrohepatic vena cava and hepatic veins have been successfully tamponaded by closing the hepatic parenchyma over the bleeding vessel [20].

Venous hemorrhage due to penetrating wounds that transverse the central portion of the liver can be managed by suturing the entrance and exit wounds with horizontal mattress sutures. Although intrahepatic hematomas may form that can become infected, this may be preferable to an intracaval shunt or deep hepatotomy. Suturing of the hepatic parenchyma is not always successful in controlling the hemorrhage particularly if it is of arterial origin [21].

Hepatic arterial ligation may be appropriate for patients with recalcitrant arterial hemorrhage from deep within the liver. However, its utility is limited since hemorrhage from the portal and hepatic venous systems will continue. Arterial ligation is a reasonable alternative to a deep hepatotomy particularly in unstable patients [22]. While ligation of the right or left hepatic artery is well tolerated in humans, ligation of the proper hepatic artery is not necessarily associated with survival. The fate of the dearterialized lobe is unpredictable [23].

An uncommon but perplexing hepatic injury is the subcapsular hematoma. This lesion occurs when the parenchyma of the liver is disrupted by blunt trauma, but Glisson's capsule remains intact. The hematoma may be recognized either at the time of the surgery or preoperatively if a CT is performed. Regardless of how the lesion is diagnosed, subsequent decision making is often difficult.

Resectional debridement is indicated for the removal of peripheral portions of nonviable hepatic parenchyma. The mass of tissue removed should rarely exceed 25% of the liver. Since additional blood loss may occur, it should be reserved for patients who are in good metabolic condition and who will tolerate additional blood loss.

Omentum has been used to fill large defects in the liver. The rationale for this is that it provides an excellent source of macrophages and that it fills a potential dead space with a viable tissue. The omentum can also provide a little additional support for parenchymal sutures and is often strong enough to prevent them from cutting through Glisson's capsule [24].

Since hemorrhage from hepatic injuries is often treated without identifying and controlling each individual bleeding vessel, arterial pseudoaneurysm may develop (**Table 3**). If the pseudoaneurysm enlarges, it will eventually rupture into the parenchyma of the liver, a bile duct, or into adjacent portal venous branch (**Figure 3**).

6.2. Gallbladder and extrahepatic bile ducts injuries

Injuries of the gallbladder are treated by lateral suture or cholecystectomy, whichever is easier.

Injuries of the extrahepatic bile ducts are challenge. Because of the proximity of the portal vein, hepatic artery, and vena cava associated vascular injuries are common and the patient's physiologic status is often poor. Sometimes laparoscopic injuries may occur (**Table 4**).

Injuries of the hepatic ducts are almost impossible to satisfactorily repair under emergency circumstances. One approach is to intubate the duct for external drainage and attempt a repair when the patient recovers. Alternatively, the duct can be ligated if the opposite lobe is normal and uninjured (see also **Figure 4** for gallbladder injury).

http://dx.doi.org/10.5772/intechopen.76474

Grade	Injury description
I	**Hematoma:** subcapsular, <10% of the surface area
	Laceration: capsular tear, <1 cm in parenchymal depth
II	**Hematoma:** subcapsular, 10–50% surface area, intraparenchymal, 10 cm in diameter
	Laceration: 1–3 cm in parenchymal depth, <10 cm in length
III	**Hematoma:** subcapsular, >50% of surface area or expanding or ruptured subcapsular hematoma with active bleeding; intraparenchymal, >10 cm or expanding or ruptured
	Laceration: >3 cm in parenchymal depth
IV	**Hematoma:** ruptured intraparenchymal hematoma with active bleeding
	Laceration: parenchymal disruption involving 25–75% of a hepatic lobe or one to three Couinaud segments within a single lobe
V	**Laceration:** parenchymal disruption involving >75% of a hepatic lobe or more than three Couinaud segments within a single lobe
	Vascular: juxtahepatic venous injuries (i.e., retrohepatic vena cava or central major hepatic veins)
VI	**Vascular:** hepatic avulsion

Table 3. American Association for the Surgery of trauma liver injury scale.

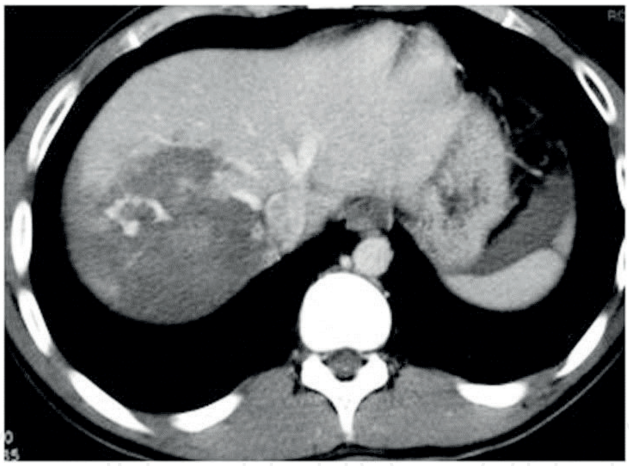

Figure 3. Grade III AAST liver injury, contrast enhanced CT image.

6.3. Spleen injuries

Splenic injuries are treated nonoperatively, by splenic repair, partial splenectomy, or resection, depending on the extent of the injury and the condition of the patient [25]. Enthusiasm for splenic salvage has been driven by the evolving trend toward nonoperative management of solid organ injuries, and the rare but often fatal complication of overwhelming postsplenectomy infection which is caused by encapsulated bacteria (e.g., *Haemophilus influenzae*, *Streptococcus pneumoniae*, *Neisseria meningitidis*) [26]. For this reason attempts to salvage the spleen are more vigorous in children [27].

Hilar injuries or pulverized splenic parenchyma are usually treated by splenectomy.

Type	Criteria
A	Cystic duct leak or leak from small ducts in the liver bed
B	Occlusion of an aberrant right hepatic duct
C	Transection without ligation of an aberrant right hepatic duct
D	Lateral injury to a major bile duct
E1	Transection >2 cm from the hilum
E2	Transection <2 cm from the hilum
E3	Transection in the hilum
E4	Separation of major ducts in the hilum
E5	Type C injury plus injury in the hilum

Table 4. Strasberg classification of laparoscopic bile duct injury.

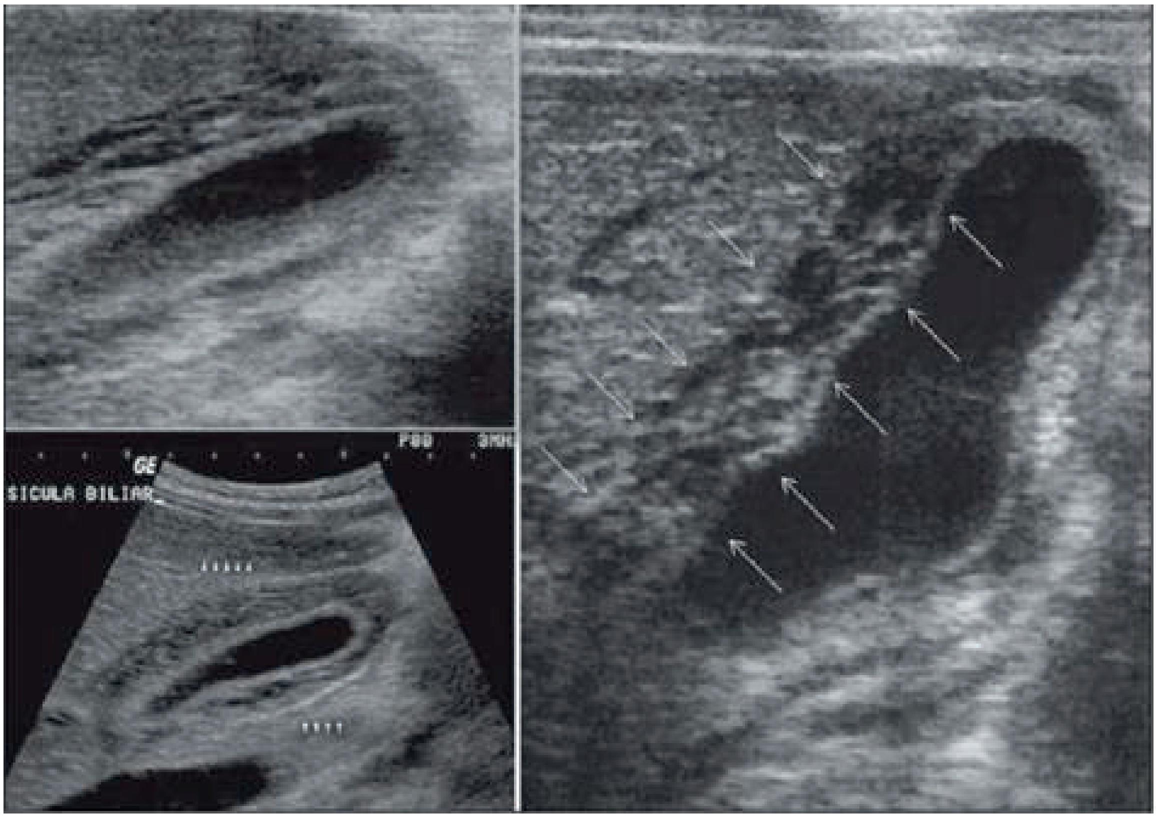

Figure 4. Longitudinal section of gallbladder (ultrasound view), parietal thickening with multiple echogenic layers intermingled with fluid.

Splenectomy also indicates for lesser splenic injuries in patients who have developed a coagulopathy and have multiple abdominal injuries, and it is usually necessary in patients with failed splenic salvage attempts [28] (**Table 5**).

If splenectomy is performed, vaccines against the encapsulated bacteria are administered (**Figure 5**).

http://dx.doi.org/10.5772/intechopen.76474

Grade	Injury description
I	**Hematoma:** subcapsular, <10% of the surface area
	Laceration: Capsular tear, <1 cm parenchymal depth
II	**Hematoma:** subcapsular, 10–50% surface area, intraparenchymal, 5 cm in diameter
	Laceration: 1–3 cm parenchymal depth, trabecular vessels not involved
III	**Hematoma:** subcapsular, >50% surface area or expanding, ruptured subcapsular or parenchymal hematoma, intraparenchymal hematoma >5 cm or expanding
	Laceration: >3 cm parenchymal depth or involving trabecular vessels
IV	**Laceration:** Involves segmental or hilar vessels producing major devascularization (>25% of spleen)
V	**Laceration:** Completely shattered spleen
	Vascular: Hilar vascular injury that devascularizes spleen

Table 5. American Association for the Surgery of trauma spleen injury scale.

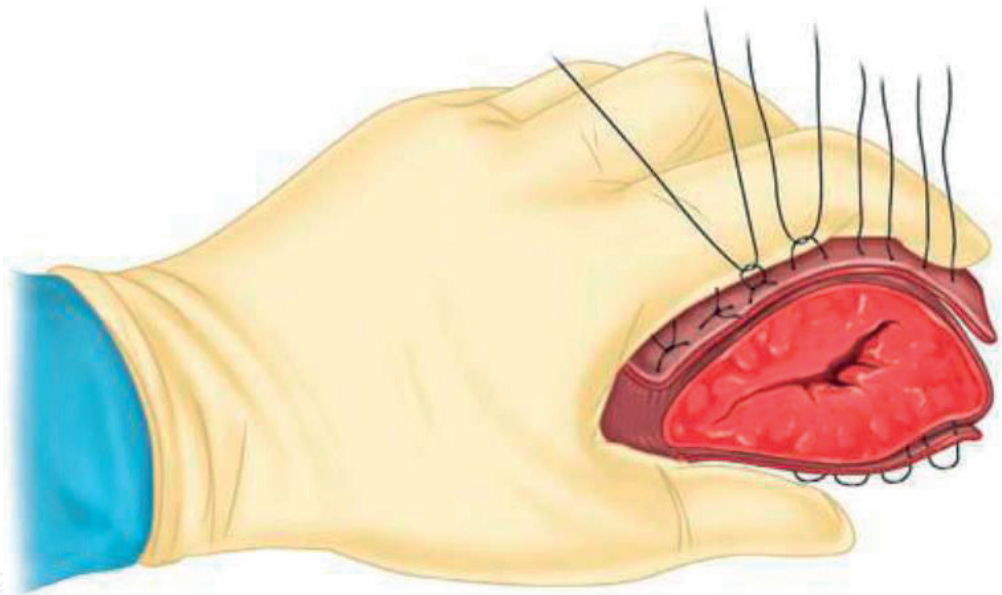

Figure 5. Interrupted pledgeted sutures may effectively control hemorrhage from the cut edge of the spleen.

The failure rate of nonoperative management of splenic injuries in adults increases with grade of splenic injury; Grade I, 5%; Grade II, 10%; Grade III, 20%; Grade IV, 33%; and Grade V, 75% in adults but not in children. Most failures occur within 72 h of injury [29]. Patients with significant splenic injuries treated nonoperatively should be observed in a monitored unit and have immediate access to a CT scanner, a surgeon, and operating room [30]. Changes in physical examination, hemodynamic stability, ongoing blood, or fluid requirements indicate the need for laparotomy. Arteriography with embolization has been reported to increase the success rate [31].

6.4. Diaphragm injuries

Diaphragmatic injuries are frequently difficult to detect initially.

The presence of abdominal contents in the thorax may not be obvious on initial chest X-ray. Insertion of a nasogastric tube may facilitate the diagnosis. However, diaphragmatic injuries may be missed even on initial CT scan (**Figures 6** and **7**).

Laparoscopy has also been used to evaluate potential diaphragmatic injuries [32].

Undiagnosed diaphragmatic injuries are a significant cause of morbidity and mortality.

6.5. Duodenum injuries

Duodenal hematomas are caused by a direct blow to the abdomen and occur more often in children than adults. Blood accumulates between the seromuscular and submucosal layers, eventually causing obstruction.

Figure 6. Hump sign of the diaphragmatic injury in CT scan (showed by arrows).

Figure 7. Band sign in diaphragmatic injury.

http://dx.doi.org/10.5772/intechopen.76474

Most duodenal hematomas in children can be managed nonoperatively with nasogastric suction and parenteral nutrition.

Duodenal perforations can be caused by both blunt and penetrating trauma. Blunt injuries are difficult to diagnose because the contents of the duodenum have a neutral pH, few bacteria, and are often contained by the retroperitoneum. Mortality may exceed 30% if the lesion is not identified and treated within 24 h.

Grade	Pancreatic injury
I	Hematoma with minor contusion/laceration but without duct injury
II	Major contusion/laceration but without duct injury
III	Distal laceration or parenchymal injury with duct injury
IV	Proximal laceration or parenchymal injury with injury to bile duct/ampulla
V	Massive disruption to pancreatic head

Table 6. American Association for Surgery in trauma pancreatic trauma grading system.

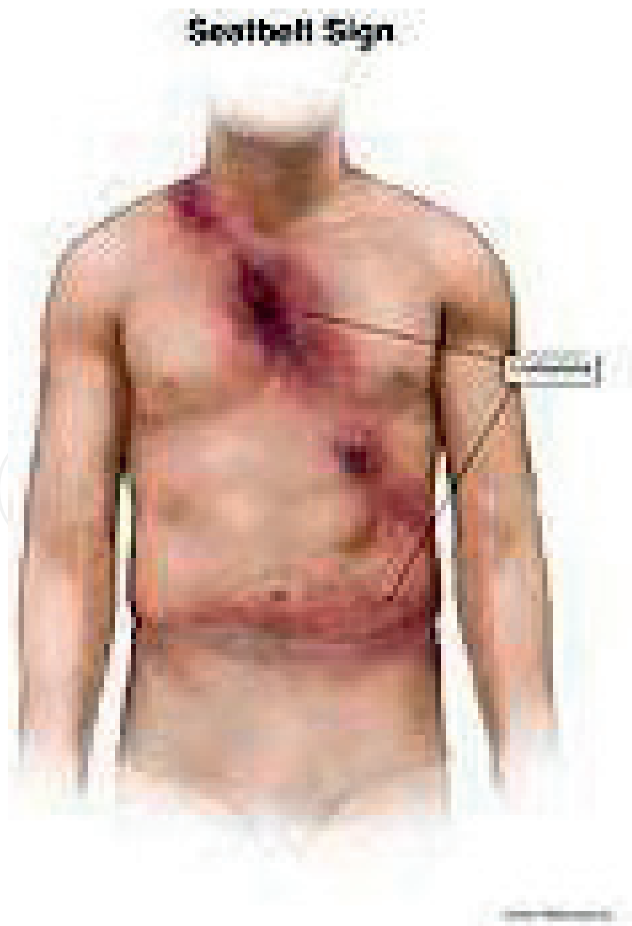

Figure 8. “Seat belt sign”.

6.6. Pancreas injuries

Blunt pancreatic transection at the neck of the pancreas can occur with a direct blow to the abdomen. As an isolated injury, it is more difficult to detect than blunt duodenal rupture; however, a missed pancreatic injury is more benign [33]. Since the main pancreatic duct is transected, the patient will develop a pseudocyst or pancreatic ascites, but there is little inflammation since the pancreatic enzymes remain unactivated [34].

It is apparent that no ideal method exists for identifying pancreatic ductal injuries that cannot be ruled out by direct exploration [35].

Fortunately, majority of pancreatic fistulas will close spontaneously with only supportive care [36] (**Table 6**).

6.7. Gastrointestinal tract injuries

Both penetrating and blunt injuries can cause gastrointestinal tract (GIT) injuries. Injuries to the GIT may be clinically difficult to detect and are more common with penetrating than blunt trauma. GIT injuries occur in 30% of stab wounds and in 80% of gunshot wounds to the abdomen [37].

In blunt trauma, an abdominal wall bruise or “seat belt sign” should raise the level of suspicion since the finding is associated with a GIT injury [38] (**Figure 8**).

GIT injuries may be missed on FAST examination or CT scan. The finding of free fluid in the abdomen on CT scan without a specific solid organ injury is highly suspicious of a hollow viscus injury [39].

Such injury may be present even if the patient can tolerate a trial of fluids by mouth in hospital care. Patients have been able to walk out of the hospital and return later with fever and a rigid abdomen [40].

7. Conclusion

Blunt abdominal trauma comprises 75% of all abdominal injury and penetrating injuries may cause sepsis if they perforate a hollow viscous. Careful examination and close follow-up and early surgical consultation may reduce mortality and mobidity of these patients.

Author details

Göksu Afacan

Address all correspondence to: goksuafacan@gmail.com

Biruni University Hospital, Florya/Istanbul, Turkey

http://dx.doi.org/10.5772/intechopen.76474

References

[1] Gracias VH et al. Defining the learning curve for the focused abdominal sonogram for trauma (FAST) examination: Implications for credentialing. The American Surgeon. 2001;**67**:364. [PMID: 11308006]

[2] Rozycki GS, Newman PG. Surgeon-performed ultrasound for the assessment of abdominal injuries. Advances in Surgery. 1999;**33**:243

[3] Gonzales RP et al. Abdominal stab wounds: Diagnostic peritoneal lavage criteria for emergency room discharge. The Journal of Trauma. 2001;**51**:939. [PMID: 11706344]

[4] Gonzales RP, Ickler J, Gachassin P. Complemantary roles of diagnostic peritoneal lavage and computed tomography in the evaluation of blunt trauma patients. The Journal of Trauma. 2001;**51**:1134. [PMID: 11740265]

[5] Taner AS et al. Diagnostic laparoscopy decreases the rate of unnecessary laparotemies and reduces hospital costs in trauma patients. Journal of Laparoendoscopic & Advanced Surgical Techniques. Part A. 2001;**11**:207. [PMID: 11569509]

[6] Ahmed N, Whelan J, Brownlee, et al. The contribution of laparoscopy in evaluation of penetrating abdominal wounds. Journal of the American College of Surgeons. 2005; **201**(2):213-216. [PMID: 16038818]

[7] DeMaria EJ et al. Complementary roles of laparoscopy abdominal exploration and diagnostic peritoneal lavage for evaluating abdominal stab wounds: A prospective study. Journal of Laparoendoscopic & Advanced Surgical Techniques. Part A. 2000;**10**:131. [PMID: 10883989]

[8] Ng AK, Simons RK, Torreggiani WC. Intra-abdominal free fluid without solid organ injury in blunt abdominal trauma: An indication for laparotomy. The Journal of Trauma. 2002;**52**(6):1134-1140. [PMID: 12045643]

[9] Albrecht RM, Schermer CR, Morris A. Nonoperative management of blunt splenic injuries: Factors influencing success in age>55 years. The American Surgeon. 2002;**68**:227. [PMID: 11893099]

[10] Pepe PE, Mosesso VN, Falk JL. Prehospital fluid resuscitation of the patient with major trauma. Prehospital Emergency Care. 2002;**6**:81. [PMID: 11789657]

[11] Armenakas NA, Duckett CP, McAninch JW. Indications for nonoperative management of renal stab wounds. The Journal of Urology. 1999;**161**:768

[12] Nicholas JM et al. Changing patterns in the management of penetrating abdominal trauma: The more things change, the more they stay the same. The Journal of Trauma. 2003;**55**:1095

[13] Pryor JP, Reilly PM, Dabrowski GP, et al. Nonoperative management of abdominal gunshot wounds. Annals of Emergency Medicine. 2004;**43**(3):344-353. [PMID: 14985662] (review)

[14] Clinical Policy. Critical issues in the evaluation of adult patients presenting to the emergency department with acute blunt abdominal trauma. Annals of Emergency Medicine. 2004;**43**(2):278-290. [PMID: 14747821]

[15] Hughes TM, Elton C, Hitos K, Perez JV, McDougall PA. Intra-abdominal gastrointestinal tract injuries following blunt trauma: The experience of an Australian trauma centre. Injury. 2002;**33**(7):617-626. [PMID: 12208066]

[16] Carrillo EH et al. Evolution in the treatment of complex blunt liver injuries. Current Problems in Surgery. 2001;**38**:1

[17] Cathey KL et al. Blunt splenic trauma: Characteristic of patients requiring urgent laparotomy. The American Surgeon. 1998;**64**:450

[18] Trunkey DD. Eval of Hepatic trauma: Contemporary management. The Surgical Clinics of North America. 2004;**84**(2):437-450. [PMID: 15062654] (Review)

[19] Croce MA et al. Nonoperative management of blunt hepatic trauma is the treatment of choice for hemodynamically stable patients. Results of a prospective trial. Annals of Surgery. 1995;**221**:744

[20] Asensio JA et al. Operative management and outcomes in 103 AAST-OIS grades IV and V complex hepatic injuries: Trauma surgeons still need to operate, but angioembolization helps. The Journal of Trauma. 2003;**54**:647

[21] Chen RJ et al. Surgical management of juxtahepatic venous injuries in blunt hepatic trauma. The Journal of Trauma. 1995;**38**:886

[22] Wahl WL et al. The need for early angiographic embolization in blunt liver injuries. The Journal of Trauma. 2002;**52**:1097

[23] Asensio JA et al. Approach to the management of complex hepatic injuries. The Journal of Trauma. 2000;**48**:66

[24] Brasel KJ et al. Trends in the management of hepatic injury. American Journal of Surgery. 1997;**174**:674

[25] Coburn MC, Pfeifer J, DeLuca FG. Nonoperative management of splenic and hepatic trauma in the multiply injured pediatric and adolescent patient. Archives of Surgery. 1995;**130**:332

[26] Carlin AM et al. Factors affecting the outcome of patients with splenic trauma. The American Surgeon. 2002;**68**:232. [PMID: 11893100]

[27] Brown RL et al. Observation of splenic trauma: When is a little too much? Journal of Pediatric Surgery. 1999;**34**:1124

[28] Uecker J, Pickett C, Dunn E. The role of follow-up radiographic studies in nonoperative management of spleen trauma. The American Surgeon. 2001;**67**:22

[29] Jacobs IA et al. Nonoperative management of blunt splenic and hepatic trauma in the pediatric population: Significant differences between adult and pediatric surgeons? The American Surgeon. 2001;**67**:149

[30] Pachter HL, Grau J. The current status of splenic preservation. Advances in Surgery. 2000;**34**:137

[31] Myers JG et al. Blunt splenic injuries: Dedicated trauma surgeons can achieve a high rate of nonoperative success in patients of all ages. 2000;**48**:801

[32] Friese RS, Coln CE, Gentiello LM. Laparoscopy is sufficient to exclude occult diaphragm abdominal trauma. The Journal of Trauma. 2005;**58**(4):789-792. [PMID: 15824657]

[33] Takishima T et al. Serum amylase level on admission in the diagnosis of blunt injury to the pancreas: Its significance and limitations. Annals of Surgery. 1997;**226**:70

[34] Bradley EL 3rd et al. Diagnosis and initial management of blunt pancreatic trauma: Guidelines for a multiinstitutional review. Annals of Surgery. 1998;**227**:861

[35] Fulcher AS et al. Magnetic resonance cholangiopancreatography in the assessment of pancreatic duct trauma and its sequelae: Preliminary findings. The Journal of Trauma. 2000;**48**:1001

[36] Patton JH et al. Pancreatic trauma: A simplified management guideline. The Journal of Trauma. 1997;**43**:234

[37] Chappuis CW et al. Management of penetrating colon injuries. A prospective randomized trial. Annals of Surgery. 1991;**212**:492

[38] Wotherspoon S, Chu K, Brown AF. Abdominal injury and the seatbelt sign. Emergency Medicine. 2001;**13**:61. [PMID: 11476415]

[39] Malhotra AK et al. Blunt bowel and mesenteric injuries: The role of screening computed tomography. The Journal of Trauma. 2000;**48**:991

[40] Fakhry SM et al. Relatively short diagnostic delays (<8 hours) produce morbidity and mortality in blunt small bowel injury: An analysis of time to operative intervention in 198 patients from a multicenter experience. The Journal of Trauma. 1999;**47**:207

IntechOpen