

Pancreatic Laceration in a Female Collegiate Soccer Athlete: A Case Report

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Objective: To characterize the diagnosis of pancreatic trauma in an athletic population and to raise awareness among health care providers of the possibility of this life- and organ-threatening injury.

Background: An 18-year-old, previously healthy female collegiate soccer athlete sustained a direct blow from an opponent's knee between the left and right upper abdominal quadrants while attempting to head the ball. She initially presented with only minimal nausea and discomfort, but this progressed to abdominal pain, tenderness, spasm, and vomiting. She was referred to the emergency department, where she was diagnosed with a pancreatic laceration.

Differential Diagnosis: Duodenal, hepatic, or splenic contusion or laceration; hemorrhagic ovarian cyst.

Treatment: The patient underwent a distal pancreatectomy and total splenectomy.

Uniqueness: Pancreatic injuries, particularly those severe enough to warrant surgical intervention, are extremely rare in athletes.

Conclusions: Recognition of a pancreatic injury can be very challenging outside the hospital setting. This is problematic, because a delay in diagnosis is a significant source of preventable morbidity and mortality after this rare injury. Thus, early identification depends on a high index of suspicion, a thorough examination, and close observation. It is imperative that athletic trainers and other health care professionals be able to identify this condition so that referral and management can occur without delay.

Key Words: abdomen, blunt trauma, cholangiopancreatography, pancreatectomy, splenectomy

Injuries to the pancreas from blunt trauma are relatively uncommon and rarely occur during athletic training and competition.^{1–3} However, these injuries are associated with high morbidity and mortality because they are difficult to detect and diagnosis is often delayed.⁴ Identification of a serious intra-abdominal condition is often challenging, as many injuries may not be apparent during the initial assessment.^{1,5} Furthermore, the mechanisms of injury often result in associated damage that may divert an athletic trainer's attention from a potentially life- or organ-threatening intra-abdominal condition. We present this case of a pancreatic laceration in a collegiate female soccer athlete to inform health care professionals in the sports setting about this uncommon but life-threatening condition. This case is unique in that this injury rarely occurs in athletes, but it was severe enough to warrant removal of the spleen and a large section of the pancreas.

CASE REPORT

History and Physical Examination

An 18-year-old, previously healthy female collegiate soccer athlete suffered a direct blow from an opponent's knee between the left and right upper abdominal quadrants while attempting to head the ball. During the initial assessment, the patient stated that she “got the wind knocked out of her” and complained of slight nausea for approximately 1 minute. No other signs or symptoms were

evident at this time, and approximately 3 minutes after the trauma, the patient complained of only slight discomfort and tightness in the area. As a precaution, the patient did not return to competition; however, she stated that she could have done so if needed. Approximately 3 hours after the injury, the patient reported abdominal pain when attempting to eat during the team's postmatch meal. At this time, there was palpable abdominal spasm but without discoloration, distention, rigidity, or rebound tenderness. Because she presented with only mild pain and spasm and was otherwise asymptomatic, the athletic training staff did not believe that immediate physician referral was warranted and that referral to the team's local trauma center, which was about 90 minutes away, would better serve the patient if necessary. When the team returned to campus, the patient again complained of nausea, now associated with increased abdominal spasm and vomiting. At this point, the patient was immediately referred to the emergency department for further evaluation.

Clinical Evaluation

In the emergency department, the patient's pain and nausea progressively worsened. The physical examination revealed upper abdominal tenderness with muscle guarding, and blood tests revealed elevated amylase and lipase levels. A computed tomography (CT) scan with oral and intravenous contrast was performed and revealed a moderate amount of pelvic fluid; mild perihepatic,

perisplenic, and peripancreatic fluid; and mesenteric infiltration (also known as stranding). However, the patient had difficulty holding her breath and remaining still during the scan. As a result of the physical examination, blood test results, and CT findings, the patient underwent an exploratory laparotomy approximately 11 hours after the initial trauma. During this procedure, a hematoma in the region of the transverse mesocolon, a jejunal contusion, and an inflamed pancreas were observed. The duodenum was intact, with no obvious tear in the neck of the pancreas or necrotic tissue at the pancreatic head. The hematoma was evacuated, and 2 Jackson-Pratt drains were inserted to drain excess fluid and permit monitoring of the fluid for pancreatic enzymes.

Postoperatively the patient had a moderate amount of amylase, lipase, and pancreatic juice leakage from the drains. As a result, magnetic resonance cholangiopancreatography (MRCP) was performed 2 days after the injury to obtain a better view of the pancreas and pancreatic duct. The MRCP revealed a large longitudinal laceration of the pancreas near the spleen at the junction of the head and body extending to the splenic vein. The width of the laceration was determined to be approximately 2 cm. At this time, the patient was referred to a pancreatic specialist at another institution, where a second CT was performed.

Differential Diagnosis

Possible alternative diagnoses based on symptoms included rib fracture; duodenal, jejunal, hepatic, and splenic contusion or laceration; mesenteric injury; and hemorrhagic ovarian cyst. The history and physical examination were nonspecific for intra-abdominal injury. Plain radiographs ruled out fractures, and the CT scan also showed only nonspecific intra-abdominal injury. Exploratory laparotomy ruled out other visceral injury.

Treatment

Four days after the trauma, the patient underwent a subtotal distal pancreatectomy resulting in removal of 75% of the pancreas. A total splenectomy was also performed. The patient did well initially postoperatively, tolerating tube feedings and resuming oral intake on the sixth postoperative day. However, an infection developed, most likely as a result of the wound being left open postoperatively to allow drainage and prevent fluid accumulation. Thus, she was not discharged until 18 days after surgery and was instructed to continue the use of a wound vacuum to manage the infection. The infection resolved and the wound healed without further complications (Figure 1). During a follow-up visit, the patient received an insulin injection to stimulate endogenous insulin secretion, to which her body responded. She was restricted from consuming glucose beverages and alcohol and instructed not to lift anything weighing more than 20 pounds (9.07 kg) for about 2 months postsurgery. Initially, her activity level was severely limited, and she required assistance to complete activities of daily living. However, approximately 7 months after surgery, she began running and was able to resume soccer activities 2 months later. The patient has returned to full soccer competition but is limited by premature fatigue.



Figure 1. Surgical incision after healing and closure.

DISCUSSION

Although intra-abdominal trauma is fairly common in people involved in automobile accidents, the occurrence during sport competition is rare.¹⁻³ Blunt trauma to the abdomen generally results from direct blows, and these forces typically result in injury to the solid viscera. Reports vary, but the liver and spleen seem to be the organs injured most frequently during this type of trauma.⁶ Because of its retroperitoneal location, the pancreas is less susceptible than other organs to visceral injuries (Figure 2). Pancreatic injuries are generally associated with penetrating trauma, such as gunshot or stab wounds, yet injuries from blunt trauma do occur in the athletic setting. The fixed position of the pancreas anterior to the vertebral column makes the organ vulnerable to compression injuries, with a contusion or laceration more likely to occur at the junction of the head and neck. This was the case with our patient, in whom the pancreas was compressed between an opposing player's knee and her spine. It is interesting to note that the pancreas was the only seriously injured organ. Isolated pancreatic injuries are rare, and associated injuries, especially to the liver, spleen, and duodenum, occur in most patients.^{7,8} In fact, it is not uncommon for 3 or more organs to be involved.² Our patient's pancreatic injury was accompanied by a jejunal contusion; however, the contusion was minor in severity and did not require intervention.

Recognition of intra-abdominal injury and, more specifically, pancreatic injury can be very challenging outside the hospital setting. Early identification therefore depends on a high index of suspicion, a thorough examination, and close observation. The mechanism of injury alone can trigger a high index of suspicion, and a pancreatic injury should always be considered when a direct anterior upper abdominal blow occurs. However, referral decisions are usually based on the history and physical examination and rarely on mechanism alone. Unfortunately, the diagnosis of pancreatic injury is often made late because the symptomatic presentation and physical examination can be unreliable.^{5,9} In one report,² abdominal pain was noted in only 78% of patients with

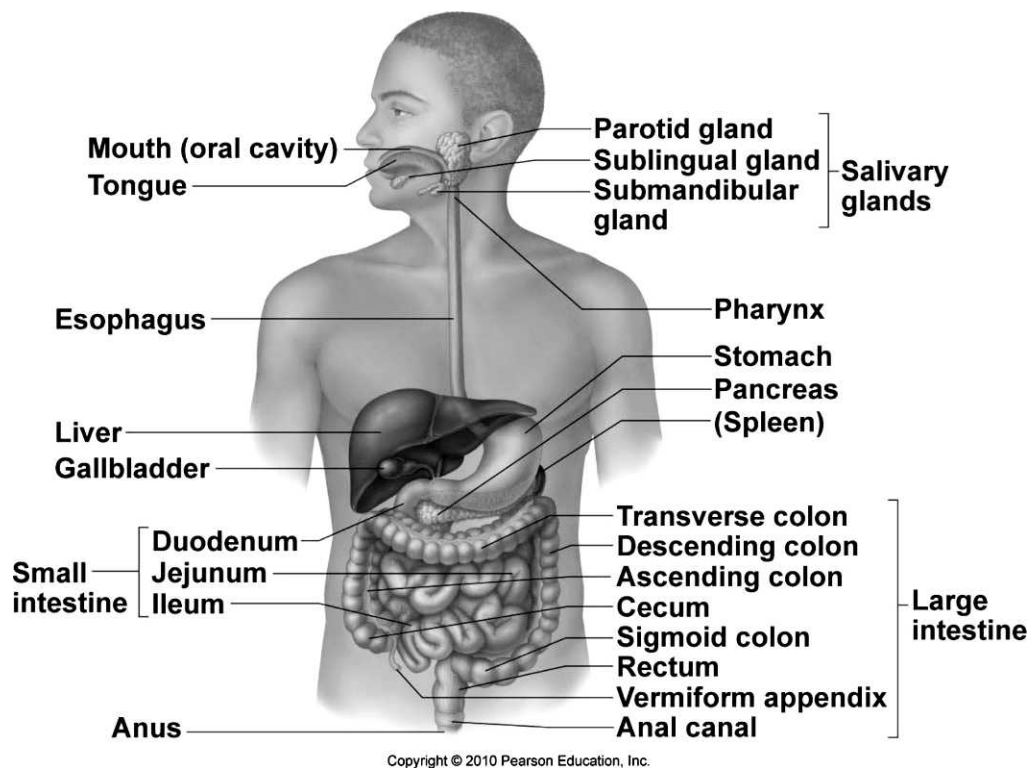


Figure 2. Abdominal anatomy. From Marieb EN, Hoehn K. *Human Anatomy & Physiology*, 8th edition, © 2010, p 852. Reprinted by permission of Pearson Education, Inc, Upper Saddle River, NJ.

blunt pancreatic trauma and was most often either diffuse or epigastric. Abdominal tenderness existed in 80% of patients and was also most often diffuse, whereas rebound tenderness was unusual and present initially in only 10%. Overall, these symptoms did not correlate with the grade of pancreatic injury or with subsequent morbidity or death. Yet the lack of these symptoms does not preclude intra-abdominal injury.^{5,9} In a similar study,¹⁰ the false-negative rate of a normal abdominal examination was 10%. Typically, the abdominal pain and tenderness initially reported by the patient diminishes in the first 2 hours after injury, only to increase again over the next 4 to 6 hours.^{11,12} This phenomenon was observed in the present case: our patient did not become symptomatic until approximately 3 hours after trauma, and symptoms were diffuse. It is possible that the introduction of food stimulated pancreatic activity and the release of pancreatic enzymes, resulting in pain and spasm. The fact that she suffered only a minor intestinal injury in addition to the pancreatic laceration may also have contributed to the presentation. Abdominal pain and tenderness are usually more prevalent when multiple organs are involved.⁹ Thus, continued observation is important when the mechanism of trauma may have resulted in organ injury.

Acute pancreatitis is one of several painful conditions, along with duodenal injury, in which visceral pain is referred to the spine. The back pain of pancreatitis is typically referred to the region of the 10th to 12th thoracic vertebrae.¹³ From there, the pain can radiate to the subscapular or midscapular regions and to the left shoulder. However, this pattern of radiating pain does not appear to occur as frequently as other types of visceral referred pain, such as the Kehr sign associated with splenic injury. Our

patient did not report back pain at any time before or during her hospital admission. Other signs and symptoms, such as vomiting, can also occur. Our patient did vomit but not until approximately 5 hours after trauma. The challenges associated with the abdominal examination are problematic, as a delay in diagnosis is a significant source of preventable morbidity and mortality after pancreatic injury.¹¹ It has been suggested^{10,14} that in patients with a potentially severe mechanism of injury, physical examination alone is insufficient to exclude all serious abdominal injuries and that objective measures in the hospital setting are needed.

Although the field examination will likely identify general intra-abdominal injury, further clinical testing in the hospital setting is necessary to confirm and identify specific conditions. Unfortunately, these clinical findings are also often nonspecific and unreliable. Serum amylase and lipase levels are commonly used to identify possible pancreatic injury, but the specificity and sensitivity of these levels are low and false-positive results are common.¹ Furthermore, not all patients with pancreatic injury present with elevations of serum amylase and lipase levels.² Thus, amylase and lipase levels are not used as the sole determinants of pancreatic injury and are usually considered in conjunction with imaging. Injuries involving the liver and spleen are common and usually detected by imaging without difficulty, but the radiologic diagnosis of pancreatic injuries can be difficult. Plain radiographs of the abdomen usually show nonspecific signs, such as gastric and duodenal distension, whereas ultrasonography usually shows only an edematous enlargement of the pancreas or a mass in the area.¹⁵ Computed tomography is widely used as screening for patients with abdominal trauma and is

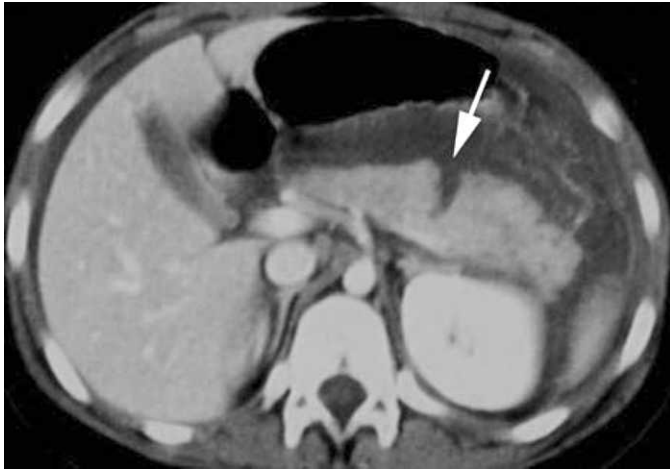


Figure 3. Computed tomography scan showing complete transection of the pancreas at the junction of the head and neck and fluid tracking adjacent to the pancreas. The latter likely represents secreted pancreatic enzymes from the injury. This image is not of our patient but is from Gupta A, Stuhfaut JW, Fleming KW, Lucey BC, Soto JAT. Blunt trauma of the pancreas and biliary tract: a multimodality imaging approach to diagnosis. *Radiographics*. 2004;24(5):1381–1395.¹⁸ Reprinted by permission of the Radiological Society of North America.

considered the most effective modality for diagnosing pancreatic injury (Figure 3). The sensitivity of the CT scan is 85% when performed within 24 hours and 90% overall.¹ These values compare with a sensitivity of 67% for diagnostic ultrasound. In a similar report,² pancreatic injury was correctly predicted by CT scan in 25 of 37 proved cases. However, CT was falsely positive for pancreatic injury in 2 patients and falsely negative in 10. False-negative CT scans have been reported in as many as 40% of patients with significant pancreatic injuries.¹⁶ Thus, the reliability of the CT scan for accurately diagnosing pancreatic injury has been questioned. Some of the inconsistencies might be due to the specific procedure and the timing of the CT scan. It is suggested that the CT examination be performed with both intravenous and oral contrast.¹⁷ This method was used for our patient, and even though the mesenteric infiltration and fluid suggested visceral trauma, the CT scan was inconclusive for pancreatic injury. Although CT scan may potentially identify a pancreatic laceration, it does not give information about the pancreatic duct. This is important because the main determinant for surgical intervention and the primary source of delayed morbidity and mortality from pancreatic trauma is disruption of the duct.^{2,18} Endoscopic retrograde cholangiopancreatography (ERCP) is commonly considered the best method to accurately define pancreatic duct integrity.¹⁹ This procedure combines the use of plain radiographs and an endoscope. Through the endoscope, the physician can visualize the duodenum and pancreatic duct and inject dyes that can be viewed radiographically. This procedure was not performed on our patient, however. The physician instead chose to perform a less invasive MRCP, which can also directly image the duct.^{19,20} The MRCP technique produces images that are similar in appearance to those obtained from ERCP and has become the noninvasive imaging method of choice when evaluating pancreatic duct injury.¹⁷ The basic principle underlying MRCP is that

stagnant pancreatic secretions have a high signal intensity on heavily T2-weighted magnetic resonance sequences, which makes them appear white. The adjacent solid hepatic and pancreatic tissue and fast-flowing fluids, such as circulating blood, generate low signal intensity and thus appear dark. Because of the inherent contrast-related properties of the fluid in the pancreatic duct, MRCP does not require administration of any exogenous contrast material. In addition, this technique uses rapid image acquisition, thus avoiding breathing artifact. A second CT scan was performed on our patient after the MRCP. An initial CT or magnetic resonance scan may be relatively normal, but a later examination after leakage of pancreatic juice may show extensive injuries. Therefore, it is not uncommon for repeat examinations to be performed.

Exploratory laparotomy is usually performed after blunt abdominal trauma if the physical examination, amylase level, or CT scan suggests a need.^{21,22} The patient's hemodynamic stability also affects the need for surgery. Patients with blunt trauma who are hemodynamically stable are most often evaluated by CT scan, whereas unstable patients generally undergo diagnostic peritoneal lavage followed by laparotomy as indicated.^{21,22} On many occasions, exploratory surgery is performed because of associated injuries and not directly related to the pancreatic injury.^{2,4} Although our patient's initial CT scan was inconclusive, the physical examination and elevated amylase levels suggested the need for a laparotomy. It is important to note that the laparotomy revealed only an inflamed pancreas and was negative for a laceration. Pancreatic injuries can remain unrecognized during laparotomy, often with disastrous consequences.^{4,11} Why this false-negative result occurred is unclear, but inspection of the pancreas requires complete exposure of the gland. This inspection is often complicated by the extent and severity of associated injuries and occasionally hindered by the reluctance of the surgeon to mobilize retroperitoneal structures.²³ Fortunately, our patient was continually monitored after surgery, which ultimately led to the correct diagnosis.

The management of pancreatic injury depends on the severity of the damage. Disruption of the pancreatic duct is generally treated surgically, whereas injuries without duct involvement are usually treated with drainage and observation.^{7,8} The location of injury also influences the surgical approach. If a distinct laceration of the pancreatic parenchyma is present, resection of that part is usually advocated.^{8,16} However, because the proportion of islet cells is highest in the tail of the pancreas, removal of more than 50% of the pancreas may lead to glucose regulation abnormalities. Thus, pancreas-sparing procedures are often attempted in these patients.¹⁶ Our patient had approximately 75% of her pancreas removed but has not suffered from endocrine or exocrine dysfunction, at least in a resting state. Yet her decreased exercise tolerance might be related to problems with glucose regulation. In an examination⁷ of 74 surgical cases, resection of more than 67% of the pancreas occurred in only 8 patients (11%). Resection of as much as 90% has been reported without endocrine or exocrine dysfunction.²⁴

The delay in our patient's diagnosis resulted in surgery being performed 4 days after trauma. This is not uncommon: surgeries have been reported as late as 44

days after initial admission.¹ On many occasions, conservative observation and drainage are used to manage the injury initially, with the need for surgery recognized later.² This protocol is potentially problematic, though, because higher complication rates have been reported when surgical intervention is delayed.^{11,12} Delayed complications, such as fistula, abscess, pseudocysts, sepsis, and hemorrhage, occur in up to 45% of patients and can lead to significant morbidity and mortality.^{1,2,7,8} These complications have been noted during conservative observation and drainage as well. Although our patient's spleen was not involved in the trauma, a total splenectomy was also performed to expedite rapid resection of the pancreas.²⁵ The tail of the pancreas is in close proximity to the left kidney and the spleen, with a relationship to the splenic blood supply. Distal pancreatectomy usually includes splenectomy if preservation of the splenic artery and vein is either contraindicated or technically impossible. Concerns about the possibility of overwhelming postsplenectomy infection have prompted several authors^{7,25} to consider distal pancreatectomy without splenectomy. The technical challenge in pancreatectomy with splenic salvage is how to isolate and ligate the pancreatic vessels off the splenic vein and artery in a reasonable amount of time and without causing injury to the spleen. The increased operating time and the potential blood loss associated with pancreatectomy without splenectomy must be balanced against the slight risk of overwhelming postsplenectomy infection. Removal of the spleen was determined to be the best course of action for our patient. Yet she did experience an infection after surgery, which extended her hospital stay. This is common after any type of open procedure and was not attributed to the splenectomy.^{7,26} No further infection occurred, and no illnesses out of the ordinary have occurred up to this time.

CONCLUSIONS

Pancreatic trauma can lead to potentially life- or organ-threatening injury. The principal cause of early death after blunt pancreatic trauma is related to the presence of associated injuries, particularly vascular injuries, whereas preventable morbidity and mortality have been related to a delay in diagnosis and treatment. Although specifically identifying pancreas injury after trauma is difficult, the ability to identify intra-abdominal injury is crucial for a positive prognosis. The key to identifying pancreatic injury is having a high index of suspicion for it, which should begin with the mechanism of injury. Lack of pain and other symptoms does not necessarily preclude pancreatic injury; thus, continued observation is necessary. It is imperative that athletic trainers and other health care professionals be able to identify this type of injury so that referral and management can occur without delay. Pancreatic injury can truly be a life-or-death situation.

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