BLUNT ABDOMINAL TRAUMA

BAT is a common cause of morbidity and mortality. Often, it results from motor vehicle accidents, although accidents of other types or assault injuries are sometimes to blame. The authors present a common case scenario and discuss the emergent management of stable and unstable patients.

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CASES

Two trauma code patients present from the same motor vehicle accident. According to EMS, they were the driver and passenger of a sedan that was traveling at approximately 45 mph when it was hit on the driver's side by a large SUV, causing significant vehicle damage. Both patients were wearing seat belts and both air bags deployed. Both patients have abdominal pain.

A quick exam reveals that the passenger is awake and stable with normal vital signs, while the driver is pale, diaphoretic, and tachycardic, requiring immediate attention.

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INTRODUCTION

Blunt abdominal trauma (BAT) is physical trauma to the abdomen caused by impact. Up to 75% of BAT cases are attributed to causes involving motor vehicles.[1] Other common causes include assaults, recreational accidents, and falls. BAT is a leading cause of morbidity and mortality in all age-groups. BAT often represents a significant diagnostic challenge, even to the experienced practitioner: findings on physical exam may be inconsistent, patients with BAT are often intoxicated, and they often present with additional distracting injuries that must be treated.

The two basic mechanisms of injury in BAT are compression force and deceleration force. Compression force is caused by a direct blow (eg, assault) or external compression (eg, steering wheel to abdomen). Compression forces deform solid and hollow organs. They cause tears or hematomas in solid organs and hollow viscus rupture. Deceleration forces are generated when a rapid decrease in the rate of speed causes discordant movement of fixed and nonfixed anatomic structures. This mechanism of injury causes stretching and linear shearing, vessel injury, and thrombosis. In BAT, the most commonly injured organ is the spleen, followed by the liver and hollow organs (stomach, intestines, bladder).[1] For management purposes, BAT can be categorized into stable and unstable presentations.

THE STABLE PATIENT

The stable abdominal trauma patient may present in three different ways: patients may be hemodynamically stable on presentation and remain so throughout the hospital course; they may present with mild hypotension that responds to resuscitation; or they may be initially unstable but stabilize after resuscitation. Due to the variety of possible presentations, it is important to use a systematic approach in evaluating the patient.

History

As is often the case in emergency medicine settings, the history can provide much relevant information about the patient's condition, and this is also true of the patient with BAT. Patients typically complain of abdominal pain following an incident in which force—either compressive or decelerative—is applied to the abdomen. It may be force from the hands of another person, from the handlebars of a bicycle, or from a seat belt across the lap. Even people who fall from standing are at risk for intra-abdominal injury from blunt trauma. Obtaining an accurate, relevant history from both the patient and the paramedics is helpful in assessing risk of intra-abdominal injury in the trauma victim. Patients may be able to provide details of the trauma itself, including mechanism, velocity, area of impact, seat belt usage, and air bag deployment. Paramedics may know about other victims at the scene, including any fatalities, damage to the vehicle, prolonged extrication, and other historical data.

Physical Examination

Some patients with BAT may have no tenderness to palpation of the abdomen despite having a significant injury, and others may present in extremis and have no identifiable visceral injury. The most reliable evidence of intra-abdominal injury on physical exam includes tenderness to palpation and peritoneal signs. Illustrating the diagnostic challenge, studies have reported injuries diagnosed by imaging alone in 35% to 45% of patients who sustained BAT, and each patient had a negative physical examination of the abdomen.[2] Also, when assessing a trauma patient, it is important to be aware of distracting injuries and the presence of altered mental status or intoxication. These factors may contribute to unreliable physical exam findings. The best way to make the physical exam reliable is to perform it serially, noting important changes.

The first step in the physical examination is inspection of the abdomen for signs of trauma. Ecchymosis, especially across the lower abdomen (the "seat belt sign"), should prompt the emergency physician to further investigate the abdomen for injury, as nearly half of patients with a seat belt sign have an underlying injury.[3] Following inspection, palpation of the abdomen should be performed to identify tenderness and distention. Adequate palpation begins at the lower ribs, assessing for possible rib fractures (which can cause penetrating trauma to the spleen or liver) and extends to an exam for stability of the pelvis. Care should be taken to palpate each quadrant separately, noting any tender points and peritoneal signs. The exam should extend to the genital area. The presence or absence of ecchymosis, swelling, and/or blood at the urethral meatus should be noted. Of course, an abdominal exam would not be complete without a rectal exam screening for a high-riding prostate, lack of rectal tone, or heme-positive stools.

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Patients with BAT may have no tenderness to palpation of the abdomen despite having a significant injury.

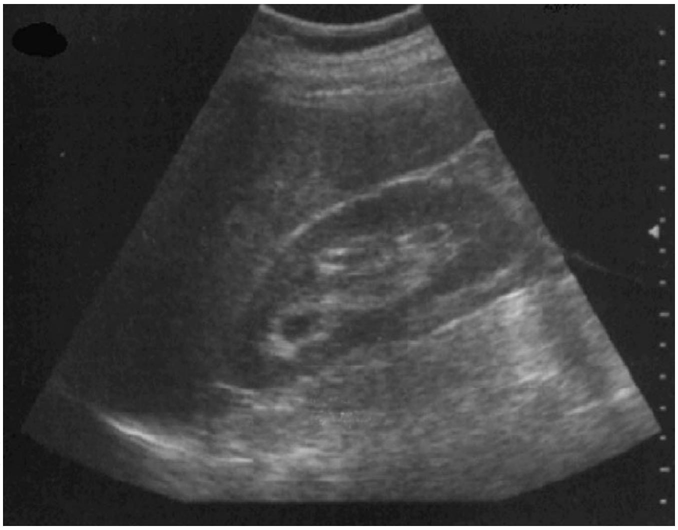
Differential Diagnosis

Injuries to consider in the differential diagnosis include solid organ (liver and spleen) lacerations, pancreatic hematomas, duodenal hematomas, hollow viscus perforations, diaphragmatic injuries, low rib fractures, pelvic or spine fractures, mesenteric vessel tears or other injuries to vasculature, and bladder rupture.

Diagnostic Studies

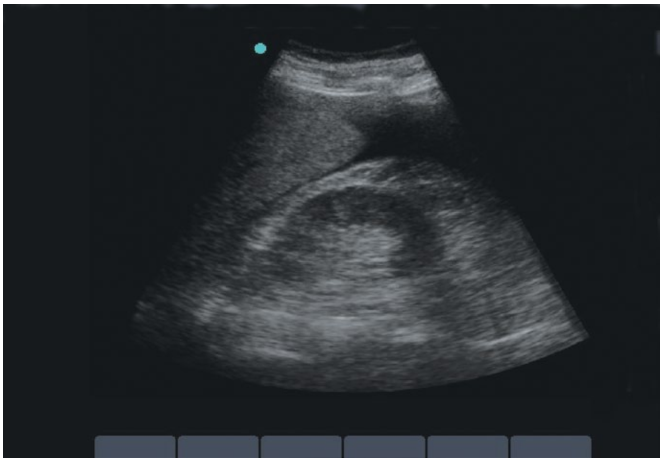
Laboratory Tests

Laboratory tests rarely add useful information in the acute management of the patient with BAT, although



Courtesy of David Bahner, MD

Figure 1. Normal FAST exam window showing the liver and kidney in a view of the right upper quadrant (Morison's pouch).



Courtesy of David Bahner, MD

Figure 2. Positive FAST exam window showing free fluid between the spleen and kidney in the left upper quadrant.

some tests may be useful in the ongoing management of the patient. Blood typing and screening, as well as a baseline hematocrit level, may be useful in the continuing care of the patient, should bleeding become a concern. Patients with abdominal injury may need serial hematocrit measurements or blood transfusions.

Urinalysis may also be useful in the BAT patient. A higher degree of suspicion for intra-abdominal injury must be maintained in stable patients with abdominal tenderness and hematuria. In patients undergoing abdominal CT at a large urban trauma center, the presence of hematuria in patients with abdominal tenderness had a sensitivity of 60% and a specificity of 90% for intra-abdominal injury.[4] A urine pregnancy test should be ordered in all women of childbearing age.

Additionally, liver function tests and pancreatic studies may be useful. Serum alanine aminotransferase or aspartate aminotransferase levels greater than 130 U/L may indicate hepatic injury. Serum amylase concentrations may be measured to check for possible pancreatic injury. Most sources recommend that serum amylase measurement be delayed until 3 hours posttrauma, because time is the major factor in a diagnostic amylase level.[5] Serum amylase is neither sensitive nor specific for pancreatic injury; however, persistently elevated or rising amylase levels in BAT should prompt further investigation, including CT, to rule out pancreatic injury. Finally, a blood glucose check in the patient with altered mental status may provide answers to the cause of the trauma.

In cases where the patient is stable, the practitioner can take some time to choose carefully among multiple diagnostic modalities. As mentioned, physical examination in the awake, alert, nonintoxicated patient is somewhat accurate, but it still may miss important intra-abdominal injuries. Therefore, most patients with significant BAT require a further diagnostic workup.

Ultrasonography

Ultrasound can be used at the bedside as part of the initial evaluation of trauma patients. The focused assessment with sonography in trauma, or FAST, is a valuable screening method in the patient with BAT (Figures 1 and 2). The benefits of ultrasonography include its utility in rapid assessment at the bedside and in detecting abdominal free fluid, as well as its lack of ionizing radiation. However, this modality has several drawbacks: it is operator-dependent, cannot differentiate ascites from blood, can be difficult to interpret in patients with a large body habitus, and is not reliable in identifying solid organ injury, bowel injury, or retroperitoneal injury. The amount of intra-abdominal fluid necessary for a positive FAST scan is debatable and operator-dependent, but data suggest that it is between 250 and 650 mL, depending on whether the patient is placed in the supine or Trendelenburg position.[6]

A consensus conference on ultrasound in trauma suggested that in a hemodynamically stable patient, a positive FAST exam (ie, one that shows free fluid) should be followed by CT of the abdomen to further elucidate the exact nature of the injury and whether operative intervention is required.[7] A negative FAST exam should be followed by serial abdominal exams, repeat ultrasonography after 6 hours, or abdominal CT. The FAST examination has a sensitivity ranging from 63% to 100% and specificity ranging from 90% to 100% for detecting intra-abdominal injury.[7] A recent randomized controlled trial found that use of FAST, or point-of-care ultrasonography, resulted in significant reductions in the use of CT, fewer days in the hospital, fewer complications, and lower charges for hospital care.[8]

Computed Tomography

With new 64-slice helical scanners, abdominal CT has improved sensitivity and specificity in diagnosing solid and hollow viscus injury, making CT the diagnostic modality of choice in the stable patient.[9] The benefits of CT include its ability to detect intraperitoneal fluid and free air in the abdomen, as well as to assess the solid organs, hollow viscus, retroperitoneum, vasculature, and diaphragm. However, CT also has several drawbacks: it is reader-dependent, requires transfer of the patient from the trauma bay, exposes the patient to ionizing radiation, and is not available in some hospitals. A 2004 American College of Emergency Physicians clinical policy statement[10] concluded that CT performs well in ruling out significant liver and spleen injuries requiring operative intervention but it cannot be used exclusively to exclude bowel, pancreatic, or diaphragmatic injuries. In addition, CT can be used to detect smaller volumes of hemoperitoneum that are not sonographically evident; CT plus serial abdominal examinations increase the ability to detect hollow viscus injury.[10]

Diagnostic Peritoneal Lavage

Diagnostic peritoneal lavage (DPL) was first described in 1965[11] and subsequently became the standard of care.[9] With tools like ultrasonography replacing it, DPL has been relegated to a secondary role. DPL can be used to access the peritoneal cavity in either an open fashion or a Seldinger approach. Aspiration of 10 mL of gross blood or gastrointestinal contents prior to infusion of the lavage fluid is a positive result, while the following are positive findings in the drained fluid: more than 100,000 red blood cells/mm^3, more than 500 white blood cells/mm^3, or vegetable matter. Any of these findings are indications for laparotomy. Benefits of DPL include the fact that it can be performed at the bedside; in addition, it is easy to learn, time-efficient in experienced hands, and highly specific. The drawbacks are that many practitioners are inexperienced in its use, it is difficult to perform in uncooperative patients or patients with a large body habitus, it does not detect injury in the retroperitoneum, and it can result in a high nontherapeutic laparotomy rate (up to 36%).[12]

A prospective comparative study of 55 stable patients with BAT who underwent all three diagnostic modalities found that ultrasonography was 92% sensitive and 95% specific; CT, 97% sensitive and 95% specific; and DPL, 100% sensitive and 84% specific for diagnosing intra-abdominal injury.[13]

Management

Patients with any intra-abdominal injury of the viscera or peritoneum should be transferred to a trauma center or referred to a surgeon who is skilled and knowledgeable in the management of traumatic injuries. For most of the 20th century, operative management of solid organ injury was the rule, but research in the nonoperative management of pediatric blunt abdominal injury led to a shift in the adult paradigm. Over the past 25 years, the standard of care for management of solid organ injuries has become nonoperative management or embolization. Advantages of nonoperative management include the avoidance of nontherapeutic surgery, decreased cost, fewer blood transfusions, and avoidance of the risk of postoperative infection. In a prospective study of 78 patients with blunt hepatic trauma, 55 were selected for nonoperative management.[14] Of these, 8 (15%) underwent surgery for other related abdominal injuries and the remainder were managed nonoperatively. No patients on the nonoperative pathway required surgery for liver-related complications, constituting a 100% success rate. Compared with those in whom nonoperative management of liver injury was successful, the 8 patients in whom it failed had similar liver injury grades but had a higher Injury Severity Score and required more blood transfusions.[14]

In a retrospective study evaluating a specific institution's practice guideline for nonoperative management of spleen injuries,[15] hemoglobin levels were measured as follows: in grade 1 injuries, every 6 hours for 24 hours; in grade 2 to 5 injuries, every 6 hours for 24 hours, then every 12 hours. Once hemoglobin levels were stable, patients were discharged if they had no other injuries. With use of this guideline, the success rate of nonoperative management of patients with splenic injuries was 96%, and all patients who required operative management were accurately identified, except in one case involving a noncompliant patient.[15]

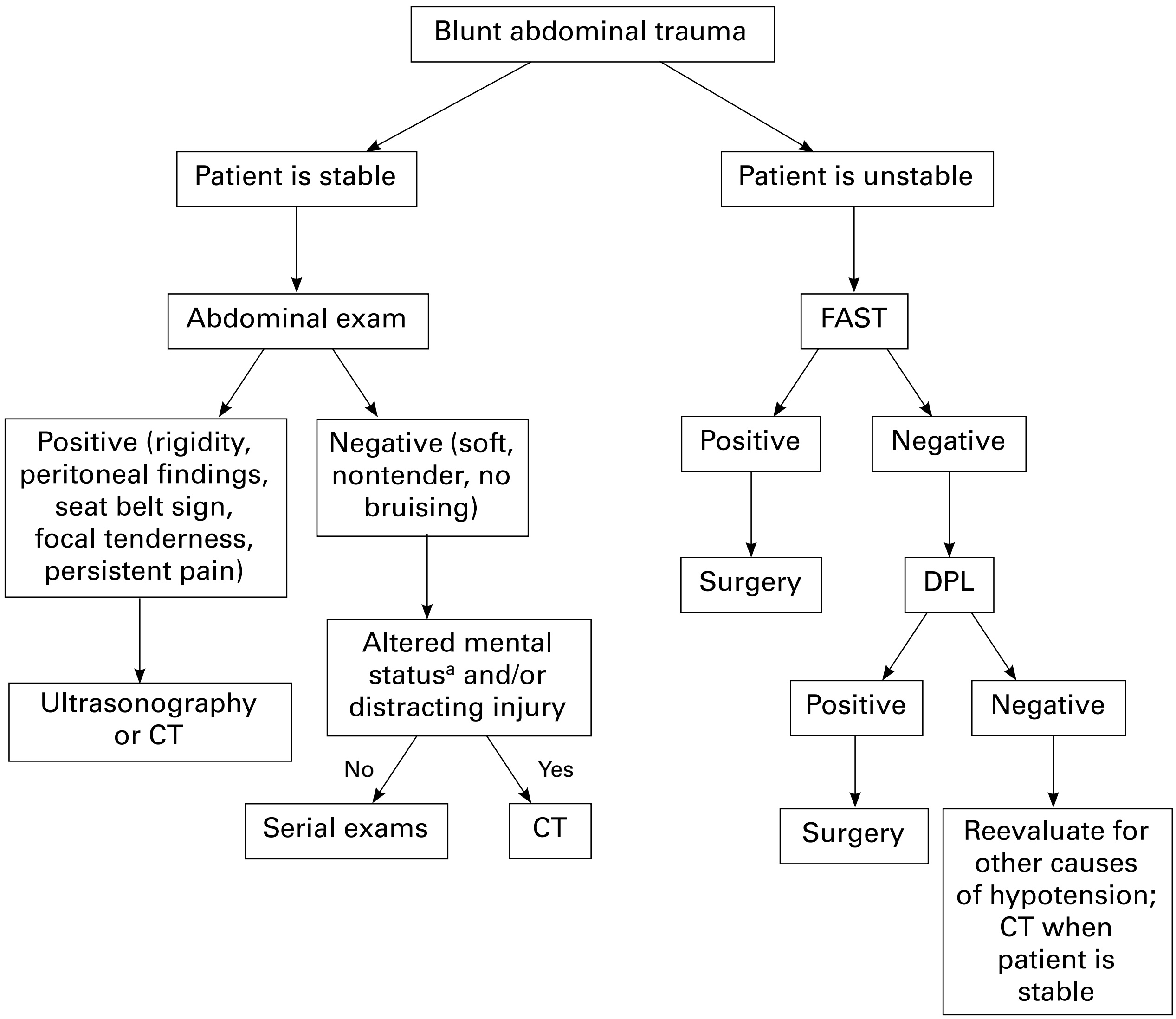
Although evidence supports the use of nonoperative management in patients with hepatic and splenic injury, patients with diaphragmatic, hollow viscus, or vasculature injuries will probably require surgical intervention; thus, consultation should be obtained in patients with such injuries.

Table. ATLS Classification of Hemorrhagic Shock

	Percentage of Blood Loss	Tachycardia	Hypotension	Decreased Urinary Output	Altered Mental Status
Class I	<15	No	No	No	No
Class II	15–30	Yes	No	No	No[a]
Class III	30–40	Yes	Yes	Yes	Yes
Class IV	>40	Yes	Yes	Yes[b]	Yes

ATLS = Advanced Trauma Life Support.
[a]Patient may be mildly anxious.
[b]Output is negligible.
Adapted from American College of Surgeons Committee on Trauma.[16]

Figure 3. Algorithmic Approach to Blunt Abdominal Trauma.



[a]Including from intoxication.
CT = computed tomography; FAST = focused assessment with sonography in trauma; DPL = diagnostic peritoneal lavage.

Disposition

Any patient with identifiable injuries on ultrasonography, CT, or DPL should be admitted or transferred to a trauma center for further monitoring and care. Patients with no injuries on diagnostic evaluation who continue to have significant abdominal pain should be admitted for observation. Patients with no injuries and unremarkable findings on physical exam can be safely discharged to home with clear instructions on reasons to return to the ED (ie, increased pain or swelling, vomiting with inability to tolerate oral intake, fever, or blood in urine, stool, or vomit).

THE UNSTABLE PATIENT

The Advanced Trauma Life Support (ATLS) manual defines instability or shock in a trauma patient as "the clinical appreciation of inadequate tissue perfusion and oxygenation."[16] Hemorrhage is the most common cause of shock in trauma patients. Increased heart rate is usually the first change in vital signs observed in early shock, and cool skin due to cutaneous vasoconstriction is usually the earliest physical finding.[16] Of note, a patient in early shock does not always have unstable vital signs. For example, a patient who is taking a β-blocker may never experience tachycardia before becoming hypotensive due to shock. A patient who is cool and tachycardic is in shock until proven otherwise. Furthermore, it is imperative to rapidly assess the unstable patient with BAT because the risk of death from isolated BAT increases with time spent in the ED.[17]

There are four classes of hemorrhagic shock based on the quantity of blood loss (Table, page 10). Class I hemorrhage, or loss of less than 15% of blood volume with normal vital signs, requires no intervention. Class II, or 15% to 30% blood volume loss with tachycardia and normal blood pressure, requires fluid resuscitation for stabilization. Class III hemorrhagic shock presents with 30% to 40% blood volume loss with tachycardia, hypotension, decreased urinary output, and altered mental status. Class IV presents with greater than 40% blood loss with tachycardia, hypotension, little urine output, and altered mental status. Both classes III and IV require administration of crystalloid solution and blood for resuscitation. Of note, patients who are hypotensive in the prehospital setting are at higher risk for more serious injury.[16]

Evaluation

Unstable trauma patients should be placed in cervical spine immobilization. As in all cases of trauma, evaluation should follow ATLS guidelines and begin with the primary and secondary surveys. During the primary survey, airway, breathing, and circulation are assessed. As part of the complete secondary survey, the abdomen should be inspected for ecchymosis or a seat belt sign. Auscultation should be performed to evaluate for bowel sounds, and the abdomen should then be palpated for tenderness, distention, or rigidity. Additionally, the patient should be log rolled for posterior exam. Genitourinary and rectal exams should evaluate for gross blood, ecchymosis, or hematoma, position of the prostate (in male patients), and sphincter tone. A nasogastric tube and Foley catheter should be placed to decompress the stomach and bladder and evaluate for signs of gross blood.

>>FAST TRACK<<

In a patient with isolated BAT and shock, disposition is simple: the patient should be taken to the operating room for exploratory laparotomy.

Management

The first step in managing the unstable patient is resuscitation. Two large-bore IV lines should be established, and placement of introducers should be considered in very unstable patients. During resuscitation, 2 to 3 L of crystalloid solution is initially given, followed by administration of type O negative blood (if crossmatched blood is unavailable). Blood typing and crossmatching of 4 to 6 units should be ordered, as time allows. If there is airway compromise, altered mental status, or hypoxia, the patient should be orotracheally intubated with cervical spine immobilization. After this initial stabilization, the next step is to determine the cause of the patient's instability.

Imaging

Abdominal radiography is not helpful in the unstable patient with BAT except as a means of investigating the cause of hypotension. The FAST exam is helpful in evaluating a patient with BAT and shock. It can be performed at the bedside, and a positive exam is an indication for laparotomy.[6] Unfortunately, FAST is not 100% sensitive. In a study of 458 adult patients with BAT, radiographically proven pelvic fracture and radiographically or operatively proven renal injury were significant predictors of a false-negative FAST result.[18]

A negative or equivocal FAST result in the setting of shock without external blood loss is an indication for DPL.[1] If the DPL is positive, the patient should proceed to the operating room for emergent laparotomy; if the DPL is negative, the evaluation for other causes of shock in trauma patients should be aggressively pursued while supportive care is continued. If the patient can be stabilized, CT of the abdomen is warranted.

Disposition

In a patient with isolated BAT and shock, disposition is simple: the patient should be taken to the operating room for exploratory laparotomy. Unfortunately, trauma patients often have multiple injuries, and the cause of hypotension is not always clear. In the multisystem trauma patient with shock, emergent evaluation of the peritoneum is necessary.

CONCLUSION AND CASE RESOLUTION

BAT occurs in all age-groups and is often difficult to evaluate, even by experienced practitioners. An algorithmic or systematic approach is paramount in identifying life-threatening intra-abdominal injuries from BAT (Figure 3).

As for our patients, we noted earlier that initial evaluation of the driver revealed that he was pale, diaphoretic, and tachycardic. Chest and pelvic radiographs were normal, and no other focal signs of trauma were identified. However, a FAST exam performed at bedside was positive in the splenorenal view, or left upper quadrant of the abdomen. The patient was taken to surgery and was found to have splenic rupture. He underwent an emergent splenectomy and recovered well.

The passenger remained stable during trauma evaluation but continued to complain of abdominal pain. No other injuries were found. Abdominal CT was negative, and the patient was admitted to the trauma surgery service for observation and serial exams. He was discharged from the hospital the following day without further incident. ☐

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