

Ultrasound in Emergency Medicine

EMERGENCY DIAGNOSTIC PARACENTESIS TO DETERMINE INTRAPERITONEAL FLUID IDENTITY DISCOVERED ON BEDSIDE ULTRASOUND OF UNSTABLE PATIENTS

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□ **Abstract**—Patients presenting with hypotension may be evaluated with a FAST (Focused Abdominal Sonography for Trauma) examination as recent literature has suggested its utility in the unstable patient. Those who are found to have intraperitoneal fluid on the FAST examination may have solid organ injury from unknown trauma, ruptured abdominal aortic aneurysm (AAA), hemorrhaging ovarian cyst, ruptured ectopic pregnancy, or other disease process responsible for intraperitoneal blood. However, because ultrasound does not assist in fluid identification, it is possible that the fluid present is not blood, but ascites. Further, a decision may need to be made regarding emergent surgical intervention or blood transfusion vs. aggressive fluid resuscitation or pressors followed by other testing such as computed tomography. This case series illustrates the utility of an ultrasound guided, emergent diagnostic paracentesis in the management of unstable patients found to have a positive FAST examination. Six unstable patients were evaluated with the FAST examination and found to have large quantities of intraperitoneal fluid. In each case the fluid was sampled and proposed management changed due to fluid identification. © 2005 Elsevier Inc.

□ **Keywords**—emergency ultrasound; intraperitoneal fluid; trauma ultrasound; hypotension; emergency medicine; blunt abdominal trauma

INTRODUCTION

The FAST (Focused Abdominal Sonography for Trauma) examination has been applied widely by both emergency physicians (EPs) and trauma surgeons for the evaluation of blunt and sometimes penetrating trauma patients (1–5). Its benefits as a screening tool before patient transfer to surgery, abdominal computed tomography (CT) scanner, or simply observation are becoming irrefutable (6). Recently, researchers have recommended its use for the evaluation of the unstable patient with unexplained hypotension (7). Combined with a rapid screening of the abdominal aorta (for abdominal aortic aneurysm, or AAA), it is perhaps an ideal initial diagnostic test for an elderly patient presenting with syncope or hypotension. Expected pathology may include pericardial effusions, abdominal aortic aneurysm, and intraperitoneal blood, among others. Similarly, even in the younger patient group, a rapid screen of the abdomen may aid in the diagnosis of a rupture of an unsuspected ectopic pregnancy, hemorrhagic ovarian cyst, or even spontaneous splenic rupture (8).

Extremely unstable patients with intraperitoneal blood probably require a combination of rapid resuscitation with blood and emergent transfer to a surgical suite. However, without the history of clear trauma, the emergency sonologist is forced to rely on physical examination and history to decide if the identified intraperitoneal



Figure 1. Bowel floating in fluid is seen (arrows). A good window for paracentesis has been identified.

fluid is blood. Positive results on the FAST examination stemming from fluid other than blood could result in an unnecessary exploratory laparotomy if CT scan or diagnostic peritoneal lavage is not performed (9). Now, when doubt exists about the identity of intraperitoneal fluid on ultrasound, some trauma surgeons opt for diagnostic peritoneal lavage (DPL) to provide the answer. However, many of the patient types described above may be seen by EPs not as part of trauma team evaluations, but rather as probable medical emergencies.

The following are 6 cases in which unstable patients, not paged out as trauma codes, were found to have free intraperitoneal fluid. In each case, an emergent paracentesis was performed at bedside that revealed the nature of the fluid discovered on the FAST, and this significantly affected management decisions.

CASE 1

A 64-year-old woman with a history of hypertension (HTN) and coronary artery disease (CAD) presented to our Emergency Department (ED) via emergency medical services (EMS) with complaints of diffuse abdominal pain and syncope. En route, EMS reported a systolic blood pressure of 70 mm Hg/palpable, as well as a palpable abdominal aorta. On arrival the patient was poorly coherent and provided little additional history. She had poor vascular access and an 8-French femoral line was placed. Normal saline was started wide open. Physical examination showed a pale elderly woman in significant distress. The systolic blood pressure was 65 mm Hg and heart rate was 83 beats per minute (bpm), with a respiratory rate of 24 breaths/min. A bedside ultrasound examination was performed to evaluate for possible AAA, but a normal caliber aorta was visualized; however, the patient had a large amount of intraperito-

neal fluid (Figure 1). At this point the patient's daughter arrived and revealed that the patient had fallen "hard" on her left side and she "heard ribs break." An emergent trauma consultation was paged out. A reexamination of the patient revealed no crepitus on the left flank or rib deformities or focal tenderness.

To optimize the patient's further management, it was thought to be critical to determine the nature of the intraperitoneal fluid. The patient's right lateral abdomen was sterilely prepared and draped. Local anesthetic was injected immediately over a large pocket of fluid seen on ultrasound. The sterilely dressed ultrasound probe was used to guide a 2-inch long angiocatheter into the fluid (Figure 2). The syringe filled with straw-colored fluid. Fluid resuscitation was continued, but because the abdominal fluid was determined not to be blood, the trauma consultation was cancelled. The patient's blood pressure responded to continued fluid resuscitation and an abdominal CT scan revealed previously unknown liver lesions. The patient was admitted to the hospital for further workup with normal vital signs.

CASE 2

A 42-year-old man without significant past medical history presented to an outside ED with syncope. Initially receiving fluids and thiamine with folate for chronic alcohol use, the patient could not be discharged due to repeated syncope. Receiving more fluid after re-admission to the ED, the patient's systolic blood pressure never exceeded 105 mm Hg. The patient's electrocardiogram (EKG) was non-specific and initial cardiac enzymes were negative. The patient was transferred to our ED for evaluation of a presumed myocardial infarction



Figure 2. A needle is guided under real-time ultrasound into a fluid pocket. The needle tip is seen (arrows) along with bowel (arrow heads).

(MI) on the part of the transferring facility. On arrival the patient complained of epigastric pain and shortness of breath. The blood pressure was 100/55 mm Hg and heart rate 87 bpm. A FAST examination was performed to evaluate for pericardial effusion or pleural effusions. No effusion was noted, but the patient had a large quantity of fluid in the abdomen. Due to the patient's long history of severe alcohol abuse, the fluid was initially assumed to be ascites. It was felt that fluid sampling would be required to confirm lack of bacterial peritonitis. Rapid, ultrasound-guided sampling of the fluid was performed at bedside and revealed blood in the abdomen. The patient was taken to the operating room by the consulting trauma surgeon and was found to have a ruptured spleen. The rupture was thought to be delayed from a previous injury. The patient recovered uneventfully and left the hospital.

CASE 3

A 36-year-old woman presented with a history of ovarian cyst, complaining of syncope and abdominal pain. On presentation the patient was lightheaded with a blood pressure of 63 mm Hg/palpable, heart rate of 123 bpm, normal respiratory rate, and was afebrile. The abdomen was diffusely tender without rebound or guarding. A bedside ultrasound showed an abdomen full of fluid. The urine sample obtained from the patient tested negative for pregnancy. Thus, a ruptured hemorrhagic ovarian cyst was suspected and emergent gynecological consultation was sought. The gynecology residents were in the operating room on an emergent case and were unavailable for 30 to 45 min. To determine if immediate blood transfusion was required, an ultrasound-guided paracentesis was performed. Straw-colored fluid was returned without any evidence of blood. The patient was aggressively resuscitated and the emergency gynecology consultation was canceled. An abdominal CT examination performed once the patient was stable revealed ovarian neoplasm. The patient was ultimately diagnosed with cancer and sepsis after admission.

CASE 4

A 44-year-old man with a long history of alcoholism presented intoxicated, with abdominal distention and pain. On physical examination the blood pressure was 86/40 mm Hg, heart rate was 103 bpm, respiratory rate was 18 breaths/min, and he was afebrile. The patient's abdomen was distended and mildly tender in the left upper and lower quadrants as well as the epigastrium. Rectal examination showed hemocult negative stool.

Laboratory tests were sent and the patient received thiamine, folate, magnesium, multivitamins and fluid intravenously. He continued to complain of abdominal pain and distention and noted some shortness of breath. The blood pressure had drifted lower to 75/35 mm Hg on the monitor with a heart rate of 97 bpm. A bedside ultrasound examination was performed that showed no pericardial effusion, but an abdomen full of fluid, presumed to be ascites due to his alcohol abuse history. A cordis was placed in the right femoral vein and the patient was given more fluid. However, the patient's blood pressure did not rise as expected and suspicion arose regarding the identity of the fluid in the abdomen. Ultrasound-guided paracentesis revealed blood rather than ascites. The trauma surgery service was emergently consulted and blood was ordered. In the operating suite the patient was found to have a ruptured splenic artery aneurysm. The patient expired 2 days postoperatively from complications.

CASE 5

A 76-year-old man with no significant past medical history presented to our ED by private car 2 days after a fall on his right side. The patient did not lose consciousness, but was noted to have a "large bruise" over his right side. One hour before arrival the patient complained of feeling nauseated and had a near syncopal event. He was brought back from triage after registering a blood pressure of 72/35 mm Hg, heart rate of 87 bpm, respiratory rate of 20 breaths/min, and temperature of 35.3°C (95.6°F). The patient complained of vague abdominal pain, nausea, and shortness of breath. The shortness of breath had increased slowly over the last 2 days. A bedside ultrasound examination showed no pericardial effusion but a large amount of intra-abdominal fluid was noted. An emergent trauma consultation was paged out. Because the patient insisted that the force of the fall was minor and he had partially caught himself, some doubt was introduced that this large quantity of fluid was blood. A fluid sample was obtained that showed straw-colored fluid. The trauma consultation was cancelled and aggressive fluid resuscitation continued. The vital signs improved and he was admitted to the hospital. After computed tomography and cytology of the ascetic fluid, no cause was revealed for the ascites. The patient was discharged from the hospital for further outpatient testing and follow-up.

CASE 6

A 68-year-old woman with a history of hypertension, diabetes, and myocardial infarction presented to our ED

due to diffuse back pain. She was noted to be hypotensive with a blood pressure of 87/44 mm Hg, a heart rate of 78 bpm, respiratory rate of 16 breaths/min, and was afebrile. She was responsive, but noted feeling lightheaded and nauseated. With AAA a concern, an abdominal ultrasound was performed. An AAA was noted that measured 5.1 cm at its greatest diameter. There was also a large quantity of fluid in the patient's abdomen. An emergent page was placed to the vascular surgeon on call and internal jugular cordis was placed for rapid fluid resuscitation. Because aneurysms of this size have a lower likelihood of rupture than larger ones, coupled with the fact that free wall rupture into the abdomen is typically rapidly fatal, an emergent paracentesis was performed and it revealed straw-colored fluid. The vascular surgeon agreed that abdominal CT scan was preferred to immediate surgical intervention in this case. The patient's blood pressure responded to fluid resuscitation and she was taken for a CT scan. This revealed a 5.0-cm AAA with no rupture. Liver and vertebral metastasis of unknown origin were noted on the scan. The patient was admitted to the hospital for further evaluation.

DISCUSSION

It is important for sonologists to be cognizant of a limitation imposed on them by the FAST examination: ultrasound identification of fluid in the abdomen, even in unstable patients, should not be confused with the identification of intra-abdominal blood. The main pitfall with locating "fluid" in the abdomen of an unstable patient is the identity of that fluid. On abdominal CT scan, density of fluid can be calculated by the scanner's computer, which can strongly suggest blood vs. ascites (10). Ascites has certain characteristics on ultrasound. If present, these findings may help distinguish ascites from blood; however, making this differentiation with a high degree of certainty is difficult. Characteristics of ascites can include fewer echoes in the fluid than blood, septations, loculations, and the liver may be of increased echogenicity and decreased size.

In an unstable trauma patient, when doubt exists about fluid identity or its presence, some would perform a DPL. However, DPL is somewhat time consuming and has an incidence of organ injury. Mean procedure time for closed DPL is approximately 18 min and is 27 min for open DPL (11). Complications can include hemorrhage, hematoma, bowel and bladder perforation. The overall complication rate can be as high as 10% when minor technical difficulties and major complications are combined (11). However, major complications are typically fewer than 1% of all procedures (11). DPL is

performed in the unstable patient's midline either infra-umbilical or supra-umbilical depending on pregnancy status. In general, a DPL can be open or closed with variations in between. A trocar or catheter is inserted through the skin or a surgical opening, to just above the peritoneum or even through it, into the peritoneal cavity, and fluid is instilled. The test is positive if blood is spontaneously returned on catheter placement or if enough red blood cells are returned in the fluid when aspirated.

Diagnostic paracentesis is most often performed in patients with suspected ascites either for analysis of fluid type or evaluation for infection. The procedure can be performed with a simple angiocatheter or using a specialized kit as described in Case 1 above. No information could be found on the mean time for diagnostic paracentesis performance. Complications typically arise from bleeding as patients receiving paracentesis often have poorly functioning platelets and are auto-anticoagulated (12). Complications such as bowel perforation can occur but this is often thought to be innocuous (12). Total complication rates are reported to be less than 3% (12). With ultrasound guidance the chances of organ injury should be decreased as loops of bowel or other structures can be visualized and avoided (13).

Although unstable patients with intraperitoneal fluid are a rare presentation to most EDs, they are likely to be some of the sickest. In such patients, determination that the fluid present in the abdomen is blood would likely lead to several immediate interventions, such as emergent blood transfusion and surgical exploration that may be lifesaving, but which also carry considerable potential for morbidity. Example etiologies include hemorrhaging ruptured ovarian cysts, ruptured abdominal aneurysms, liver or spleen rupture from unknown (to the physician) trauma or delayed organ rupture from previous trauma, and ruptured ectopic pregnancy. Thus, it is important to rapidly and safely differentiate any of the entities listed from ascites coupled with unstable vital signs due to an etiology other than blood loss.

In 2001, a group of emergency physicians published a description of a protocol designed to rapidly evaluate and diagnose patients with undifferentiated hypotension (7). The authors cited three example cases in which ultrasound examination, combining a typical trauma ultrasound examination with an interrogation of the abdominal aorta (for AAA), helped change their management significantly. Of specific interest was the diagnosis of one patient with delayed rupture of the spleen. In the patient described, with whom communication was not possible at the time of evaluation, an emergent diagnostic paracentesis could have been management changing; for example, if the large amount of fluid identified in the

abdomen were ascites rather than blood, emergent laparotomy would have been forgone.

In this case series, all of the patients were prepared identically to a typical diagnostic paracentesis using sterile technique and local anesthesia. A 2-inch 18-G angiocatheter was used to obtain fluid under real-time ultrasound guidance after local anesthetic instillation. The diagnosis was immediate as fluid was either straw-colored or blood. Although it can be successfully argued that this technique does not take the place of diagnostic peritoneal lavage with its high sensitivity (but relatively low specificity for intra-abdominal injury), the two are used in quite different situations. The sampling method used in these six cases is most applicable in unstable patients with a significant amount of fluid in the abdomen. This large amount of fluid, presumably blood, may explain the hypotension. In such patients, decisions regarding giving packed red cells or emergent laparotomy have to be made very quickly. However, when small amounts of fluid are seen that cannot be easily and safely sampled with a traditional paracentesis technique, the potential intraperitoneal blood loss is not very large and thus the patient probably can be resuscitated and safely taken to the CT scanner to look for the diagnosis.

The ability to rapidly and safely identify fluid can be crucial in making management decisions in an unstable patient. In the cases presented above, determination of fluid identity led to change in management in four of the six patients, as all were initially assumed to have a large amount of intraperitoneal blood in the abdomen. All of these four patients avoided possible blood products and surgery, both of which would otherwise have been indicated. Conversely, two patients assumed to have ascites proved to actually have intraperitoneal blood. When doubt about intraperitoneal fluid identity exists, sterile emergency diagnostic paracentesis under ultrasound

guidance may lead to significant management change in selected cases, and potentially decrease patient morbidity from avoided interventions.

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