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Ultrasound-guided percutaneous periarterial thrombin injection for paracentesis-related hemoperitoneum

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ABSTRACT

Paracentesis is a common procedure used in the diagnostic evaluation of peritoneal fluid as well as the therapeutic removal of high-volume ascites. Although generally regarded as a safe procedure, complications may arise from arterial injury, including hematomas and pseudoaneurysms. Transcatheter embolization and surgery are first-line interventions for injuries refractory to conservative management. We present a case where a patient failed conventional therapies for hemoperitoneum following a paracentesis which resolved after thrombin injection into the subcutaneous tissues, a novel use for thrombin. Using a linear 12-3 MHz transducer, approximately 3000-3500 U of thrombin was injected through connecting tubing and a 25-gauge needle by the interventional radiologist into the subcutaneous tissues around the origin of the arterial hemorrhage. The bleeding ceased and the patient's hemoglobin and hemodynamics stabilized.

Case report

A 50-year-old man presented to the emergency department with a 2- to 3-day history of progressively worsening unsteady gait, weakness, and somnolence. His medical history included systolic heart failure (ejection fraction of 21%), remote orthotopic liver transplantation for alcohol- and hepatitis C-induced cirrhosis, and acute renal failure requiring hemodialysis. He reported nonadherence to his immunosuppressant medications (tacrolimus and everolimus) for at least 4 months. His laboratory results at presentation were a creatinine of 6.1 mg/dL, blood urea nitrogen of 23 mg/dL, prothrombin time of 15.9 seconds, partial thromboplastin time of 35 seconds, and international normalized ratio of 1.5. The patient had leukocytosis of 13.4×10^9/L and underwent a diagnostic and therapeutic paracentesis without image guidance performed by the critical care team using a 5Fr Yueh centesis catheter needle (Cook Medical LLC, Bloomington, IN). Two liters of bloody ascitic fluid was drained. No evidence of spontaneous bacterial peritonitis was found on workup of the fluid sample. However, due to concern for sepsis from another source, the patient was started on broad-spectrum antibiotics with vancomycin and piperacillin/tazobactam. Overnight, the patient became hypotensive to 73/35 mm Hg and his hemoglobin dropped from 7.4 to 5.6 gm/dL. Following 3 units of packed red blood cells, 1 L of

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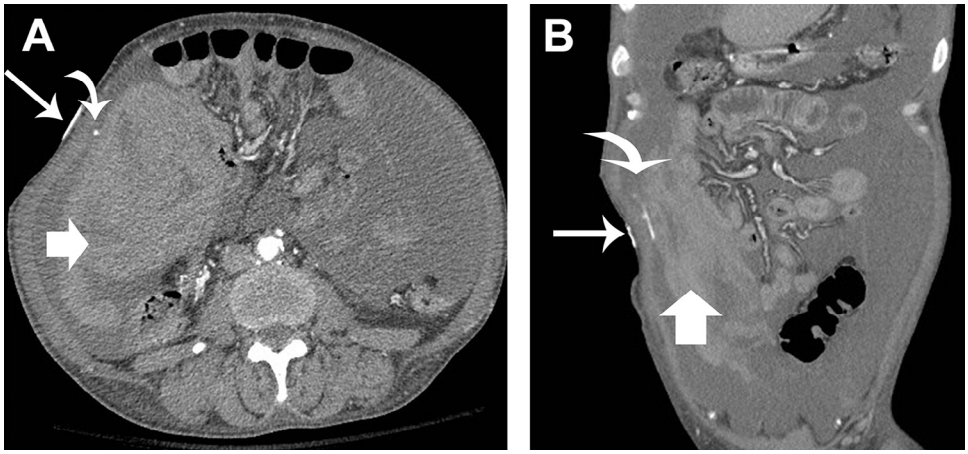

Fig. 1 – Axial (A) and coronal (B) images from a contrast-enhanced computed tomography scan showing bandage over the site of paracentesis (long arrow), extravasation of contrast indicating active bleeding (curved arrow), and a large intraperitoneal blood clot (short arrow).

Ringer's lactate, 75 g of albumin, and 1 unit of fresh frozen plasma, his hemoglobin improved to 7.1 mg/dL and his hemodynamics normalized. Vasopressor medications were not initiated.

A computed tomography of the abdomen and pelvis with and without contrast demonstrated intraperitoneal active extravasation at the right lateral abdomen, presumably at the site of prior paracentesis (Fig. 1). Injury to the right inferior epigastric artery or an intercostal artery was suspected.

The patient was taken to the interventional radiology fluoroscopy suite and positioned supine. The right groin was prepped and draped in normal sterile fashion, the right common femoral artery was accessed under ultrasound-guidance with micropuncture technique, and a wire was advanced centrally. A 5Fr sheath was placed. A 5Fr Mikaelson catheter (Angiodynamics, Lathan, NY) was used to select the right 10th, 11th, and 12th intercostal arteries. These distinct catheterizations were followed by their corresponding arteriograms. The 11th and 12th intercostal artery angiograms showed irregularity associated with the external marker placed at the site of paracentesis, suggesting possible involvement (Fig. 2A). Sequential selection using a microcatheter and embolization of the right 11th and 12th intercostal arteries using gelatin foam that had been made into a slurry was then performed. Completion angiogram showed successful occlusion of these vessels (Fig. 2).

The patient's hemoglobin again decreased to 5.6 mg/dL the following day. Repeat computed tomography of the abdomen and pelvis with contrast demonstrated persistent arterial extravasation (Fig. 3). The patient required an additional 3 units of packed red blood cells, 1 unit of platelets, 2 units of fresh frozen plasma, and 1 dose of a prothrombin complex concentrate. Again, vasopressors were not initiated. The critical care, interventional radiology, and surgical teams discussed treatment options. Conservative management was implemented. The patient was deemed too high risk of surgical intervention

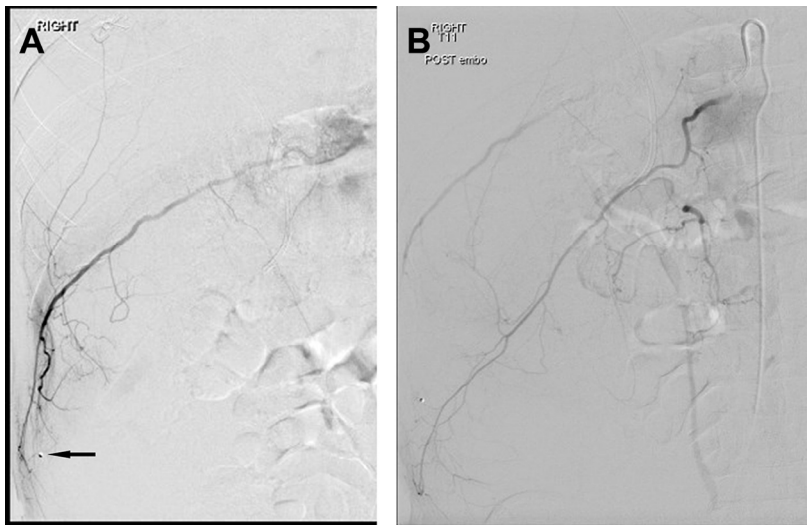

Fig. 2 – Digital subtraction angiographic images of the right T11 and T12 intercostal arteries before (A) and after (B) gel-foam embolism. Note the bead to denote site of paracentesis (thin arrow).

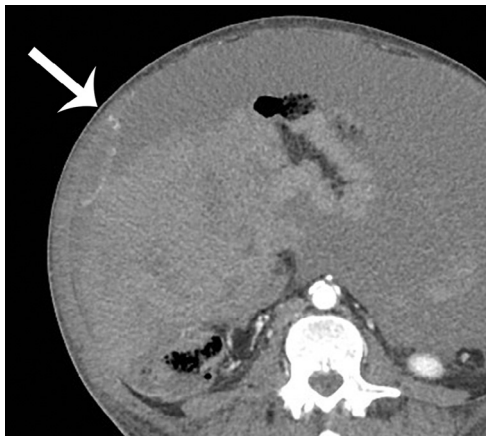

Fig. 3 – Axial CT image from the repeat contrast-enhanced computed tomography scan showing extravasation of contrast indicating active bleeding (arrow).

by laparotomy or laparoscopy because of multiple severe comorbidities. Endovascular success was unlikely to succeed as no clear extravasation was demonstrated previously.

Evaluation of the paracentesis site by Doppler ultrasound demonstrated a color jet extending into the distended peritoneum (Fig. 4A). This vessel could not be followed proximally or distally on ultrasound. After discussion of risks and benefits with the treatment team, an attempt at percutaneous clotting-agent injection directly into the site of the bleed was undertaken. A 25-gauge needle was connected to K50 intravenous tubing. A 1-mL syringe of 5000 U bovine thrombin (Thrombostat; Parke-Davis, Ann Arbor, MI; Johnson & Johnson, New Brunswick, NJ) and a 5-mL syringe of sterile saline were connected to a 3-way stopcock and mixed. The stopcock was then attached to the K50 tubing. Under ultrasound guidance using a linear 12-3 MHz transducer, thrombin was injected by the interventional radiology fellow in a slow pulsatile fashion adjacent to the origin of the vascular jet. After approximately 3.5 mL of the thrombin-saline mixture was injected, an approximate dose of 3000-3500 U, the vascular jet was no longer visualized (Fig. 4B). The patient's hemoglobin remained stable and the patient's hemodynamics improved over the 72 hours after the procedure.

The patient had persistent leukocytosis without systemic inflammatory response syndrome or identified source of infection and was continued on empiric vancomycin and piperacillin/tazobactam. The patient was restarted on his immunosuppressant medications and transferred to the outside hospital where the liver transplant had been performed.

Discussion

Paracentesis is a common procedure performed at the bedside for diagnostic evaluation of peritoneal fluid as well as treatment of elevated abdominal pressure caused by high-volume ascites [1,2]. It is generally considered to be a low-risk procedure, especially under ultrasound guidance, which reduces the rates of injury by ensuring proper needle placement [3]. A blind-entry approach increases the risk of perforating peritoneal solid organs, bowel, or vasculature. Nevertheless, complications may arise despite all precautions. Ascitic fluid leak is relatively common, whereas hemorrhage, arteriovenous fistula formation, bowel perforation, and infection are rare but potentially serious complications [4].

Arterial hemorrhage is an important complication following paracentesis. A recent review of the literature demonstrated that mortality rates for paracentesis-related hematomas, hemoperitoneum, and pseudoaneurysms approaches 50% [5]. Conservative management, surgery (open or laparoscopic), or transcatheter interventions (eg, embolization or coiling) are the mainstay of management options, with the best 30-day outcomes seen with transcatheter interventions, particularly embolization [5].

In the case of our patient, blind-stick paracentesis resulted in formation of an intraperitoneal bleeding (Fig. 4A and B), leading to hemoperitoneum. The patient continued to bleed after attempts at transcatheter gelatin sponge embolization of arterial extravasation seen on fluoroscopy. Because of the patient's comorbidities and prior embolization, additional

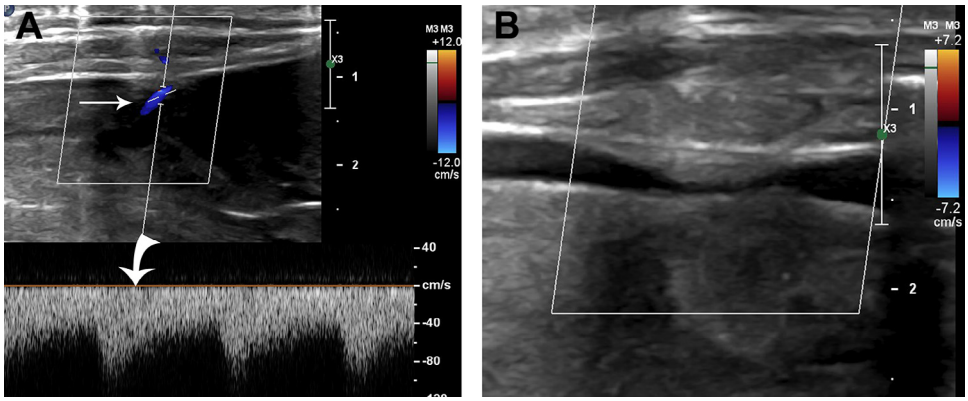

Fig. 4 – Doppler ultrasound images at the site of paracentesis before (A) and after (B) periarterial injection of thrombin. (A) Color flow (straight arrow) and arterial waveform (curved arrow) consistent with active arterial bleeding into the peritoneal cavity. (B) Post-thrombin injection images showing cessation of color flow.

conventional interventions were imprudent because of elevated operative risks and low likelihood of success. With an understanding that conservative management had a high risk of mortality, familiarity with the use of thrombin injection for select pseudoaneurysm led to the ultrasound evaluation of the paracentesis site, the discovery of the bleeding vessel, and the off-label periarterial injection of thrombin. Under real-time visualization of hemorrhage, the interventionalist directly targeted the site of bleeding and created a thrombin wheal around the vessel to stop the bleed.

At present, there are currently no guidelines for appropriate thrombin dosing, but most pseudoaneurysm thrombin injections approximate 50-450 U [6]. In our case, nearly 3500 U thrombin was used. We decided to continue injecting past the typical dose for several reasons: ultrasound-directed therapy permitted direct visualization of the needle tip directing the thrombin into the tissues surrounding the artery; the hemorrhaging artery could not be traced proximally or distally, suggesting it was an end artery and any thrombin injected intraluminally would likely result in minimal complications even with arterial thrombosis or embolism; clotting factor administration could be stopped at the moment of bleeding cessation; and the high risk of mortality with failure. No complications were seen in the presented case.

In summary, the reported case shows the efficacy of ultrasound-guided percutaneous thrombin injection in the setting of arterial hemorrhage following paracentesis when performed by a well-trained interventional radiologist. Although transcatheter embolization and surgery remain the first-line therapies because of their proven efficacy and safety, ultrasound-guided thrombin injection could be considered as an alternative, particularly when traditional therapies fail or are prohibited by comorbidities.

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