

Percutaneous glue embolization for recalcitrant iatrogenic portal hemorrhage

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ABSTRACT

N-butyl cyanoacrylate glue is well established as a transcatheter or direct injection embolic agent. Herein, targeted glue embolization was performed by direct needle injection into peripheral portal branches and along the surface of the liver to directly treat actively extravasating portal venous injury. In both cases, hemodynamically unstable patients underwent exploratory laparotomy, which was not able to definitively treat the hemorrhage. Subsequently, emergent visceral angiography and indirect portography revealed active portal phase extravasation. Transhepatic direct needle injection of the peripheral portal active extravasation with glue was successful in both cases and the patients stabilized, demonstrating this as an efficacious salvage approach.

Portal venous hemorrhage is uncommon and when traumatic, has mortality rates above 50% (1). Despite medical advances, the fatality rates of portal venous injuries have not improved (2). Prompt control of hemorrhage is imperative as exsanguination is the most common cause of death. Aside from resuscitation and correction of coagulopathy, portal injuries have traditionally been treated with ligation or venorrhaphy (3). Extrahepatic portal venous injuries have been treated with stent-grafts in case reports (4). However, there is a paucity of experience in the treatment of intrahepatic and peripheral portal venous injuries, in particular through catheter or needle directed modalities. Portal vein embolization (PVE) is recognized as a safe procedure to hypertrophy a future liver remnant; however, it has not been described in the treatment for portal venous bleeding. Herein, two patients with iatrogenic capsular portal venous hemorrhage were treated with direct percutaneous cyanoacrylate glue embolization after failing operative intervention.

Technique

Institutional review board approval was granted for this publication. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Patient 1

A 63-year-old male, with hepatitis C presented with worsening abdominal pain and became suddenly unresponsive. Laboratory values at presentation were hemoglobin 16.0 g/dL, platelet count 100 K/ μ L, prothrombin time (PT) 15.1 s, international normalized ratio (INR) 1.5, partial thromboplastin time (PTT) 29.9 s, creatinine 1.0 mg/dL, and total bilirubin 0.6 mg/dL. He was not on any anticoagulants or antiplatelet medications. A focused assessment with sonography for trauma (FAST) scan revealed a large intraperitoneal bleed in the right upper quadrant. Emergent laparotomy revealed a ruptured hepatic aneurysm, which was successfully ligated. During the emergent exposure, the right lobe was lacerated. The capsular tear was cauterized, but continued perihepatic bleeding of uncertain etiology was noted, requiring massive transfusion.

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Patient 2

A 27-year-old dialysis dependent female with history of lupus nephritis was obtunded on presentation from mitral valve endocarditis and acute subarachnoid hemorrhage. Her history was further complicated by chronic thromboses of multiple prior bilateral upper extremity and left lower extremity dialysis grafts, extending to the subclavian and external iliac veins, respectively. Additionally, she had interval removal of an infected right lower extremity arteriovenous graft. Laboratory values at presentation were hemoglobin 8.0 g/dL, platelet count 151 K/ μ L, PT 12.8 s, INR 1.2, PTT 23.1 s, creatinine 2.2 mg/dL, and total bilirubin 4.0 mg/dL. A transhepatic route was chosen to establish dialysis access. Ultrasonography of the right upper quadrant was performed to guide initial needle access, but hepatic morphology, patient body habitus, and rib shadowing made it difficult to accurately target a hepatic venous branch. Instead, under fluoroscopic guidance, a 21-gauge Chiba needle was advanced and slowly withdrawn while simultaneously injecting contrast to identify a hepatic venous branch. Multiple attempts in the same vicinity of the liver were unsuccessful. Ultimately, a different hepatic venous branch was successfully identified and wire access was established. A tunneled 14.5 F Equistream catheter (Bard Peripheral Vascular Inc) was placed in standard fashion. Approximately six hours later, the patient developed hypotension and tachycardia. The patient required large volumes of blood products for resuscitation despite lack of laboratory evidence of coagulopathy.

Peripheral portal venous embolization

Visceral angiography and portal embolization procedures were performed in an Artis Zee interventional angiography suite (Siemens Medical). Both procedures were performed under general anesthesia administered by a certified registered nurse anesthetist or attending anesthesiologist.

Main points

- Portal venous injuries are generally uncommon, difficult to diagnose, and have high mortality rates due to uncontrolled hemorrhage.
- Portal vein embolization is routinely performed as a prelude to surgery, but experience with traumatic portal embolization is uncommon.
- Percutaneous glue embolization of a peripheral portal hemorrhage may be an effective and life-saving therapy in emergent situations.

While massive resuscitation continued and the patients remained without coagulopathy, emergent visceral arteriography was performed with no arterial extravasation identified. Delayed portal venous imaging revealed active extravasation arising from peripheral right portal venous branches in both patients (Fig. 1). The hepatic parenchyma in the area of suspected injury was directly probed with a 21-gauge Chiba needle (Cook Medical). The needle was advanced under fluoroscopic guidance into the hepatic parenchyma, then withdrawn slowly while nonionic iodinated contrast was simultaneously injected to evaluate the segmental portal radicals. Direct peripheral portography was performed revealing hepatopedal flow toward the capsule and active extravasation (Fig. 2). With the needle in the portal vessels leading to the sites of hemorrhage, nonionic iodinated contrast was exchanged for *N*-butyl cyanoacrylate glue (TruFill, Codman and Shurtleff), which was diluted to a

1:2 ratio with ethiodized oil (Lipiodol, Guerbet). The portal radicals were directly injected with 3-4 mL of glue as was the adjacent hepatic parenchyma through multiple passes. Care was taken to ensure glue injection extended to the capsular surface with each pass through the capsule (Fig. 3). After all tertiary portal radicals in each territory were embolized to the capsular surface and the hemodynamic parameters of both patients improved, the procedures were concluded.

Each patient underwent one procedure (two procedures in total) with concordant findings of active peripheral portal extravasation on visceral arteriography with delayed portal venous imaging as well as direct transhepatic portography. Technical success defined as glue filling the tertiary portal branches at the site of extravasation occurred in both cases (100%). Completion visceral arteriography with delayed portal venous imaging revealed no further peripheral portal extravasation in either patient.

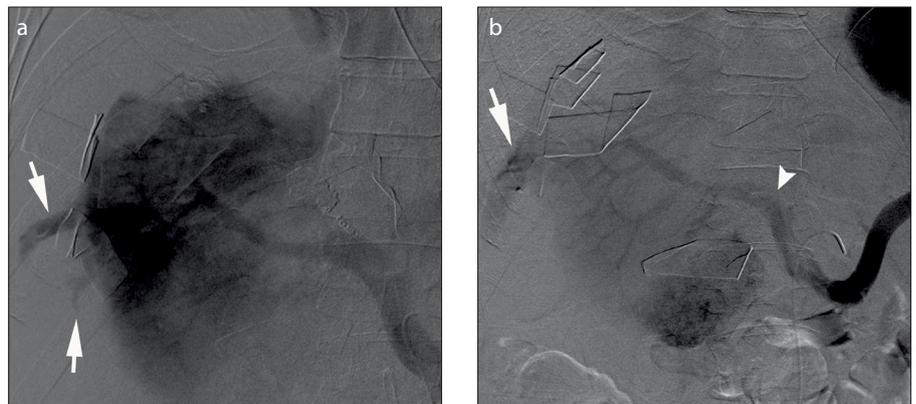


Figure 1. a, b. Visceral arteriography and indirect portography reveals hepatopedal flow in the main portal vein during the portal venous phase (*white arrowhead*) with brisk portal venous extravasation from the right lateral edge of the liver (*white arrows*) in the 63-year-old (a) and 27-year-old (b) patients.

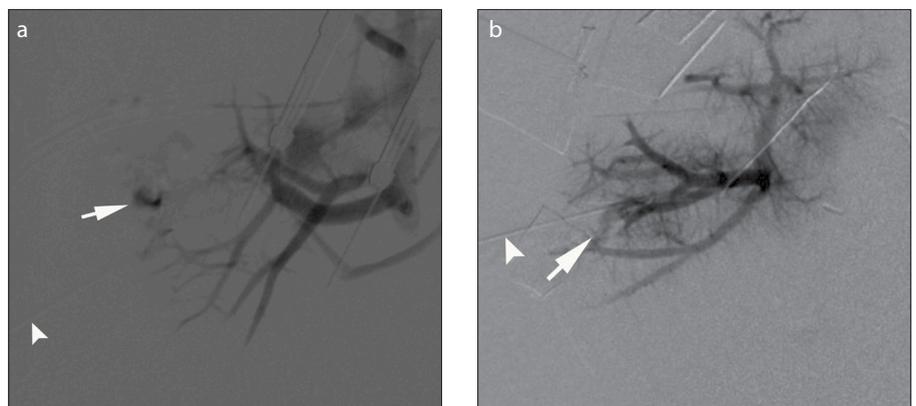


Figure 2. a, b. A 21-gauge needle (*white arrowhead*) was used to perform direct portography of peripheral right portal venous segments, which confirms active portal venous extravasation (*white arrow*) in the 63-year-old (a) and 27-year-old (b) patients.

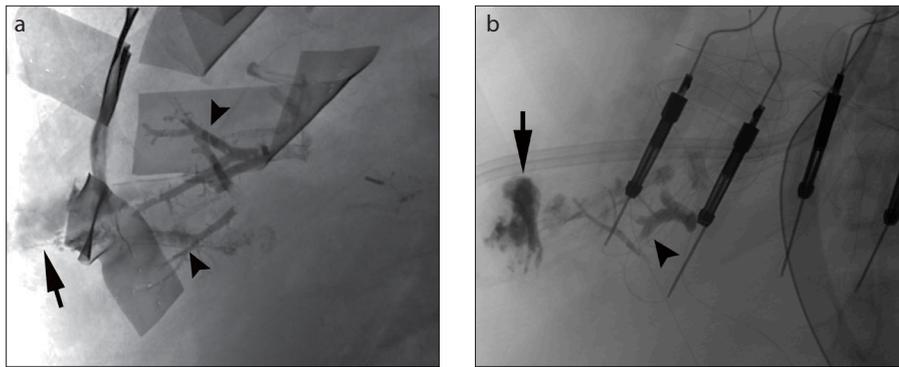


Figure 3. a, b. Glue fills the segmental portal branches (black arrowhead) to the capsular surface where the previous site of extravasation was noted (black arrow) in the 63-year-old (a) and 27-year-old (b) patients.

Overnight, no additional blood products were transfused for either patient. Patient 1, was surgically re-explored the next day to evacuate the hematoma. The liver surface was carefully examined and showed no signs of active bleeding, and the abdomen was subsequently closed. After 48 hours, the patient was transitioned from the surgical intensive care unit (ICU) to floor status and eventually discharged. At one-month clinic follow-up, the patient was feeling well. At one-year follow-up the patient remains well with all laboratory values within normal limits. Patient 2 was surgically explored the next day given concern for abdominal compartment syndrome, confirming cessation of active hemorrhage from the liver. The hemoperitoneum was evacuated and the abdomen was closed. After a protracted ICU course due to her underlying infection, the patient was eventually discharged home. She developed no complications directly related to the portal glue embolization at follow-up 1 month later, but was subsequently no longer followed at our institution.

Discussion

Portal venous injuries are generally uncommon, difficult to diagnose, and have high mortality rates due to uncontrolled hemorrhage. A 1995 review of eight academic Level 1 trauma centers over a combined 62 years reported 46 portal vein injuries with a 62% mortality rate when a portal vein injury was present in isolation (5). In 2002, Pearl et al. (6) reviewed 18 900 patients over a 10-year period and reported 15 portal vein injuries (0.08%) with 50% mortality rate in isolated portal vein injuries. Most recently, in a review of 26 387 trauma patients over a 20-year period, only 15 (0.06%) had an injury to the portal vein with 53% mortality in this population. Most often, the mechanism of injury was

penetrating rather than blunt and the overall mortality of portal vein injuries ranged from 45%–71%. Despite improvements in overall survival rates for trauma, outcomes for portal venous injuries have not improved over the last several decades (2).

In the interventional literature, case reports of transhepatic stent grafting of extrahepatic portal vein injuries are present (4). Creation of transjugular intrahepatic portosystemic shunt has also been described for intrahepatic portal venous bleeding in portal hypertensive patients (7). However, peripheral portal venous hemorrhage in a noncirrhotic is uncommonly seen and most often treated with correction of coagulopathy, surgical packing, venous ligation, or venorrhaphy (1–3, 6). In these cases, resuscitation and surgical treatment alone was insufficient and unsuccessful, hence an approach to focally treat the portal venous bleed was undertaken.

Elective portal venous embolization as a prelude to surgical resection is routinely performed, well tolerated, and typically encompasses multiple hepatic segments if not an entire lobe. Moreover, glue embolization of transhepatic portal venous access tracts is effective and well tolerated with immediate hemostasis (8). In combination, a targeted, peripheral, and small area portal glue embolization as was performed for each patient in this report would similarly be well tolerated, effective, and a potentially heroic measure in an emergent situation. In particular, given that it can be delivered through a small needle, it may be able to safely, quickly, and focally treat peripheral bleeds in coagulopathic or cirrhotic patients without establishing a formal transhepatic or transjugular portal access. After our initial success with Patient 1, we proceeded to treat Patient 2 in similar fashion.

Transjugular and transsplenic approaches are alternative portal access routes, though each may have drawbacks in such situations. Either access would take additional time to establish, as opposed to direct percutaneous treatment. Additionally, transjugular access may be subject to angulation, which may make it difficult to perform a peripheral embolization. Transsplenic access could eliminate angulation, but does leave the possibility of a different site of hemorrhage. Transjugular, transsplenic, and direct percutaneous routes are all viable and ultimately the most appropriate access should be guided by patient factors.

Limitations to this study include that it was performed at a single institution with a sample size of two patients. Additionally, because portal venous hemorrhage is uncommon and may require emergent care as was the case for these patients, this technique could not be compared to alternative embolics or embolization approaches.

In conclusion, portal venous hemorrhage can be difficult to diagnose and treat, leading to poor patient outcomes despite normal coagulation parameters. Percutaneous glue embolization for peripheral portal hemorrhage is an innovative interventional treatment which may be a useful option in time-sensitive situations.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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