International Journal of Gastrointestinal Intervention

journal homepage: www.ijgii.org

Case Report

Transhepatic glue injection for hepatic pseudoaneurysm and arteriohepatic venous fistula after the failure of transarterial embolization

Thanh Dung Le[1], Minh Duc Nguyen[2,3], and Van Sy Than[1,*]

A B S T R A C T

The liver is the most frequently injured organ during abdominal trauma. Vascular injuries account for approximately 3% to 25% of all liver trauma and are typically treated by transarterial embolization (TAE). We describe a case of American Association for the Surgery of Trauma (AAST) grade V liver injury with a huge pseudoaneurysm and an arteriohepatic venous fistula (AHVF), which failed to respond to TAE. This case was successfully treated using a direct transhepatic glue injection without complications. AHVF is an exceedingly rare type of vascular injuries in blunt trauma. Direct transhepatic glue injections could represent a reliable alternative to TAE for the treatment of visceral pseudoaneurysms, especially when TAE fails to eliminate the lesion.

Keywords: Abdominal injuries; Arteriovenous fistula; Embolization; False aneurysm; Hemoperitoneum; Rupture

Introduction

Liver injury is the most frequent abdominal trauma, and more than 50% of cases are classified as American Association for the Surgery of Trauma (AAST) high-grade injuries (III, IV, and V).[1] High-grade liver injuries often include liver vascular injuries, such as pseudoaneurysm (PSA), arterial-venous fistula, and contrast extravasation due to damaged blood vessel walls, typically requiring intervention treatment.[2–8]

Transarterial embolization (TAE) is the current standard vascular injury treatment, associated with a high success rate and low morbidity.[6,9–12] The percutaneous direct injection technique has been usually used to treat vascular malformations and in some specific cases of vascular injuries in the head, neck, and limbs[13–16] but rarely applied to visceral vascular lesions.[17–19] We describe a case of grade V liver injury associated with a huge PSA and an arteriohepatic venous fistula (AHVF), which was successfully treated by injecting glue through the hepatic parenchyma into the PSA following endovascular treatment failure.

Case Report

An 18-year-old male patient was transferred to our institution due to severe abdominal pain following a motorcycle accident. On arrival, the patient was conscious but pale. Examination revealed a pulse rate of 110 bpm and blood pressure of 80/50 mmHg, both of which improved after fluid resuscitation. Whole-body multislice computed tomography showed a right hepatic trauma, classified as AAST grade V, with several lacerations and a large intraparenchymal hematoma measuring 10 cm × 13 cm. A huge PSA was observed, extending from a branch of the anterior segmental artery, sized 3.2 cm × 5.5 cm, and an AHVF was identified connecting the PSA with the right hepatic vein (Fig. 1). Moderate hemoperitoneum was observed. No other injuries were found at that time. The blood test results revealed the following values: white blood cells, 23×10^9/L; red blood cells, 3.62×10^{12}/L;

[1]Department of Radiology, Viet Duc University Hospital, Hanoi, Vietnam
[2]Department of Radiology, Pham Ngoc Thach University of Medicine, Ho Chi Minh, Vietnam
[3]Department of Radiology, Children's Hospital 2, Ho Chi Minh, Vietnam
Received March 25, 2021; Revised April 12, 2021; Accepted April 12, 2021
* Corresponding author. Department of Radiology, Viet Duc University Hospital, 40 Trang Thi Street, Hang Bong Ward, Hoan Kiem District, Hanoi 100000, Vietnam.
E-mail address: sy.hmu0915@gmail.com (V.S. Than).

Thanh Dung Le, Minh Duc Nguyen, and Van Sy Than contributed equally to this work as first authors.

pISSN 2636-0004 eISSN 2636-0012 https://doi.org/10.18528/ijgii210022

hemoglobin, 8.6 mg/dL; hematocrit, 0.308 L/L; platelets, 54 × 10^9/L; prothrombin time, 54%; aspartate aminotransferase, 178 IU/L; and alanine aminotransferase, 1,118 IU/L.

The patient underwent emergency TAE to treat vascular injuries. The anterior segmental hepatic artery was embolized using a 3 mm × 50 mm fibered coil (Cirrus coil; BALT, Montmorency, France) (Fig. 2). However, on the subsequent angiography, the PSA continued to display perfusion by small collaterals from the sixth subsegmental branch, which was completely embolized using a glue mixture consisting of n-butyl 2-cyanoacrylate (NBCA) and lipiodol (1 : 3 ratio) (Fig. 2, 3). On the next angiography, the PSA remained visible. The seventh segmental artery and the remaining anterior segmental branch were occluded using gelfoam, but the PSA could not be excluded (Fig. 3B). Therefore, we advanced an angiocath 16 G × 5.25" (Angiocath™ BD, Sandy, UT, USA) needle directly into the PSA, under ultrasonography (US) and digital subtraction angiography guidance, and a 5 mL mixture of NBCA and lipiodol (1 : 1 ratio) was injected into the PSA (Fig. 3C). The final angiography showed total PSA obliteration (Fig. 3D). Neither nontarget vessel occlusion nor distal embolism was found. After the procedure, the patient's hemodynamics remained stable, with no signs of blood loss and no complications. Two units of blood was transfused. The intraparenchymal hematoma was drained on day 12. The patient recovered and was discharged from the hospital on day 15. At 1-month and 3-month follow-up, clinical examination, liver function tests and abdominal echography showed normal liver function, and no complications were found.

Consent for publication was obtained for every individual person's data included in the study during the post-withdrawal visit, noted in the patient's paper medical record.

Discussion

Hepatic vascular injuries occur in approximately 3% to 25% of all liver trauma cases,[1,2] with a high probability of failure associated with conservative management. Most common hepatic vascular injuries in blunt trauma are PSA, contrast extravasation,

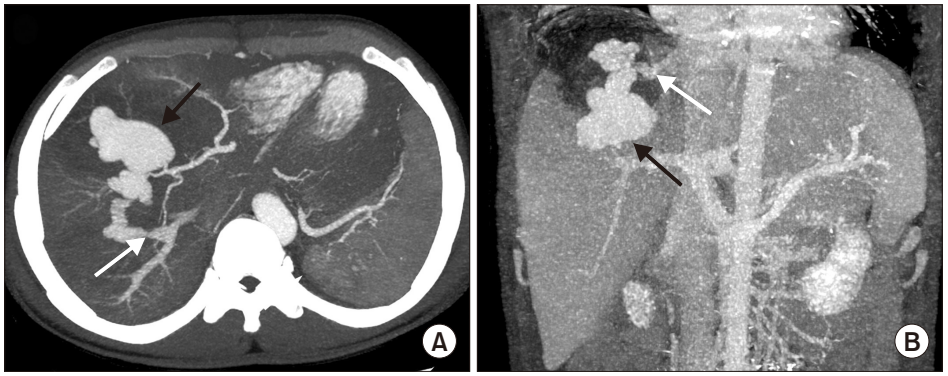

Fig. 1. Multislice computed tomography images from the maximum intensity projection of the post-contrast phase (A, B) show a huge pseudoaneurysm of the anterior segmental hepatic artery (black arrows), and arteriohepatic venous fistula (white arrows).

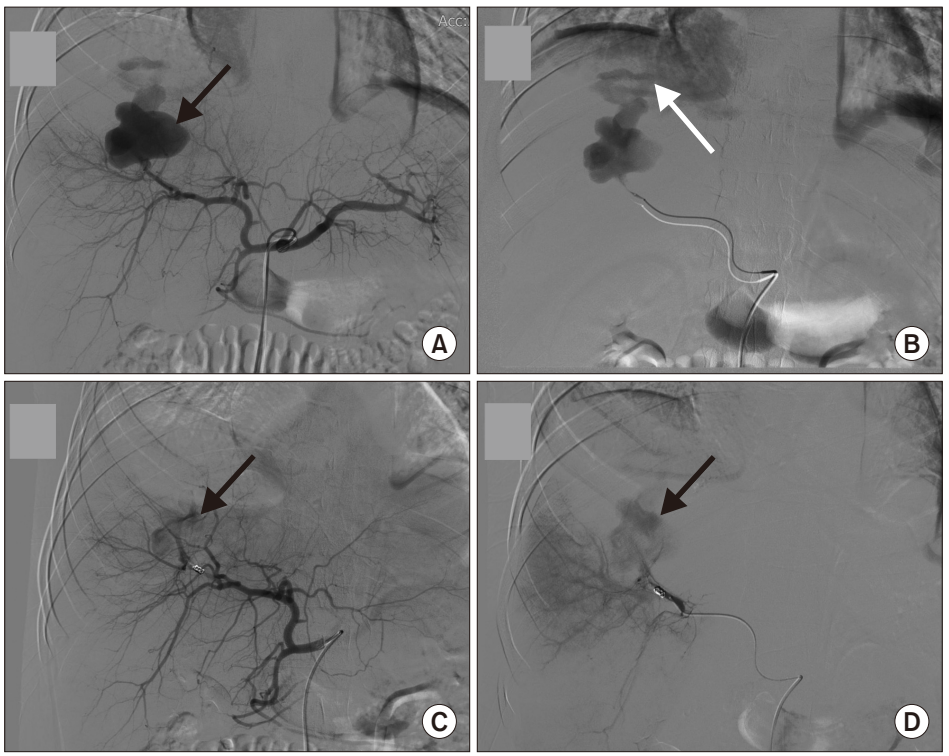

Fig. 2. Angiographic images from celiac trunk (A) and selective anterior segmental hepatic artery (B) show the pseudoaneurysm (black arrow in A) and arteriohepatic venous fistula draining into the right hepatic vein (white arrow), confirming the multislice computed tomography diagnosis. A 3 mm × 60 mm fibered coil was deployed at the neck of the pseudoaneurysm. On post-coiling embolization angiogram (C, D), the pseudoaneurysm was still perfused via collaterals (black arrows).

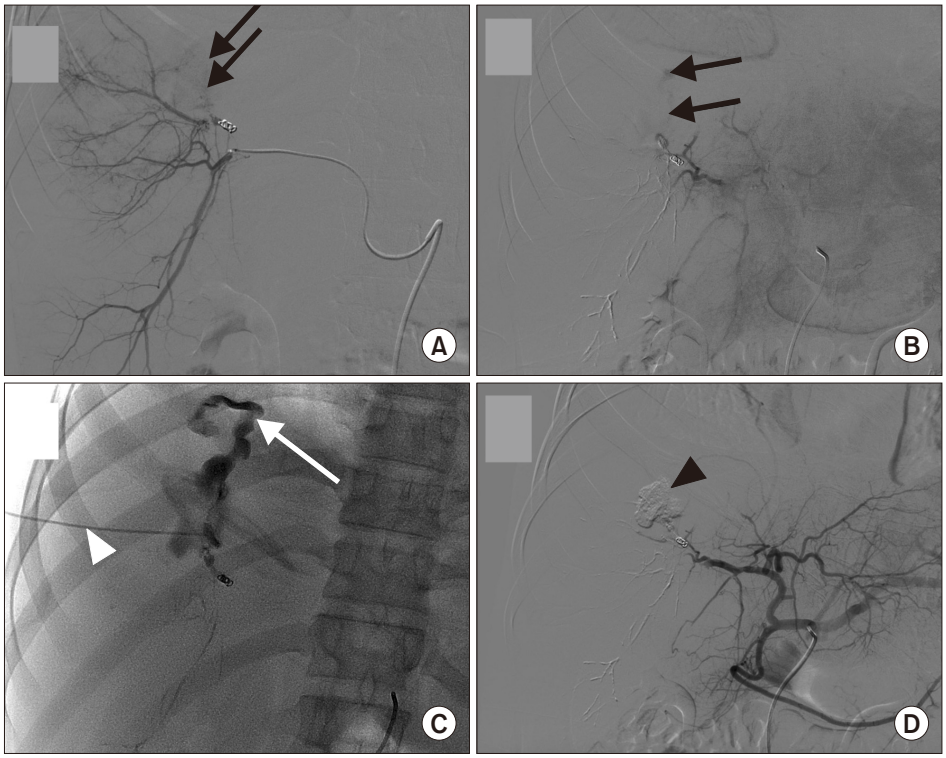

Fig. 3. Selective sixth subsegmental hepatic artery (A) angiogram showing small collaterals feeding the pseudoaneurysm (black arrows). The control angiogram after embolizing the sixth and seventh subsegmental hepatic arteries and the other branches of the anterior segmental artery (B) illustrates the opacification of the pseudoaneurysm. (C) The pseudoaneurysm was canulated by an angiocath 16 G needle (white arrowhead) through the hepatic parenchyma. Contrast material was injected through the needle, confirming the location of the pseudoaneurysm and arteriohepatic venous fistula (white arrow). The pseudoaneurysm was embolized using a mixture of n-butyl 2-cyanoacrylate and lipiodol (1:1 ratio). (D) The final control angiography shows the complete occlusion of the pseudoaneurysm and arteriohepatic venous fistula (black arrowhead).

or arterioportal venous fistula while AHVF is quite rare.[20–22] We found only less than ten case reports about AHVF, three of which are in blunt trauma situation.[20–22]

Owing to the rapid development of interventional radiology in recent decades, TAE has become the standard treatment for hepatic trauma with vascular injuries, associated with minimized complications and improved treatment outcomes.[4,5,8,10,11] Currently, primary surgery is only necessary to treat severe hepatic injury cases associated with hemodynamic instability.[10,11,23,24]

Our patient presented with a grade V liver injury. Although the patient's hemodynamics were initially unstable, the patient responded to fluid resuscitation, allowing for hemostatic treatment by interventional radiology. After nearly all branches of the right hepatic artery were occluded, the PSA continued to be fed by previously undetected collaterals branches. The broader application of embolization is associated with the risk of post-intervention complications, such as biliary ischemia, cholecystitis, or gallbladder necrosis.[25,26] Therefore, alternative embolization approaches remain necessary to avoid complications and prevent the need for secondary surgery due to residual PSA.

Direct percutaneous embolization has been used to treat arteriovenous malformations in the head, neck, and extremities, which are difficult to access transvascularly.[13,14,27] Visceral PSAs that can be delineated by US can be accessed percutaneously under US guidance. The literature describes the use of this technique to treat visceral aneurysms and PSAs in select circumstances associated with favorable outcomes.[17–19,28]

Direct percutaneous embolization of vascular malformations and PSAs using gelfoam, thrombin, glue, and coils have previously been reported.[18,19,28,29] Thrombin, also known as coagulation factor IIa, was initially used to initiate thrombosis, which is visible on ultrasound without long-term mass effects. A very high success rate of thrombin injection for treatment of peripheral PSAs was reported, up to 96% according to Pezzullo et al.[30] However, Gorsi et al.[17] reported a technical success rate of only 53% when using thrombin to treat 19 visceral PSAs. Large PSAs and PSAs with wide necks were described as unfavorable factors for this technique.[17] Allergic reactions and the risk of end-organ infarctions are negative factors associated with thrombin use. Gelfoam is an accessible agent with worldwide popularity, but it has a high risk of recurrence has been described following gelfoam absorption after a few weeks. In our experience, gelfoam injections are more difficult to control compared with other materials, especially in PSAs with large necks or combined with arteriovenous fistulas (as in our case). The coil is a reliable, permanent embolization agent with a high success rate and a high safety profile even in high flow arteriovenous fistula cases. However, in our patient, the PSA was very large, and the necessary quantity of coils was too expensive for the patient.

NBCA is a commonly used embolic agent with many advantages, including a permanent occlusion effect, a low recurrence rate, and minimal tissue toxicity. Combining NBCA with lipiodol increases the polymerization time and allows the mixture to be visualized under fluoroscopy, improving injection control. Ideally, the glue should be injected into the PSA sac until the PSA is filled to the neck.[18] In the present case, after hepatic artery embolization, the low residual flow AHVF allowed the use of highly concentrated glue without the risk of distal embolism via hepatic vein. In a study by Gorsi et al,[18] the use of this technique in 21 visceral PSAs was only associated with one case of minimal reflux to the parent artery (intercostal artery) without any symptoms.

However, direct percutaneous glue injection is also associated with several disadvantages. First, because the glue is a liquid agent, injection is associated with the risk of reflux into the parent artery, which can lead to downstream infarction or residual PSA. Fortunately, these effects can be minimized by the slow injection of the agent under fluoroscopic guidance. In the case of residual PSA, the procedure can be repeated quickly until the PSA sac is totally eliminated.[19,29] Second, although this technique

is performed under imaging guidance, the risk of further organ damage remains a possibility due to the needle passing through the parenchyma. In previous reports, no needle pathway complications were recorded;[18,19,29] however, further evaluations using larger patient populations remain necessary to evaluate the safety and efficacy of this method.

In conclusion, we described a case of AAST grade V liver trauma associated with a huge PSA and AHVF that could not be completely eliminated using TAE. The direct percutaneous glue injection could be a reliable and safe supplementary or alternative method for endovascular embolization, contributing to the avoidance of high-risk surgeries.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

ORCID

Thanh Dung Le, https://orcid.org/0000-0001-5257-2092
Minh Duc Nguyen, https://orcid.org/0000-0001-5411-1492
Van Sy Than, https://orcid.org/0000-0001-5162-5631

References

1. Wagner ML, Streit S, Makley AT, Pritts TA, Goodman MD. Hepatic pseudoaneurysm incidence after liver trauma. *J Surg Res.* 2020;256:623-8.
2. Lada NE, Gupta A, Anderson SW, Dinh DC, Campbell JM, Maggi A, et al. Liver trauma: hepatic vascular injury on computed tomography as a predictor of patient outcome. *Eur Radiol.* 2020. doi: 10.1007/s00330-020-07373-9. [Epub ahead of print]
3. Kozar RA, Crandall M, Shanmuganathan K, Zarzaur BL, Coburn M, Cribari C, et al. Organ injury scaling 2018 update: spleen, liver, and kidney. *J Trauma Acute Care Surg.* 2018;85:1119-22.
4. Fodor M, Primavesi F, Morell-Hofert D, Kranebitter V, Palaver A, Braunwarth E, et al. Non-operative management of blunt hepatic and splenic injury: a time-trend and outcome analysis over a period of 17 years. *World J Emerg Surg.* 2019;14:29.
5. Brillantino A, Iacobellis F, Festa P, Mottola A, Acampora C, Corvino F, et al. Non-operative management of blunt liver trauma: safety, efficacy and complications of a standardized treatment protocol. *Bull Emerg Trauma.* 2019;7:49-54.
6. Green CS, Bulger EM, Kwan SW. Outcomes and complications of angioembolization for hepatic trauma: a systematic review of the literature. *J Trauma Acute Care Surg.* 2016;80:529-37.
7. Xu H, Jie L, Kejian S, Xiaojun H, Chengli L, Hongyi Z, et al. Selective angiographic embolization of blunt hepatic trauma reduces failure rate of nonoperative therapy and incidence of post-traumatic complications. *Med Sci Monit.* 2017;23:5522-33.
8. Coccolini F, Coimbra R, Ordonez C, Kluger Y, Vega F, Moore EE, et al. Liver trauma: WSES 2020 guidelines. *World J Emerg Surg.* 2020;15:24.
9. Shimohira M, Hashizume T, Sasaki S, Ohta K, Suzuki K, Nakagawa M, et al. Transcatheter arterial embolization for hepatic arterial injury related to percutaneous transhepatic portal intervention. *Cardiovasc Intervent Radiol.* 2017;40:291-5.
10. Letoublon C, Amariutei A, Taton N, Lacaze L, Abba J, Risse O, et al. Management of blunt hepatic trauma. *J Visc Surg.* 2016;153(Suppl 4):33-43.
11. Ward J, Alarcon L, Peitzman AB. Management of blunt liver injury: what is new? *Eur J Trauma Emerg Surg.* 2015;41:229-37.
12. Ierardi AM, Duka E, Lucchina N, Floridi C, De Martino A, Donat D, et al. The role of interventional radiology in abdominopelvic trauma. *Br J Radiol.* 2016;89:20150866.
13. Le TD, Than VS, Nguyen MD. Percutaneous balloon-assisted ultrasound-guided direct glue embolization of deep femoral artery pseudoaneurysm rupture. *Radiol Case Rep.* 2020;16:425-9.
14. Aytekin C, Boyvat F, Gebedek O, Coskun M. Balloon-assisted ultrasound-guided direct percutaneous embolization of a peripheral pseudoaneurysm with n-butyl cyanoacrylate. *Eur Radiol.* 2002;12(Suppl 3):S185-8.
15. Hanson JM, Atri M, Power N. Ultrasound-guided thrombin injection of iatrogenic groin pseudoaneurysm: Doppler features and technical tips. *Br J Radiol.* 2008;81:154-63.
16. Parihar A, Tomar S, Phadke RV. Direct sac puncture and glue embolization of intraosseous AVM of the maxilla. *Int J Oral Maxillofac Surg.* 2011;40:749-52.
17. Gorsi U, Agarwal V, Yaser M, Kalra N, Chaluvashetty S, Kang M, et al. Utility of percutaneous thrombin injection for treating visceral pseudoaneurysms. *Minim Invasive Ther Allied Technol.* 2020. doi: 10.1080/13645706.2020.1720251. [Epub ahead of print]
18. Gorsi U, Chaluvashetty S, Kalra N, Kang M, Bhatia V, Lal A, et al. Percutaneous glue embolization as a primary treatment for visceral pseudoaneurysms. *Minim Invasive Ther Allied Technol.* 2020;29:170-6.
19. Lal A, Kumar A, Prakash M, Singhal M, Agarwal MM, Sarkar D, et al. Percutaneous cyanoacrylate glue injection into the renal pseudoaneurysm to control intractable hematuria after percutaneous nephrolithotomy. *Cardiovasc Intervent Radiol.* 2009;32:767-71.
20. Hung SC, Chen JD, Tiu CM, Chiou YY, Chang CY. Traumatic hepatic pseudoaneurysm with arterio-hepatic venous fistula: diagnosis with MDCT angiography. *Inj Extra.* 2006;37:349-52.
21. Chandrasekharan R, Kp S, Moorthy S, Kulkarni C. Traumatic hepatic arteriohepatic venous fistula managed with selective coil embolization: a case report. *BJR Case Rep.* 2017;3:20150512.
22. Karegowda LH, Keerthi T, Rathore T, Rajagopal K. Trauma-induced dual vascular lesions in the liver-hepatic pseudoaneurysm with arteriohepatic venous fistula. *BMJ Case Rep.* 2018;2018:bcr2018226311.
23. Goedecke M, Kühn F, Stratos I, Vasan R, Pertschy A, Klar E. No need for surgery? Patterns and outcomes of blunt abdominal trauma. *Innov Surg Sci.* 2019;4:100-7.
24. Biffl WL, Moore EE. Management guidelines for penetrating abdominal trauma. *Curr Opin Crit Care.* 2010;16:609-17.
25. Shah RP, Brown KT. Hepatic arterial embolization complicated by acute cholecystitis. *Semin Intervent Radiol.* 2011;28:252-7.
26. Lee YS, Kim K. Biliary complications after transcatheter arterial chemoembolization for hepatocellular carcinoma. *Int J Gastrointest Interv.* 2020;9:27-30.
27. Marra P, Guazzarotti G, Palumbo D, Salvioni M, Venturini M, De Cobelli F. Percutaneous ultrasound-guided direct glue embolization: a practical approach to Iatrogenic Inferior epigastric artery pseudoaneurysms. *J Vasc Interv Radiol.* 2019;30:1673-5.
28. Sakr MA, Desouki SE, Hegab SE. Direct percutaneous embolization of renal pseudoaneurysm. *J Endourol.* 2009;23:875-8.
29. Gulati GS, Gulati MS, Makharia G, Hatimota P, Saikia N, Paul SB, et al. Percutaneous glue embolization of a visceral artery pseudoaneurysm in a case of sickle cell anemia. *Cardiovasc Intervent Radiol.* 2006;29:665-8.
30. Pezzullo JA, Dupuy DE, Cronan JJ. Percutaneous injection of thrombin for the treatment of pseudoaneurysms after catheterization: an alternative to sonographically guided compression. *AJR Am J Roentgenol.* 2000;175:1035-40.