

Aspiration thrombectomy for inferior vena cava tumor thrombus arising from hepatocellular carcinoma

David Chadow, MD,^{a,b} Paul Haser, MD,^c Alok Aggarwal, MD,^d Roberto Perezgrovas-Olaria, MD,^b Giovanni Soletti Jr, MD,^b Christopher Lau, MD,^b Ricardo Castillo, MD,^e Vijay Jaswani, MD,^f Mario Gaudino, MD, PhD,^b and Hal Chadow, MD,^g Brooklyn and New York, NY

ABSTRACT

Pharmacomechanical therapy and catheter-directed thrombolysis have been shown to be very effective in the treatment of venous thromboembolism; however, there is much less data regarding inferior vena cava thrombi. Tumor thrombi pose an even greater clinical challenge as anti-coagulation and thrombolysis are not effective. We present the case of a 61-year-old male who presented with an inferior vena cava thrombus emanating from an accessory right hepatic vein, treated with aspiration thrombectomy. (*J Vasc Surg Cases Innov Tech* 2022;8:538-41.)

Keywords: Aspiration thrombectomy; Hepatocellular carcinoma; IVC thrombus

HISTORY OF PRESENTATION

A 61-year-old male presented to our institution with a 1-month history of vague abdominal pain, located primarily in the right upper quadrant, and a 1-day history of nausea and vomiting. He denied any weight loss, changes in bowel habits, or any previous abdominal symptoms. Vital signs were stable and within normal limits. No acute abnormalities were noted on his physical exam. Alpha-fetoprotein was significantly elevated at 1117.0 ng/mL (reference range, 0.0-8.3 ng/mL). No other acute laboratory abnormalities were noted. Imaging confirmed hepatocellular carcinoma (HCC). The patient underwent portal vein embolization (PVE) and was discharged home the following day with plans for a right hepatectomy after PVE effect and medical clearance. Two weeks after discharge, he underwent transthoracic echocardiography as part of his preoperative workup, which revealed a large thrombus in the inferior vena cava (IVC) extending to the cavo-atrial junction (CAJ).

Our study received the proper ethical oversight and the patient discussed above has consented to the publication of their case details and images.

PAST MEDICAL HISTORY

Past medical history was significant for untreated schizophrenia. He reported no significant surgical or family history. Social history was significant for chronic marijuana and alcohol abuse and occasional tobacco use.

Investigations. When the patient initially presented with abdominal pain, he underwent computerized tomography (CT) scan of the abdomen and pelvis, which showed a 9.8 × 8.5 cm right-sided liver mass, predominantly in segment six with extension into segments five and seven (Fig 1). The patient also had a magnetic resonance imaging of the abdomen, which, along with the findings on CT scan and the marked elevation of alpha-fetoprotein levels, confirmed the diagnosis of HCC, likely secondary to alcoholic liver disease.

When the patient returned with the IVC thrombus 2 weeks after his initial presentation, he underwent CT angiography of the chest and CT of the abdomen and pelvis, which showed a large, non-occlusive IVC thrombus emanating from an accessory right hepatic vein (RHV), extending to just below the CAJ (Fig 2), without any radiographic evidence of portal hypertension, which was not present on the initial scan. At this time, there were no pulmonary emboli, and the patient was asymptomatic. Furthermore, the liver mass was enlarging, now measuring 11.7 × 9.4 cm. Labs at the time of readmission showed mild elevation of alkaline phosphatase to 211 U/L (reference range, 38.0-126.0 U/L), but no other acute abnormalities.

MANAGEMENT

During his first admission, he underwent PVE in hopes of increasing the size of the future liver remnant (FLR)

From the Department of General Surgery, Brookdale University Hospital Medical Center, Brooklyn^a; the Department of Cardiothoracic Surgery, Weill Cornell Medicine, New York^b; the Department of Vascular Surgery,^c the Department of Hepato-Pancreatico-Biliary Surgery,^d the Division of Interventional Cardiology,^e the Department of Interventional Radiology,^f and the Division of Cardiology, Cardiac Catheterization Laboratory, ^g Brookdale University Hospital Medical Center, Brooklyn.

Author conflict of interest: none.

Correspondence: Hal Chadow, MD, Brookdale University Hospital Medical Center, Division of Cardiology, 1 Brookdale Plaza, Brooklyn, NY, 11212 (e-mail: hchadow@bhmcny.org).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2468-4287

© 2022 The Author(s). Published by Elsevier Inc. on behalf of Society for Vascular Surgery. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<https://doi.org/10.1016/j.jvscit.2022.06.024>



Fig 1. First computed tomography (CT) scan of the abdomen and pelvis with contrast showing a 9.8 × 8.5 cm right-sided liver mass (red dotted circle and red arrow), predominately in segment six with extension into segments five and seven. Also shown is the inferior vena cava (IVC) (white arrow) with no signs of thrombus.

and reducing tumor blood supply. The procedure was performed using percutaneous transhepatic access to enter the peripheral hepatic vein branch, and then a wire was used to advance an Omni Flush catheter into the main portal vein. Next the posterior sector veins were accessed, and gel foam, followed by a metallic coil, were inserted to complete the embolization. The procedure was without complication, and the patient was subsequently discharged from the hospital. Given the size of the tumor at the time of presentation, there would have been an inadequate FLR if surgery was performed immediately.

After returning with the IVC thrombus, he was started on a heparin drip. Given the size and extent of the thrombus, it was felt that there was a high risk of embolization, and the decision was made to perform a thrombectomy. IVC venography demonstrated a large filling defect consistent with thrombus emanating from the accessory RHV and extending cephalad (Fig 3). Right internal jugular access was obtained using ultrasound guidance and the Inari Flow Trierer XL Disc was inserted with a single disc deployed near the CAJ to act as a filter that would reduce risk of pulmonary embolization (Fig 4). Aspiration thrombectomy was performed from the right femoral vein with the Inari Flow Trierer 24 catheter, which was advanced into the vicinity of the accessory RHV. Aspiration was performed twice, yielding highly organized, white thrombotic material. The guidewire was then advanced into the accessory RHV, and an Inari Trierer 20 Curve was inserted for directional aspiration. One final aspiration was performed, yielding more organized thrombotic material. Final venography confirmed complete removal of thrombus. Pathological

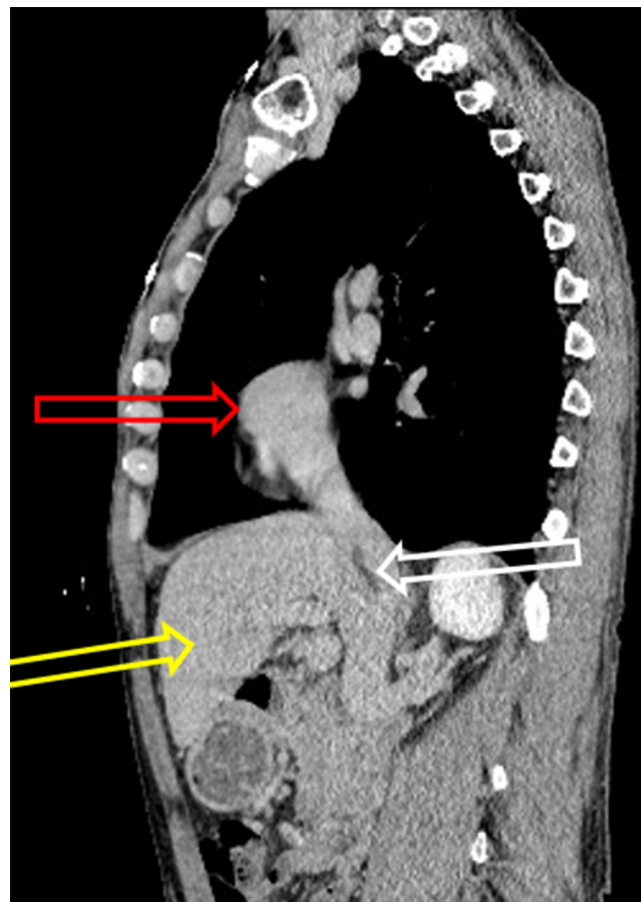


Fig 2. Computed tomography (CT) angiography of the chest, abdomen, and pelvis from the second admission showing a nonocclusive inferior vena cava (IVC) thrombus (white arrow) emanating from the accessory right hepatic vein (RHV). Also seen is the liver (yellow arrow) and the right atrium (red arrow).

analysis of the specimen (Fig 5) confirmed the diagnosis of tumor thrombus secondary to HCC. The patient recovered well, was started on rivaroxaban (Xarelto) and was subsequently discharged home.

Follow-up. Unfortunately, the patient was unable to undergo surgery because of the aggressive nature of the tumor and inadequate liver remnant following PVE. He received multiple rounds of transarterial chemoembolization with a mixed response.

DISCUSSION

The Inari FlowTrierer device functions using controlled aspiration via a large-bore catheter measuring 16, 20, or 24 French, connected to a 60-cc syringe to prevent blood loss. The disc can be deployed proximally to decrease risk of pulmonary embolism.

PVE can lead to hepatic vein thrombus but is a rare event.¹ Precipitating factors for this include injury to portal venous wall, reduced portal flow, inflammatory process, hypercoagulable states, malignancy, and portal

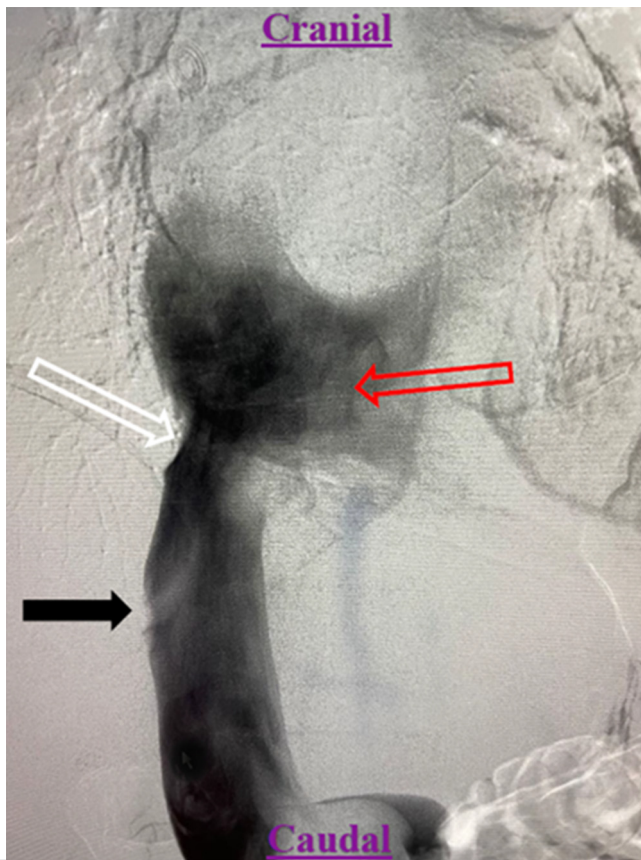


Fig 3. Venogram showing thrombus emanating from the accessory right hepatic vein (RHV) (*black arrow*) and extending to the cavo-atrial junction (CAJ) (*white arrow*). No thrombus is seen in the right atrium (*red arrow*).

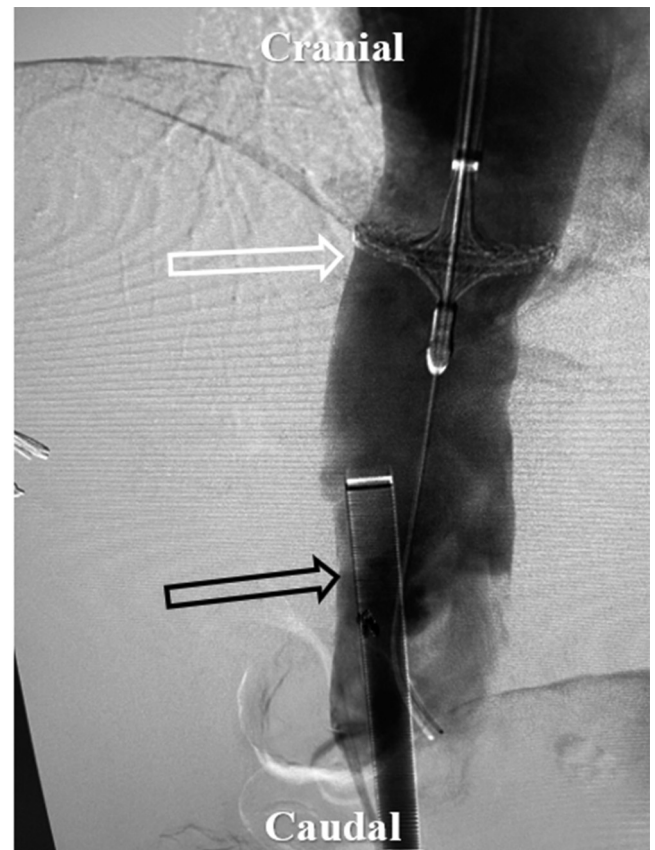


Fig 4. Venogram of inferior vena cava (IVC) showing Clot Triever disc in place with disc extended (*white arrow*) along with the introducer sheath in the femoral vein (*black arrow*).

hypertension among others.¹ In this case, however, final pathology revealed the thrombotic material to be HCC, and therefore was not secondary to PVE.

The management of IVC thrombus can be quite challenging and differs based on etiology. Treatment options include conservative management with long-term anticoagulation, systemic thrombolysis, endovascular intervention with catheter-directed thrombolysis (CDT) with or without mechanical thrombectomy, and open surgical intervention. Surgical intervention including bypass, reconstruction, replacement, or ligation are infrequently used owing to their high morbidity and mortality.² Medical therapy is far less effective, with less than 10% of patients achieving clot lysis in 10 days, and up to 40% of patients showing evidence of thrombus propagation.³ Systemic thrombolysis carries increased risk of hemorrhage and does not always lead to rapid resolution of thrombus.³ However, medical therapy, CDT, and systemic thrombolysis are not effective against tumor thrombus, as was the case with our patient.

As shown by the CaVenT study, where mortality was zero, CDT, with or without mechanical thrombectomy, is a safe and effective procedure for the treatment of

iliofemoral thrombus.⁴ There is far less data regarding CDT or mechanical thrombectomy for the management of IVC thrombus, as this condition is infrequently seen. Pharmacomechanical therapy appears to be superior to CDT alone regarding clot lysis and venous recanalization, although further randomized trials are needed to validate this.² Regarding tumor thrombus, there is even less data available, and the treatment is more complicated as they are much less responsive to anticoagulation and thrombolytic therapy. Most societies and guidelines require a FLR of 25% to 30% for patients with no underlying liver disease, and as much as 40% to 50% with underlying cirrhosis. In this case, if surgery was performed on initial presentation, there would have been an inadequate liver remnant, and the patient would have developed liver failure.^{5,6}

Variations of hepatic vascular anatomy are frequent, occurring more than 50% of the time.⁷ One of the most common variations is an accessory RHV, as in this case. It is important to understand these anatomic differences before performing any procedures to avoid injury to these structures.



Fig 5. Specimen from inferior vena cava (IVC) thrombus measuring just under 10 cm in length.

In addition to the Inari device, there are other aspiration tools available, such as AngioVac and Angio Jet, which can be used to perform aspirational thrombectomy. There is limited data regarding which system is the most effective and has the lowest risk profile, and most often the decision is made by the physician performing the procedure based on familiarity and comfort.

CONCLUSION

There is limited data regarding IVC thrombi, and further research is needed to identify the optimal treatment strategy, but aspiration thrombectomy with flow-based filter protection provides a novel option for tumor thrombus removal while avoiding pulmonary embolization.

The authors thank Dr Abdullah Kahn for his invaluable contributions including the treatment of the patient included in this case report and his insight and assistance in putting this manuscript together. The authors also thank Dr Mohammad Abdallat for his assistance in management of this patient during his hospital stay.

REFERENCES

1. Yeom YK, Shin JH. Complications of portal vein embolization: evaluation on cross-sectional imaging. *Korean J Radiol* 2015;16:1079-85.
2. McAree B, O'Donnell M, Fitzmaurice C, Reid J, Spence R, Lee B. Inferior vena cava thrombosis: a review of current practice. *Vasc Med* 2013;18:32-43.
3. Yamada N, Ishikura K, Ota S, Tsuji A, Nakamura M, Ito M, et al. Pulse-spray pharmacomechanical thrombolysis for proximal deep vein thrombosis. *Eur J Vasc Endovasc Surg* 2006;31:204-11.
4. Enden T, Haig Y, Kløw N-E, Slagsvold C-E, Sandvik L, Chanima W, et al; CaVenT Study Group. Long-term outcome after additional catheter-directed thrombolysis versus standard treatment for acute iliofemoral deep vein thrombosis (the CaVenT study): a randomised controlled trial. *Lancet* 2012;379:31-8.
5. Kawaguchi Y, Lillemoe HA, Vauthey J-N. Dealing with an insufficient future liver remnant: PVE and two-stage hepatectomy. *J Surg Oncol* 2019;119:594-603.
6. Delis SG, Dervenis C. Selection criteria for liver resection in patients with hepatocellular carcinoma and chronic liver disease. *World J Gastroenterol* 2008;14:3452-60.
7. Ugurel MS, Battal B, Bozlar U, Nural MS, Tasar M, Ors F, et al. Anatomical variations of hepatic arterial system, coeliac trunk and renal arteries: an analysis with multidetector CT angiography. *Br J Radiol* 2010;83:661-7.

Submitted Feb 3, 2022; accepted Jun 30, 2022.