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Case Report

Clearing Disseminated Venous Thromboembolism in a Single Procedure Using Thrombolytic-Free Large Bore Suction Thrombectomy: A Versatile Toolbox to Unclog the Venous Circulation

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Disseminated venous thromboembolism (VTE) occurs commonly in cancer patients, who tend to have contraindications to systemic thrombolysis and require cancer surgery. Such clinical scenarios are often challenging to manage. In this case report, we illustrate an innovative, single procedural approach in such a patient to remove extensive VTE, improve symptoms, prevent hemodynamic decompensation, and allow for a minimal level of anticoagulation such that necessary cancer surgery can proceed safely.

Keywords: pulmonary emboli, inferior vena cava thrombus, mechanical thrombectomy

Introduction

Disseminated venous thromboembolism (VTE) occurs commonly in cancer patients, who tend to have contraindications to systemic thrombolysis and require cancer surgery. Such clinical dilemmas are often challenging to manage. In this case report, we illustrate a single procedural approach in such a patient to remove extensive VTE, improve symptoms, and allow for a minimal level of anticoagulation for needed cancer surgery to proceed safely.

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Case Report

A 62-year-old male was admitted with nausea, large-volume bilious vomiting, and rapid weight loss. Abdominal computed tomography (CT) demonstrated a distended stomach with gastric outlet obstruction due to a pancreatic mass. Unable to tolerate oral feeds, a nasogastric tube was inserted for drainage and total paternal nutrition was commenced. On the fourth day of admission, he noticed painless swelling of his left leg, and the next day, he experienced near syncope and sudden onset of breathlessness. Physical examination revealed BP of 110/70 mmHg, sinus tachycardia of 120 beats per minute (bpm), and saturation of 98% requiring 5 L/min oxygen.

The clinical history and findings were consistent with pulmonary emboli (PE) in a patient with unconfirmed pancreatic cancer. Ultrasonic Doppler venography confirmed the presence of a left femoral deep vein thrombosis. CT venography showed saddle and bilateral PE with right heart dilatation (right ventricular/left ventricular [RV/LV] ratio of greater than 1); severe stenosis of a segment of inferior vena cava (IVC) extending from below the renal veins to the hepatic margins caused by extrinsic compression by the pancreatic mass; and thrombi visible in the left renal vein, femoral vein, and IVC (**Fig. 1**). He was started on subcutaneous low molecular weight heparin (Clexane; Sanofi-Aventis, Gentilly, France) and treatment strategies were discussed. The conservative option was the continuation of anticoagulation alone, with a 5%–10% risk of hemodynamic compensation. However, his symptoms would take weeks to resolve and gastric outlet obstruction surgery would be deemed high risk for a few months. The alternative strategy was percutaneous mechanical thrombectomy of the pulmonary, IVC, and femoral thrombi without the need for thrombolysis, combined with IVC stenting to restore normal flow and prevent further VTE, which he consented to. The main benefits of this approach were to resolve his symptoms more rapidly, avoid potential decompensation, and allow for early cancer surgery.

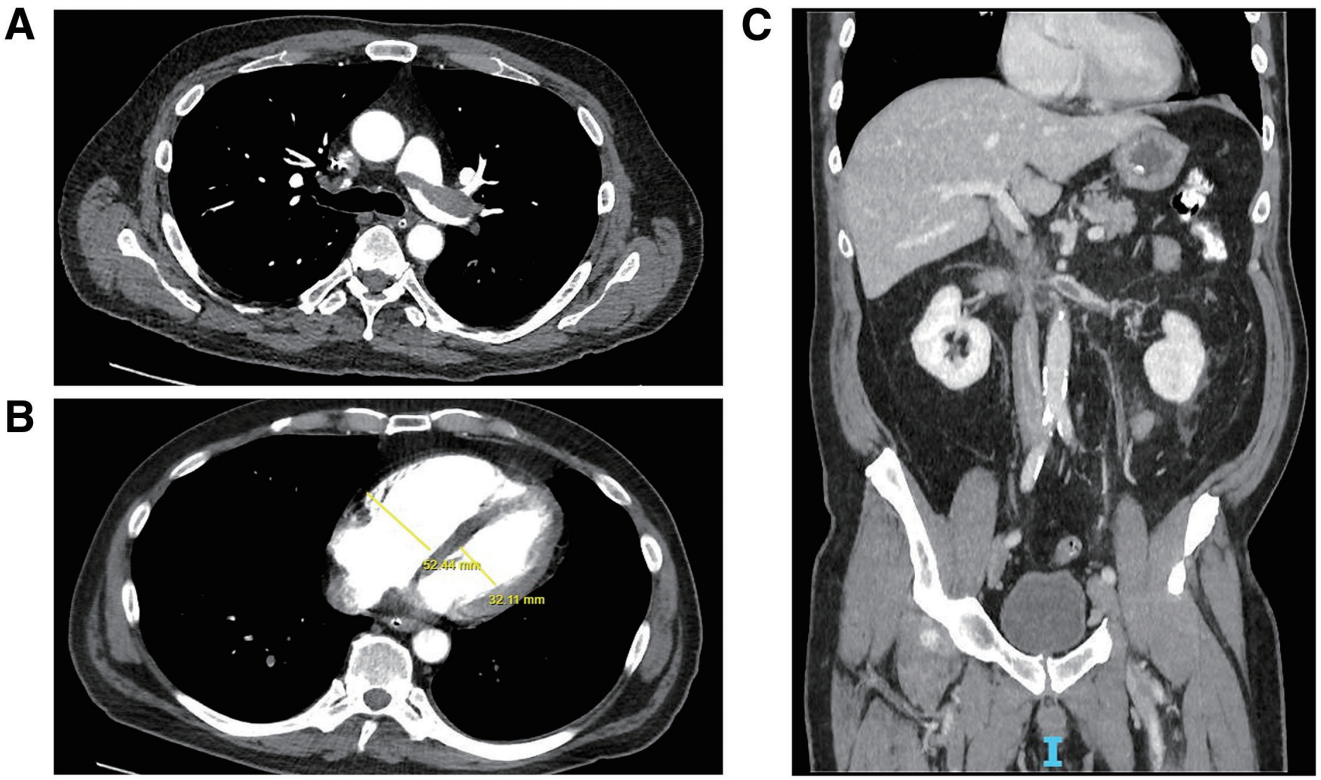

Fig. 1 (**A**) Saddle and bilateral PE seen on computed tomography pulmonary angiography. (**B**) Right ventricular dilatation as evident by RV/LV ratio of more than 1. (**C**) Severe stenosis of the supra-renal IVC with thrombus seen in the left renal vein and IVC. IVC: inferior vena cava; PE: pulmonary emboli; RV/LV: right ventricular/left ventricular

Under local anesthesia and conscious sedation, a 7Fr short sheath was inserted into the right internal jugular vein (RJV) under ultrasonic guidance. A Swan-Ganz catheter was floated into the right pulmonary artery, to position a stiff guidewire. The short sheath was exchanged for a larger 28Fr introducer sheath (Intri; Inari Medical, Irvine, CA, USA). 10000 units of bolus heparin was given to maintain activated clotting times of more than 250 seconds. A 20Fr suction catheter (Flowtriever 20; Inari Medical) was introduced over the stiff guidewire into the right and left pulmonary arteries (**Fig. 2A**). A larger 24Fr suction catheter (Flowtriever 24; Inari Medical) could not track into the pulmonary arteries. Multiple aspiration runs were made with filtered blood returned via the Intri sheath. Significant clot burden was aspirated from both lungs, after which contrast angiography confirmed proximal vessels to be free from emboli, good pulmonary perfusion bilaterally with significant hemodynamic improvement. Heart rate decreased to 73 bpm and oxygen requirement fell to 2 L/min. BP remained stable at 124/65 mmHg. Before proceeding with IVC and femoral interventions, self-expanding nitinol discs (Flowtriever XL, Inari Medical), suitable for use in vessels ranging from 19 to 25 mm, were deployed at the IVC-RA junction to provide proximal protection against further PE that could develop during IVC interventions (**Fig. 2B**).

A second 28Fr Intri sheath was inserted into the thrombus-free right femoral vein (RFV). A 24Fr aspiration catheter was used to aspirate all visible IVC thrombi. Contrast angiography confirmed the precise location of the supra-renal IVC stenosis (**Fig. 2C**). A 60 × 20 mm venous stent (Venovo; Becton Dickinson, Franklin Lakes, NJ, USA) was deployed and post-dilated (**Fig. 2D**). Contrast angiography was repeated inferior to the nitinol discs to confirm the absence of thrombus before the discs were retrieved (**Fig. 2E**).

Given the difficulty of advancing a catheter crossing over from the RFV into the distal left femoral vein (LFV), a 16Fr aspiration catheter was passed from the RJV, across the IVC stent and into the LFV to perform suction thrombectomy (**Fig. 2F**). Contrast was then injected into the LFV. Patency, brisk flow, and the absence of residual thrombi from the LFV into the right atrium were confirmed (**Supplementary Video**).

Figure of 8 sutures was used at both access sites for hemostasis. The procedure took 150 minutes, requiring 43 minutes of fluoroscopic time, 120 ml of contrast, and 100 ml of blood loss. The patient remained on 1.5 mg/kg clexane until 12 hours before his next surgery.

He was weaned off supplementary oxygen the same night and his left leg swelling resolved the next day. Three days

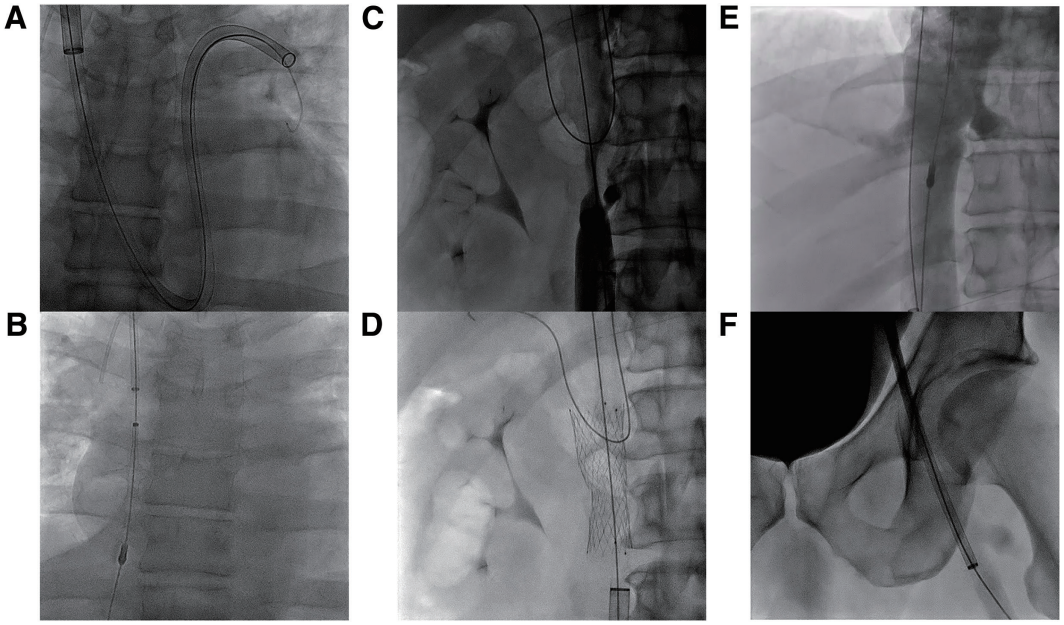

Fig. 2 (**A**) Suction thrombectomy of the left pulmonary artery. (**B**) Deployment of nitinol discs at the right atrial–IVC junction to provide proximal protection against further PE during IVC interventions. (**C**) Contrast angiography confirmed the site of the IVC stenosis. (**D**) Stent deployed across the IVC stenosis. (**E**) Angiography to confirm the absence of thrombus below the IVC discs before retrieval. (**F**) Suction thrombectomy of the left ileo-femoral vein. IVC: inferior vena cava; PE: pulmonary emboli

after his thrombectomy, he underwent gastro-jejunal bypass surgery. Intraoperative biopsy confirmed the diagnosis of pancreatic adenocarcinoma. No malignant cells were found in the histological analysis of the aspirated clots. He was transferred from the ICU to the general ward 1 day after bypass surgery and 2 days later, resumed clexane at prophylactic doses. He was discharged 5 days after bypass surgery on 20 mg rivaroxaban for secondary VTE prevention.

Discussion

Active cancer is a major risk factor for VTE and as many as 63% of PE occur in inpatients, similar to the case presented.[1] Historically, such patients would be treated with anticoagulation, with systemic thrombolysis reserved only for hemodynamic deterioration and hypotension. However, the slow resolution of thrombi leads to persistent symptoms, incomplete recovery, and delays in cancer treatments. The advent of thrombolytic-free, suction thrombectomy allows for effective thrombus clearance within the venous circulation extending from the lungs into the caval and peripheral veins. Despite treating disseminated VTE with large-volume aspiration, the unique feature of the Inari Medical thrombectomy system to return filtered blood back to the patient resulted in minimal blood loss.[2] As seen in our patient, once most of the venous circulation was cleared from thrombi, with immediate symptom resolution; averted hemodynamic compromise, and a much lower level of anticoagulation, even a transient cessation, was needed, allowing for cancer surgery to proceed safely just a few days later.

Malignant infiltration of the IVC causing severe stenosis was an important etiological factor in this case for VTE. Hence, concomitant stenting of the IVC was necessary to reduce the risk of VTE recurrence.[3]

Conclusion

Large bore suction thrombectomy deployed with different components of a versatile toolkit can be used to safely and effectively clear disseminated VTE, in this case, bilateral PE, IVC, and ileofemoral venous thrombi. It can be combined with other procedures such as IVC scenting or filter deployment to reduce the risk of further PE and permit temporary interruption of anticoagulation, allowing for cancer surgery to proceed expediently.

Declarations

Compliance with ethical standards

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 the participants included in the study. Consent for publication was also obtained for

the individual patient's anonymized data included in this manuscript. Institutional ethics approval was not necessary for the publication of an anonymized case report.

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Accountability for all aspects of the work: all authors.

Supplementary Information
Supplementary Video
Contrast venography via a 16Fr catheter inserted from the RJV into the distal femoral vein showing patent femoral vein, IVC with a stent in situ after completion of the procedure.

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