

Percutaneous suction thrombectomy of large tumor thrombus causing massive pulmonary embolism

Zachary S. Pallister, MD, Miguel Montero-Baker, MD, Joseph L. Mills, MD, and Jay Chung, MD, MSc,
Houston, Tex

ABSTRACT

We describe a patient who underwent a renal cell carcinoma resection with inferior vena cava thrombectomy complicated by tumor embolization. This resulted in massive pulmonary embolism requiring venous-arterial extracorporeal membrane oxygenation. The patient was ineligible for systemic or catheter-directed thrombolysis because of the recent surgical resection and postoperative hemorrhage. Hence, the patient underwent percutaneous suction thrombectomy with successful removal of the tumor thrombus and significant clinical improvement. This report represents a unique case of suction thrombectomy for the removal of tumor embolus from the pulmonary circulation and highlights the ability of suction thrombectomy in the management of massive pulmonary embolism. (*J Vasc Surg Cases and Innovative Techniques* 2018;4:244-7.)

Keywords: Pulmonary embolism; Continuous aspiration embolectomy; Renal cell carcinoma

CASE REPORT

A 66-year-old man originally presented to an emergency department with acute-onset right flank pain. Imaging demonstrated a 6.0- × 6.5- × 8.4-cm right kidney mass that was infiltrative into the retroperitoneal space, involving the right renal vein and extending 5 mm into the inferior vena cava (IVC). In addition, prominent perirenal lymph nodes were present, although no metastatic disease was noted on imaging. The mass was highly suggestive of a renal cell carcinoma (RCC). The patient had excellent functional status with an Eastern Cooperative Oncology Group score of 0 and had no significant weight loss. By imaging, the tumor was stage III (T3bN1M0).

The patient underwent elective resection of the mass through right radical nephrectomy and IVC thrombectomy. Efforts to identify the most proximal extent of the tumor included intraoperative ultrasound and transesophageal echocardiography (TEE). The right side of the liver was mobilized, allowing vascular

control of the IVC 4 cm cranial to the right renal vein. Despite control of the IVC, the TEE showed that the thrombus had embolized initially to the right atrium. At this juncture, the cardiothoracic surgery service was consulted, with the intention of placing the patient on cardiopulmonary bypass and removing the tumor embolus from the right atrium. Before the cardiothoracic surgeon's arrival, however, the tumor embolized farther into the pulmonary arterial system during the course of the IVC thrombectomy despite control of the proximal and distal IVC. The patient's clinical status deteriorated rapidly, with worsening oxygenation and hemodynamic collapse. There was severe right-sided heart strain on TEE, with massive right ventricular dilation. The decision was made by the cardiothoracic surgeon to place the patient on venous-arterial extracorporeal membrane oxygenation (ECMO) through the common femoral vessels and to initiate systemic anticoagulation with heparin. The RCC resection was then completed, and the midline laparotomy was closed.

The patient was transferred to the intensive care unit in critical condition. The patient required several transfusions of packed red blood cells and had decreasing urine output with marked abdominal distention, concerning for hemoperitoneum and abdominal compartment syndrome. The abdomen was therefore promptly explored, which revealed large hemoperitoneum with diffuse oozing from the surgical bed. There was a small amount of bleeding noted from the spleen, which was repaired, and the abdomen was temporarily closed.

The patient failed to improve hemodynamically despite adequate hemostasis and stable hemoglobin levels. The right ventricle also showed significant dilation when attempts were made to wean the patient from venous-arterial ECMO. Computed tomography angiography (CTA) was performed, which demonstrated significant bilateral pulmonary embolism (PE) to the main pulmonary arteries (Fig 1). He was determined

From the Division of Vascular Surgery and Endovascular Therapy, Michael E. DeBakey Department of Surgery, Baylor College of Medicine.

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Correspondence: Jay Chung, MD, MSc, Assistant Professor, Division of Vascular Surgery and Endovascular Therapy, Micheal E. DeBakey Department of Surgery, Baylor College of Medicine, One Baylor Plaza, MS 390, Houston, TX 77030 (e-mail: jayer.chung@bcm.edu).

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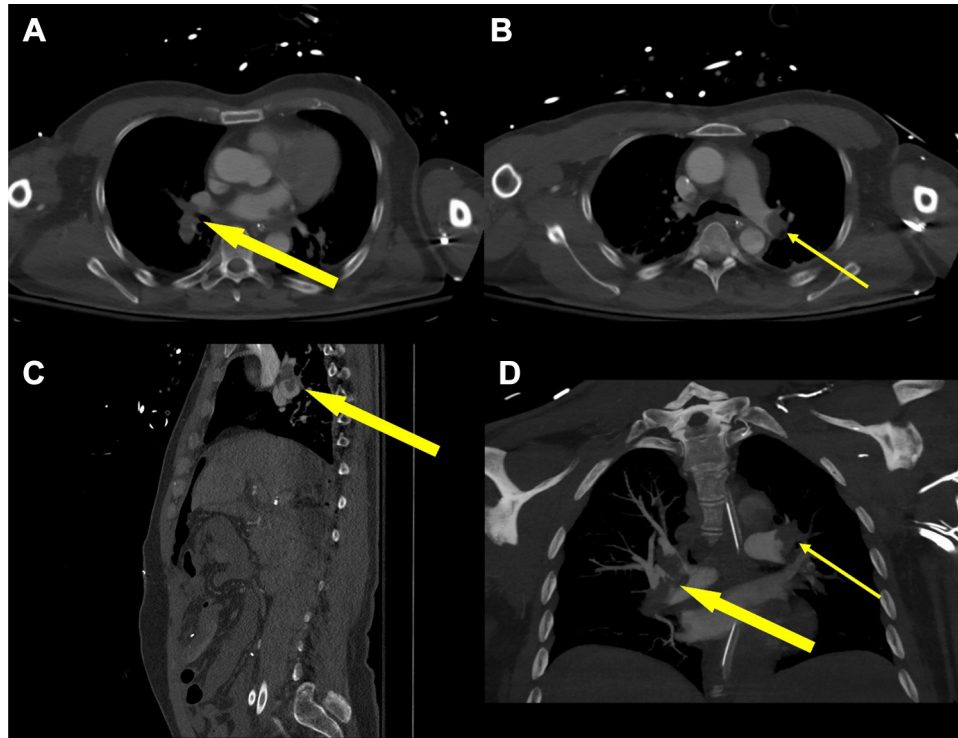


Fig 1. Computed tomography angiography (CTA) demonstrating the extent of the tumor embolus to the right (*large arrows*) and left (*narrow arrows*) pulmonary arterial circulation, resulting in a massive pulmonary embolus. **A** and **B**, Representative axial images. **C** and **D**, Sagittal and coronal images, respectively.

to not be a candidate for open embolectomy by the cardiac surgery service because of the severe coagulopathy and concern for further hemodynamic compromise with induction of general anesthesia. In addition, because of the recent intra-abdominal hemorrhage and splenic laceration, he was not a candidate for systemic thrombolysis or catheter-directed thrombolysis (CDT). Therefore, the vascular surgery service was consulted to evaluate for possible aspiration thrombectomy.

The patient was taken to the angiography suite, and pulmonary angiography was performed (Fig 2). Bilateral emboli were identified in the lobar branches, with the largest burden noted in the right superior trunk and interlobar artery. The initial Miller index was 16 by CTA.¹ The Miller index provides a numeric score to quantify the effect of occluded pulmonary arterial branches, with a maximal score of 9 for the right lung (3 for the upper lobar branch, 2 for the middle lobar branch, and 4 for the lower lobar branch) and 7 for the left lung (2 for the upper lobe and lingula and 3 for the lower lobe branch).¹ Selective angiography was performed, and access was obtained to each lobar branch. Mechanical aspiration thrombectomy using the Indigo Continuous Aspiration Mechanical Thrombectomy device (Penumbra, Inc, Alameda, Calif) was performed. There was concern that solid tumor material was likely present in the emboli and would not respond to chemical thrombolysis. Several passes were made with a CAT8 catheter without the flow-separator within the right inferior, medial, and left inferior pulmonary arterial branches with successful extraction of solid tumor thrombus (Fig 3). Completion pulmonary arteriography demonstrated



Fig 2. Initial angiogram demonstrating a large filling defect in the right superior and interlobar pulmonary arteries (*arrow*).

improvement in flow to the treated segmental branches (Fig 4). Estimated blood loss was 500 mL. Several further passes with the CAT8 catheter were also performed on the left because of the CTA findings of significant thrombus in the left pulmonary artery. However, minimal thrombus was extracted from the left side. Completion angiography showed the Miller index to have been reduced to 4. The tumor thrombus was sent for pathologic evaluation and demonstrated carcinoma cells of renal origin.

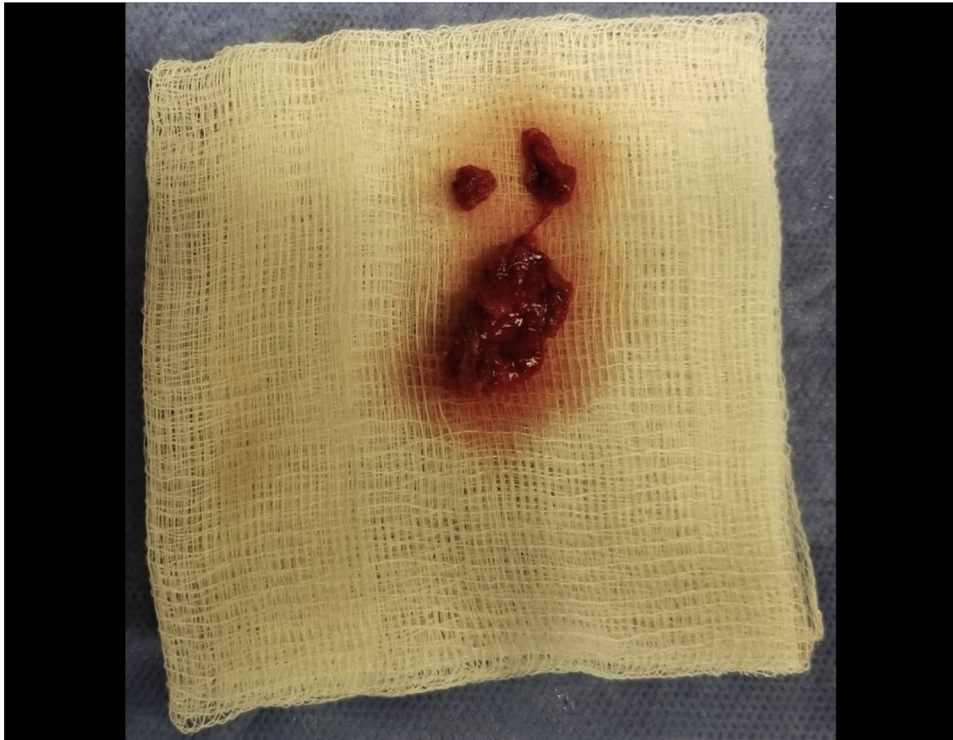


Fig 3. Tumor that was aspirated from the right superior and interlobar pulmonary arteries. Final pathologic examination revealed that the mass was indeed renal cell carcinoma (RCC).

The patient showed almost immediate improvement in hemodynamics and oxygenation. Transthoracic echocardiography also showed decreased right-sided heart strain with decreasing ECMO support. The patient was able to be weaned off of vasopressor and ECMO support and was decannulated from ECMO on postintervention day 1. He was successfully extubated on postintervention day 3. He has subsequently been discharged to home at his baseline functional status.

The patient consented to the reporting of his clinical case and all relevant images.

DISCUSSION

This case demonstrates an occurrence of massive PE originating from a known RCC tumor thrombus in the patient's IVC. PE is the third most prevalent cause of cardiovascular death in hospitalized patients in the United States.² Massive PE is defined as PE with sustained hypotension (systolic blood pressure <90 mm Hg) requiring vasopressor support without any other cause.³ Treatment focuses on decreasing the embolic burden and preventing further embolism. The primary treatment modalities include therapeutic anticoagulation, systemic thrombolysis, CDT, and surgical thrombectomy. When thrombolysis is not contraindicated, systemic thrombolysis is the consensus recommendation for treatment.⁴ When thrombolysis is contraindicated, traditional open thrombectomy is the standard of care.



Fig 4. Completion pulmonary angiography revealing normal filling of the superior and interlobar pulmonary arterial branches (*arrow*), with reactive hyperemia of the right middle and upper lobes of the lung.

Emerging evidence supports an endovascular approach to PE management, although current options remain limited. Ultrasound-assisted CDT has been shown to be safe and efficacious.⁵ Unfortunately, our patient had a course complicated by hemoperitoneum postoperatively, precluding CDT or systemic thrombolysis. Rheolytic aspiration thrombectomy carries a black box warning for use in pulmonary embolus in spite of several small case series describing the efficacy of rheolytic

aspiration thrombectomy for PE.⁶ Continuous aspiration thrombectomy has been shown to be feasible for more conventional PE in small case series and represents the only alternative when open thrombectomy, CDT, or systemic thrombolysis is contraindicated.⁷⁻⁹

Whereas IVC tumor thrombosis is common in patients with locally advanced RCC, massive embolism is a rare occurrence.⁸ In a retrospective analysis, of 13 patients treated with large IVC tumor thrombus associated with RCC, only one patient had a documented embolism of the tumor thrombus.¹⁰ Microemboli are relatively common, occurring in approximately 26% to 31% of patients, but are not of hemodynamic significance.¹¹ Standard of care approach to this pathologic process involves IVC control and cavotomy with tumor thrombectomy or segmental resection with interposition repair. No clear consensus exists regarding need for cardiopulmonary bypass or TEE monitoring.^{12,13}

The presence of tumor tissue in the embolism decreases the possible therapeutic options available for massive PE as thrombolysis alone is unlikely to be successful. Data suggest that systemic thrombolysis with recombinant tissue plasminogen activator can be given when massive tumor thrombus embolism is known or suspected to assist with minimization of the inflammatory reaction.¹⁴ However, this is unlikely to have any effect on the tumor cells present in the embolism causing a massive obstruction in the pulmonary arterial system and leading to hemodynamic collapse. The primary surgical option for tumor embolization has been open thrombectomy while on cardiopulmonary bypass.¹⁵ This was deemed infeasible in this case by our cardiac surgery colleagues. Hence, percutaneous aspiration thrombectomy was attempted and ultimately successful in this case.

CONCLUSIONS

Our report represents a unique case of the use of continuous aspiration thrombectomy to extract tumor embolus from the pulmonary circulation. Our report adds to the available literature in regard to management of tumor embolism in radical tumor thrombus resection associated with RCC. Our experience suggests that endovascular suction thrombectomy can be an alternative approach to treating the hemodynamically unstable patient with massive and submassive PE.

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