Novel Use of AngioVac System to Prevent Pulmonary Embolism during Radical Nephrectomy with Inferior Vena Cava Thrombectomy

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Key Words

Nephrectomy • Venous thrombus • Pulmonary embolism • Vena cava

Abstract

Venous tumor thrombus occurs in 5–10% of patients with renal cell carcinoma. Surgical excision offers the best chance for survival, but is technically difficult. Risk of pulmonary embolism from venous thrombus or tumor thrombus is high, especially with tumors located higher in the inferior vena cava. Cardiopulmonary bypass may be used when a tumor extends above the diaphragm, but carries significant risk. We present an 86-year-old woman with a 7 cm renal mass extending into the inferior vena cava just below the confluence of the hepatic vessels. Prior to surgery she was found to have increasing pulmonary embolisms despite appropriate anticoagulation. Intraoperatively, the AngioVac aspiration system was utilized to prevent further pulmonary embolism. This is the first reported case of the use of this system during radical nephrectomy.

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Introduction

Roughly 5–10% of patients with renal masses have venous tumor thrombus [1, 2] and tumor thrombus level has been shown to correlate with survival [3] as well as higher rates of adverse events [4]. Higher levels of tumor thrombus [5] often require liver mobilization and possible cardiac bypass [6]. With increased inferior vena cava (IVC) manipulation, the risk of emboli increases and different techniques to ensure tumor control have been reported with good results [7]. IVC filters have been utilized in an attempt to prevent pulmonary embolism (PE), but are not recommended due to the potential for caval thrombosis, provided the patient does not have active tumor embolus [2]. The patient we present had suspected tumor emboli, given her worsening chest CT despite appropriate anticoagulation. Cardiothoracic surgery was consulted preoperatively and was present during the operation. Intraoperatively, the patient demonstrated signs of PE expansion prior to liver mobilization and significant IVC manipulation. As such, the decision to use the AngioVac system (Vortex Medical, Norwell, MA) was made in an attempt to prevent further PE.

Case Report

An 86-year-old female presented with a 7 cm left renal mass with IVC thrombus extending to the confluence of the hepatic vein. Metastatic workup was negative and plans for a radical nephrectomy with IVC thrombectomy were made. One week later, she developed acute shortness of breath and chest CT showed bilateral PEs. The patient was admitted, started on Lovenox 100 mg daily, and discharged 3 days later. Surgery was delayed 2 weeks to allow pulmonary vascular recanalization. One week after discharge the patient was readmitted with worsening dyspnea and pleuritic chest pain. Repeat chest CT showed increasing bilateral PEs, raising suspicion for tumor emboli. She was admitted for anticoagulation and cardiothoracic and liver surgeons were consulted. The patient was educated regarding the significant mortality risk with or without surgery. Cardiothoracic surgery recommended consideration of the AngioVac aspiration system during liver mobilization/thrombus manipulation to prevent intraoperative PE, with the caveat that the device required full anticoagulation. The patient was taken to surgery on hospital day 3 for radical nephrectomy with IVC thrombectomy. The left kidney was embolized immediately preceding surgery. Post-embolization arteriogram showed adequate occlusion of the arteries supplying the tumor.

The case was subsequently performed through a Chevron incision. The patient was stable during exposure of the IVC. However, prior to liver mobilization, the patient became markedly hypotensive, increasing concern for additional PEs. The decision was made to use the AngioVac aspiration system during the procedure until the thrombus was extracted. Heparin was administered to achieve an activated clotting time of greater than 200 s. A 7 Fr catheter was inserted into the right internal jugular vein (IJV). An angled glide catheter was placed to the level of the right atrial-IJV junction. The catheter was exchanged over an Amplatz ST-EX wire and the existing introducer exchanged with progressively larger dilators until the 26 Fr GORE DrySeal (W.L. Gore, Inc., Flagstaff, AZ) sheath introducer could be advanced into the right IJV. The hemostatic balloon within the introducer was inflated after removing the dilator. The right femoral vein was percutaneously cannulated, serially dilated to 17 Fr and a reinfusion cannula placed. An AngioVac aspiration cannula was advanced under fluoroscopic and echocardiographic guidance over the Amplatz wire into the right atrium. The AngioVac cannula balloon was inflated to 1.5 atmospheres. The inflow portion of a standard extracorporeal circuit was connected to the AngioVac catheter and the outflow was connected to the reinfusion catheter. The BioMedicus centrifugal pump (Medtronic Inc., Minneapolis, MN) was gradually adjusted to achieve 1–3 liters of flow. The liver was then mobilized and the tumor isolated. Debris and thrombus were prevented from entering the heart by the AngioVac cannula.

The infrahepatic IVC was clamped diagonally below the thrombus, a Pringle maneuver performed, and the suprahepatic IVC clamped above the thrombus. Once the IVC was controlled, the AngioVac flow was reversed by splicing the inflow and outflow cannulas. At the time of IVC clamping, veno-venous bypass from the femoral vein to the right IJV was performed assisting in venous decompression and cardiac preload.

A cavotomy was then performed, circumscribing the left renal vein hiatus, and carried up the midline of the IVC. The thrombus was removed, included a portion adherent to the wall of the IVC. The IVC was then closed with running 4-0 Prolene. The total liver

clamp time was less than 15 minutes. The venous sheaths were removed and pressure held. Good IVC hemostasis was apparent.

After initiation (and reversal) of coagulation the patient was noted to have significant venous bleeding throughout the retroperitoneum. After an episode of asystole, she was resuscitated and the left kidney and adrenal gland rapidly removed using a stapler to divide the arteries. Visible bleeding vessels were ligated but due to the patient's unstable condition, her abdomen was packed with sponges, her fascia closed with a running #1 PDS, and her skin layer packed and dressed with Kerlix.

Her course was tenuous the remainder of the evening, requiring maximal pressor support and she died the night of surgery. Final pathology showed a T3a, renal cell carcinoma, Fuhrman grade 3, and 8 cm in greatest dimension.

Discussion

The AngioVac aspiration system has been previously described [8] and consists of a 22 Fr catheter, a circuit with a built-in filter, a centrifugal pump head, and a reinfusion cannula. The AngioVac system is approved in the U.S. for removal of unwanted intravascular material. The current version allows a percutaneous approach for distal embolic protection and removal of debris. Used exclusively in cardiothoracic cases to this point, we present a novel use for the device. The obvious disadvantage of the system is the required anticoagulation. Patients undergoing radical nephrectomy with IVC thrombectomy are at high risk of hemorrhage, with mortality rates ranging from 5 to 12%. Observation remains an option, though patients tend to fare poorly with studies reporting median survival times of 3–5 months and a 2-year mortality of roughly 95% [9].

Our patient was a previously healthy and independent octogenarian. Given her significant morbidity from bilateral PEs, she understood her risk and desired surgery. Despite the unfortunate outcome, the case demonstrates the feasibility of using the AngioVac system to prevent PE during radical nephrectomy with IVC thrombectomy. The case highlights the utility and danger in employing such a system in a case where complications and morbidity are common. The use of the AngioVac in a patient undergoing radical nephrectomy with IVC thrombectomy is a novel approach to preventing emboli passage from the IVC to the heart.

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