

Case Reports

Anesthetic Management of a Patient with Renal Cell Carcinoma-Associated Venous Thrombosis and Massive Transfusion

Gary Zhang¹, Ryan Palacios¹, Jamal Hasoon², Christopher L Robinson³, Anvinh Nguyen¹

¹ Department of Anesthesiology, Baylor College of Medicine, ² Department of Anesthesiology, Critical Care, and Pain Medicine, The University of Texas Health Science Center at Houston, ³ Department of Anesthesiology, Critical Care, and Pain Medicine, Brigham and Women's Hospital

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A 53-year-old male with a history of multiple deep venous thromboses (DVTs) underwent a right open radical nephrectomy with inferior vena cava (IVC) thrombectomy in the context of renal cell carcinoma (RCC)-associated venous thrombosis. Imaging and renal biopsy revealed a diagnosis of RCC with non-occlusive thrombosis of the left renal vein and occlusive thrombosis of the infrarenal IVC. The major risks of concern for the procedure included thrombus embolization from surgical manipulation and massive bleeding. Intraoperatively, the patient experienced significant hemorrhage requiring massive transfusion protocol. The purpose of this case report is to emphasize the importance of multidisciplinary involvement, intraoperative thrombus monitoring, and principles of massive transfusion in the management of similar cases.

INTRODUCTION

Accounting for more than 90% of kidney malignancies seen worldwide, renal cell carcinoma is frequently associated with thrombotic complications due to intravascular extension.¹ An estimated 4-10% of cases involve thrombosis of the renal vein and inferior vena cava (IVC), while approximately 1% extend further into the right atrium.^{2,3} The prognosis for such cases when managed expectantly is poor, with a median survival time of only 5 months and a 1-year disease-specific survival rate of 29%.⁴ As such, the standard of care for these patients involves surgical resection of both the primary tumor and the venous extension, with multiple studies showing improved outcomes and 5-year survival rates ranging from 45% to 69%.^{5,6} However, the surgery itself carries a number of potential complications as well, with the major concerns being massive hemorrhage leading to hemodynamic instability and tumor-thrombus embolization from surgical manipulation leading to a pulmonary embolus.⁷ This case report aims to provide insights for similar cases by discussing our perioperative management and highlighting the factors that contributed to a successful outcome.

CASE PRESENTATION

Our patient was a 53-year-old male with a history of multiple deep venous thromboses (DVTs) who had been previously prescribed anticoagulation therapy, but stopped taking it due to medication non-compliance. The patient presented to the emergency with complaints of chronic right flank pain and subacute right leg swelling. Imaging studies, including a CT abdomen and an MRI kidney, re-

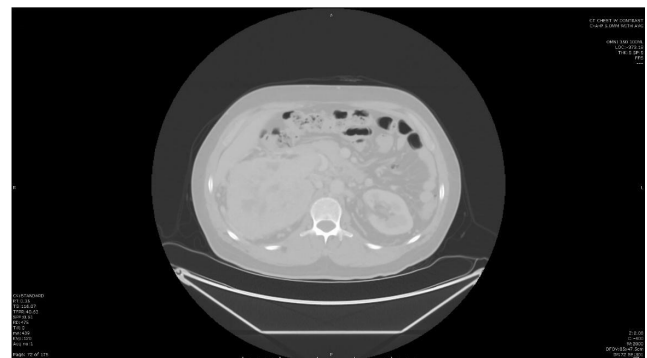


Figure 1. Large 7.7 cm right renal mass with invasion into left renal vein and IVC.

vealed a significant 7.7 cm right renal mass, a non-occlusive thrombus in the distal left renal vein, and an occlusive thrombus in the inferior vena cava (IVC) (Figure 1). The patient underwent a renal biopsy, confirming the diagnosis of RCC, and the patient was for further evaluation regarding the need for right radical nephrectomy with IVC thrombectomy. The patient was started on a heparin drip for full anticoagulation.

A multidisciplinary approach involving urology, general surgery, cardiology, cardiothoracic surgery, nursing, perfusion, and cardiac anesthesiology was implemented to optimize the patient's condition for the surgery. A transthoracic echocardiograph (TTE) and cardiac MRI were performed, with the results indicating no extension of the tumor thrombus into the suprahepatic IVC or right atrium. An EKG and stress test were also unremarkable, showing no evidence of inducible ischemia or right heart strain.

In the preoperative period, a thoracic epidural was successfully placed at the T8-T9 level without complications, though it was not activated until the end of the case due to concerns for hemodynamic instability intraoperatively. Large-bore peripheral intravenous access was also obtained. Once in the operating room, in addition to standard monitors, the patient's arterial line was connected to the Edwards Lifesciences FloTrac for additional hemodynamic information. The patient was induced with lidocaine, fentanyl, propofol, rocuronium, and intubated under direct laryngoscopy. General anesthesia was maintained with sevoflurane, hourly ketamine boluses, and a low-dose dexmedetomidine infusion. Post-induction, a second large-bore PIV was inserted in the arm, and a 9 Fr MAC central venous catheter was inserted in the right internal jugular vein under ultrasound guidance. A companion catheter was inserted into the introducer port of the MAC catheter to increase the number of central access infusion ports. TEE evaluation was performed, revealing normal cardiac anatomy and function. The occlusive thrombus of concern was confirmed via TEE to be located in the IVC near the junction with the hepatic vein. The distance of the thrombus from the junction was 3.1 cm, and this measurement was continually rechecked throughout the case due to concern for embolization. Blood was available in the operating room at the time of induction, and a Hotline Blood and Fluid Warmer was primed and connected to the CVC.

At the time of exposure and access of the IVC, the patient initially manifested signs of moderate blood loss. This was managed effectively with intermittent pressor boluses, titration of the norepinephrine background infusion, and a steady transfusion of pRBCs. This initial phase of steady bleeding lasted approximately 1.5 hours. Following this phase was the critical portion of the case with significant hemorrhage from the IVC. The hemorrhage manifested as persistent, refractory hypotension with arterial pressures as low as 50-70 mmHg systolic and 40-50 mmHg diastolic. A Smiths Medical Level 1 Rapid Infuser was utilized. The institutional massive transfusion protocol (MTP) was activated. To help with the rapid infusion of blood products, the companion catheter attached to the MAC CVC was removed allowing higher flow rates through the central line. Fresh frozen plasma (FFP) and platelets begun transfusing in the approximate MTP ratio and according to serial ABG's, thromboelastogram (TEG), and coagulation information. A vasopressin infusion, epinephrine infusion, and large epinephrine and norepinephrine boluses were started and administered during this phase to maintain adequate perfusion. The hemorrhage continued until clamping of the IVC. This allowed time for our massive transfusion and resuscitation. Shortly after clamping, the thrombus was fully resected. The patient remained hemodynamically stable for the rest of the case, but during closing, he required an additional 3 units of pRBCs due persistently low hemoglobin. In total, the patient received 19 units of pRBC, 10 units of FFP, 5 units of platelet, 4.5 L of crystalloid fluids, and 2 L of albumin.

Following the surgery, the patient was transported back to the intensive care unit (ICU) in stable condition. The

patient remained intubated and sedated using dexmedetomidine, fentanyl, and propofol infusions. Hemodynamics were monitored closely, and the patient's hemoglobin levels remained stable throughout the hospital stay. Imaging tests, including CXR and CT-PE, showed no significant abnormalities, and adequate urine production was observed. Sedation was gradually reduced, and the patient was successfully extubated on postoperative day 1. The epidural catheter was activated in the ICU before being removed on day 3 by the acute pain service.

Patient's hospital course was complicated by persistent altered mental status postoperatively. Neurology, internal medicine, and psychiatry were consulted for further evaluation, with the most likely etiology being postoperative delirium or autoimmune encephalitis. Autoimmune encephalitis is a known paraneoplastic syndrome of RCC. On postoperative day 3, the patient developed a drooping of the left side of the mouth and aphasia, which raised concerns about a possible cerebrovascular accident due to intraoperative blood loss and hypotension. Stroke workup, including CT and MRI scans of the head, CTA, and EEG, did not reveal any abnormalities. Empiric thiamine and B12 replacement therapy was initiated, and infectious laboratory results were within normal limits. By post-operative day 11, the patient's status had significantly improved, and he was discharged with plans for follow-up autoimmune lab testing and anticoagulation with apixaban. His mental status returned to preprocedural baseline.

DISCUSSION

Massive hemorrhage is an anticipated complication of complex radical nephrectomy and IVC thrombectomy. The activation of the institutional MTP, use of a level 1 transfuser, removal of the companion catheter to utilize a larger CVC lumen, and additional anesthesiology support staff were all significant factors in the successful outcome. In addition, surgical clamp of the IVC helped maintained intravascular blood volume and reduced surgical hemorrhage allowing our team to resuscitate effectively. Though there is no universal definition or protocol for MTP, the classic definition is the transfusion of at least 10 units of packed red blood cells (pRBC) within a 24-hour period in a roughly 1:1:1 ratio of pRBCs, fresh frozen plasma (FFP), and platelets. Doing so allows for transfusion of large quantities in a short amount of time while avoiding dilutional coagulopathy by ensuring proper replenishment of depleted platelets or coagulation factors. Since patients who undergo massive blood loss are also more susceptible to hypothermia, employing a Level 1 Rapid Infuser serves a dual purpose of enabling rapid transfusion while simultaneously warming the fluids to match body temperature.⁸ Finally, establishing good venous access played a vital role in the successful resuscitation of the patient, as doing so allowed for transfusion of larger volumes. A MAC CVC allows for flow rates up to 7x greater than that of an 18 g PIV.⁹ The removal of the companion catheter attached to the central venous catheter allowed for wider lumen space and further facilitated the rapid infusion of the blood products.

Transesophageal echocardiography (TEE) is also a key component in the intraoperative management of RCC-associated venous thrombosis, as it can provide a number of important pieces of information on the extent and status of the thrombus. For instance, when performed post-induction, it can allow for better visualization of the location and quality of the thrombus to better inform the surgical dissection, clamping, and resection. Throughout the case, it is necessary to visualize the proper removal of the thrombus as well as monitor for any evidence of embolization into the heart or lungs.¹⁰ In our case, it confirmed normal cardiac function, identified the thrombus of concern, and allowed for continuous monitoring of its position relative to other organs. This real-time feedback enabled the surgical team to make informed decisions and kept them informed about the potential migration of the thrombus. Furthermore, it helped aid volume resuscitation with real-time visualization of the ventricular preload and contractility.

Although the case was successful overall, there are still areas for improvement. One aspect that could be addressed is the need for more aggressive blood pressure control, as extended episodes of intraoperative hypotension have been linked to increased incidence of post-operative complications such as AKI, ischemic stroke, and elevated mortality rates.¹¹⁻¹⁴ For instance, in a recent 12-year retrospective cohort study, it was found that a mean arterial pressure of less than 55 mmHg during non-cardiac surgery was significantly correlated to the development of post-operative delirium within 30 days. Furthermore, this correlation was duration dependent, as episodes greater than 15 minutes showed stronger correlation than those less than 15, as well as having amplified effect in patients undergoing surgeries longer than 3 hours.¹⁵ In light of the patient's stroke-like symptoms and new-onset altered mental status, most likely due to post-operative delirium, it is possible that the extended period of severe hypotension was a major contributing factor and more aggressive resuscitation could have improved the patient's subsequent post-operative course. Two ways this could have been achieved include placing additional large-bore venous lines and getting additional rapid infusers to the operating room more promptly. Since the use of mechanical rapid infusers are significantly faster with rates of up to 1000 ml/min, both adjustments would have allowed us to transfuse the patient faster and improved our chances of stabilizing his blood pressure sooner.¹⁶ Finally, more prompt surgical exposure and application of the hemostasis clamp would have also helped resuscitation efforts.

Finally, it is also important to recognize the incidence of altered mental status and its etiologies in these patients, as they possess a number of significant predisposing risk fac-

tors. For instance, post-operative delirium is a fairly common occurrence, with one observational study finding a 30.8% incidence rate in patients one-week post-radical nephrectomy and IVC thrombectomy.¹⁷ Because of the presence of RCC, these patients also have an additional risk of developing autoimmune encephalitis, a rare but documented paraneoplastic syndrome associated with RCC. This may present in a number of ways, including seizures, cognitive impairment, behavior changes, and psychiatric symptoms.¹⁸ In our case, our patient had the additional risk factor of severe intraoperative hypotension, and experienced waxing and waning mental status with minimal grimacing to painful stimulus. His altered mental status ultimately resolved on its own with only thiamine and B12 supplementation. The patient was eventually discharged with plans to follow-up on autoimmune work up with his primary care physician.

CONCLUSION

In conclusion, the successful management of this case demonstrated the importance of multidisciplinary involvement, adherence to principles of massive transfusion, and intraoperative thrombus monitoring via TEE. The utilization of a Level 1 Rapid Infuser and establishment of good venous access were also crucial factors in the stabilization of the patient during massive blood loss. However, there are still areas for improvement, as pursuing more aggressive blood pressure control could potentially reduce subsequent morbidities associated with extended periods of severe intraoperative hypotension.

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PRESENTATION

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