Am J Clin Exp Urol 2022;10(2):123-128
www.ajceu.us /ISSN:2330-1910/AJCEU0141017

Case Report

Renal cell carcinoma with right atrium tumor thrombus treated with radical nephrectomy and tumor thrombectomy in a patient with previous coronary artery bypass graft: a case report

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Received December 7, 2021; Accepted February 8, 2022; Epub April 15, 2022; Published April 30, 2022

Abstract: Renal cell carcinoma (RCC) with inferior vena cava (IVC) and right atrium (RA) tumor thrombus (TT) is a rare occurrence and its resection is surgical challenge. Management becomes even more difficult when the TT causes hepatic vein obstruction and leads to Budd-Chiari syndrome. We report a case of 68-year-old male with right RCC with IVC and RA TT with associated Budd-Chiari syndrome. Surgical management was performed without cardiopulmonary bypass (CPB) and re-sternotomy due to the patient's previous history of coronary artery bypass grafting (CABG) for 3 vessel coronary artery disease. Through a transabdominal approach, the diaphragm was dissected off the IVC and the RA was gently pulled into the abdomen and clamped under transesophageal echocardiogram (TEE) control. As use of CPB in these surgeries is associated with increased morbidity and mortality, this organ transplant-based approach is encouraged for patients requiring resection of RCC with supradiaphragmatic TT.

Keywords: Renal cell carcinoma, supradiaphragmatic tumor thrombus, Budd-Chiari syndrome, coronary artery bypass graft, cardiopulmonary bypass

Introduction

Renal cell carcinoma (RCC) represents the most common type of kidney cancers, however venous migration and tumor thrombus (TT) formation is a rare, occurring in 10% of all cases [1]. Migration of the tumor is into the right atrium (RA) is an even rarer event and occurs in 1% of cases [2-5]. Tumor thrombus may present asymptomatically or cause a variety of symptoms, such as varicocele, lower extremity swelling, cardiac dysfunction, pulmonary embolism, or Budd-Chiari syndrome (BCS) [6, 7]. The treatment of metastatic RCC is rapidly evolving and the role of immunotherapy is ongoing [8], however surgery remains the most effective form of treatment for RCC with TT [9-12]. In attempts to render the patient tumor free, urological surgeons perform a radical nephrectomy with tumor thrombectomy [13]. The search of numerous surgical approaches have been described in the resection of RCC with TT, including cardiopulmonary bypass (CPB) with or without deep hypothermic circulatory arrest, veno-venous bypass (VVB), and thoracic approach [14]. Use of CPB for treatment of TT that extends above the diaphragm has been advocated, however coagulopathy and central nervous system complications have been described [15]. Surgical treatment can be complicated by the prescence of BCS, which has been reported to secondary to hepatic venous obstruction from invasive IVC TT in RCC [4, 12, 16].

Here, we report the case of a patient with RCC with TT extending into the RA. He had a prior coronary artery bypass graft (CABG) for 3 vessel coronary artery disease (CAD). Redo sternotomy is technically difficult to perform due to

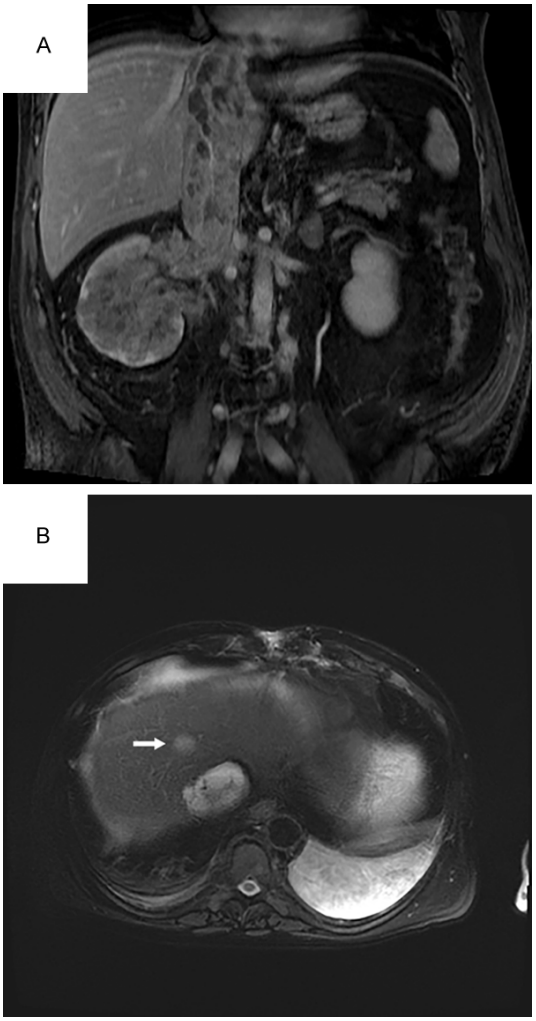

Figure 1. A: Magnetic resonance image (MRI) showing right renal mass, inferior vena cava and right atrium tumor thrombus. B: MRI showing liver metastases of segment VIII (2.1 cm) (white arrow).

adhesions and risk of injury to critical structures lying underneath the sternum [17]. Our goal is to describe a strategy to deal with these complicated tumors without having to perform CPB and re-sternotomy [18] which can be beneficial for patients presenting with BCS and a previous history of CABG.

Case presentation

A 68-year-old male presented to outside hospitals with right-sided abdominal pain, weakness, and hematuria. Computed tomography of chest and abdomen, magnetic resonance, and echocardiogram revealed a large right renal mass with TT extending into the RA (**Figure 1A**) and three liver metastases: one in segment VIII (2.1 cm) (**Figure 1B**), the second one in the junction between segments VII/VIII (1.3 cm), and the last one in segment VI (2 cm). The TT was causing Bud-Chiari syndrome (BCS), which presented with ascites. The patient's history is significant for CABG for 3 vessel CAD at 5 months prior to this presentation. After extensive evaluation and cardiology clearance, including cardiac catheterization showing patent CABG, informed consent was obtained for right radical nephrectomy and tumor thrombectomy with possible CPB. TT levels were level IV [19]. The patient tested Covid-19 positive prior to surgery, so the procedure was delayed for 7 weeks after a negative Covid-19 test [20].

Procedure in detail

After anesthesia induction, an introducer was inserted into the right internal jugular vein and used for possible CPB. Surgical approach involved a modified chevron incision, and the use of Thompson retractor. The right kidney was mobilized laterally and posteriorly and the renal artery was ligated and divided [15]. The IVC and aorta were isolated for possible cannulation if CPB deemed necessary.

Using Piggyback liver mobilization techniques, the liver was mobilized off the IVC and the hepatic veins and porta hepatis (**Figure 2A**) were isolated [2-5, 9]. The central diaphragm tendon was dissected to identified the intrapericardial IVC. The right and left inferior phrenic veins were engorged due to complete obstruction of the IVC. The right inferior phrenic vein was stapled and the left one was stapled at the time of complete occlusion of the IVC to avoid more congestion of the liver.

The intra-operative transesophageal echocardiography (TEE) delineated the cranial extent and mobility of the TT. The TEE ensured that there were no pulmonary artery emboli.

Vascular isolation of the IVC was achieved inferior and superior to the TT including the left and right renal veins. Pringle maneuver was performed to temporarily occlude blood inflow into the liver. Vascular clamps were placed in the infra-renal vena cava and the left renal vein. Under TEE monitoring, a vascular clamp was placed across the RA (**Figure 2B**). The cava was opened from the renal vein to the major hepatic veins. The TT was dissected sharply off the IVC

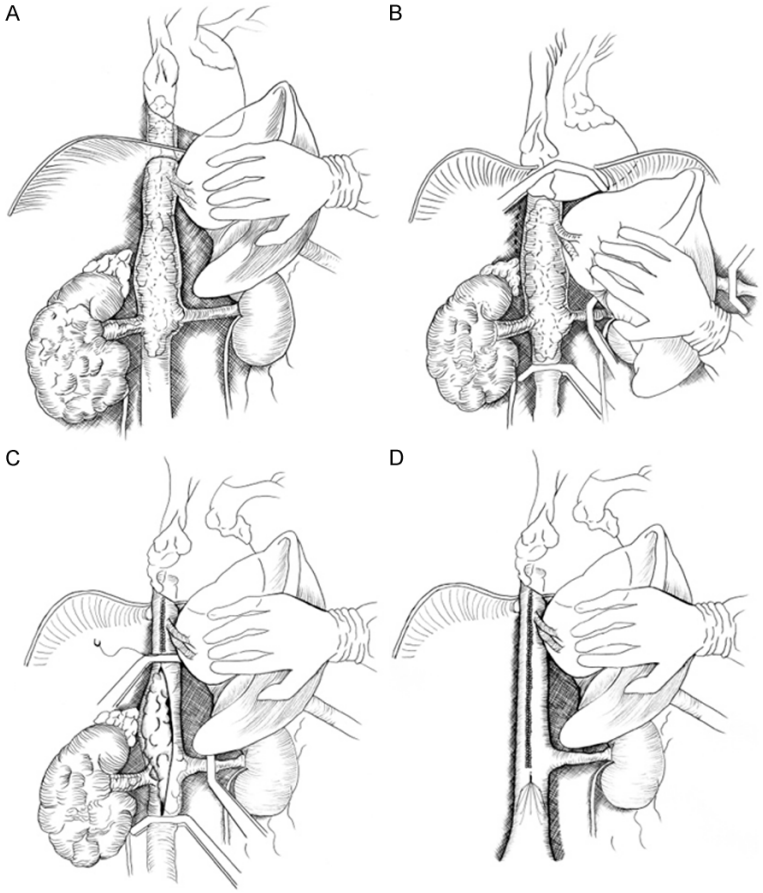

Figure 2. Drawing showing abdominal removal of renal cell carcinoma with level IV tumor thrombus (TT) (intraatrial extension). A: The abdominal inferior vena cava (IVC) is exposed by mobilizing the liver off the retrohepatic IVC. B: The central tendon of the diaphragm and IVC are dissected off the posterior abdominal wall (dotted lines). The right atrium, distal IVC, porta hepatis and left renal vein are clamped. C: If the TT cannot be milked downward below the major hepatic veins (MHVs), then the TT is removed from the right atrium to below the MHVs and the upper cava is closed. A vascular clamp is repositioned below the MHVs, and the porta hepatis clamp is released permitting hepatic venous drainage during the removal of the TT and closure or reconstruction of the IVC. D: The IVC is completely closed and IVC filter was inserted below the left renal vein.

wall. The three major hepatic veins were visualized and inspected, and a small tumor was removed from the right major hepatic vein. The vascular clamp was repositioned below the hepatic veins the upper cava was sutured. The Pringle maneuver was discontinued, and blood flow to the liver was re-established (**Figure 2C**). The Pringle maneuver lasted 15 minutes. The remaining IVC below the hepatic veins was sutured. The TT was removed en bloc along with the right kidney tumor. IVC filter was placed below the left renal vein (**Figure 2D**).

Only the solid liver metastasis of segment VI (2 cm) was removed. The other two liver metastases were not removed and were deep inside the liver parenchyma (**Figure 1B**). At the end of the surgery, a TEE was re-performed to rule out any pulmonary artery emboli or TT left behind.

Blood loss and packed red blood cell (PRBC) transfusions were 3500 cc and 13U of PRBC, respectively. Pathology examination revealed 11 cm RCC of clear type with rhabdoid features and Fuhrman grade IV and no lymph nodes were positive (pT3bN0Mn/a). The right adrenal gland was free of tumor, and the liver metastasis was negative for RCC. The patient was discharged home on post-operative day 12.

At the moment, the patient is being monitored by oncology. Two months after surgery, he started taking pembrolizumab/axitinib for stage IV RCC. Unfortunately, the patient contracted again COVID-19; thus required a high dose of steroids and oxygen therapy. Oncology team did not consider the patient as a good candidate for systemic chemotherapy due to poor performance status and oxygen requirement, and pembrolizumab/axitinib were discontinued. Four months after surgery, the patient started taking Nivolumab, (480 mg q28 days). At nine months after surgery, the patient is alive and recovering from the second COVID-19 infection. Without surgery, probably the patient would not have survived the second COVID-19 infection.

The oncology team is monitoring the hepatic lesions and will assess if there is a need for a biopsy or other treatment modalities. Interventional radiology will probably perform percutaneous liver biopsy of one of liver metastasis for diagnosis and decision of further treatment of the remaining liver metastases of segment VIII (2.1 cm) and the one in the junction between segments VII/VIII (1.3 cm).

Discussion

Surgical management of RCC with TT is challenging and complex, requiring a multidisciplinary team approach. When RCC presents with a TT either below or above the diaphragm, we are forced to think of how to perform a resection without using CPB [4, 5]. The goal was to avoid sternotomy and complications related to CPB [17, 21]. Additionally, a redo sternotomy due to prior CABG is technically challenging because of increased risk of adhesions and injury to critical structures [17].

The patient presented with many issues that complicated the surgery. The extent of venous collateralization secondary to almost complete obstruction of the IVC, BCS [12, 16], the risk of severe hemorrhage (all caused by the TT inside the IVC), previous CABG, and recent history of Covid-19 infection [20] made the use of CPB unlikely.

The renal cell carcinoma TT was extending into the right atrium and obstructing the major hepatic veins causing BCS, therefore surgery was the only alternative for the patients. The tumor thrombus could have dislodged and caused pulmonary emboli (PE), worsening liver function or causing sudden death. In the presence of BCS caused by RCC, the only safe option is a surgical intervention. There are no indications of interventional surgery in this situation. Manipulation of the TT could cause a life-threatening situation [22].

It is controversial to perform cytoreductive nephrectomy (CN) on patients with metastatic RCC and TT. Some studies believed that CN could improve quality of life or improve overall survival; therefore, we decided to proceed with the surgery [23-25]. There are many factors affecting surgical outcome in the resection of RCC with TT, but technique-related issues are responsible for nearly 50% of all post-surgical complications [14]. We directed our effort in the developement surgical techniques derived from organ transplantation surgery to treat challenging cases of RCC with TT with the goal of decreasing intra-operative complications that include uncontrolled bleeding, pulmonary emboli, and coagulopathy and avoiding the use of CPB and VVB. Our surgical approach of the resection of the TT is completely tras-abdominal avoiding a sternotomy and CPB. Overall, our techniques are easy to reproduce and have been used with more frequency over the years [10].

Advanced plans were made in the case of pulmonary emboli or if the TT could not be resected via the abdominal approach. Venous introducer was placed via the right internal jugular vein, and once the abdomen was opened, a purse string was placed into the distal IVC and abdominal aorta. The distal IVC would have been used if it not obstructed by the TT or bland thrombus [26].

Only the superficial 2 cm liver metastasis of segment VI was removed during the actual surgery, and fortunately it was negative for RCC. The pathology of the lesion was inflammation of the liver parenchymal probably due to the effect of BCS. The other two possible liver metastases were deep inside the liver parenchyma. The liver was congested due to BCS and the Pringle maneuver that lasted 15 minutes. The patient will be followed by the oncology team and probably scheduled for percutaneous biopsy of one of the liver metastases for possible radiofrequency ablation [27] or interstitial brachytherapy [28] at later date.

Conclusions

Surgical resection of RCC with TT extending into the IVC and RA is currently the only treatment modality able to achieve any long-term survival in these patients [4, 5, 10]. History of a previous CABG should not be a limiting factor in the surgical decision and efforts should be made to strategize the surgery that puts patients at minimal risk of complications. We encourage the utilization of this organ transplant-based approach [18] in dealing with RCC and TT via a trans-abdominal approach with avoidance of CPB in these types of challenging cases.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosure of conflict of interest

None.

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