

at T2 and T3 stages, along with the presence of distant metastases in some patients, implementing protocols for early diagnosis is advisable.

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SURGICAL MANAGEMENT OF RENAL CELL CARCINOMA WITH INFERIOR VENA CAVA THROMBOSIS: A CLINICAL CASE

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Baimakhanov B.B.

<https://orcid.org/>

Madadov I.K.

<https://orcid.org/0000-0003-2241-8603>

Belgibaev E.B.

<https://orcid.org/0000-0002-9439-2628>

Nabiev E.S.

<https://orcid.org/0000-0002-6167-1962>

Rgebayev B.G.

<https://orcid.org/0000-0002-5201-3888>

Saduakas N.T.

<https://orcid.org/0000-0002-5249-1783>

Akhmetov D.

<https://orcid.org/0009-0004-4598-0652>

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Author for correspondence:

Madadov I.K.

urologist, transplant surgeon, head of kidney transplantation, urology and nephrology department.

dominic89@mail.ru,

87478397110

ORCID 0000-0003-2241-8603

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Baimakhanov B.B., Madadov I.K., Belgibaev E.B., Nabiev E. S., Rgebayev B.G., Saduakas N. T., Akhmetov D.

Syzganov National Scientific Center of Surgery, Almaty, Kazakhstan

Abstract

Kidney cancer with inferior vena cava thrombosis represents a complex condition that requires meticulous surgical treatment. The most common malignant kidney tumor in adults is renal cell carcinoma. The incidence of renal cell carcinoma has increased recently due to the enhanced resolution of imaging techniques. Most cases are discovered incidentally. Renal cell carcinoma's ability to spread to vascular systems without developing metastases is a significant feature. Venous involvement can manifest as a tumor thrombus in the renal vein on the affected side, potentially extending to the right atrium or the inferior vena cava. The risk of having a tumor thrombus in the renal vein or inferior vena cava ranges from 2-10%, with the right side being more frequently affected. The level of tumor thrombus extension can reach the hepatic veins and even the right atrium. This condition thus requires a multidisciplinary approach and a rational surgical strategy, focusing on achieving favorable outcomes in such complex cases.

Introduction

Renal cell carcinoma (RCC) represents 85% of all renal malignancies and is the most prevalent kind of kidney cancer.^{1,2} RCC frequently shows no symptoms until it progresses, at which point it may manifest as hematuria, flank discomfort, and a palpable lump. It correlates with worse prognosis, aggressive histology, and advanced illness.³⁻⁵ Tumor thrombus extension into the renal vein and, in certain situations, into the inferior vena cava (IVC) is one of the more serious side effects of advanced RCC.⁶⁻¹⁰ This condition's intricate anatomy and the IVC's vital function in venous return make surgical therapy extremely difficult.

About 4-10% of RCC instances result in inferior vena cava thrombosis, which is linked to an increased risk of morbidity and death.¹¹⁻¹⁴ When IVC thrombus is present, careful surgical technique is required, frequently requiring multidisciplinary cooper-

ation. Depending on the degree of thrombus involvement, several techniques are used, from a simple nephrectomy to more involved treatments such as thrombectomy and, in certain situations, cardiac bypass.¹⁵

RCC with IVC thrombus poses a significant surgical challenge due to the complexities of achieving complete tumor resection while minimizing complications. The presence of IVC thrombus impacts survival outcomes negatively; however, aggressive surgical intervention has shown to improve survival rates significantly. Survival rates decrease with higher levels of thrombus extension. For localized stages (like Level I), the 5-year survival rate can be around 93%. For regional involvement (Levels II and III), the survival rate drops to approximately 74%. Distant stages, which include Level IV, have a significantly lower 5-year survival rate of about 17%.^{16,17}

This report describes a case that

demonstrates the clinical presentation, diagnostic process, and surgical treatment of a patient who has both severe IVC thrombosis and RCC. We go over the preoperative planning, intraoperative difficulties, and postoperative results, offering an understanding of the interdisciplinary approach needed in such complicated situations. We hope that this case report will add to the body of knowledge on RCC with IVC involvement and highlight the significance of specialized surgical techniques for successful treatment.

Case presentation

Patient H, a 60-year-old male, presented to our center with a chief complaint of hematuria persisting for one week. He was referred to our urology department after a renal ultrasound revealed a mass in the right kidney. Upon admission, Patient H. underwent further evaluation, including a computed tomography (CT) scan with contrast. The imaging revealed a large mass in the right kidney, extending into the inferior vena cava (Figure 2). Laboratory investigations indicated thrombocytopenia, elevated liver enzymes (ALT and AST), while coagulation parameters remained within normal limits. A chest CT scan showed no evidence of metastasis. The renal CT scan depicted a heteroge-

neous mass measuring 12x8.5x9.6 cm, with clear, irregular contours, located in the upper and middle thirds of the right kidney. The mass deformed the renal contour and extended into the renal vein, reaching the lumen of the renal tubular vein (4.8 cm in length). Collateral vessels, up to 1.1 cm in diameter, were observed. Intense contrast agent accumulation within the mass was noted post-injection. In order to determine the complexity of the surgery required and the likelihood of complications we used The Mayo Clinic classification (Figure 1).

It is based on the level of the tumor thrombus extension into the inferior vena cava. This classification helps in planning the surgical approach and predicting the prognosis. The classification is divided into four levels:

1. Level I: The tumor thrombus extends into the renal vein but does not reach the IVC or extends slightly into the IVC but remains below the diaphragm.

2. Level II: The tumor thrombus extends into the IVC but remains below the liver (subhepatic).

3. Level III: The tumor thrombus extends into the IVC up to the liver but does not involve the heart (intrahepatic).

4. Level IV: The tumor thrombus extends above the diaphragm and may involve the heart or right atrium.

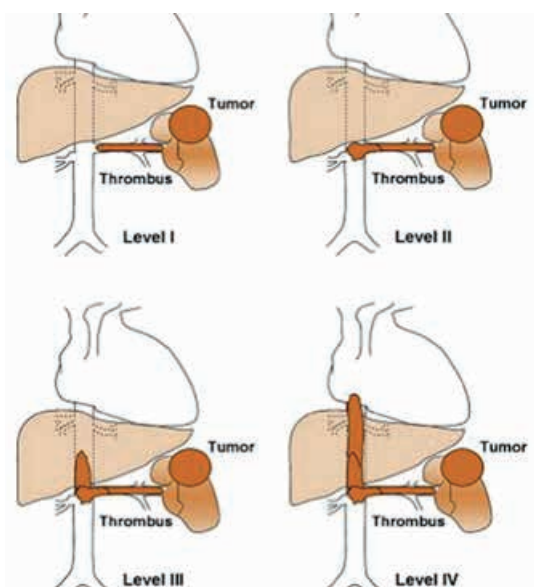


Figure 1.

The Mayo classification of macroscopic venous invasion in RCC. Level I: A tumor thrombus present at the renal vein entrance or inside the IVC less than 2 cm from the renal vein and IVC confluence. Level II: The thrombus stays below the hepatic veins but spreads more than 2 cm into the IVC above the junction of the renal and IVC veins. Level III: The intrahepatic IVC is involved in thrombosis. The thrombus can vary in size, from filling the lumen and expanding the IVC to having a small tail that reaches in to the IVC. Level IV: The thrombus grows into the right atrium or over the diaphragm. Inferior vena cava or IVC.^{17,18}

Diagnosis: Right kidney mass with inferior vena cava thrombosis. Staging: T3bN1M0. Level III.

Comorbidities: Patient H. had a his-

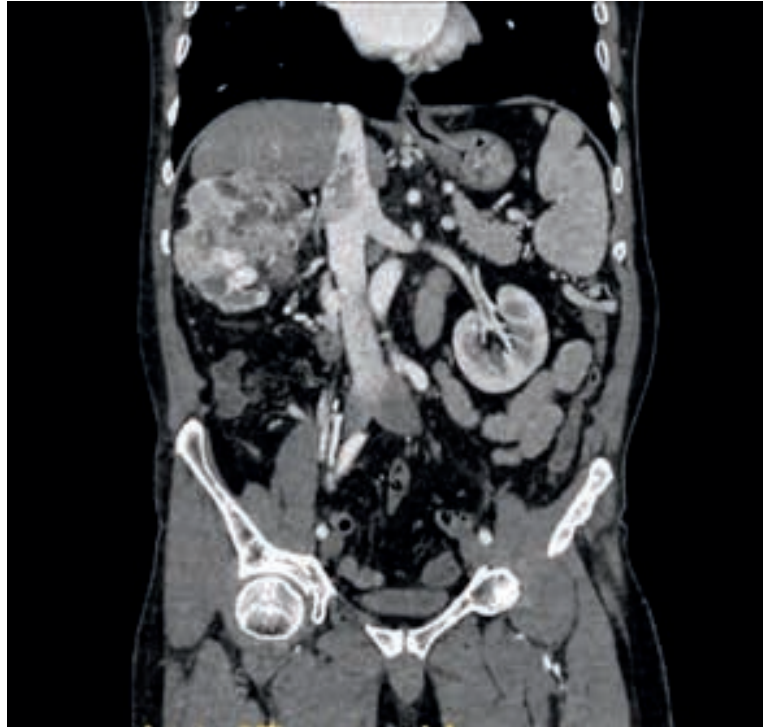
tory of ischemic heart disease, aneurysm of the interatrial septum, stage 1 arterial hypertension (high risk), and liver cirrhosis (Child-Turcotte-Pugh class B, MELD-9)

secondary to chronic viral hepatitis C. After thorough consultations with a cardiologist and hepatologist, Patient H. provided informed consent for surgical

intervention. The proposed surgical approach included laparotomy, nephrectomy, and thrombectomy with reconstruction of the inferior vena cava.

Figure 2.

Contrasted computed tomography (CT) scan. Imaging showed a sizable tumor that extended into the inferior vena cava in the right kidney.



Surgical treatment

Patient H. was positioned supine on the operating table under general anesthesia. Preoperative antibiotics were administered, and standard monitoring devices were applied. A right laparotomy was performed to access the retroperitoneal space and gain exposure to the right kidney and inferior vena cava. The incision provided adequate access to the affected structures while minimizing intraoperative complications. The right kidney was carefully dissected from the surrounding tissues, ensuring preservation of adjacent structures. Additional vessels and collaterals were isolated, ligated, and divided. The ureter in the lower third was isolated, ligated, and divided. The renal vein, along with its entry into the inferior vena cava, was isolated and secured with a vessel loop. Three renal arteries were isolated, clamped, divided, and ligated. A *Satinsky clamp* was applied to the IVC at the entry of the renal vein. The renal vein was divided, and an incision was made in the IVC. The entire kidney, including the tumor mass, was excised en bloc. Attention was then turned to the inferior vena cava, where

the thrombus was located. Special care was taken to avoid dislodging the thrombus during manipulation. Using meticulous dissection techniques, the 5cm thrombus was carefully removed from the lumen of the vena cava (Figure 2), ensuring complete clearance of the vessel. Following thrombus removal, the integrity of the inferior vena cava was assessed. Reconstruction of the vena cava was performed using primary closure (Figure 3). Hemostasis was ensured, and meticulous attention was paid to controlling any bleeding points. The surgical field was thoroughly irrigated with saline to remove any debris or residual thrombus. The surgical procedure was successful, with complete removal of the renal tumor and thrombus from the inferior vena cava. Patient's H. postoperative recovery was uneventful, and he was discharged home with appropriate follow-up instructions. This surgical approach highlights the importance of meticulous dissection techniques and careful vascular management in achieving favorable outcomes in Patients H. with renal cell carcinoma and inferior vena cava thrombosis.

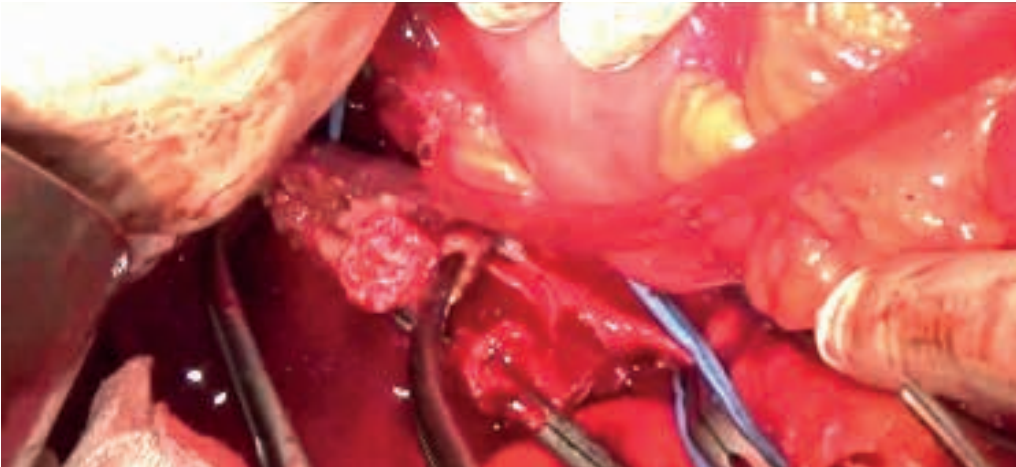


Figure 3.
Removal of a tumor thrombus from the IVC lumen

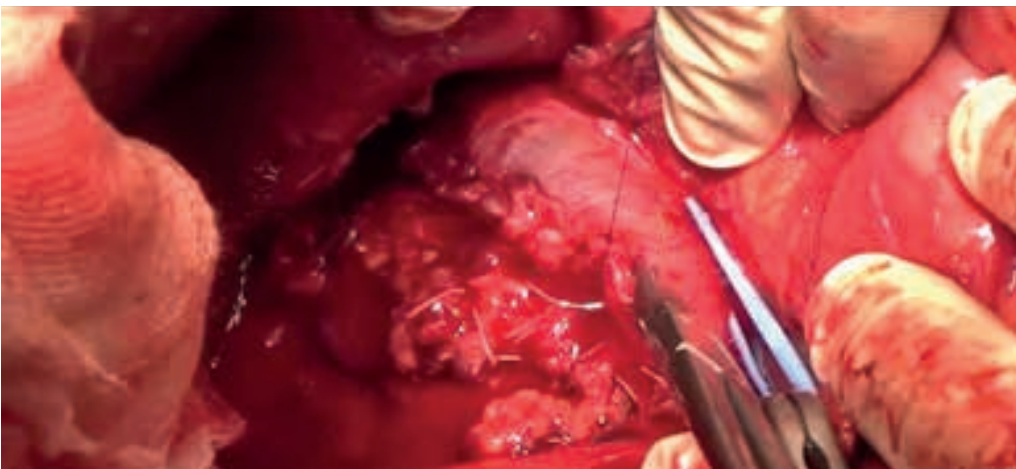


Figure 4.
Closure of vena cava

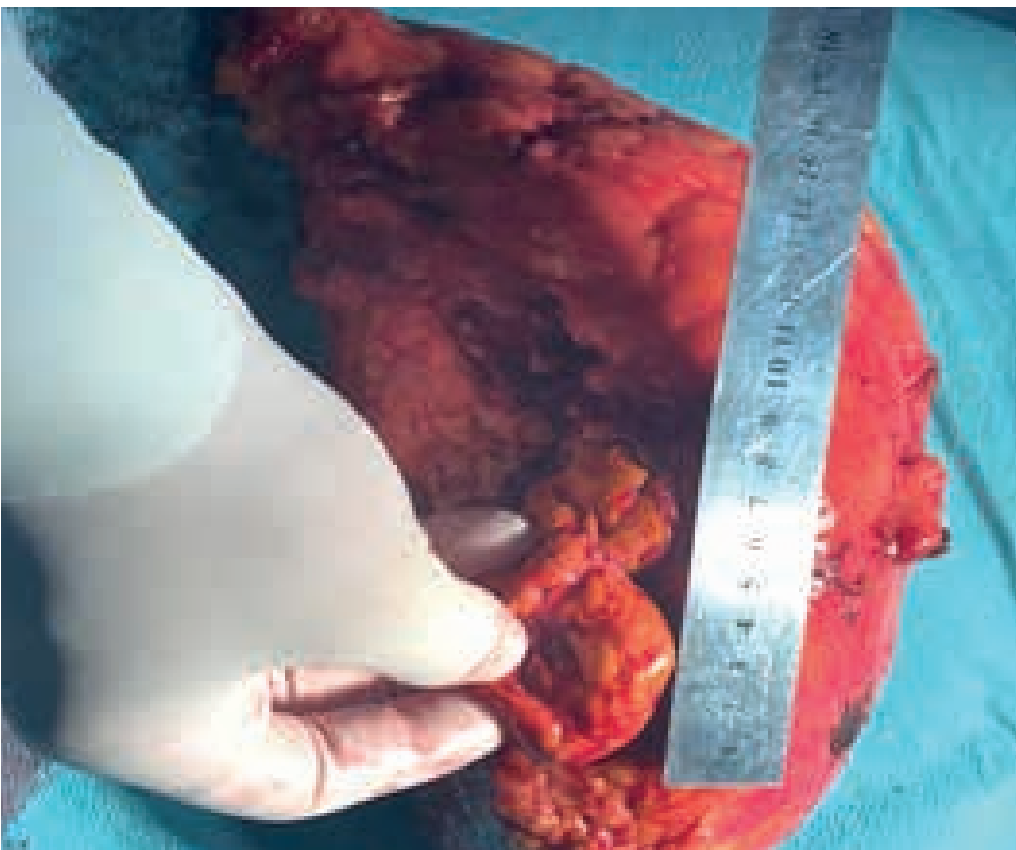


Figure 5.
Gross specimen of a kidney with a tumor thrombus

Discussion

Renal cell carcinoma with inferior vena cava thrombus presents a significant surgical and clinical challenge, necessitating a multidisciplinary approach for effective management. This case highlights several critical aspects of surgical and perioperative management, contributing to the broader understanding of advanced RCC treatment.

RCC often remains asymptomatic until it reaches an advanced stage, as illustrated by our Patient's H. presentation with hematuria a common symptom of advanced renal tumors. The diagnostic journey began with a renal ultrasound, a standard initial imaging modality, which identified a mass in the right kidney. Further evaluation with contrast-enhanced computed tomography was crucial for detailed anatomical assessment. Contrast-enhanced CT scans are indispensable in RCC cases for visualizing tumor extension, vascular involvement, and potential metastases.¹⁹

The CT scan in this case revealed a large, heterogeneous mass in the right kidney with clear, irregular contours extending into the IVC. The ability of CT imaging to provide detailed visualization of the tumor thrombus was instrumental in surgical planning. This aligns with findings in the literature that underscore the importance of high-resolution imaging for accurate staging and preoperative assessment.²⁰

The surgical management of RCC with IVC thrombus is complex and requires a highly specialized approach. The choice of a cherry right laparotomy provided optimal exposure to the kidney and IVC, facilitating meticulous dissection and thrombus removal. Nephrectomy, combined with thrombectomy and IVC reconstruction, was necessary due to the extent of the thrombus. This approach is consistent with current surgical guidelines that recommend aggressive resection to achieve complete tumor removal and minimize recurrence.¹⁷

The intricacies of performing thrombectomy from the IVC involve preventing thrombus dislodgement, which could lead to potentially fatal pulmonary embolism. In this case, careful surgical technique and intraoperative management were critical to avoiding such com-

plications. Literature reviews support that experienced surgical teams and meticulous technique are essential for successful outcomes in such high-risk surgeries.²¹

This case presented several intraoperative challenges, including the Patient's H. thrombocytopenia and elevated liver enzymes, indicating an increased risk of bleeding. Careful intraoperative hemostasis was paramount to manage this risk effectively. The presence of significant comorbidities—ischemic heart disease, arterial hypertension, and cirrhosis—required comprehensive preoperative optimization and interdisciplinary collaboration. Preoperative consultations with cardiology and hepatology were essential for risk stratification and management, highlighting the importance of a holistic approach to patient care.²²

Postoperative care involved intensive monitoring to detect and address early complications, such as bleeding or thromboembolic events. The successful outcome in this case, marked by the uneventful recovery and confirmed patency of the IVC on postoperative imaging, underscores the effectiveness of the surgical approach and the importance of comprehensive perioperative care.²³

The Patient's H. recovery was facilitated by a multidisciplinary team that included surgeons, anesthesiologists, intensivists, and nursing staff, ensuring that all aspects of the patient's care were addressed. The literature supports the role of multidisciplinary teams in improving surgical outcomes for complex cases such as RCC with IVC thrombus.²⁴

The management of RCC with IVC thrombus has evolved significantly, with advances in imaging, surgical techniques, and perioperative care contributing to improved outcomes. Studies have shown that aggressive surgical intervention, even in advanced cases, can lead to prolonged survival and improved quality of life.²⁵ However, the inherent risks of such extensive surgeries, including morbidity and mortality, must be carefully weighed against the potential benefits.

Emerging surgical techniques, such as minimally invasive approaches and robotic-assisted surgeries, offer the po-

tential for reduced morbidity and faster recovery times. Initial studies on these techniques have shown promising results, although further research and long-term data are needed to establish their efficacy and safety in managing RCC with IVC thrombus.²⁶

Limitations: The primary constraints of this research were the retrospective nature of data collection and the very small sample size, which may have resulted in underpowered statistical analyses. To validate the findings and evaluate the impact of the categorization system and related surgical techniques and methods on both short- and long-term survival, more research with a bigger sample size is required.

What's known? Renal cell carcinoma with inferior vena cava thrombosis is a complex and challenging condition. The involvement of the IVC raises the risk of mortality and morbidity. Surgical resection, that includes nephrectomy and thrombectomy, is the mainstay of treatment which often involves a multidisciplinary team as well as advanced surgical techniques. Survival depends on the extent of thrombus, where early stage involvement has higher survival rates

What's new? This particular situation emphasizes the competent surgical treatment of a patient suffering from renal cell carcinoma along with thrombosis of the inferior vena cava level three through a careful method of dissection plus reconstruction.

Conclusion

The management of RCC with IVC thrombosis requires a tailored and multidisciplinary approach, incorporating meticulous surgical technique, comprehensive preoperative assessment, and close postoperative monitoring. This case study highlights the importance of collaboration between different specialties and the challenges encountered in the surgical management of complex renal tumors. Further research and clinical studies are warranted to refine treatment strategies and improve outcomes in this challenging patient population.

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