

# Surgery for Renal Cell Carcinoma, Vital Role of Cardiopulmonary Bypass: Case Report

## Böbrek Hücreli Karsinomda Cerrahi Tedavi, Kardiyopulmoner Baypasın Hayati Rolü

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**ABSTRACT** Renal cell carcinoma has a high potential for tumor and thrombus extension into the renal veins, inferior vena cava and even the right atrium. Surgical excision of the tumor and the thrombus is challenging and may require cardiopulmonary support. In this case report, we present successful surgical treatment of two renal cell carcinoma cases with thrombi in their inferior vena cava, one also having an intracardiac involvement. Cardiopulmonary bypass and total circulatory arrest was necessary in the second patient. Especially in high levels of renal cell carcinoma extension, very careful handling of the related organs and vasculature is essential to minimize the risk of pulmonary embolization. While simple venotomy/cavotomy after clamping may be enough in some cases, cardiopulmonary bypass may be life-saving especially in stage 3 and 4 tumors, or in cases where intraoperative massive pulmonary embolization occurs. Thus, a multidisciplinary approach with cardiopulmonary bypass standby is necessary for a successful surgery.

**Key Words:** Carcinoma, renal cell; cardiopulmonary bypass; pulmonary embolism; vena cavae; surgery

**ÖZET** Böbrek hücreli karsinom, beraberinde vena kava inferiora trombus ve intrakardiyak yayılım ile birlikte bulunduğu kadir tümörün yayıldığı alanları da içeren bir çözüm sunulmalıdır. Bu çalışmada böbrek hücreli karsinom ile birlikte vena kava inferiora trombus bulunan ve birinde intrakardiyak yayılımı da bulunan iki olgunun başarılı cerrahi tedavisi anlatılmaktadır. İkinci hastanın cerrahisi sırasında gelişen masif pulmoner emboli sonucunda kardiyak arrest gelişmiştir. Bu hasta ancak acil şartlarda başlanan kardiyopulmoner baypas ve total sirkulatuar arrest ortamında yapılan pulmoner embolektomi ve kardiyopulmoner destek ile kurtarılabildiği. Özellikle ileri evre böbrek hücreli karsinom vakalarında etkilenmiş organ ve damarlara yapılan müdahalelerde pulmoner embolizasyon riskini en aza indirmek için son derece nazik olunmalıdır. Bazı vakalarda klempleme sonrası basitçe venotomi/kavotomi yeterli olabilirken, özellikle evre 3 ve 4 tümörlerde veya intraoperatif masif pulmoner embolizasyonun gerçekleştiği vakalarda kardiyopulmoner baypas hayat kurtarıcı olabilecektir. Bu tip vakalarda başarılı bir cerrahi yaklaşım için kardiyopulmoner baypas desteği ve multidisipliner yaklaşım hayati rolü.

**Anahtar Kelimeler:** Karsinom, böbrek hücreli; kardiyopulmoner baypas; pulmoner emboli; vena kava; cerrahi

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**D**espite the advances in surgical techniques, complete excision of the tumor in renal cell carcinoma (RCC) remains a challenge due to early extension of the tumor into the renal veins and the inferior vena cava (IVC). Extension into the IVC is seen in 4% to 25% of all patients.<sup>1</sup> The level of cephalic extension ranges from the IVC, to the right

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atrium, or even to the pulmonary artery. In such a case, the surgery is complex and requires a multi-disciplinary approach. Sternotomy and cardiopulmonary bypass with total circulatory arrest may be necessary for a safe and effective excision of the tumor and thrombus.

In this article, we report surgery of two cases with RCC, one of them with right atrial and pulmonary arterial invasion.

## CASE REPORTS

### CASE 1

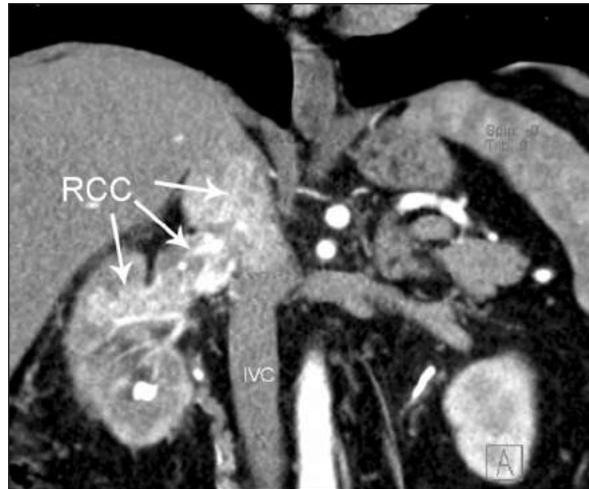
Abdominal ultrasonography and computerized tomography (CT) showed a 11-cm right renal mass and thrombus in the IVC in a 62-year-old lady. CT angiography also showed massive thrombus in the pulmonary arterial bifurcation.

Considering the acute massive pulmonary embolism, surgical treatment was considered. The cardiovascular surgical team was asked for help. A transesophageal echocardiography (TEE) probe was inserted for cardiac evaluation, and monitoring for possible intraoperative pulmonary emboli. Indeed, massive embolization developed abruptly during simple exploration of the right kidney causing cardiac arrest, after which cardiopulmonary bypass (CPB) was initiated immediately. Radical nephrectomy was followed by a short period of total circulatory arrest for tumor thromboemblectomy from the right atrium, pulmonary artery, and the IVC.

Pathological examination revealed RCC with areas of necrosis. The patient was discharged in good condition after 10 days. Despite adjuvant chemotherapy the patient passed away 10 months later due to multiple metastases in the lungs.

### CASE 2

A 55-year-old male patient was found to have a right renal mass and thrombus in the subdiaphragmatic IVC on abdominal CT (Figure 1). Subcostal laparotomy was performed to expose the IVC and the renal veins with cardiopulmonary bypass instruments on standby. The tumor thrombus was removed through a longitudinal cavotomy with clamps on the IVC below the hepatic veins, the in-



**FIGURE 1:** Abdominal computerized tomography of the second patient revealing the tumor mass in the right kidney and the thrombus extending into the inferior vena cava up to the level of the liver.

RCC: Renal cell carcinoma; IVC: Inferior vena cava.

frarenal IVC and the contralateral renal vein. Radical nephrectomy was performed and the IVC was directly sutured. The patient was discharged in good condition after 8 days and followed-up for 18 months.

## DISCUSSION

Renal cell carcinoma is the most common type of kidney cancer in adults and responsible for approximately 80% of cases. Historically, the classic triad of symptoms in renal cell CA includes hematuria, flank pain and abdominal mass. Today RCC is fairly asymptomatic and is generally detected incidentally.

In 1913, Berg first reported nephrectomy and cavotomy for RCC extending into the IVC.<sup>2</sup> Since then, aggressive surgical treatment including tumor thrombectomy has improved survival. Hormone therapy, chemotherapy, radiotherapy, and immunotherapy have all been unsuccessful in control of tumor progression; therefore aggressive surgical treatment is generally accepted.<sup>1</sup>

Classically, RCC presents with the triad of flank pain, hematuria and abdominal mass. Pulmonary embolism is a rare and unusual presentation.<sup>3</sup>

**TABLE 1:** Levels of tumor thrombus extension in renal cell carcinoma.

Level	Position	Detailed anatomic localization of the tumor thrombus
I	Infrahepatic	Renal vein
II	Retrohepatic	Inferior vena cava below the liver
III	Suprahepatic	Inferior vena cava behind the liver, and up to the diaphragm
IV	Intraatrial	Above the diaphragm and into the right atrium

Up to 20% of the patients with RCC have tumor extension into the venous system at the time of diagnosis.<sup>4</sup> The level of extent varies within the venous system (Table 1). Use of cardiopulmonary bypass allows safe tumor resection especially in level 4 involvement.

Median sternotomy was performed in addition to the subcostal incision in the first case. The tumor thrombus was removed through a right atriotomy and a pulmonary arteriotomy under total circulatory arrest. Complete exposure and isolation of the IVC is essential during resection of the tumor thrombus. Transesophageal echocardiography is valuable for intraoperative monitoring of the tumor thrombus in the IVC and it can diagnose pulmonary embolism and consequent right heart dysfunction right away, as was the case in our patient. Gentle surgical maneuvers and hemodynamic stability are essential to minimize the risk of intraoperative pulmonary embolism. The use of cardiopulmonary bypass stabilizes hemodynamics during IVC isolation and enables complete tumor resection and venous reconstruction. It should preferably be initiated before any attempt to expose the kidney or the adjacent vasculature especially in level 4 tumors. The potential risk of cardiopulmonary bypass, on the other hand, would be tumor dissemination; but it is reported that the use of cardiopulmonary bypass during the tumor thrombus resection does not affect long-term survival.<sup>5</sup>

Stage 4 tumors are associated with a higher risk of metastatic spread. Our first patient died 10 months after the operation, following the development of multiple lung metastases. Despite an effort

to totally resect the tumor and its concomitant thrombus extension, embolic showers of tumor cells can define the poor prognosis of this patient. Radical nephrectomy and vena caval thrombectomy were performed successfully in the second patient, and no metastases were detected in the following 18 months.

Patients with a thrombus from RCC extending into the IVC, and no lymph node metastasis, have a favorable prognosis. Five-year survival rates have been reported as 32-64%.<sup>5</sup>

Although higher levels of tumor thrombus constitute greater surgical difficulty and risk, the stage of the primary tumor and lymph node status remain the main determinants of prognosis.<sup>5</sup>

## CONCLUSION

In cases of renal cell carcinoma with tumor thrombus extension into the venous system, surgery may be quite cumbersome, and should certainly be attempted in a setting where cardiopulmonary bypass facilities are at hand. All maneuvers at all stages of surgery should be delicate considering a high potential for pulmonary embolization. A multidisciplinary approach including urology, interventional radiology, anesthesiology, pulmonology, cardiology, vascular and cardiothoracic surgery and oncology provides optimal results.

### *Conflict of Interest*

*Authors declared no conflict of interest or financial support.*

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