

## Extensive Surgical Management for Renal Tumors with Inferior Vena Cava Thrombus

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**Introduction:** The aim of this study was to evaluate the outcome in patients with renal cell carcinoma (RCC) and the inferior vena cava (IVC) or the right atrium tumor thrombus that were treated with radical nephrectomy and thrombectomy.

**Materials and Methods:** Eleven of a total of 105 patients who underwent radical nephrectomy due to RCC had tumor thrombus extended to the IVC and/or the right atrium. We evaluated the surgical techniques used and the perioperative mortality and morbidity in these patients.

**Results:** The median age of the patients was 47 years (range, 16 to 59 years). They all underwent radical nephrectomy with cavotomy, tumor thrombus removal, and lymphadenectomy. Eight patients underwent extracorporeal circulation and hypothermic circulatory arrest; 2, temporary venovenous bypass by chevron incision and median sternotomy; and 1, only chevron incision with mobilization of the right lobe of the liver and cross-clamping proximal to the tumor thrombus and cavotomy. In 1 case, a solitary liver metastasis was excised and the patient died within 30 days postoperatively because of massive hemorrhage due to liver metastatectomy. Two patients had invasion to the IVC wall and 7 had pathological lymph node involvement. Four patients were tumor free (follow-up range, 9 to 18 months) and 7 died due to multiple metastases during the follow-up.

**Conclusion:** This study supports the role of extensive surgical treatment as the best initial management of patients with renal cancer extended to the IVC only in highly selected cases.

**Keywords:** renal tumor, thrombus, vena cava, right atrium

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### INTRODUCTION

Extensive management of renal cell carcinoma (RCC) with venous thrombus has been supported by corroborative evidence.<sup>(1-5)</sup> Tumor thrombus extension into the renal vein or the inferior vena cava (IVC) occurs in up to 10% of patients with RCC and the involvement of the right atrium is seen in 1%. Factors influencing the outcome of these patients include the clinical staging, completeness of the resection, and biological characteristics of the primary tumor.<sup>(1)</sup> Survival may be

significant in patients with organ-confined tumors.<sup>(6-9)</sup> The 5-year survival is about 60% for the most favorable tumors.<sup>(4-6)</sup> In nonmetastatic patients with IVC involvement, the 5-year survival rate is reported to be between 18% and 68% with a perioperative mortality rate of 2.7% to 13% after complete surgical resection.<sup>(1,4,5)</sup> However, intravenous tumor extension will not be associated with an adverse prognosis provided that a complete resection is possible.<sup>(10-12)</sup> We report the operative strategies and outcomes in our

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patients with RCC extending into the IVC and/or the right atrium.

## MATERIALS AND METHODS

### Patients

Between 1999 and 2005, a total of 105 patients with RCC underwent radical nephrectomy at our center. Venous tumor thrombus was reported in 11 patients. According to the classification used by Blute and colleagues (Table 1),<sup>(1)</sup> there were 1 patient with infrahepatic IVC tumor thrombus (level 2), 2 with retrohepatic IVC tumor extension (level 3), 7 with suprahepatic IVC extension (level 4), and 1 with extension into the right atrium (level 4). All of the patients underwent abdominal, pelvic, and chest computed tomography (CT). Magnetic resonance imaging (MRI) was performed in cases suspected to have tumor thrombus. Based on the findings of CT scan and MRI, all tumors were confined to the Gerota's fascia. Four of the patients had suspected lymph node involvement and 1 had a solitary metastasis in the right lobe of the liver (Table 2).

### Surgical Strategy

We applied the following approaches depending on the disease condition: in cases with thrombus

extension into the infrahepatic IVC, a chevron incision with mobilization of the right lobe of the liver was made and cross-clamping of IVC above and below the tumor thrombus and then cavotomy were performed. If cross-clamping of the IVC was necessary and venous return to the heart was impaired, a chevron incision was made and median sternotomy with temporary venovenous bypass from the IVC below the cross-clamping site to the right atrium was done. For level 4 tumor extensions, a chevron incision was made and median sternotomy with extracorporeal circulation and hypothermic circulatory arrest were performed.

The median follow-up of the patients was 11 months (range, 0 to 36 months). None of the patients received postoperative immunotherapy. Only 1 patient with Wilms tumor received adjuvant chemotherapy.

## RESULTS

The clinical characteristics and outcomes are listed in Table 2. The median age of the patients was 47 years (range, 16 to 59 years). Eight patients were men and 3 were women. They all underwent radical nephrectomy with concomitant cavotomy, tumor thrombus removal, and lymphadenectomy. Eight patients underwent extracorporeal circulation and

**Table 1.** Levels of Tumor Thrombosis\*

Levels	Definition
1	Tumor extending up to 2 cm above the renal vein
2	Tumor extending more than 2 cm above the renal vein but limited to the infrahepatic IVC
3	Tumor extending into the IVC up to the diaphragm
4	Tumor extending into supradiaphragmatic IVC or the right atrium

\*Based on a classification used by Blute and colleagues.<sup>(1)</sup> IVC indicates the inferior vena cava.

**Table 2.** Clinical Characteristics, Surgical Managements, and Outcomes\*

Pathology	Tumor Extension Level	Stage	Surgical Technique	Follow-up, mo	Outcome
RCC	4	T3c N2 M0	Hypothermic circulatory arrest	10	Died of metastases
RCC	4	T3c N2 M0	Hypothermic circulatory arrest	13	Died of metastases
RCC	4	T3c N2 M0	Hypothermic circulatory arrest	10	Died of metastases
RCC	4	T3c N2 M1	Hypothermic circulatory arrest	0	Died of bleeding
RCC	4	T3c N1 M0	Hypothermic circulatory arrest	12	Died of metastases
RCC	4	T3c N1 M0	Hypothermic circulatory arrest	9	Died of metastases
RCC	4	T3c N0 M0	Hypothermic circulatory arrest	14	Alive without tumor
RCC	3	T3b N0 M0	Venovenous bypass	18	Alive without tumor
RCC	3	T3b N0 M0	Venovenous bypass	15	Alive without tumor
RCC	2	T3b N0 M0	Elevation of liver and cross-clamping of IVC	9	Alive without tumor
Wilms tumor	4	T3 N+	Hypothermic circulatory arrest	36	Died of metastases

\*RCC indicates renal cell carcinoma and IVC, the inferior vena cava.

hypothermic circulatory arrest and 2 were managed with temporary venovenous bypass by chevron incision and median sternotomy. In 1 patient, we used only chevron incision with mobilization of the right lobe of the liver and cross-clamping proximal to the tumor thrombus and cavotomy. A solitary liver metastasis was excised by a general surgeon, but the patient died within 30 days postoperatively because of massive hemorrhage due to liver metastatectomy. The median estimated blood loss was 2 L (range, 350 mL to 12 L). Two patients had invasion to the IVC wall and 7 had pathological lymph node involvement. Four patients were alive at the end of the follow-up without evidence of local tumor recurrence or distant organ metastases (follow-up range, 9 to 18 months). Finally, 7 patients died due to multiple metastases.

## DISCUSSION

Outcome predictors in RCC with tumor thrombus extending into the IVC or the right atrium are variably discussed. The most common factors influencing the prognosis are local infiltration to perinephric tissue, lymph node involvement, distant metastases, pathological stage of the tumor, and invasion to the vena cava regardless of the level of tumor extension.<sup>(1)</sup> Therefore, complete staging should be performed for these patients.<sup>(13)</sup> The role of MRI in the evaluation of the renal vein and IVC for detection of the thrombus extension is crucial.<sup>(14)</sup> Another good technique for detection of the thrombus extension into the right atrium is preoperative and intraoperative transesophageal echocardiography.<sup>(4,9)</sup>

The role of proximal extension of tumor thrombus as a prognostic factor in the absence of lymph node involvement or metastatic disease is controversial. Libertino and colleagues detected no differences in the prognosis regarding the level of IVC involvement.<sup>(15)</sup> In contrast, Sosa and associates reported a poor outcome in patients with tumor thrombus.<sup>(16)</sup> Outcome of the surgery in the presence of synchronous metastatic disease is also a matter of debate. Some authors have reported grave survival rate, while others have advocated surgery with satisfactory results.<sup>(9,17)</sup> Overall, 1-year survival in the patients with IVC and lymph node involvement supports the role of surgery only in patients with RCC and venous thrombus without any

concomitant lymphadenopathy or metastases. Ficarra and coworkers reported that the best chance of cure and long-term survival is achieved by a combination of radical surgery and adjuvant immunotherapy.<sup>(13)</sup> The surgical approach should be individualized according to the level of the tumor thrombus and decision should be made by both cardiovascular surgeon and urologist. The choice of incision, caval control method, and venous return provision are important factors in surgical approach. According to our experience, a combined chevron incision with median sternotomy is the most appropriate method for adequate access to the kidneys, the IVC, and the heart.

Side-clamping or cross-clamping of the IVC may be sufficient if the involvement of the IVC is limited to the level of the renal vein. However, patients with partially obstructed IVC and inadequate collaterals may not permit caval cross-clamping. In these cases, venous blood flow from the IVC has to be provided.<sup>(18,19)</sup> In some patients, an intraluminal shunt may be applicable, but may be accompanied by the risk of tumor embolization. Therefore, we prefer a temporary venovenous bypass from the IVC to the right atrium if cross-clamping of the IVC significantly impairs the venous return.<sup>(20)</sup> When the tumor thrombus reaches the intrapericardial IVC or the right heart, hypothermic circulatory arrest is the approach of choice. This technique allows complete resection of the tumor in a virtually bloodless operation field without the risk of leaving tumor cells or tumor thrombus embolization, in contrast to cardiopulmonary bypass alone or blind mobilization of the tumor thrombus via the right atrium. Also, the risk of uncontrollable massive bleeding is nearly eliminated which provides a safer operation.<sup>(21)</sup> Furthermore, the IVC may be inspected thoroughly and an appropriate resection may be performed. If resection of the intrapericardial IVC or the right atrium is necessary, it can also be done more easily by this approach.<sup>(22)</sup>

## CONCLUSION

Surgical removal of RCC tumors through a chevron incision and median sternotomy is possible. We believe that patients with lymph node and IVC involvement do not benefit from this aggressive surgical management. Therefore, accurate clinical

staging is mandatory and surgery is recommended only for highly selected patients.

## CONFLICT OF INTEREST

None declared.

## REFERENCES

1. Blute ML, Leibovich BC, Lohse CM, Cheville JC, Zincke H. The Mayo Clinic experience with surgical management, complications and outcome for patients with renal cell carcinoma and venous tumour thrombus. *BJU Int*. 2004;94:33-41.
2. Kaplan S, Ekici S, Dogan R, Demircin M, Ozen H, Pasaoglu I. Surgical management of renal cell carcinoma with inferior vena cava tumor thrombus. *Am J Surg*. 2002;183:292-9.
3. Belis JA, Levinson ME, Pae WE Jr. Complete radical nephrectomy and vena caval thrombectomy during circulatory arrest. *J Urol*. 2000;163:434-6.
4. Marshall FF, Dietrick DD, Baumgartner WA, Reitz BA. Surgical management of renal cell carcinoma with intracaval neoplastic extension above the hepatic veins. *J Urol*. 1988;139:1166-72.
5. Novick AC, Kaye MC, Cosgrove DM, et al. Experience with cardiopulmonary bypass and deep hypothermic circulatory arrest in the management of retroperitoneal tumors with large vena caval thrombi. *Ann Surg*. 1990;212:472-6.
6. Gettman MT, Boelter CW, Cheville JC, Zincke H, Bryant SC, Blute ML. Charlson co-morbidity index as a predictor of outcome after surgery for renal cell carcinoma with renal vein, vena cava or right atrium extension. *J Urol*. 2003;169:1282-6.
7. Quek ML, Stein JP, Skinner DG. Surgical approaches to venous tumor thrombus. *Semin Urol Oncol*. 2001;19:88-97.
8. Bissada NK, Yakout HH, Babanouri A, et al. Long-term experience with management of renal cell carcinoma involving the inferior vena cava. *Urology*. 2003;61:89-92.
9. Staehler G, Brkovic D. The role of radical surgery for renal cell carcinoma with extension into the vena cava. *J Urol*. 2000;163:1671-5.
10. Neves RJ, Zincke H. Surgical treatment of renal cancer with vena cava extension. *Br J Urol*. 1987;59:390-5.
11. Baumgartner F, Scott R, Zane R, et al. Modified venovenous bypass technique for resection of renal and adrenal carcinomas with involvement of the inferior vena cava. *Eur J Surg*. 1996;162:59-62.
12. Chiappini B, Savini C, Marinelli G, et al. Cavoatrial tumor thrombus: single-stage surgical approach with profound hypothermia and circulatory arrest, including a review of the literature. *J Thorac Cardiovasc Surg*. 2002;124:684-8.
13. Ficarra V, Righetti R, D'Amico A, et al. Renal vein and vena cava involvement does not affect prognosis in patients with renal cell carcinoma. *Oncology*. 2001;61:10-5.
14. Oto A, Herts BR, Remer EM, Novick AC. Inferior vena cava tumor thrombus in renal cell carcinoma: staging by MR imaging and impact on surgical treatment. *AJR Am J Roentgenol*. 1998;171:1619-24.
15. Libertino JA, Zinman L, Watkins E Jr. Long-term results of resection of renal cell cancer with extension into inferior vena cava. *J Urol*. 1987;137:21-4.
16. Sosa RE, Muecke EC, Vaughan ED Jr, McCarron JP Jr. Renal cell carcinoma extending into the inferior vena cava: the prognostic significance of the level of vena caval involvement. *J Urol*. 1984;132:1097-100.
17. Zisman A, Wieder JA, Pantuck AJ, et al. Renal cell carcinoma with tumor thrombus extension: biology, role of nephrectomy and response to immunotherapy. *J Urol*. 2003;169:909-16.
18. Janosko EO, Powell CS, Spence PA, Hodges WE, Lust RM. Surgical management of renal cell carcinoma with extensive intracaval involvement using a venous bypass system suitable for rapid conversion to total cardiopulmonary bypass. *J Urol*. 1991;145:555-7.
19. Attwood S, Lang DM, Goiti J, Grant J. Venous bypass for surgical resection of renal carcinoma invading the vena cava: A new approach. *Br J Urol*. 1988;66:402-5.
20. Rotker J, Schmid C, Oberpennig F, et al. Surgery of the inferior vena cava for tumor-related obstruction. *Int J Angiol*. 1998;7:173-6.
21. Laas J, Schmid C, Allhoff E, Borst HG. Tumor-related obstruction of the inferior vena cava extending into the right heart—a plea for surgery in deep hypothermic circulatory arrest. *Eur J Cardiothorac Surg*. 1991;5:653-6.
22. Skinner DG, Pritchett TR, Lieskovsky G, Boyd SD, Stiles QR. Vena caval involvement by renal cell carcinoma. Surgical resection provides meaningful long-term survival. *Ann Surg*. 1989;210:387-92.