Case Reports in Oncology

Case Rep Oncol 2020;13:1202–1208
DOI: 10.1159/000510404
Published online: September 29, 2020

Case Report

Extracorporeal Partial Nephrectomy with Orthotopic Autotransplantation under Pharmaco-Cold Ischaemia for Cancer of a Single Kidney: A Case Report

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Keywords

Renal cell carcinoma · Inferior vena cava tumour thrombosis · Tumour of a single kidney · Nephron-sparing surgery · Contrast-enhanced multiple detector computed tomography

Abstract

Up to 10% of patients with renal cell carcinoma (RCC) have locally advanced disease with venous tumour thrombosis involving the inferior vena cava (IVC). 30–50% of them present with synchronous metastatic disease. Surgical treatment remains the only potentially radical method for patients suffering from RCC and IVC tumour thrombosis without distant metastases. Five-year cancer-specific survival for such patients is 40–60%. The role of surgery in the treatment of RCC is significant, even if only cytoreductive operation is possible. Nephron-sparing surgery (NSS) is reasonably preferable for patients suffering from single kidney RCC, but it is not always radical enough. Extracorporeal approach allows to perform a radical dissection of

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Case Rep Oncol 2020;13:1202–1208
DOI: 10.1159/000510404

the tumour in special complicated cases, but it is seldom used because of technical difficulties. We present a case of successful NSS by extracorporeal approach in our modification for RCC with IVC tumour thrombosis.

Introduction

Renal cell carcinoma (RCC) takes the 10th place in the cancer morbidity pattern for both sexes. There is a significant 26% increase in RCC incidence over the last 10 years [1]. Formation of venous tumour thrombus spreading into the renal vein and inferior vena cava (IVC) is typical for RCC, making up to 25% of cases [2]. The thrombi can reach the right atrium and ventricle and even the pulmonary artery [3]. The combination of RCC and IVC tumour thrombus is a complex high-risk surgical problem.

Case Report

A 65-year-old man presented with dull low-intensity pain in the right lumbar region. The patient had a left-sided nephrectomy for a gunshot wound 20 years before. A contrast-enhanced multiple detector computed tomography scan showed a large multinodular transmurally growing tumour of the upper half of the right kidney, sized 101 × 75 × 95 mm, spreading to the renal sinus. A non-occlusive vascularized tumour thrombus was visualized in the right renal vein and IVC. The thrombus component located in the IVC was 62 mm in length, the thrombus head was found on the border of the liver segment of IVC. There was also a single metastasis in the right adrenal gland, sized 25 × 20 mm (Fig. 1). Cancer of the solitary right kidney, stage IV, cT3bN0M1 [ADR], complicated with cava-renal intraluminal invasion was diagnosed.

The preoperative level of urea was 5.18 mmol/L, creatinine 122 μmol/L, and glomerular filtration rate was 66 mL/min.

Subsequently, extracorporeal partial nephrectomy (ECPN) of the solitary right kidney with orthotopic vascular replantation under pharmaco-cold ischaemia, thrombectomy of the IVC, right-sided adrenalectomy, lymphadenectomy, preventive creation of an arteriovenous fistula on the right radial artery were performed within the Urological Department of the A.V. Vishnevsky National Medical Research Center of Surgery.

Intraoperatively, a tumour node measuring 101 × 75 × 95 mm was found on the lateral surface of the upper part of the kidney. One-third of the node was located extrarenally. A tumour thrombus was palpated in the renal vein. The intraoperative ultrasound (US) showed inhomogeneous floating thrombotic masses along the entire length of the renal vein. The length of the tumour thrombus was 67 mm, the head of the thrombus located in the IVC, almost spreading to the hepatic segment of the IVC. There was no retrograde apposition thrombus present.

The ureter was mobilized without transection. The supra- and infrarenal segments of aorta, IVC, and right renal artery and vein were mobilized. We also formed a channel under the IVC to conduct the right renal artery during the reimplantation. Systemic heparinization at a dose of 2,500 units was performed. The renal artery was clamped and crossed near its origin. The arterial stump was ligated and stitched. The IVC was clamped below the hepatic and right renal veins. The IVC was resected along the origin line of the right renal vein with a hood pattern from the IVC wall in the distal direction. The tumour thrombus was pulled out

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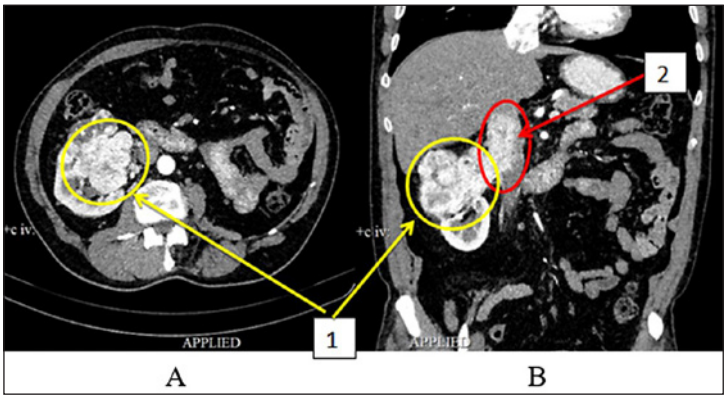

Fig. 1. Contrast-enhanced multiple detector computed tomography. **A** Axial plane. **B** Coronal plane. 1, multinodular tumour; 2, non-occlusive vascularized tumour thrombus in the right renal vein and IVC.

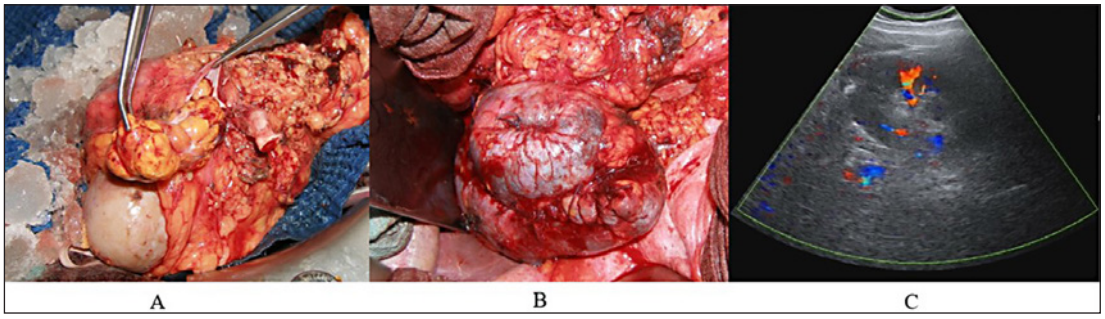

Fig. 2. Intraoperative photographs. **A** The mobilized kidney removed into the tray with ice crumbs. **B** The kidney after the re-start of blood flow. **C** Ultrasound image of the kidney after the start of blood flow.

of the vein. Vascular clamps were taken off the IVC immediately after a clamp was applied on the IVC defect. The time of warm ischaemia was 12 min.

The mobilized kidney was placed on the abdominal wall into the tray filled with ice crumbs. From that point and during the whole ischaemia time the kidney was being conserved with ice crumbs wrapping, and perfusion of refrigerated (+2–4°C) pharmacoplegic solution was performed via the cannula inserted into the renal artery (Fig. 2A). The perfusion pressure of 100 mm Hg was achieved with a pneumatic cuff with a pressure gauge.

The renal tumour was removed without any violation to pelvicalyceal system. The vessels of the resected area were sutured. The intraluminal tumour mass was extracted from the dissected renal vein to the level of segmental veins. The intraparenchymal part of the intraluminal segmental tumour masses was excised. The kidney parenchyma was sutured and additionally treated with haemostatic foam. We created the cava-renal vascular anastomosis end-to-side, implanting the renal vein into the IVC defect. Aortotomy was carried out infrarenally with a punch, and the renal artery was implanted there end-to-side. The vascular anastomoses were tested. Kidney perfusion looked acceptable (Fig. 2B), and US testing confirmed that (Fig. 2C). The time of pharmaco-cold ischaemia was 218 min.

The postoperative period was characterized by the development of acute kidney injury stage F on RIFLE criteria, which required 2 haemodiafiltration sessions. Antibacterial, infusion, blood transfusion, and anticoagulant therapy were carried out postoperatively. Diuresis was restored on the 6th day after surgery. The patient was discharged from the hospital in satisfactory condition on the 12th postoperative day.

According to histopathology, it was a clear-cell RCC of the solitary right kidney, grade 3, characterized by ingrowth into the perinephric tissue, venous invasion and the formation of

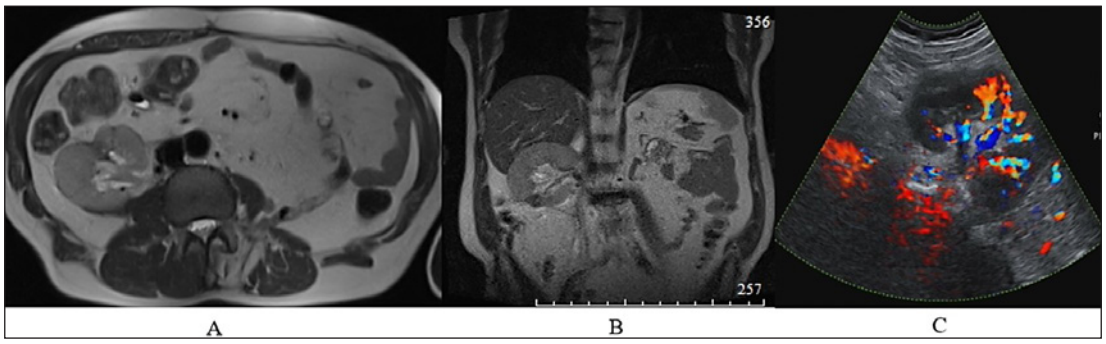

Fig. 3. Sixteen months after the operation: magnetic resonance imaging of the kidney (**A** axial plane; **B** coronal plane) demonstrates the post-surgical defect of the kidney, but no recurrent tumour. **C** Ultrasound image of the kidney proves adequate blood flow.

Table 1. Evaluation of the kidney function before and after surgery

Biochemical parameters of the excretion function	Longitudinal evolution of kidney function			
	Before surgery	1st day after surgery	3 months after surgery	16 months after surgery
Urea, mmol/L	5.18	9.2	12.4	10.3
Creatinine, μmol/L	122	312	183	189
Glomerular filtration rate, mL/min	66	26	44	43

a tumour thrombus in the IVC. The right adrenal gland metastasis was also clear-cell RCC. There were no tumour metastases in the 10 regional lymphatic nodes.

On follow-up examination 16 months after the surgery there were no signs of local tumour recurrence and metastases to parenchymal organs according to magnetic resonance imaging of the abdominal cavity and pelvis (Fig. 3A, B). According to US (Fig. 3C) and laboratory data (Table 1), the kidney function is satisfactory at follow-up, and there is no need in the renal replacement therapy (RRT).

Discussion

The treatment of patients who suffer from RCC complicated by tumour thrombosis is still debatable. Nowadays, the gold standard for it is radical nephrectomy (RN) with thrombectomy [2].

The research of Gayed et al. [4] at the University of Texas Southwestern Medical Center is probably the largest one in the field of RN and thrombectomy in patients with RCC. The study included 146 patients who underwent RN with venous thrombectomy between 1998 and 2012. The rate of complications was 77 (53%), high-grade complications occurred in 15 (10%) of cases. Thirty-day postoperative mortality was 2.7%. Five-year overall survival (OS) and 5-year cancer-specific survival were 51 and 40%, respectively. Metastases were the only independent predictor of cancer-specific survival and OS in all patients [5].

Nephron-sparing surgery (NSS), which is more preferable for preserving of the renal function, may not always be oncologically radical, and therefore it is partly an experimental

technique now. However, resection is recognized as the standard of treatment for patients with RCC of a single kidney [2, 4]. NSS allows maintaining acceptable kidney function and avoiding the constant need for RRT. NSS equally has advantages over kidney transplantation, considering the shortage of donor organs worldwide. Moreover, it is a more cost-effective method, not requiring any delay or immunosuppressive therapy known for its adverse effects [6–15].

One of the largest studies of NSS for RCC spreading to the IVC includes 140 patients who underwent treatment at Emory University, Atlanta, from 2005 to 2016. Postoperative complications were noted in 39 (28%) cases. Ninety-day mortality was 7%: 4 patients died due to postoperative complications, and 6 fatal outcomes were associated with the progression of RCC. RCC recurrence was noted in 25% of cases. Median OS of the entire cohort was 43.8 months (5-year OS: 43%), and 73.6 months (5-year OS: 59%) for those without metastatic disease. RRT was required in 2 (1%) cases [16].

In some cases, when "in situ" renal resection is not possible (multiple, large, or centrally located tumours), authors resorted to performing ECPN with ortho- or heterotopic autotransplantation of the resected kidney [12, 17]. Currently, the experience with such operations is not great, but their results are satisfactory [12, 14, 16–19]. Anyhow, we could not find cases of ECPN with orthotopic replantation under pharmaco-cold ischaemia for RCC complicated by IVC tumour thrombosis in single kidney in the literature.

Conclusion

ECPN of a solitary or the only functioning kidney is a technically difficult intervention, requiring not only precise surgical technique, but also a specific approach to examination and postoperative conservative therapy. This operation should be performed in a selected group of patients in a highly specialized multidisciplinary hospital.

Statement of Ethics

The patient gave his written informed consent to publish this case (including publication of images).

Conflict of Interest Statement

There is no conflict of interest.

Funding Sources

The case report was written without any funding.

Author Contributions

Tatiana Baitman – acquisition, analysis, and interpretation of data for the work; drafting the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Irina Miroshkina – acquisition, analysis, and interpretation of data for the

work; drafting the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Alexander Gritskevich – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Alexander Teplov – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Andrey Zotikov – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Alexander Kochetov – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Valentina Demidova – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Andrey Chupin – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Yulia Stepanova – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Wolfgang Schima – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work. Grigory Karmazanovsky – contributions to the conception and design of the work; revising the work; final approval of the version to be published; agreement to be accountable for all aspects of the work.

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