# Renal Autotransplantation and Extracorporeal Nephron-Sparing Surgery for De Novo Renal Cell Carcinoma in a Kidney Allograft

Shinichiro Ono, MD, PhD,[1] Takashi Kenmochi, MD, PhD,[1] Taihei Ito, MD, PhD,[1] Naohiro Aida, MD,[1] Kazunori Otsuki, MD, PhD,[2] Naotake Akutsu, MD, PhD,[2] Michihiro Maruyama, MD, PhD,[2] Mamoru Kusaka, MD, PhD,[3] Ryoichi Shiroki, MD, PhD,[3] and Kiyotaka Hoshinaga, MD, PhD[3]

**Abstract:** De novo renal cell carcinoma (RCC) rarely occurs in kidney allografts; however, the risk of RCC in these patients is 100-fold that of the general healthy population. Although total nephrectomy has been the standard treatment for kidney allograft RCC, several authors have reported that early-stage RCC in kidney allografts was successfully treated with nephron-sparing surgery. We herein describe a new procedure involving renal autotransplantation and extracorporeal nephron-sparing surgery, which was performed to treat de novo RCC near the hilum of a transplanted kidney. In the 22 months since transplantation, the patient's renal function has been favorable, and no recurrence has been observed. In conclusion, renal autotransplantation is a feasible technique for the treatment of RCC in kidney allografts, especially RCC located near the hilum.

The increasing incidence of metabolic diseases such as diabetes mellitus has resulted in an increase in the number of renal transplants.[1] The risk of de novo primary renal cell carcinoma (RCC) in renal transplant patients is 100-fold that of the general healthy population,[2] with most cases occurring in the native kidney. In contrast, the incidence of RCC in kidney allografts is only 0.19% to 0.5%.[3,4] The standard treatment for kidney allograft RCC has been radical total nephrectomy. However, nephron-sparing surgery (NSS) has started to become

a standard treatment for early-stage RCC. In the initial decade, NSS was indicated based on the tumor size (<4 cm) and location.[5,6] The indications for NSS were recently extended to T1b (4-7 cm) RCC, and the outcomes have been like those achieved by radical nephrectomy.[7,8] Similarly, the indications for NSS in kidney allograft RCC have gradually expanded.[9] In cases involving patients with kidney allografts, NSS is usually performed via intracorporeal partial nephrectomy. There are currently no reports on extracorporeal partial nephrectomy and autotransplantation for kidney allograft RCC. We herein report the case of a patient with an RCC that was centrally located in a kidney allograft, in which the patient's renal function was preserved by renal autotransplantation and extracorporeal NSS.

## CASE REPORT

The patient was a 48-year-old man who had undergone living donor simultaneous pancreas and kidney transplantation at 40 years of age at another hospital. The donor was the patient's 66-year-old father. The patient had a 25-year history of unstable type 1 diabetes mellitus. Hemodialysis had been introduced 1 year before transplantation. After transplantation, immunosuppression was achieved using quadruple therapy consisting of basiliximab for induction, and tacrolimus, mycophenolate mofetil, and prednisolone as maintenance therapy. The target trough level of tacrolimus was 3 to 8 ng/mL. At 4 years after transplantation, he was admitted to another hospital due to general fatigue and low-grade fever. Computed tomography (CT) showed multiple liver tumors, and posttransplant lymphoproliferative disorder

**FIGURE 1.** CT showed a 29 × 27 × 24-mm Bosniak 3 to 4 lesion with multiloculated cystic components.

was suspected. A subsequent pathological examination revealed diffuse large B-cell lymphoma. The patient was treated with rituximab, and tacrolimus was withdrawn. Complete remission was achieved after 8 courses of rituximab therapy. During this period, his pancreatic function gradually declined, and a small amount of insulin was required to maintain euglycemia. The patient's creatinine level stabilized at approximately 1.8 mg/dL. At 8 years after transplantation, follow-up ultrasonography revealed a mass lesion near the renal hilum of the kidney allograft. Abdominal CT and MRI also showed a mass lesion of 29 × 27 × 24 mm in size (Bosniak grade: 4) with multiloculated cystic components near the distal renal hilum (Figures 1 and 2). Positron emission tomography-CT showed the uptake of $^{18}$F-fluorodeoxyglucose in the tumor with a maximum standardized uptake value of 2.0 (Figure 3). These imaging findings were strongly suggestive of malignancy. The patient was referred to our hospital to undergo treatment for suspected RCC in the kidney allograft. Vessel clamping seemed necessary for intracorporeal NSS because the RCC was in the renal hilum. We were concerned that intracorporeal NSS might extend the warm ischemic time (WIT) and cause crucial damage to the kidney allograft. We therefore decided to perform extracorporeal NSS to reduce the WIT and the risk of damage to the hilum structure.
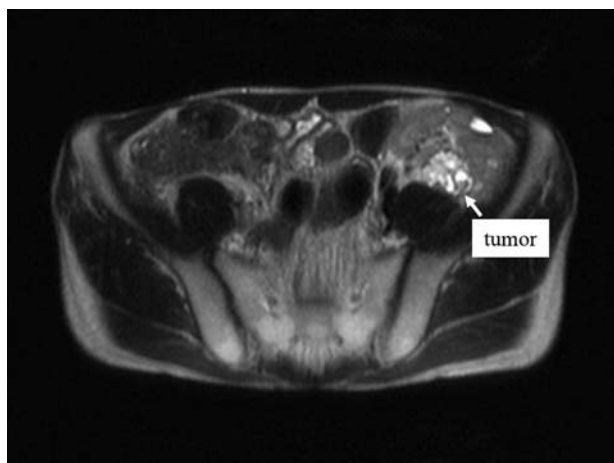


**FIGURE 3.** PET/CT showed the uptake of $^{18}$F-FDG in the tumor. The maximum SUV was 2.0. $^{18}$F-FDG, $^{18}$F-fluorodeoxyglucose; PET, positron emission tomography; SUV, standardized uptake value.

We dissected the adhesion around the kidney allograft through the initial incision and completely skeletonized the renal hilum structures (Figures 4 and 5). After cutting the artery and vein following the ureter of the kidney allograft, the kidney allograft was flushed with University of Wisconsin solution and kept cold on ice immediately after graftectomy. Extracorporeal NSS was performed on a back table using ultrasound sonography to ensure a free margin (Figures 6 and 7), and the kidney allograft was repaired to make it watertight (Figure 8). Extracorporeal NSS took 40 minutes, and autotransplantation was performed at the same site. The renal vein of the allograft was anastomosed to the external iliac vein, and the renal artery of the allograft was anastomosed to the left internal iliac artery in an end-to-end manner. The graft ureter was anastomosed to the patient's own ureter in an end-to-end manner and a 12 Fr double J catheter was inserted (Figure 9). The WIT was kept to within 116 seconds, and the total ischemic time was 89 minutes. The operation time was 307 minutes, and the volume of blood loss was 437 mL. Urine was observed soon after retransplantation, and the serum creatinine level was maintained at approximately 2.0 mg/dL after transplantation. The pathological findings showed



**FIGURE 2.** MRI also showed a 29 × 27 × 24-mm Bosniak 3 to 4 lesion with multiloculated cystic components.
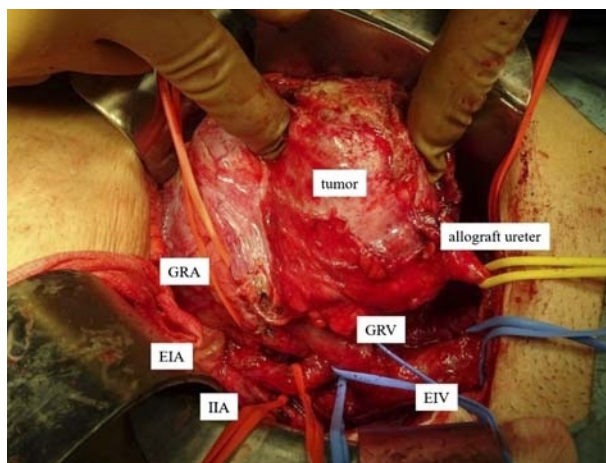


**FIGURE 4.** EIA, external iliac artery; EIV, external iliac vein; IIA, internal iliac artery; GRA, graft renal artery; GRV, graft renal vein.
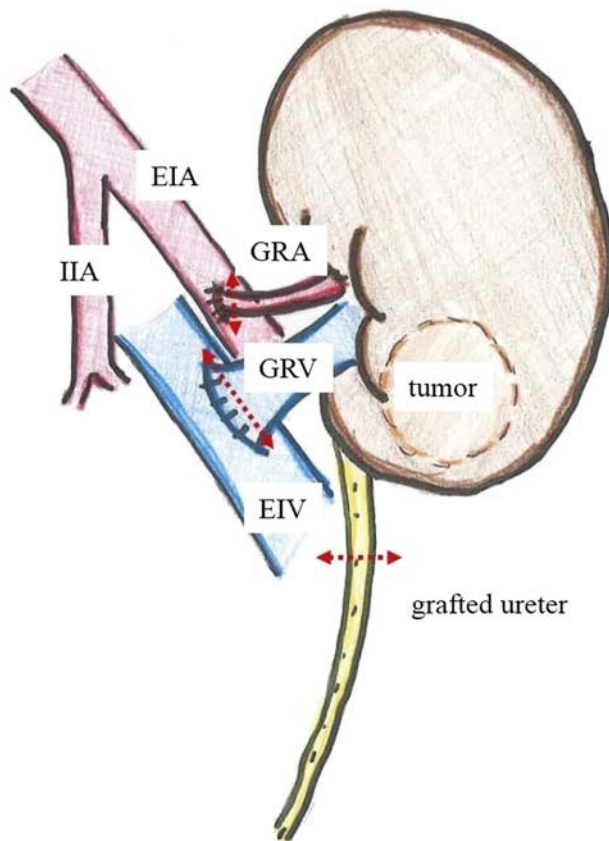
**FIGURE 5.** A schematic illustration showing the locations of the tumor and the vessels. The dashed horizontal arrows indicate the cutting line.

clear margins; the histological type was clear cell carcinoma. The perioperative course was uneventful. Immunosuppression was maintained using the same regimen as before autotransplantation.

## DISCUSSION

Reports of RCC in allograft kidneys are increasing due to the extension of graft and patient survival; however, this condition is still uncommon. The mean time between transplantation and the detection of kidney allograft RCC is more than
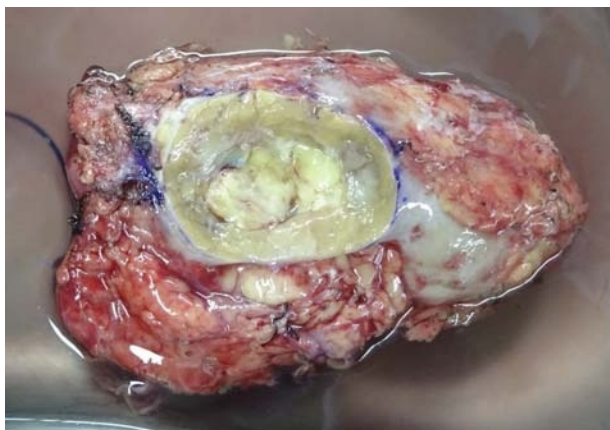


**FIGURE 7.** RCC in the kidney allograft was resected with a free margin by extracorporeal NSS.

10 years.[3,4,10] Thus, standard treatment has been total nephrectomy.[11,12] Partial nephrectomy has recently become the standard treatment for early-stage kidney allograft RCC. In our case, a preoperative evaluation revealed that the RCC in the renal hilum, near the sinus structure of the kidney allograft, was clinical stage T1a. Kitagawa et al[13] reported that the 5-year recurrence-free rate of RCC patients with T1a disease was 98.4% after total nephrectomy and 97.2% after NSS. In contrast, Shim et al[14] reported that the 5-year recurrence-free survival of patients with clinical T1a RCC located in the hilum was 89.2% and that partial nephrectomy was associated with poorer 5-year recurrence-free survival than total nephrectomy (79.5% vs 93.0%). It has been recommended that ultrasonography be performed at least yearly to facilitate the early detection of recurrence.[10,15,16] We performed ultrasonography at 1, 3, 6, and 12 months after surgery and yearly thereafter. A whole-body CT scan was also performed yearly. Thus, these examinations have not revealed any recurrence of RCC.

In this case, we decided to perform extracorporeal NSS to reduce the WIT and the risk of structural damage to the hilum. We considered that the intra-abdominal resection of the tumor would have required the clamping of the renal vessels for a long period. Several reports have noted that warm ischemia damages the renal parenchyma and increases the
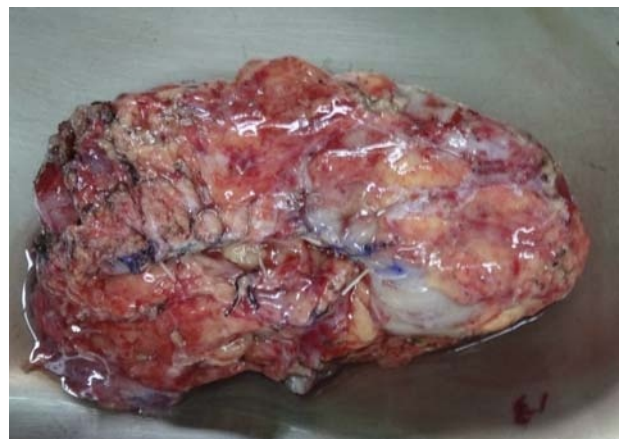


**FIGURE 6.** Extracorporeal NSS could be performed with a bloodless surgical field and without injuring the hilum.



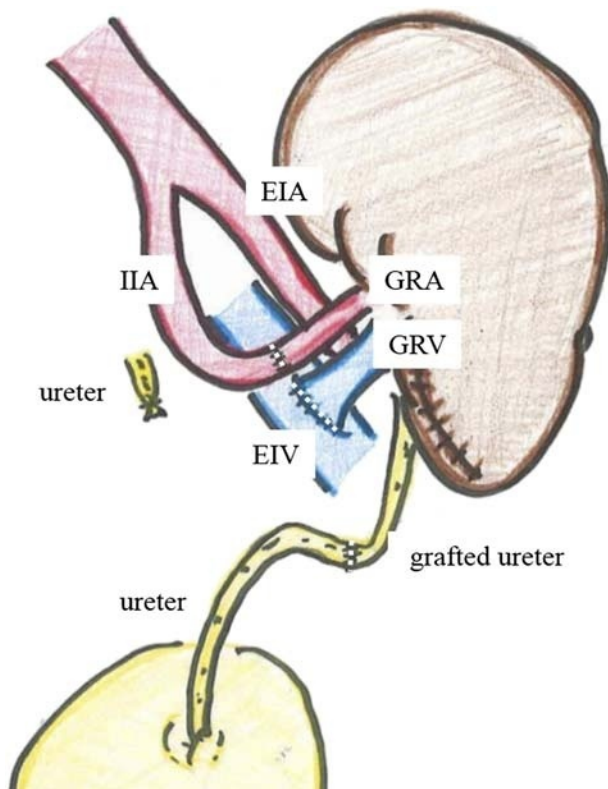**FIGURE 8.** The kidney allograft was repaired to make it watertight.

**FIGURE 9.** The GRV was anastomosed to the remaining renal vein, and the GRA was anastomosed to IIA in an end-to-side manner. The graft ureter was anastomosed to the patient's own ureter in an end-to-end manner.

risk of acute and chronic renal failure in a time-dependent manner.[17-19] In contrast to the WIT, the cold ischemic time is thought to have much less of an effect on the renal function. In addition to these advantages, extracorporeal NSS provides a bloodless surgical field, which enables clear margins to be secured—enabling better oncological control. A bloodless surgical field is also useful for preventing hilar injury. We found no reports on extracorporeal NSS with autotransplantation for kidney allograft RCC. In the present case, the procedure allowed for a prolonged WIT to be avoided, and the bloodless field helped to preserve the normal parenchyma. These factors led to a favorable postoperative course.

## CONCLUSIONS

This is the first report on the performance of renal autotransplantation and extracorporeal NSS for de novo kidney allograft RCC. The advantages of this procedure are that it reduces the WIT and allows the optimal dissection line to

be confirmed. However, long-term follow-up is needed to confirm that this procedure reduces the risk of postoperative renal failure and recurrence. This procedure may be a helpful option for treating de novo RCC of the renal hilum.

## REFERENCES

1. Tufton N, Ahmad S, Rolfe C, et al. New-onset diabetes after renal transplantation. *Diabet Med*. 2014;31:1284–1292.
2. Doublet JD, Peraldi MN, Gattegno B, et al. Renal cell carcinoma of native kidneys: prospective study of 129 renal transplant patients. *J Urol*. 1997; 158:42–44.
3. Penn I. Primary kidney tumors before and after renal transplantation. *Transplantation*. 1995;59:480–485.
4. Tillou X, Doerfler A, Collon S, et al. De novo kidney graft tumors: results from a multicentric retrospective national study. *Am J Transplant*. 2012; 12:3308–3315.
5. Hafez KS, Fergany AF, Novick AC. Nephron sparing surgery for localized renal cell carcinoma: impact of tumor size on patient survival, tumor recurrence and TNM staging. *J Urol*. 1999;162:1930–1933.
6. Van Poppel H, Dilen K, Baert L. Incidental renal cell carcinoma and nephron sparing surgery. *Curr Opin Urol*. 2001;11:281–286.
7. Lee HJ, Liss MA, Derweesh IH. Outcomes of partial nephrectomy for clinical T1b and T2 renal tumors. *Curr Opin Urol*. 2014;24:448–452.
8. Meskawi M, Becker A, Bianchi M, et al. Partial and radical nephrectomy provide comparable long-term cancer control for T1b renal cell carcinoma. *Int J Urol*. 2014;21:122–128.
9. Su MZ, Campbell NA, Lau HM. Management of renal masses in transplant allografts at an Australian kidney-pancreas transplant unit. *Transplantation*. 2014;97:654–659.
10. Végső G, Toronyi É, Deák PÁ, et al. Detection and management of renal cell carcinoma in the renal allograft. *Int Urol Nephrol*. 2013;45:93–98.
11. Heinz-Peer G, Helbich T, Nottling B, et al. Renal cell carcinoma in an allograft kidney transplant. *Transplantation*. 1994;57:475–478.
12. Gunji Y, Sakamoto K, Yamada K, et al. Successful surgical treatment of renal cell carcinoma in a transplant kidney from a cadaveric donor: report of a case. *Surg Today*. 2001;31:374–377.
13. Kitagawa Y, Nakashima K, Shima T, et al. Clinicopathological outcomes of clinical T1a renal cell carcinoma by tumor size. *Jpn J Clin Oncol*. 2011;41: 637–641.
14. Shim M, Song C, Park S, et al. Hilar location is an independent prognostic factor for recurrence in T1 renal cell carcinoma after nephrectomy. *Ann Surg Oncol*. 2015;22:344–350.
15. Ploussrd G, Chambade D, Meria P, et al. Biopsy-confirmed de novo renal cell carcinoma (RCC) in renal grafts: a single-centre management experience in a 2396 recipient cohort. *BJU Int*. 2012;109:195–199.
16. Zavos G, Kakisis J, Bokos J, et al. De novo renal cell carcinoma in a kidney allograft 13 years after transplantation: a case report and review of the literature. *Urol Int*. 2007;78:283–285.
17. Lane BR, Russo P, Uzzo RG, et al. Comparison of cold and warm ischemia during partial nephrectomy in 660 solitary kidneys reveals predominant role of nonmodifiable factors in determining ultimate renal function. *J Urol*. 2011;185:421–427.
18. Thompson RH, Lane BR, Lohse CM, et al. Renal function after partial nephrectomy: effect of warm ischemia relative to quantity and quality of preserved kidney. *Urology*. 2012;79:356–360.
19. Funahashi Y, Yoshino Y, Sassa N, et al. Comparison of warm and cold ischemia on renal function after partial nephrectomy. *Urology*. 2014;84: 1408–1412.