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Renal cell carcinoma in a horseshoe kidney treated with robot-assisted partial nephrectomy

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A B S T R A C T

Horseshoe kidney is one of the most common congenital renal fusion anomalies and the incidence of renal cell carcinoma in horseshoe kidney is predicted to be approximately 5.2/100000 individuals. Because horseshoe kidney merges malformations and vascular changes, open surgery is the standard for treatment. There are no reports of robot-assisted partial nephrectomy (RAPN) for renal cell carcinoma in horseshoe kidney. We describe for the first time the safety and the utility of RAPN in a horseshoe kidney with renal cell carcinoma.

Introduction

Renal cell carcinoma with horseshoe kidney is rare disease and technically difficult to resect due to its malformations. We report a case of renal cell carcinoma with horseshoe kidney treated by RAPN of retroperitoneal approach.

Case presentation

In March 2018, a 62-year-old male patient was referred from the Department of Gastrointestinal Surgery in our hospital for renal tumor in a horseshoe kidney, which was accidently discovered by enhanced computed tomography (CT). The patient had a history of surgery for sigmoid colon cancer and bile duct cell carcinoma. Chest and abdominal enhanced CT revealed a left renal tumor of 16 mm in diameter graded as cT1aN0M0 in the horseshoe kidney (Fig. 1A, B, C). The tumor was in the middle of the kidney and completely buried, and the R.E.N.A.L. nephrometry score was 10a. Because of the surgery for sigmoid colon carcinoma, his inferior mesenteric artery and vein were isolated. Three-dimensional (3D) CT revealed precise vascular information around the horseshoe kidney (Fig. 1D), and we judged that only one artery was nourishing the left kidney. Preoperative serum creatinine was 0.80 mg/dL and estimated glomerular filtration rate (eGFR) was 75.8 mL/min. We planned RAPN via a retroperitoneal approach because of the tumor location, vascularity and history of multiple abdominal surgeries.

Before laparoscopic surgery, a left ureteral stent was placed and RAPN was performed conventionally in the flank position, and the third arm of the robot was also used. The camera port was placed on the middle axillary line, two 12-mm trocars were inserted on the anterior axillary line and posterior axillary line, and a 5-mm working port was placed at the caudal side of the operator's left-hand trocar. We performed laparoscopic surgery until we isolated the main left renal artery. The mobility of the kidney was poor, and adhesions between the kidney capsule and the surrounding renal fat were strong, requiring much time to peel off and identify the kidney tumor. At this point we switched to robotic surgery (da Vinci Si®). The 12-mm assistant ports were inserted on the caudal side of both sides of the camera port, and both of the operator's 12-mm trocars and the 5-mm working port were switched to robotic arms. The renal tumor was confirmed by ultrasonography (Fig. 2A), the left renal artery was clamped, and the tumor isolated with sufficient margin. Even during dissection of the renal tumor, bleeding was typical, and clamping of the main renal artery was sufficient to ischemia. No opening of the renal pelvis was observed and after coagulation, the resected renal parenchyma was sutured in two layers and the specimen was extracted (Fig. 2B) in an Endo-bag before we released the ischemia. A drainage tube was placed in the renal hilus, and the incisions were closed (Fig. 2C).

The operation time was 339 min, console time was 93 min, warm ischemia time was 36 min, and the estimated blood loss was 90 mL. Postoperative serum creatinine was 0.85 mg/dL and eGFR was 70.9 mL/min. The postoperative course was uneventful and the pathological examination revealed clear cell renal cell carcinoma (pT1a, Fuhrman grade 2) with negative surgical margins. At 4 months later, enhanced CT revealed no sign of recurrence and metastasis.

Abbreviations: RAPN, robot-assisted partial nephrectomy; 3D-CT, three-dimensional computed tomography; eGFR, estimated glomerular filtration rate

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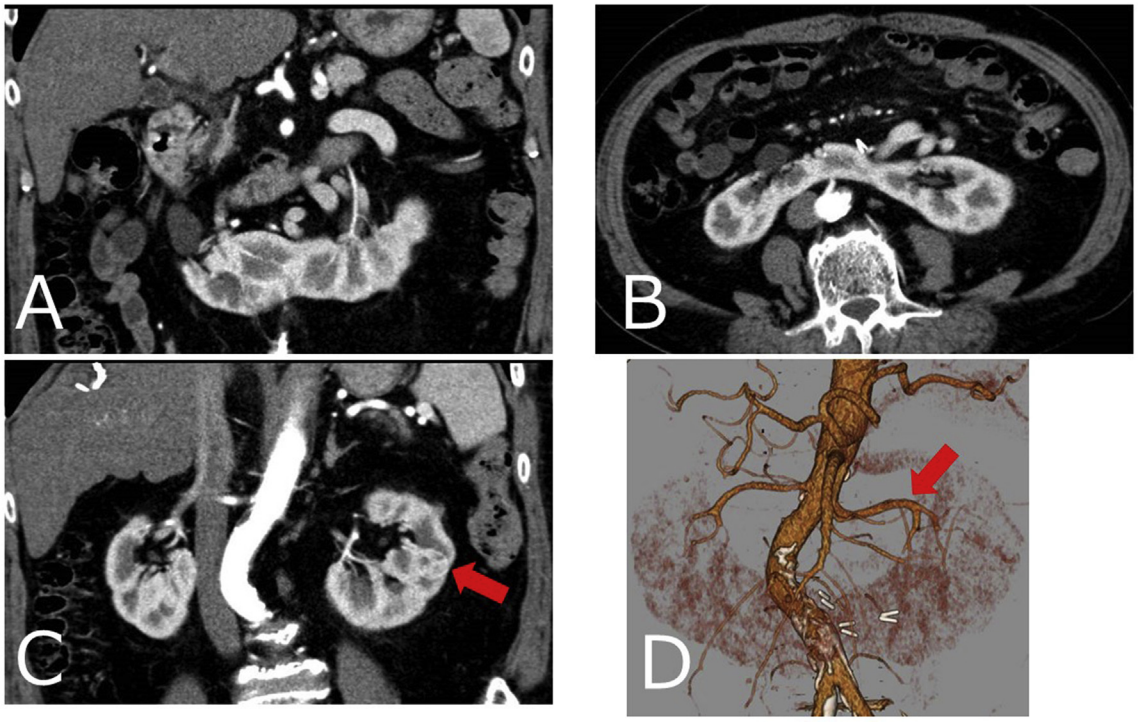

Fig. 1. Abdominal enhanced CT showing renal tumor with horseshoe kidney. (**A**) Coronal image revealing the isthmus. (**B**) Axial image revealing the isthmus. (C) Coronal image: left renal cell carcinoma of 1.6 cm (arrow) in diameter in the arterial phase. (**D**) Three-dimensional CT arterial image: the shape of horseshoe kidney and only one artery nourishing the left kidney (arrow).

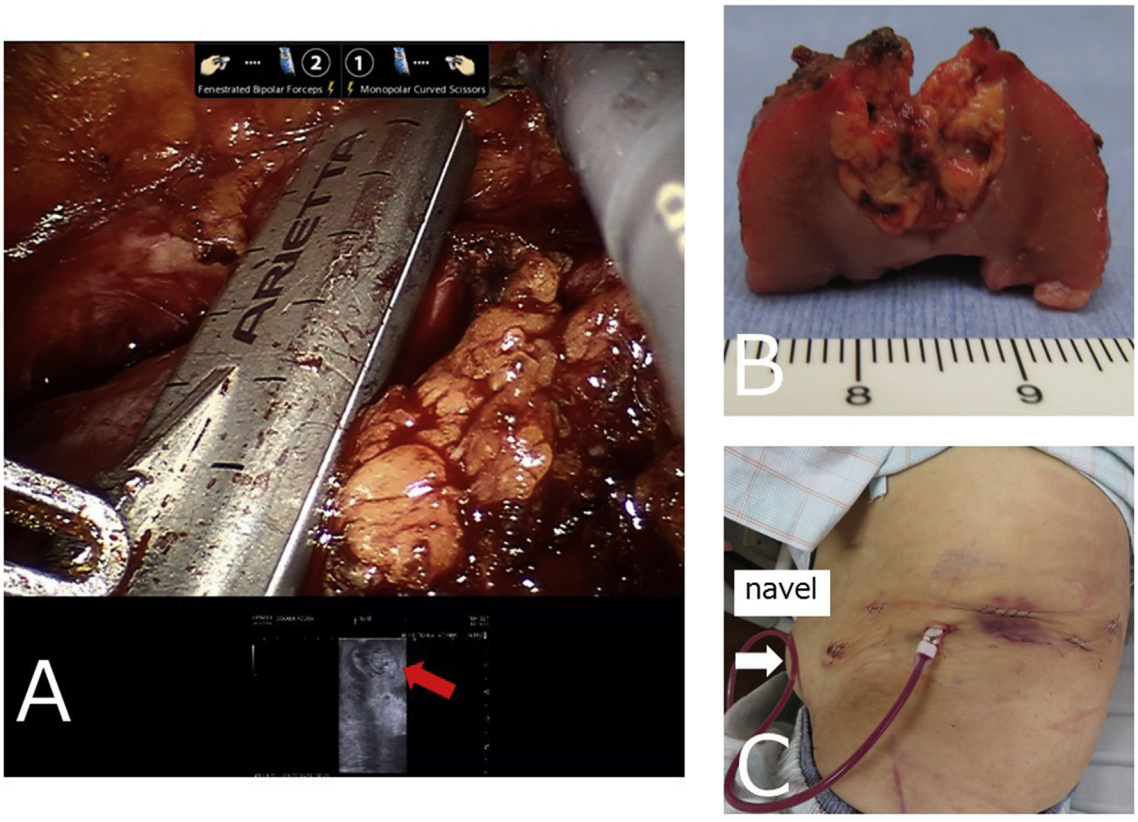

Fig. 2. (**A**) Ultrasound image of renal cell carcinoma (arrow) during RAPN surgery. (B) Resected renal cell carcinoma with negative surgical margins. (C) The positions of the surgical ports and patient's wound after surgery (arrow reveals the navel).

Table 1
Summary of cases of robot-assisted heminephrectomy or partial nephrectomy in fusion anomaly of the kidney.

Author (Year)	Side	Size (cm)	TNM	Operating time (min)	WIT time (min)	Blood loss (mL)	Approach	Procedure	Pathology
Rogers (2008)	Left	11	pT3bN0Mx	190	N/A	450	Intraperitoneal	Heminephrectomy, cavotomy and thrombectomy	Clear cell
Kumar (2015)	Right	18	pT2bN0Mx	120	N/A	600	Intraperitoneal	Heminephrectomy	Chromophobe
Raman (2017)	Right	3	pT1aN0Mx	170	13	< 150	Intraperitoneal	Partial nephrectomy	Oncocytoma
Present case (2018)	Left	1.6	pT1aN0M0	339	36	90	Retroperitoneal	Partial nephrectomy	Clear cell

TNM, tumor, node, metastases; WIT, warm ischemia time.

Discussion

Horseshoe kidney is a congenital benign malformation present in the population at a rate of 0.15–0.25% and is characterized by anatomical abnormalities such as ectopia, malformation and vascular changes.[1] The incidence of renal cell carcinoma in horseshoe kidneys is estimated to equal that in normal kidneys. Preoperative imaging of the blood vessels in partial nephrectomy for kidney tumor with fusion anatomies is necessary.[2]

For patients with T1a renal cell carcinoma, radical nephrectomy significantly increased cardiovascular events and decreased the overall survival rate compared with partial nephrectomy. In addition, RAPN is more useful than open partial nephrectomy and laparoscopic partial nephrectomy.[3] And the local recurrence rate of T1 renal tumors after renal cryoablation was significantly higher than that after RAPN.[4] Although there have been reports of RAPN in horseshoe kidney for benign tumor and heminephrectomy using a robotic device,[2] there have been no reports of RAPN for renal cell carcinoma in a horseshoe kidney, in particular, that treated via a retroperitoneal approach (Table 1).

The blood vessels that nourish the kidneys in horseshoe kidney are categorized as three types: (1) in which the renal arteries directly diverge from the aorta (15%), (2) in which the renal arteries diverge directly from the aorta not only to the both kidneys but also to the isthmus (65%), and (3) in which the renal arteries diverge from the aorta and arteries other than the aorta (20%).[5] Fortunately, type (1) was found in our patients on preoperative 3D-CT. In addition, because the location of the tumor was relatively dorsal, it was possible to select a retroperitoneal approach for RAPN and to progress without serious complications. In partial nephrectomy, robotic surgery is easier than laparoscopic surgery because resecting and suturing is easier because of the advantage of 3D vision of the robot with EndoWrist technology (Intuitive Surgical Inc, Sunnyvale, CA, USA)[2] and many joints is very useful for precisely procedure in narrow space.

Conclusion

We report the first case of RAPN for renal cell carcinoma in a horseshoe kidney and found it to be a safe and feasible procedure. Depending on the location of the renal cell carcinoma, the vessel anatomy on pre-operative 3D-CT imaging and EndoWrist technology it may be possible to perform RAPN via a retroperitoneal approach.

Conflicts of interest statement

None.

Consent for publication

Informed consent was obtained from the patient for this publication.

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