

## Case Report

# Robotic Partial Nephrectomy for the Treatment of Renal Cell Carcinoma in Horseshoe Kidneys: First Case Report and Literature Review

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*Horseshoe kidneys are common congenital renal malformations. Affected patients will have fusion of the lower poles of both kidneys. This condition is usually associated with aberrant renal vessels and ureteropelvic junction obstruction. The procedures needed for treatment of associated conditions in horseshoe kidneys are challenging. Renal cell carcinoma in horseshoe kidneys is not a common condition. For clinical T1 tumors, partial nephrectomy should be considered as the first treatment option, as in a normal kidney patient. We report our first experience of a robotic partial nephrectomy of renal cell carcinoma in a horseshoe kidney patient. A 48-year-old man presented with nonspecific abdominal pain, and the abdominal imaging revealed horseshoe kidneys with a solid, enhancing renal mass of 43x37 mm at the upper pole of the right kidney. A robotic partial nephrectomy was successfully performed without perioperative complications. Kidney function remained the same. Robotic partial nephrectomy in horseshoe kidneys is technically safe and feasible and is able to achieve trifecta for a partial nephrectomy. Our surgical techniques and the literatures on this topic are discussed within.*

**Keywords:** Horseshoe kidneys, Robotic partial nephrectomy, Renal cell carcinoma

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Horseshoe kidneys are the most common congenital renal fusion anomalies<sup>(1,2)</sup>. This condition was first discovered during an autopsy and reported by di Capri in 1522<sup>(3)</sup>. Besides fusion of the inferior portion of the metanephric blastema, horseshoe kidneys are usually associated with malrotation and abnormal vascular supplies. These usually lead to high ureteral insertion, associated with ureteropelvic junction obstruction and kidney stones. The risk of Wilms' tumor in horseshoe kidneys is double compared to the general population, but the risks of other tumors in horseshoe kidneys are equal to the general population<sup>(4)</sup>. Renal cell carcinoma in horseshoe kidneys is not a common condition. However, renal cell carcinoma is still the most common cancer in horseshoe kidneys, with an incidence of 45%, whereas Wilms' tumor accounts for 25%<sup>(5)</sup>.

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Partial nephrectomy is considered as first-line treatment of clinical T1 renal cancer. However, partial nephrectomy in horseshoe kidney patients is a challenging procedure due to the alteration of renal anatomy and wide variation of blood supply. We report a case of renal cell carcinoma in a horseshoe kidney patient with successful robotic partial nephrectomy. We will highlight the challenging surgical techniques and review the literatures. To the best of our knowledge, this is the first case report of its kind in Thailand.

### Case Report

We reported a case of a 48-year-old male presenting to the hospital with unrelated complaints of recurrent abdominal pain. On physical examination, the patient had a soft abdomen without pain on palpation. There was no palpable mass or sign of organomegaly. An abdominal computed tomography documented a solid endophytic enhancing lesion, 43x37 mm, in the cortical region of the upper right kidney (Fig. 1). In addition, the image revealed parenchymal fusion of the lower poles and a renal pelvis oriented anteriorly. There were no distant metastases. The clinical staging was considered as clinical stage T1b. This mass was

designated 9A by the RENAL. Nephrometry Scoring System (4.3 cm radius, entirely endophytic, 3 mm length from renal sinus and entirely upper-pole)<sup>(6)</sup>. We fully discussed the benefits and risks of all available treatment options with the patient.

The patient decided to have a robotic right partial nephrectomy. He was placed in the modified flank position, and the da Vinci® SI Surgical System was used to complete the procedure. The first 12-mm trocar was placed intraperitoneum at the level of the umbilicus and right midaxillary line. Pneumoperitoneum was created with limited intra-abdominal pressure at 15 mmHg. The other three 12-mm robotic trocars and one assisted trocar were placed as shown in Fig. 2.

After dropping the ascending colon and the colorenal ligaments, the right renal artery and vein were identified and meticulously dissected free from adjacent tissue. To prevent deterioration of kidney function and promote diuresis, 12.5 g/250 ml of mannitol was administered intravenously. Gerota's fascia was opened, and the renal mass was identified. The upper pole of the right kidney was freely mobilized. Perinephric fat at the mass border was cut and separated to prepare for tumor removal. Then laparoscopic bulldog clamps were applied on the renal artery and vein respectively. Complete resection of the mass was performed with robotic scissors. Renorrhaphy was done with a Maxon 2-0 suture. To decrease the ischemic time, Hem-O-Lok

clips were used to avoid knot tying. Successful robot-assisted laparoscopic partial nephrectomy was performed with a warm ischemic time of 20 minutes. The operative finding was a confined, 4-cm pseudocapsule solid renal mass not involving the collecting system, as shown in Fig. 3. The pathological finding was a clear cell renal cell carcinoma with a size of 3x2.8x2.6 cm. The tumor was limited to the kidney with free surgical margin. The nuclear grade was 2 by World Health Organization/International Society of Urological Pathology (WHO/ISUP) classification<sup>(7)</sup>. The total surgical time was 180 minutes, with an estimated blood loss of 300 ml.

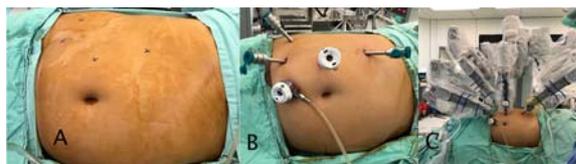
The patient stayed in the hospital for 3 days, and the postoperative course was uneventful. The drain was removed at postoperative day 3. At the 3-month follow-up, there was no evidence of local recurrence. The patient's preoperative serum creatinine was 1.22 mg/dl and had increased to 1.4 mg/dl at the time of his discharge on postoperative day 3. His creatinine had returned to a baseline 1.36 mg/dl at the 3-month follow-up.

## Discussion

Partial nephrectomy is considered as first-line treatment for clinical T1 renal masses suspected of renal



**Fig. 1** Abdominal computer tomography showed a solid endophytic enhancing lesion, 43x37 mm, in the cortical region of the upper pole of the right kidney (A) and a fusion anomaly of the lower poles of both kidneys (B).



**Fig. 2** Trocar sites for robotic partial nephrectomy before and after robot docking.



**Fig. 3** Renal cell carcinoma with negative surgical margin.

cancer. The meta-analysis showed comparable oncological outcomes when compared to radical nephrectomy. However, the benefit of partial nephrectomy is not only the oncological outcomes, as partial nephrectomy also preserves kidney function and significantly decreases the chance of chronic kidney disease in the future<sup>(8)</sup>.

The incidence of horseshoe kidneys is 1: 400 in the general population<sup>(4)</sup>. Renal cell carcinoma in horseshoe kidneys is not a common condition. There are approximately 200 reported cases<sup>(9)</sup>. Furthermore, partial nephrectomy and nephron-sparing surgery in horseshoe kidneys are challenging procedures because horseshoe kidneys are usually associated with abnormal kidney location, malrotation, high ureteral insertion, and renal vessel variations (origin, number, and size). Unfamiliar anatomy and variation of renal arteries and veins make the surgery more difficult and may increase risk of intra-operative complications.

Robotic and laparoscopic partial nephrectomy are minimally invasive approaches that have good treatment outcomes comparable to open partial nephrectomy. When evaluating the treatment outcomes of partial nephrectomy for trifecta, trifecta for partial nephrectomy is defined as the absence of perioperative complications, negative surgical margin, and ischemic time < 25 minutes. Porpiglia et al. reported 62.4%, 63.2%, and 69.5% trifecta achievement for open, laparoscopic, and robotic partial nephrectomy, respectively<sup>(10)</sup>. The open approach had the shortest warm ischemic time, but the laparoscopic and robotic approaches had low rates of positive surgical margins and perioperative complications<sup>(10)</sup>.

Currently, there are only 3 case reports of laparoscopic partial nephrectomy in horseshoe kidneys<sup>(11-13)</sup>. Successful robotic pyeloplasty and pyelolithotomy in horseshoe kidneys have also been reported<sup>(14-16)</sup>. However, there is no report of a robotic approach for partial nephrectomy yet. To the best of our knowledge, this is the first reported case of successful robotic partial nephrectomy in horseshoe kidneys.

Partial nephrectomy in horseshoe kidneys can be done via transperitoneal approach for an anterior tumor or retroperitoneal approach for a posterior tumor. Careful hilar dissection is an important step because of aberrant blood vessels. In horseshoe kidneys, one kidney still receives blood supply from the other kidney. Therefore, there is some chance of more bleeding (even after renal vessel clamping) than for partial nephrectomy in normal kidneys<sup>(4)</sup>. The robotic approach has 3D

visualization and allows the surgeon to perform more meticulous hilar dissection, precise renorrhaphy, and decrease ischemic time. These are benefits of robotic partial nephrectomy especially in horseshoe kidney.

We achieved trifecta for partial nephrectomy in this patient with a warm ischemic time of 20 minutes and negative surgical margin without perioperative complications. Robotic partial nephrectomy in horseshoe kidneys is technically feasible and safe. This technique is more suitable than the laparoscopic approach, especially for novice or less-experienced laparoscopic surgeons.

### **Conclusion**

Renal cell carcinoma in horseshoe kidneys is not a common condition. Partial nephrectomy for clinical T1 tumors in horseshoe kidneys is a challenging procedure, but it still should be the first-line treatment, the same as for a normal kidney patient. Robotic partial nephrectomy in horseshoe kidneys is technically safe and feasible and is able to achieve trifecta for partial nephrectomy.

### **What is already known on this topic?**

Renal cell carcinoma is not a common condition. For the treatment of clinical T1 renal tumor, partial nephrectomy should be the first option in order to prevent kidney function deterioration after surgery. Furthermore, this technique also provides good oncological outcomes comparable to radical nephrectomy. However, partial nephrectomy in a horseshoe kidneys patient is more challenging because of alteration of renal anatomy and blood vessels. To date, there are only 3 case reports of laparoscopic partial nephrectomy in horseshoe kidneys.

### **What this study adds?**

Robotic partial nephrectomy in horseshoe kidneys is technically safe and feasible and is able to achieve trifecta for partial nephrectomy. To the best of our knowledge, this is the first reported case of successful robotic partial nephrectomy in horseshoe kidneys. The authors hope that our surgical techniques can be reproducible to other Urologists in Thailand.

### **Potential conflicts of interest**

None.

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การผ่าตัดไตออกบางส่วนด้วยหุ่นยนต์สำหรับการรักษามะเร็งไตในผู้ป่วยไตเรื้อรังเป็นรายงานผู้ป่วยรายแรกและ  
บททบทวนวรรณกรรม

เปรมสันดี สังข์คุ้ม, ปิยะพงษ์ วงศ์จิตรารภณ, สุเทพ พัทธตระกูล, วิสูตร คงเจริญสมบัติ

ไตเรื้อรังเป็นความผิดปกติของไตแต่กำเนิดที่พบได้บ่อย ผู้ป่วยที่เป็นโรคนี้อาจมีการตีตันของไตส่วนล่างทั้งสองข้าง ภาวะนี้มักจะพบร่วมกับความผิดปกติของเส้นเลือดที่มาจากไตและการอุดตันของกรวยไต ทำให้การผ่าตัดเพื่อรักษาความผิดปกติต่างๆ ในผู้ป่วยไตเรื้อรังมีความยากกว่าปกติ มะเร็งไตในผู้ป่วยไตเรื้อรังพบได้ไม่บ่อย สำหรับการรักษาในผู้ป่วยมะเร็งไตระยะที่หนึ่ง การรักษาควรเป็นการตัดไตออกบางส่วนเหมือนกับผู้ป่วยที่มีไตปกติ ผู้นี้พบรายงานการผ่าตัดรักษามะเร็งไตในผู้ป่วยไตเรื้อรังด้วยการตัดไตออกบางส่วนด้วยการใช้หุ่นยนต์ช่วยผ่าตัด ผู้ป่วยชายอายุ 48 ปี มาโรงพยาบาลเพราะอาการปวดท้อง ผลการตรวจเอกซเรย์คอมพิวเตอร์ช่องท้อง พบว่าผู้ป่วยเป็นไตเรื้อรังและมีก้อนเนื้ออกที่ไตที่เห็นชัดขึ้นหลังฉีดสีขนาด 43x37 มิลลิเมตร ที่ตำแหน่งขั้วบนของไตขวา การผ่าตัดไตออกบางส่วนด้วยหุ่นยนต์สำเร็จด้วยดี โดยไม่มีภาวะแทรกซ้อนระหว่างผ่าตัด การทำงานของไตหลังผ่าตัดยังคงใกล้เคียงเดิม การผ่าตัดไตออกบางส่วนด้วยหุ่นยนต์ในผู้ป่วยไตเรื้อรังสามารถทำได้ดีและปลอดภัย และถือว่ามีประสิทธิภาพสูงที่สุดสำหรับการผ่าตัดไตออกบางส่วน ผู้นี้พบได้รายงานเทคนิคการผ่าตัดที่ใช้ และได้บททบทวนวรรณกรรมที่เกี่ยวข้องในรายงานนี้

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