# Laparoscopic partial nephrectomy for renal cell carcinoma in a horseshoe kidney

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## Abstract

Horseshoe kidney has an incidence rate ranging from 1 in 400 to 1 in 1000, with a 2:1 ratio in men. It also has a predilection for chromosomal aneuploidies. From a pathophysiology standpoint, this anomaly occurs during the second to sixth week of gestation when the inferior portion of the metanephric blastema fuses to form an isthmus, commonly in the lower renal pole (90%). As a result of this fusion, the kidney may not bypass the inferior mesenteric artery and is impeded in its ascent. With an aberrant anatomical orientation and location, complications arise including hydronephrosis, renal calculi and a twofold risk of Wilms tumour. Despite these findings, the association of renal cell carcinoma (RCC) within a horseshoe kidney is extremely rare and fewer than 200 cases have been described. Therapeutically speaking, partial nephrectomies are the gold standard of treatment for renal tumours smaller than 4 cm in diameter, with a growing indication to accomplish this procedure by laparoscopic or robotic means. We report a case of an asymptomatic 58-year-old male with an incidental computed tomography scan finding of a 4-cm solid mass in the right moiety of a horseshoe kidney. He was treated by laparoscopic partial nephrectomy. There have only been 2 other reported cases to our knowledge on a laparoscopic partial nephrectomy in a horseshoe kidney for RCC. We believe that, in experienced hands, the laparoscopic approach may be used successfully for this clinical situation.

## Introduction

The horseshoe kidney was first described by di Capri in 1522, but it was not until 1761 that Morgnani elucidated its clinical complications.<sup>1,2</sup> With an incidence of 1 in 400 to 1 in 1000, horseshoe kidney has a predilection for males (2:1) and appears more often in chromosomal aneuploidies (trisomies 20% and Turner syndrome 60%).<sup>3,4</sup> From a pathophysiology standpoint, horseshoe kidney occurs during the

second and sixth week of gestation when the inferior portion of the metanephric blastema fuses to form an isthmus, commonly in the lower renal pole (90%) and anteriorly to the aorta and vena cava.<sup>1</sup> Consequently, the fused kidney may not bypass the inferior mesenteric artery during its embryological ascent nor adopt its native orientation, causing the organ to adopt an anatomical and positional aberrancy. This leads to abnormal vascularization of the kidney and urological complications. While a third of patients are asymptomatic, renal calculi and ureteropelvic junction obstruction are common, leading to hydronephrosis.<sup>5,6</sup>

In addition, a twofold risk of Wilms tumour has been described.<sup>7</sup> The association of renal tumours within a horseshoe kidney is extremely rare, with only 200 reported cases.<sup>8</sup> Treatment of horseshoe kidney consisted initially of routine separation of the isthmus in addition to pyeloplasty.<sup>9,10</sup> Currently, open partial nephrectomy is the standard of care for renal lesions, renal neoplasms, tumours in the solitary kidney or in kidneys with pre-existing renal dysfunction. With advances in standardized techniques, a growing indication suggests that laparoscopic or robotic approaches may be just as appropriate.<sup>11</sup> Interestingly, our online literature review elicited only 2 prior cases of RCC within a horseshoe kidney treated by laparoscopic partial nephrectomy. We are thus presenting the third case reported to date.<sup>12-13</sup>

## **Case report**

We report a case of a 58-year-old male presenting to the hospital with unrelated complaints of recurrent abdominal pain. On physical examination, the patient had a soft and non-tender abdomen, with pain on superficial and deep palpation, but no palpable masses or signs of organomegaly. The patient brought with him a computed tomography (CT) of his abdomen demonstrating a solid endophytic nodular lesion,  $36 \times 31$  mm, in the cortical region of the upper right kidney. In addition, the image revealed parenchymal fusion of the lower poles and a renal pelvis oriented anteriorly.

Until that time, the patient neither was unaware of any renal fusion anomaly nor had demonstrated signs or symptoms of urological complications.

Magnetic resonance imaging (MRI) and renal angiography were subsequently ordered to elucidate the nature of the nodule and of this fusion anomaly. The characteristics of the nodule on MRI revealed the lesion to be consistent with a primary renal neoplasm (Fig. 1). Secondly, the MRI 3D reconstruction demonstrated the abnormal renal anatomy (Fig. 2). Renal angiography was able to reveal the aberrant pattern of vascularization (Fig. 3). Renal cancer staging tests were negative for distant metastases and the patient was considered at clinical stage I (TNM).

Port placement planning was initiated using a modified right partial nephrectomy template to target the right-sided tumour. Thereafter, all ports were displaced 1 inch medially to account for the horseshoe aberrancy. A 10-mm camera port was placed to the right of the umbilicus; 2 additional 5-mm ports were placed at the right hypogastric area and another 10-mm port was placed just below the costal margin at the right hemiclavicular line. Finally, a 5-mm port was inserted for the liver retraction. The patient then underwent a laparoscopic right partial nephrectomy via a transperitoneal approach. During the procedure, we chose to dissect the secondary branches of the renal artery. We identified a small caliber artery that ran directly to the tumour area; this vessel was subsequently ligated and dissected. A second larger-caliber artery from the upper pole was temporarily occluded with the use of Bulldog clamps. In total, the partial warm ischemia lasted 25 minutes; the tumour resection was performed with cold endoscopic scissors. The approach on the remaining renal parenchyma was accomplished using

sliding clips with U stitches anchored by 10-mm Hem-olocks (Teleflex Medical Inc., Research Triangle Park, NC).

The pathology report confirmed that the mass was grade 1 renal cell carcinoma (RCC) with a clear cell subtype, 4.0 cm in diameter and with negative margins (Fig. 4). The total surgical time was 180 minutes, with an estimated blood loss of 200 mL. The patient remained hospitalized for 2 days and the postoperative course was uneventful. At the 12-month follow-up, there was no evidence of recurrence.

### Discussion

Currently, the laparoscopic approach to treat the complications of horseshoe kidney has been as effective as the gold standard open technique.<sup>8</sup> Due to the abnormal vasculature formed as a result of the fusion anomaly, the use of preoperative imaging becomes crucial to identify the location of the renal vessels and to allow accurate disposition of the renal collecting system. Thus, CT angiography is indispensable in preoperative planning, especially when conducting surgical planning in patients with renal malignancies.<sup>2,12,13</sup> To date, the transperitoneal approach via laparoscopy is the most utilized technique for isthmus separation, pyeloplasty, partial and complete nephrectomies. When choosing the surgical access in cases like this one, the surgeon should pay close attention to all anatomic variations. The presence of a very complex vasculature or extreme kidney malrotation/ displacement can be a contraindication for the laparoscopic approach. Moreover, the diameter of the renal tumours amenable for partial resection has increased as a result of improved surgical experience. In a series of 800 partial nephrectomies completed laparoscopically and conducted between 1999 and 2008, the diameter of the lesions ranged from 1.6 to 5.6 cm, with no statistically significant differences regarding peri- or postoperative complications.<sup>14</sup> Although



*Fig. 1.* Magnetic resonance image demonstrating a lesion consistent with a primary renal neoplasm.



*Fig. 2.* Magnetic resonance image 3D reconstruction demonstrating abnormal renal anatomy.



*Fig. 3.* Renal angiography demonstrating the abnormal pattern of vascularization.

the 2 previously recorded cases used heminephrectomies to achieve tumour control, our approach preserved the right moiety of the horseshoe kidney and thus as much normal renal parenchyma as possible. The main difference is the fact that, even during clamping time, the kidney is still irrigated from the other moiety, which can make the dissection very challenging, yet it can enhance substantial long-term renal function.

#### Conclusion

We describe the third case in which the laparoscopic approach has been successfully used in the partial removal of horseshoe kidney affected by RCC. We believe that in experienced hands, this method may be used in similar situations.

Competing interests: Authors declare no competing financial or personal interests.

This paper has been peer-reviewed.

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Fig. 4. Renal cell carcinoma with negative margins.

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