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Isthmectomy of Horseshoe Kidney During Partial Nephrectomy: A Case-based Approach

Parsiyel Nefrektomi Sırasında At Nalı Böbreğin İstmektomisi: Vaka Bazlı Bir Yaklaşım

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Abstract

Horseshoe kidneys (HSK) are the most prevalent congenital renal fusion anomalies. Its atypical anatomy with a high prevalence of vascular anomalies makes the HSK a challenging target for partial nephrectomy. Various preventive measures are to be considered before engaging in this particular surgery. In this case report, we outline our cautious surgical approach for a case of partial nephrectomy, which included an isthmectomy for safe tumour resection.

Özet

At nalı böbrekler (HSK), en yaygın doğuştan böbrek füzyon anomalilerinden biridir. Atipik anatomisi ve yüksek oranda vasküler anomali göstermesi, HSK'yı parsiyel nefrektomi için zorlu bir hedef haline getirmektedir. Bu özel ameliyata başlamadan önce çeşitli önleyici tedbirler göz önünde bulundurulmalıdır. Bu vaka raporunda, güvenli tümör rezeksiyonu için isthmektomiyi de içeren, parsiyel nefrektomi vakasına yönelik ihtiyatlı cerrahi yaklaşımımızı özetliyoruz.

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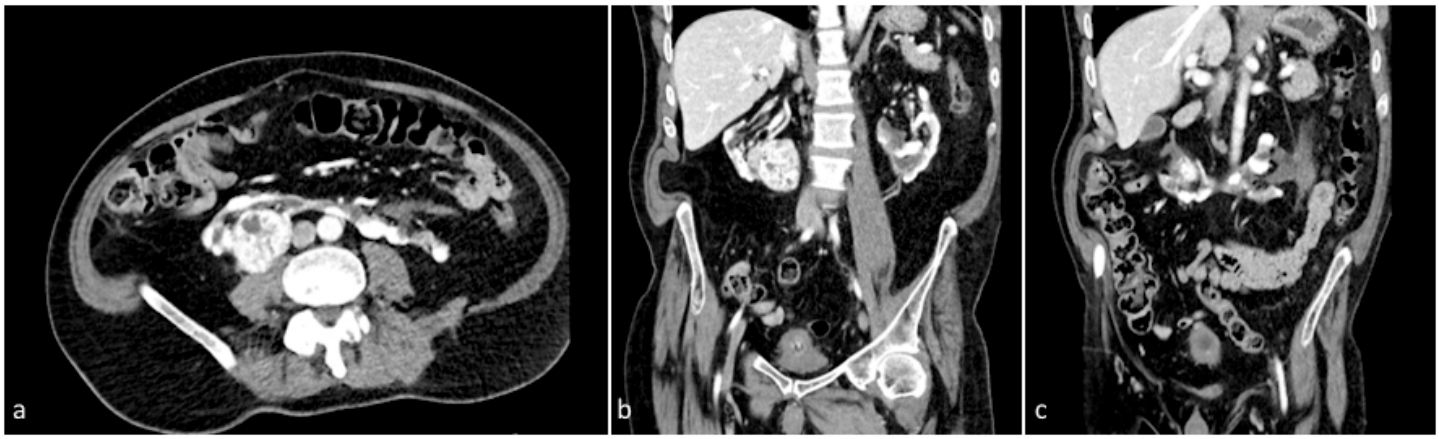

Figure 1. (a) Axial view of RCC in right moiety of the horseshoe kidney on abdominal CT, **(b)** Coronal view of RCC in right moiety of the horseshoe kidney on abdominal CT, highlighting its exophytic location, **(c)** CT enhanced coronal view on the istmus and relation to the tumour

Introduction

The horseshoe kidney (HSK) is a well-known yet insufficiently understood renal anomaly. Although higher incidences arise in men, families with renal anomalies or Turner Syndrome (14-20%), no clear genetic predisposition has been found. General incidence is around 0.15-0.45% [1,2].

During the embryogenesis horseshoe kidneys evolve from a fusion of the kidneys, most often at the lower pole (90%), connected by an isthmus consisting of functional parenchyma or fibrous tissue [1,3]. HSK could receive vascularisation from the aorta, common iliac artery, inferior and superior mesenteric artery or sacral artery. Often multiple branches are encountered for both poles and separate isthmic branches [1-3]. Venous malformations arise most often from the inferior vena cava (IVC), where double IVC, left IVC and pre-isthmic IVC are possible [1, 2]. Ureteral duplications, alternated positions in combination with different calyceal positions are often seen and could cause infections, UPJ obstruction or nephrolithiasis [1]. The diagnostic pathway for these pathologies occasionally uncovers an incidental tumour diagnosis. Tumours of the HSK are primarily renal cel carcinoma (RCC) and urothelial carcinoma, but more rare tumours like Wilms tumour and carcinoid tumour have higher incidences in HSK compared to the general population. The risk of developing urothelial cell carcinoma in HSK is four times higher, due to recurrent urinary tract infections and chronic inflammation because of stone formation and hydronephrosis [1].

Multiple treatment options exist in the management of renal cell carcinoma. The gold standard for small (< 7cm) lesions in normal shaped kidneys with chronic kidney disease remains the partial nephrectomy [4]. Robot-assisted laparoscopy is the preferred technique for performing partial nephrectomy, offering comparable oncological outcomes to open or standard laparoscopic approaches, but with a significantly lower complication rate [5]. Treatment of RCC in HSK remains to have a case-based approach, to date no guideline exists.

In this report we present the case of a robot-assisted partial nephrectomy of a solid renal mass combined with an isthmectomy while using indocyanine green (ICG) fluorescence to demarcate the isthmus.

Case

The patient was referred to our hospital after a diagnostic workup for chronic kidney disease. Ultrasound of the kidney showed an irregular mass in the lower right pole. Additional contrast enhanced CT showed a lesion measuring 55x38x51mm in the lower pole of the right kidney half of a horseshoe kidney (**Figure 1**). The lesion had a heterogenous enhancement with arterial flow. It was suspect of RCC without presence of tumor thrombus, extracapsular extent, or pathologic lymphadenopathy. Further staging with CT Thorax was negative. Baseline eGFR was 27 mL/min/1.73m2.

Vascularization showed an abnormal constitution with bilateral renal arteries, no isthmal branches, but with two accessory arteries originating from the left common iliac artery supplying the left pole.

The procedure was started in classic left lateral decubitus, with standard linear trocar placement. The Da Vinci Xi surgical robot was used with a 30-degree lens. After colon mobilization the kidney approached from the right upper pole. The renal hilum was dissected and secured with vessel loops. We started opening the Gerota fascia and followed the kidney until we found the isthmus. After placing bulldog clamps on the right renal artery, we injected ICG. Using the avascular border as demarcation we performed an isthmectomy using the monopolar scissors **(Figure 2)**. After unclamping we controlled hemostasis and continued preparing the tumor. After reclamping we started with an enucleation of the tumor. Internal renoraphy was performed using two monocryl 3-0. Early unclamping was performed followed by an external renoraphy using one hemo-lock-bolstered vicryl 3-0. Warm ischemia time was 21 minutes.

The patient left the hospital on the second postoperative day. Kidney function 1 week after surgery remained stable with an eGFR of 25 mL/min/1.73m2. The final histology report confirmed a clear cell renal cel carcinoma measuring 4.5cm with negative surgical margins and without lymphovascular invasion. Written informed consent was obtained from the patient.

Discussion

This case demonstrates a cautious approach to a potential complex partial nephrectomy. Keeping in mind that horseshoe

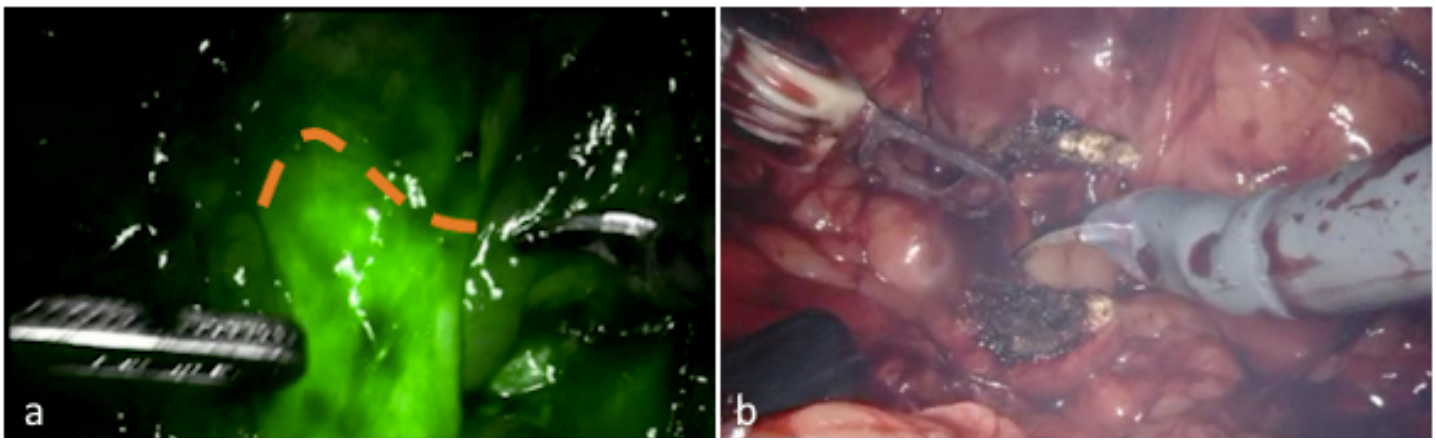

Figure 2. (a) Intra-operative view of the ICG coloration of the (non-) vascularised part of isthmus after right renal artery clamping. Orange line depicts the border of vascularisation, **(b)** Intra-operative view after isthmectomy. Right kidney moiety lays in the upper part of the picture

kidneys are difficult to mobilize, imposing an easy vascular access to a renal hilum with possible malformations making a partial nephrectomy extremely challenging. Several precautions are to be thought of before the surgery to mitigate risks and optimize outcomes.

Of utmost importance stays a high-quality contrast enhanced CT abdomen to map out the vascularisation. Vascular malformations occur in up to 95.1% of horseshoe kidneys, which imposes a great challenge while performing partial nephrectomy [6].

The aid of ICG-fluorescence during partial nephrectomy in HK is only been reported twice, yet it proves to be a useful tool [7,8]. The application of ICG gives a real-time image of active vascularisation as ICG binds serum proteins, detected by the Near-Infrared Fluorescence camera of the DaVinci system [9]. Guiding the dissection on ICG could be useful to avoid major blood loss and potential heminephrectomy. In our case, we applied ICG to perform a preventive isthmectomy. After clamping the right renal artery, we demarcated the border of the right moiety and the isthmus. If major blood loss occurred, we would have been able to safely perform a heminephrectomy, without wasting additional time on the isthmus, an additional benefit was the increased mobility of the renal moiety. We performed the isthmectomy using the monopolar scissors, as the isthmus had a small diameter and without proximity of renal calyces, as seen on the preoperative CT scan. In previous, mostly laparoscopic, reports various techniques have been reported using linear staplers, bipolar or monopolar coagulation, Ligasure or Harmonic scalpel, and even with sutures [9-13].

Newer techniques using 3D models with infield overlay of kidney, tumour, ureter and vascularisation are still under development, but have the potential to improve safety on difficult partial nephrectomies, as is the case of the horseshoe kidney [14].

Conclusion

This report describes a safe approach to partial nephrectomy in the horseshoe kidney. The use of ICG and performing an isthmectomy increases vascular control and safer tumour resection.

Ethics Committee Approval: Not Applicable.
Informed Consent: Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.
Publication: The results of the study were not published in full or in part in form of abstracts.
Peer-review: Externally peer-reviewed.
Authorship Contributions: Any contribution was not made by any individual not listed as an author. Concept – P.D., S.T.; Design – P.D., S.T.; Supervision – S.T.; Resources – P.D., S.T.; Materials – P.D.; Data Collection and/or Processing – P.D.; Analysis and/or Interpretation – P.D.; Literature Search – P.D., S.T.; Writing Manuscript – P.D.; Critical Review – S.T.
Conflict of Interest: The authors declare that there are no competing interests regarding the publication of this article.
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