

# Laparoscopic Donor Nephrectomy from a Donor with a Horseshoe Kidney: A Challenging Surgical Case and Review of the Literature

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Kidney Transplantation; Horseshoe Kidney;  
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## 1. Abstract

The horseshoe kidney is the most common kidney fusion abnormality that includes irregular migration of both kidneys with simultaneous polar fusion. Obtaining a graft from a living donor with a horseshoe kidney by laparoscopic approach is quite rare. It is reported in the literature that around 90 cases of horseshoe kidney were transplanted. Most of them were performed from deceased donors. On PubMed and Google Scholar search only living donors with 13 horseshoe kidneys were found, and only two of them were performed laparoscopically. Herein, we report a challenging surgical case of laparoscopic donor nephrectomy from a donor with a horseshoe kidney.

## 2. Introduction

Kidney transplantation is the gold standard therapy for end-stage kidney failure. As in the rest of the world, organs donated after brain death do not meet our country's requirements, and the majority of kidney grafts are received from living donors [1,2]. Nevertheless, kidney transplants from living donors do not meet the demand, and this shortage forces medical professionals to expand the donor criteria. Laparoscopic donor nephrectomy, first presented by Ratner and Kavoussi, has globally become popular in living-donor kidney transplantation procedures since it can be safely performed in a short period [3]. Consequently, the laparoscopic approach is the preferred technique in cases previously indicated for open procedures. The horseshoe kidney is the most common kidney fusion abnormality (1 in 600-800 births) that includes irregular migration of both kidneys with simultaneous polar fusion [4]. Although us-

ing a cadaveric horseshoe kidney as a graft is a routine surgical procedure, obtaining a graft from a living donor with a horseshoe kidney by laparoscopic approach is quite rare. Although the functions of both kidneys are usually normal, vascular and/or urinary system anomalies are often found in them. In cases where both kidneys are functionally normal, the kidneys can be surgically separated in accordance with their anatomy and used as a renal graft. Herein, we report a challenging surgical case of laparoscopic donor nephrectomy from a donor with a horseshoe kidney.

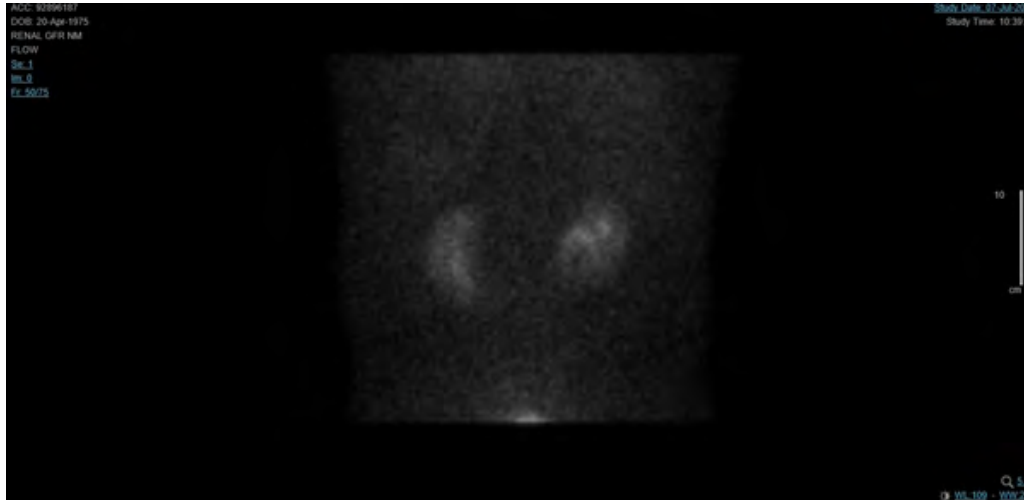
## 3. Case

### 3.1. Donor

A 47-year-old male patient applied to donate a kidney to his wife. BMI: 29.8kg/m<sup>2</sup>. In the examination, serum creatinine: 1.01mg/dl, e GFR: 92 ml/min, Cystatin/CKD EPI: 0.91 ml/min, HbA1c: 5.6%, blood lipids are normal, Prostate specific antigen total and free 0.5 and 0.15 ng/ml respectively, protein in spot urine 14 mg/dl, microalbuminuria: 34 mg/dl. Dynamic renal scintigraphy (DTPA) revealed GFR 101 ml/min, right kidney 48%, left kidney 52%, and lower shoe fusion anomaly (Figure 1). In abdominal renal angiography, parenchymal thickness of both kidneys was found to be 19 mm. Single renal artery and vein on the right and double renal artery (1 main branch and accessory polar artery) were detected on the left kidney (Figure 2 and 3). Therefore, the patient underwent right laparoscopic donor nephrectomy. After the kidneys were mobilized, the fused parenchymal part was separated with an endo-Gia (45 mm long, 2.5 mm height) white cartilage tri-stapler (Covidien AG, Dublin, Ireland) (Figure 4). There were no periop-

erative complications. A total of 50 ml of sero-hemorrhagic fluid came from the drain in the first 2 days. The donor was discharged on the 3rd postoperative day after removing the drain. Serum cre-

atinine: 1.1 mg/dl, e GFR: 71 mg/min, total protein in urine 9.3 mg/dl, microalbuminuria: 20 mg/dl were found in the 3rd month controls. The patient has no complaints.



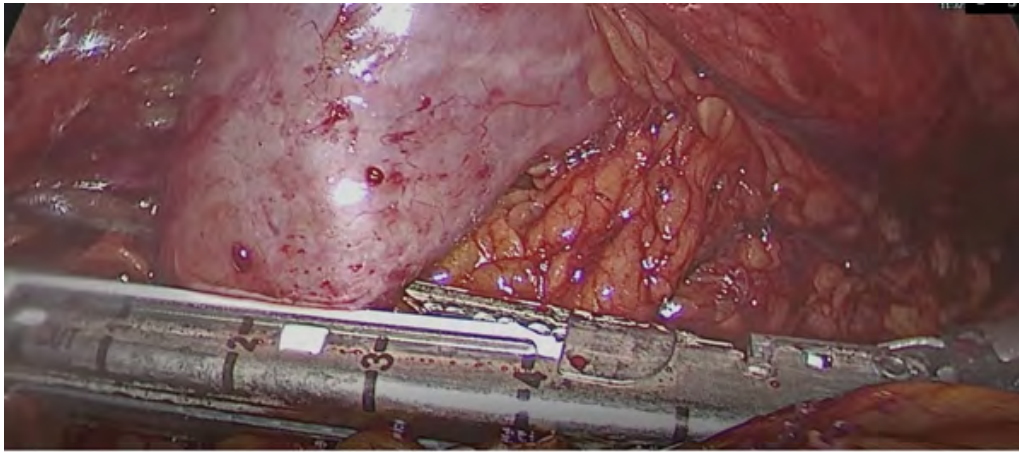
**Figure 1:** Radionuclide syngigraphy of the donor (DMSA)



**Figure 2:** 3-D abdominal CT angiography



**Figure 3:** CT abdominal angiography



**Figure 4:** Stapler line of transection

### 3.2. Recipient

44-year-old female patient. She has been on dialysis for 10 months with the diagnosis of end-stage renal disease due to chronic glomerulonephritis. She has no history of diabetes or hypertension, but she was anuric. She has no family history of any kind of renal disease. In abdominal ultrasonography, bilateral kidneys are small, parenchymal thickness of both kidneys is 8 mm, parenchymal echoes are increased by grade 3. e GFR 4.9 ml/min. The kidney implanted to her right iliac fossa, urinary reconstruction was performed by Lich-Gregoir method via double J catheter. There were no perioperative complications. Urine came out immediately after the kidney was reperfused. It was observed that there was no urine leakage from the incision where the fusion was separated. Antithymocyte globulin (1.5 mg/kg/d 5 days) for induction as immunosuppressive therapy, prednisolone (20 mg), tacrolimus (0.15 mg/kg/d- trough level 6-8 ng/ml) and mycophenolate mofetil (2 g/d) as maintenance therapy are used. 140 ml of sero-hemorrhagic fluid came from the drain for the first 3 days totally, and it was taken out on the 3rd day. The patient was discharged on the postoperative 5th day with serum creatinine 0.68 mg/dl and e GFR 109 ml/min. At the 3rd month follow-up, the patient has no complaints. Serum creatinine: 0.82 mg/dl, e GFR 98 ml/min, urine total protein 6.8 mg/dl, microalbuminuria 5 mg/dl.

### 4. Discussion

Horseshoe kidney is the most common congenital anomaly of the kidney. Incidental fusion of ureteral buds between the 4th and 6th intrauterine weeks may result in a horseshoe kidney [4, 5]. Fusion takes place while the kidneys are still in the pelvis, before they reach their normal dorsolumbar position. Its incidence is 1 in 600-800 in adults and 1 in 400 in children [4,5] 90% of the fusion is in the lower pole and therefore the kidneys cannot complete their ventral rotation and remain united in the midline. The fusion part may contain either the parenchyma or it may remain only as a fibrous band. Arterial, vein and ureter number and position anomalies may accompany this anatomical anomaly. Renal arteries may arise from the aorta and iliac arteries, rarely from the hypogastric

or middle colic artery [6,7]. Horseshoe kidney was first used by Politano as a graft by splitting it in 1963, but this case was not published [8]. It is reported in the literature that around 90 cases of horseshoe kidney were transplanted [9]. Most of them were performed from deceased donors. On PubMed and Google Scholar search only living donors with 13 horseshoe kidneys were found, and only two of them were performed laparoscopically (Table 1). In addition, we performed right laparoscopic donor nephrectomy in our case.

Graves [10] basically divided the horseshoe kidney into 5 regions and 3 types according to the distribution of the arteries.

- HS Type 1: Blood flow of both kidneys originates from a single artery and supplies blood to the whole kidney. The frequency of early branching after emergence is high.
- HS Type 2: The artery to the upper and middle sections exits the aorta separately, but the artery to the lower poles exits the aorta independently, then enters the kidney separately from the anterior surface or after leaving a single trunk.
- HS Type 3: The artery to the upper, middle and lower sections arises separately from the aorta.

In some cases, these types may be combined. One type can be seen in one kidney and another type in the other kidney. Our donor had Type 1 anomaly in the right kidney and Type 2 anomaly in the left kidney. There was also a small branch of vein coming from the iliac external vein in the right kidney.

Horseshoe kidney transplantation from deceased donors can be “en-bloc” or split depending on the condition of the vessels. Kidneys should be splitted if it is living donor transplantation. If a deceased donor transplant is to be made, it would be appropriate to split after making the vascular structure clear by injecting methylene blue. Since there is no such opportunity in living donor transplants, a good 3-dimensional angiographic study is required in the preoperative period. In addition, vesicoureteral reflux, ureteropelvic junction obstruction, kidney stones, cryptorchidism and hypopadias may accompany in two thirds of horseshoe kidneys [11,

12]. This may pose a risk for the remaining kidney in the donor. For this, a detailed medical history should be taken. We also examined this aspect in detail in our patient and we did not detect any accompanying pathology. In living donor transplants, radionuclide studies are a good idea to make sure both kidneys are working well. In our patient, in the DTPA study, the functions of both kidneys were very close to each other and they were functioning well. Some authors [13,14] argue that horseshoe kidney transplant outcomes are lower than normal kidneys due to vascular and ureteral anomalies. However, considering that kidney transplantation is superior to dialysis method in terms of life expectancy and quality of life, we think that it can be used easily when there is no other donor

in the family. Although it is technically difficult to harvest, we can say that harvesting is easy considering the anatomical structure of this donor, as a team that has been performing laparoscopic donor nephrectomy for decades. The most important complication in using this type of donor is urine leakage in the donor or recipient kidney. We think that separating the fusion parenchyma by tri-stapler method reduces urinary leakage. After revascularization in the recipient kidney, the stapler line should be observed for a period of leakage, and in case of leakage to the recipient and donor, drains should be placed in the area. Because of the technical challenge, horseshoe kidney donor transplantation should remain in experienced teams [15-25].

**Table 1:** List of living donor horseshoe kidney transplantation

Author	Year	Country	Case Number	Technique	Donor Complication	Receipt Complication
Inoue S. et al.14	2000	Japan	1	Open	Urine leak	Seroma
Goyal A. et al.15	2003	India	2	Open	No complication	No complication
Huser N. et al.16	2005	Germany	1	Open	No complication	No complication
Dinckan A. et al.17	2007	Turkey	3	Open	No complication	No complication
Sezer TO. et al.18	2013	Turkey	1	Open	No complication	No complication
Kumar S. et al.19	2015	India	1	Open	No complication	No complication
Justo-Janeiro JM. et al.20	2015	Mexico	1	Open	No complication	Delayed graft function
Kikkawa K. et al.21	2015	Japan	1	Open	No complication	No complication
Kaabak M. et al.22	2016	Russia	1	Open	No complication	No complication
Sozener U.23	2019	Turkey	1	Open	No complication	No complication
Sevmis M. et al.24	2020	Turkey	2	Open	No complication	No complication
Kumata H. et al.9	2021	Japan	1	Laparoscopic	No complication	No complication
Galvez D et al.26	2021	USA	1	Laparoscopic	No complication	No complication
Kivilcim T et al.	2022	Turkey	1	Laparoscopic	No complication	No complication

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