A Horseshoe Kidney From a Live Donor as a Renal Transplant: Case Report

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Abstract

Objectives: This case report presents our experience regarding a horseshoe kidney from a live donor to be used as a renal transplant.

Materials and Methods: The recipient was a 48-year-old man with chronic renal failure owing to hypertension who had been on hemodialysis for 2 years. The donor was his 43-year-old sister who had an uncomplicated horseshoe kidney with negative results on a urinalysis. An aortogram showed that the arterial supply to the kidney consisted of 2 superior arteries (1 on each side) and 1 inferior accessory artery that was divided to feed the lower fused parenchyma of the kidney.

Results: Surgery was performed via a retroperitoneal lumbotomy incision; the left half of the kidney was mobilized. The left kidney was procured by clamping the inferior accessory renal artery, transecting the parenchyma within the demarcation boundary. The transplant kidney was placed in the recipient’s contralateral iliac fossa. The graft vein was anastomosed to the recipient’s external iliac vein, the artery to the external iliac artery, and the ureter to the bladder. After perfusing the graft, no urine leakage was detected from the transected surfaces, and the graft began producing urine. There were no complications after surgery. The patient was discharged on the 10th day after surgery with a creatinine level of 0.07 µmol/L. Maintenance immunosuppressive treatment included tacrolimus, mycophenolate mofetil, and prednisolone.

Conclusions: We believe using a horseshoe kidney as a renal allograft after a detailed preoperative evaluation may help expand the donor pool.

Key words: Renal transplant, Horseshoe kidney, Live donor

Introduction

Despite advances in immunosuppressive treatment, the continuing donor organ shortage has led to an expansion of the criteria for the acceptability of deceased-donor organs, directing transplant surgeons to more challenging cases. Among these, a horseshoe kidney probably represents the least used cases. Although the horseshoe kidney is frequently associated with vascular, ureteral, and parenchymal anatomic abnormalities, the evidence of normally functioning parenchyma seems allow using these kidneys as split or en bloc renal grafts.

Since the first split transplant of a horseshoe kidney was performed by Politano from the monozygotic twin of the donor in 1963, several cases of a horseshoe kidney transplant, split and en bloc, have been reported. While several deceased-donor transplants have been performed to date, the number of overall horseshoe kidney transplants from live donors is only six. This study sought to present our experience with a horseshoe kidney used as renal transplant from a live donor.

Case Report

The recipient was a 48-year-old man with chronic renal failure owing to hypertension who had been on hemodialysis for 2 years. The donor was his
43-year-old sister who had an uncomplicated horseshoe kidney with negative results on a urinalysis. The results of her renal functioning were normal. The calyceal systems, with 1 ureter on each side, were not fused but positioned laterally. On aortogram, the arterial supply to the kidney consisted of 2 superior arteries (1 on each side) and 1 inferior accessory artery that divided to feed lower fused parenchyma of the kidney (Figure 1). Venous drainage paralleled the arterial anatomy. The left half of the kidney was chosen for a transplant.

Surgery was performed via a retroperitoneal lumbotomy incision; the left half of the kidney was mobilized. The left kidney was procured by clamping the inferior accessory renal artery and transecting the parenchyma within the demarcation boundary. A coagulator was used to minimize hemorrhage at the donor site, and the cut ends were sealed with dual mesh with polypropylene sutures. At the recipient site, the cut ends were sealed with polyglactin sutures. The left kidney was perfused, in vitro, with perfusion solution. The graft was placed in the recipient’s contralateral iliac fossa. The graft vein was anastomosed to the recipient’s external iliac vein, the artery to the external iliac artery, and the ureter to the bladder (Figure 2). After perfusing the graft, no urine leakage was detected from the transacted surfaces, and the graft began producing urine. There were no complications after surgery. As an induction agent, antithymocyte globulin (2.5 mg/kg/d) was introduced, and maintenance treatment composed of mycophenolate mofetil (2 g/d), tacrolimus (0.15 mg/kg/d), and prednisolone (20 mg/d).

The patient was discharged on the 10th day after surgery with a creatinine level of 0.07 mmol/L. At was 3-month follow-up, the patient readmitted owing to a rise in her creatinine level to 0.138 mmol/L. An allograft biopsy was performed. After 2 days, a biopsy showed her serum creatinine level at 0.25 mmol/L. Ultrasonography demonstrated grade 2 hydronephrosis and ureteral obstruction. His urine output was decreased (200 mL/d). Test results for serum cytomegalovirus DNA were negative. Owing to a ureteral obstruction, the patient was reoperated on, and the transplant ureter was anastomosed to the native ureter with double J stent. On the seventh postoperative day, his creatinine level was 0.08 mmol/L and his urine output was 2000 mL/d. On light microscopy, the allograft renal biopsy revealed 19 glomeruli with normal properties. Mild inflammatory infiltration limited on the corticomedullary junction and minimal edema also were observed. Some tubules on the medulla bore suspicious signs of viral atypia or reactive/regenerative atypia. Immunohistochemical staining with anti-SV 40 antibodies showed nuclear
staining compatible with viral infections (Figure 3). No C4d deposits were seen on peritubular capillary membranes. An allograft biopsy was diagnosed as acute *Polyomavirus hominis* 1 nephropathy stage A. Tacrolimus was discontinued and mycophenolate mofetil was tapered to 1 g/d. Maintenance immunosuppressive treatment included tacrolimus (0.15 mg/kg/d), mycophenolate mofetil (1 g/d), and prednisolone (10 mg/d). Serum *Polyomavirus hominis* 1-DNA was negative and anti SV-40 staining was negative at 6-month protocol biopsies. At the time of this writing, the patient is doing well and his 8-month follow-up shows a creatinine level of 1.6 mg/dL.

**Figure 3.** Immunohistochemical Study With Anti-SV 40 Antibody Showing Nuclear Staining Compatible With Viral Infections

### Discussion

A horseshoe kidney is the result of an incidental fusion of the ureteral buds that forms the ureter and its pelvis and the major calyces, between the fourth and sixth gestational week. A horseshoe kidney is the most common anatomic variation of the kidney, with an incidence of 1 in 600 to 800 in adults and 1 in 400 in childhood. Horseshoe kidneys are more frequent in male patients (2/1).  

Most horseshoe kidneys are fused at the lower poles. As a result, the kidneys fail to rotate medially during embryogenesis, resulting in a ventral position of the renal pelvis. Hence, the ureters course in front the lower poles. Horseshoe kidneys show variation in origin, number, and size of the arteries and veins. Graves divides the variable arterial supply into 3 distinct types according to the 5 segments of the kidney. In type 1, a single lateral aortic artery to each side supply all the segments of the kidney. In type 2, the upper and middle segments are supplied by 1 lateral aortic branch to each side, and the lower segment is supplied separately. In type 3, the upper, middle, and lower segments are supplied separately.

Since the first publication of a split transplant of a horseshoe kidney by Politano and associates from the monozygotic twin of the donor in 1963, thirty more case reports have been published. Of them, 5 horseshoe kidneys were transplanted from living donors (Table 1). The average age of the donors was 52.1 years (range, 42-59 y). There were 3 urine leakages during the postoperative period. All transplanted kidney allografts demonstrated good function at a median follow-up of 25 months (range, 12-54 mo). There was no death or graft loss.

The horseshoe kidney can be transplanted en block or split for 1 or 2 recipients after dividing it. If the number and structures of the arteries and veins are not suitable for anastomosing, an en block technique can be used to insert the kidney without dividing it.

In the split technique, the major question is: How to split it? Most authors transect the parenchyma by using methylene blue into the arterial system. We use a different technique. First, we clamp the inferior polar artery and after the demarcation line, the parenchyma is transected by cautery. Urine leakage is another complication after dividing the parenchyma. In our patient, there was no urine leakage or urologic complication.

There is no consensus regarding outcomes from using transplanted horseshoe kidneys; some authors

### Table 1. Summary of All Reported Cases of Horseshoe Living Kidney Transplants Since 1998

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Diagnosis</th>
<th>Donor Age / Relation</th>
<th>En Bloc/Split</th>
<th>Postoperative Complication</th>
<th>Follow-up (mo)</th>
<th>Graft Function (µmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aikawa</td>
<td>1998</td>
<td>NA</td>
<td>55/Father</td>
<td>Split</td>
<td>Urine leakage</td>
<td>20</td>
<td>Good/0.09</td>
</tr>
<tr>
<td>Inoue</td>
<td>2000</td>
<td>GL</td>
<td>55/Father</td>
<td>Split</td>
<td>Urine leakage</td>
<td>54</td>
<td>Good/0.08</td>
</tr>
<tr>
<td>Goyal</td>
<td>2003</td>
<td>DN</td>
<td>47/Sister</td>
<td>Split</td>
<td>-</td>
<td>18</td>
<td>Good/0.08-0.13</td>
</tr>
<tr>
<td>Goyal</td>
<td>2003</td>
<td>NA</td>
<td>55/Mother</td>
<td>Split</td>
<td>Urine leakage</td>
<td>12</td>
<td>Good/0.11</td>
</tr>
<tr>
<td>Huser</td>
<td>2005</td>
<td>NA</td>
<td>59/ Daughter</td>
<td>Split</td>
<td>-</td>
<td>16</td>
<td>Good/NA</td>
</tr>
<tr>
<td>Dinckan</td>
<td>2007</td>
<td>HTN</td>
<td>42/Sister</td>
<td>Split</td>
<td>-</td>
<td>30</td>
<td>Good/0.04-0.06</td>
</tr>
</tbody>
</table>
claim that there is no significant difference between a horseshoe and a normal kidney. Some surgeons claim that the results are better when clinicians perform the transplant en block. On the other hand, some authors think that it is worse than the normal kidney transplant owing to vascular and urologic abnormalities. This case is our first live horseshoe kidney transplant. We think that transecting the isthmus parenchyma and anastomosing the vascular and collecting systems make it difficult to transplant. However, owing to the scarcity of donors, the horseshoe kidney must be evaluated by experienced transplant surgeons.

The horseshoe kidney is a congenital malformation that predisposes immune competent individuals to severe urinary tract infections owing to the fused lower poles of the kidneys, resulting in an anteriorly displaced collecting system with high insertion of the ureters. In individuals with impaired immune functions, the BK virus is associated with nephropathy, hemorrhagic cystitis, ureteric stenosis, pneumonitis, hemophagocytic syndrome, encephalitis, retinitis, multiorgan failure, and multifocal leukoencephalopathy. Histopathology is the criterion standard for diagnosing and/or staging of BK nephropathy. In the early stage of the disease, there is a focal medullary involvement, with limited cytopathy of tubular epithelial cells. However, advancing to other stages, there is extensive renal involvement showing diffuse/multifocal cytopathy with necrosis, nuclear smudging of tubular epithelial cells, and accompanying diffuse mixed leukocytic infiltration. In our patient, BK virus and ureteral obstruction were detected 3 months after surgery. The BK virus infections were treated by adjusting the immunosuppression without antiviral drugs, and ureteral obstruction was treated by surgery alone (native ureteroureterostomy). Anomaly of the collecting system and addition of immunosuppression after transplant may lead to BK virus nephropathy.

Many transplant centers are reluctant to use horseshoe kidneys for transplant. This is because the rarity of a horseshoe kidney, as well as its accompanying vascular, parenchymal, and ureteral abnormalities, necessitates qualified technical experience. However, considering increasing number of patients on the waiting lists for renal transplant, we believe that using a horseshoe kidneys as a renal allograft after a detailed preoperative evaluation may contribute to an expanded donor pool.

References