Laparoscopic Heminephrectomy for Benign Disease of the Horseshoe Kidney

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ABSTRACT

Background and Objective: Minimally invasive surgery plays a definitive role in the management of complications associated with the horseshoe kidney (HK). Aberrant vessels, the renal isthmus, and renal ectopia are all unique features of this anomaly that make the laparoscopic approach a challenge. We report our experience with this technique in 2 patients.

Methods: Two patients with an HK were evaluated for recurrent urinary tract infection. In both cases, the non-functioning renal moiety was demonstrated by renal scan. A transperitoneal laparoscopic heminephrectomy was performed. The Endostapler device was used to divide the renal isthmus.

Results: The operative time was less than 3 hours. Blood loss was negligible. No intraoperative complications occurred. The hospital stay was 48 hours. Postoperative discomfort was minimal.

Conclusion: Laparoscopic heminephrectomy is a safe and feasible approach for benign diseases of the HK. The Endostapler is a useful adjunct in the division of the renal isthmus.

Key Words: Laparoscopic, Horshoe kidney, Heminephrectomy.
function of the left kidney and 98% function of the right. With clinical evidence of chronic pyelonephritis, we decided to remove the atrophic kidney laparoscopically.

METHODS

The patient is placed in the right semilateral position at 40 degrees. After CO2 insufflation of the peritoneal cavity, the left hemicolon is reflected along the line of Toldt. The splenocolic and renocolic ligaments are taken down with a Harmonic scalpel. The ureter is identified medial to the psoas muscle and dissected cephalad to identify the renal isthmus. Then the isthmus is dissected circumferentially and divided with an Endostapler (Figure 3). This facilitates dissection of the aberrant vessels to the isthmus. Further dissection is performed medially to identify as many aberrant vessels as are present. These are individually clipped and divided. The nephrectomy is completed after division of the ureter, and the kidney is morcellated within a Lap Sac® (COOK, Spencer, IN).

RESULTS

Both patients had an uneventful convalescence and were discharged home on the third postoperative day. They subsequently returned to work within 2 weeks. The duration of the operation was 3 hours. Average estimated blood loss was 150 cc.

DISCUSSION

The horseshoe kidney is the most common renal fusion anomaly. It occurs at an incidence between 1 in 400 and 1 in 800, with a slight predominance in males. While the majority of horseshoe kidneys go undiagnosed, the most common presenting symptoms are secondary to ureteropelvic junction (UPJ) obstruction, renal stones, or both. UPJ obstruction, the most common complication of the horseshoe kidney, occurs at an incidence of 25% to 40%. The cause of UPJ obstruction is believed to be the abnormal course of the ureter over the isthmus, high insertion of the ureter into the renal pelvis, and rarely, secondary to an anomalous blood supply to the isthmus crossing the UPJ. Most authors agree that abnormal motility of the UPJ causes obstruction. Secondary UPJ obstruction from vesicoureteral reflux is also possible. Finally, the anterior location of the renal pelvis also contributes to urinary stasis, infection, and the formation of stones, which can cause obstruction at the level of the UPJ.

Traditionally, UPJ obstruction in a horseshoe kidney has been treated by open dismembered pyeloplasty in a functioning kidney or by open nephrectomy in a poorly or nonfunctioning moiety. With the advent of minimally invasive surgery in the last 2 decades, conditions associated with the horseshoe kidney are now treated successfully via a laparoscopic, retrograde endoscopic, or percutaneous approach.
encountered during laparoscopic nephrectomy. Three groups of arteries were differentiated. In addition to normal renal arteries, accessory arteries originating from the great vessels entering the hilum and aberrant vessels entering directly into the poles of the kidneys and the isthmus were described. This vascular pattern of the horseshoe kidney can guide the laparoscopist during nephrectomy.

Radiographic imaging studies can play a vital role in the preoperative planning of heminephrectomy for horseshoe kidneys. The use of magnetic resonance urography was described by Mostafavi et al.\textsuperscript{14} to evaluate UPJ obstruction. This study, as an alternative to conventional urography, allows a better delineation of the anatomy. They believe that this technique offers superior imaging compared with other imaging modalities, allowing simultaneous evaluation of renal anatomy and function. On the other hand, 3-dimensional computed tomographic angiography may offer the same information with less cost. Most recently, Strauss et al.\textsuperscript{15} using sonography reviewed 34 patients with horseshoe kidneys. “The typical sonographic images of the horseshoe kidney include caudal renal position, malrotation with reversed longitudinal axis of each kidney, and anterior extrarenal pelves.”\textsuperscript{15} As our case demonstrates, sonography can easily identify hydronephrosis; however, it remains ineffective for identifying the isthmus or characterizing the blood supply to the horseshoe kidney. Finally, radioisotope scans can demonstrate the presence of obstruction; however, like sonography, this imaging modality lacks the ability to identify the vasculature.\textsuperscript{16,17}

Although all the case reports regarding heminephrectomy describe standard CT scans to evaluate the horseshoe kidney, Donovan et al.\textsuperscript{18} suggested that routine preoperative arteriography is essential to identify all vessels. We believe that arteriography adds to the cost and subjects the patient to unnecessary radiation exposure and dye load leading to renal insufficiency or failure. Careful dissection of the isthmus and the renal pedicle should allow the surgeon to systematically identify the aberrant vessels, obviating the need for an arteriogram.

The isthmus can be handled in several ways. Ao et al.\textsuperscript{6} brought the isthmus outside the abdominal wall and divided it with electrocautery under direct vision. Others,\textsuperscript{7,18} including ourselves, have successfully used the Endostapler. Depending on the thickness of the isthmus, the Endostapler can be used several times. In case 1, the

Laparoscopic heminephrectomy for the horseshoe kidney is a safe and effective minimally invasive technique that was first described by Reidl et al.\textsuperscript{9} However, 3 factors are unique to the horseshoe kidney that make the laparoscopic approach challenging: its association with aberrant vessels, the isthmus, and the anatomic position. Familiarity with the anatomy and variations in the technique are essential for a successful outcome.

The arterial supply of the horseshoe kidney has been studied by Janetschek et al.\textsuperscript{13} in 6 postmortem horseshoe kidneys. Although this anatomical study was oriented to establish the risk of hemorrhage during a percutaneous nephrolithotomy, it is reflective of the arterial patterns
isthmus was thick and required 3 loads of the Endostapler to complete the division. During placement of the Endostapler, one must be aware that the isthmus is supplied by vessels entering dorsally, and these must be avoided. The use of ultrasonic shears, as well as a microwave coagulator device, has been described in dividing the isthmus. Further data about these methods, however, are lacking. Whatever technique is used, it is important not to violate the collecting system of the contralateral kidney and to obtain adequate hemostasis. Finally, the conventional notion that lateral fixation of the lower pole should accompany division of the isthmus to protect the remaining kidney from developing ureteropelvic junction obstruction is no longer true.

Retroperitoneal laparoscopic nephrectomy, initially reported by Gaur et al in 1993, has become the technique of choice in most institutions. Retroperitoneal surgery has the theoretical advantage of preventing intraabdominal adhesions. In addition, it provides an optimal view of all the vessels. As the anterior surface of the horseshoe kidneys is covered with posterior parietal peritoneum, it can become difficult to confine CO₂ to the retroperitoneal space while maintaining an adequate working space without inadvertently opening the peritoneum. Two cases of retroperitoneal nephrectomy for horseshoe kidneys have been reported by Hemal et al. It is a challenging approach and more experience is needed before it becomes the standard of care.

**CONCLUSION**

Laparoscopic heminephrectomy is a feasible alternative in the surgical management of benign disease of the horseshoe kidney and may one day become accepted as the standard of care. As more surgeons continue to become familiar with laparoscopic surgery, open surgery for the horseshoe kidney for all indications may become obsolete. In addition, awareness of the differences in techniques unique to this congenital anomaly and familiarity with the anatomy will promote satisfactory results.

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