Laparoscopic Upper Pole Heminephrectomy in Adults for Treatment of Duplex Kidneys

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Purpose: To present our results of laparoscopic upper pole heminephrectomy in adult patients with duplex kidney.

Materials and Methods: A total of 10 patients with an age range of 27 to 54 years old underwent laparoscopic upper pole heminephrectomy for complete duplication of the renal collecting system. The key point of the technique included the placement of a catheter in the normal ureter at the beginning of the procedure. The patient was positioned in a 45-90 degrees lateral decubitus position and a 4-port transperitoneal or 3-port retroperitoneal technique was applied followed by the mobilization of the upper pole ureter away from the renal hilum. Afterwards, the vasculature supplying the upper pole was precisely identified and ligated. Followed by transection of the ureter and its transposition cephalad to the hilum, the upper pole moiety was fully transected using the harmonic scalpel.

Results: Eight patients were operated on using the transperitoneal approach and 2 using the retroperitoneal technique. One patient required preoperative percutaneous drainage due to pyonephrosis. The operation time ranged between 150 to 350 min with minimal blood loss (0-200 mL). Hemostasis was achieved with an Argon laser in one patient. The lower pole calyceal system was perforated in one patient and repaired intracorporally. No major intraoperative complications occurred. All of the patients except two had their drains removed in 72 h after the operation and were generally discharged on postoperative day 3.

Conclusion: Laparoscopic upper pole heminephrectomy for an ectopic ureter is safe and reproducible and offers benefits of laparoscopic surgery even in patients with complicated urinary tract infection.

Keywords: kidney; abnormalities; surgery; laparoscopy; nephrectomy; methods; postoperative complications.

INTRODUCTION

A complete duplex kidney is not an uncommon congenital anomaly of the urinary tract and has a prevalence of 1/125. It is usually associated with ureteroceles, vesicoureteral reflux and ectopic ureters accompanied by a poorly functioning upper pole segment.[1,2] It manifests with urinary tract infections (UTI), urinary incontinence and voiding dysfunction during childhood, whereas flank pain or recurrent UTI might be signs of the disease when undiagnosed until adulthood. The standard treatment for the duplicated system is upper pole heminephrectomy with ureterectomy when needed, which used to be performed with a flank incision. Since the first laparoscopic upper pole heminephrectomy with ureterectomy in a pediatric patient was reported by Jordan and Winslow in 1993, urologists tend to perform this surgery using the laparoscopic technique.[2] The published reports on laparoscopic heminephrectomy are limited and occasionally confined to the pediatric population.[1,3-5] We report our results and experience in laparoscopic upper pole heminephrectomy for the treatment of duplex kidneys in adults.

MATERIALS AND METHODS

Study Population

The endourological databases of two high-volume urology clinics (Department of Urology, School of Medicine in Hacettepe and Çukurova Universities) were retrospectively reviewed to analyze the results of laparoscopic heminephrectomy. Between April 2005 and March 2010, six males and four females within the age range of 27–54 years underwent laparoscopic upper pole heminephrectomy for duplicated collecting systems. Five and 4 patients had a duplicated system on the right and left sides, respectively, while one patient had a bilateral duplicated system. Ipsilateral kidney stones were detected in 2 patients, one of them, in which the stone was in the affected system, was treated laparoscopically during heminephrectomy and the other one who had the stone in the healthy lower pole was managed with an internal stent to facilitate further treatment modalities. All patients had ectopic ureters, additionally an ureterocele was revealed in 2 patients who had a history of previous endoscopic ureterocele incision in the duplicated region site and 1 patient had a cecal ureterocele.

The main complaint on admission was side or abdominal pain in all patients. Eight patients had a history of recurrent UTI, two of them presented with high fever and required long-term antibiotic therapy and one required nephrostomy drainage. Preoperative imaging evaluation was done using ultrasonography, computed tomography

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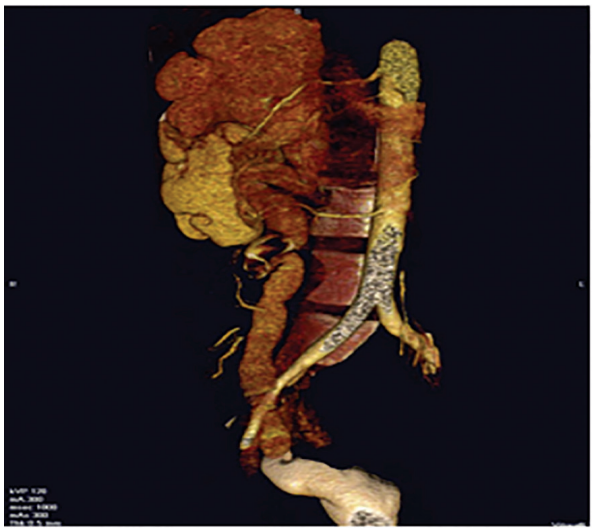

Figure 1. Three dimensional reconfiguration of computed tomography demonstrating the non-functioning upper pole moiety.

and voiding cystourethrography when necessary (**Figure 1**).

Surgical Technique

After the induction of general anesthesia, cystoscopy was carried out routinely in all patients and a 6 French (F) open-ended catheter was placed into the normal ureter under fluoroscopic guidance. The urethral Foley catheter was left in situ. Thereafter, the patient was positioned in a 45-90 degrees lateral decubitus position and the transperitoneal technique (retroperitoneal in 2 patients) was performed. We applied a similar technique as first performed by Wang and colleagues in 2004.[6]

No bowel preparation was used routinely in our patients; however, all of them were wearing either pneumatic whole leg compressors or surgical stockings. Peritoneal access is obtained using a Veress needle inserted at the umbilicus and the abdomen is insufflated up to 15 mm Hg. All trocars were placed under direct vision. A three-port transperitoneal technique is utilized with a 10 mm trocar at the umbilicus, a 10 mm port in the midclavicular line just below the umbilicus, and a third 5 or 10 mm port subcostally. An optional fourth port (5 mm) was placed just above the umbilical level in the midaxillary line when needed. Four trocars were used in six patients, 3 trocars in two patients whereas 5 trocars were used in another two patients.

After moving the colon medially, the kidney and the duplicated ureters were identified with blunt and sharp dissection. The normal lower pole ureter was identified by the previously placed catheter, which helped the operators to precisely dissect it away from the effected upper pole ureter. Then, the upper pole ureter was fully mobilized away from the renal hilum (posterior and cephalad). Because duplicated systems are mostly accompanied by vascular anomalies, the upper pole ureter dissection must be performed carefully.

Close dissection to the serosa of the upper pole ureter will be protective against harming unexpected vascular structures. During dissection, the artery and vein supplying the upper pole were precisely identified and ligated. After transection of the ureter and its transposition cephalad to the hilum, dissection of the upper pole moiety was performed using harmonic scalpel through the demarcation line, which is easily distinguished. Hook electrocautery is used in some cases to mark the renal capsule between the upper pole and the lower pole. Hemostasis was achieved using bipolar and monopolar electrocautery. No adjuvant coagulative agent was used. Indigo blue injected through the ureteral catheter showed extravasation from the lower pole collecting system in only one patient. A drain was placed in the surgical field before removal of the trocars (**Figure 2 A and B**).

RESULTS

Patient characteristics are summarized in **Table**. No conversion to open surgery or re-operation was required. In one patient, the collecting system of the lower pole was opened and the defect was sutured intracorporeally by using 3.0 Vicryl suture. No other intraoperative complications occurred. The mean blood loss volume was minimal (0-200 mL) and the mean operation time was 230 min (150-350 min). Dissection of the upper pole was technically difficult in the two cases with UTI as expected.

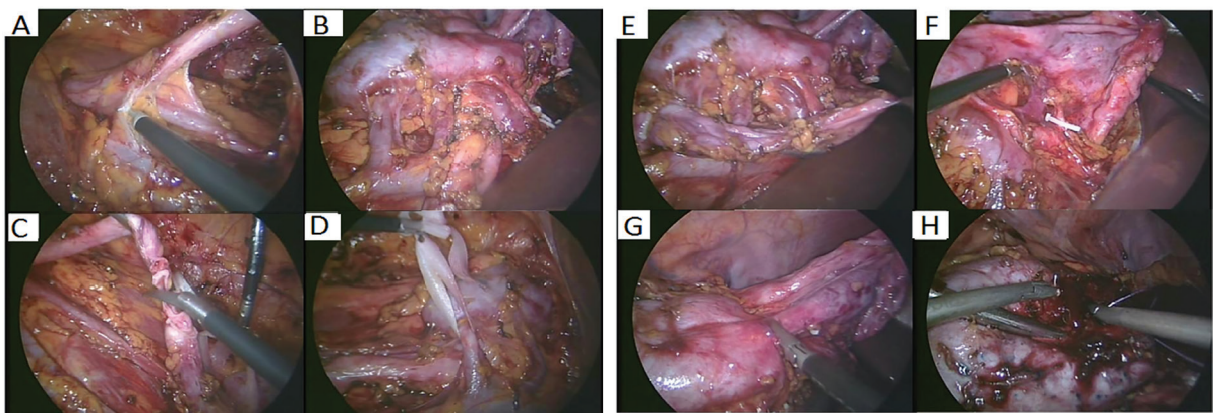

Figure 2. A) Fine dissection of upper pole ureter from the lower pole ureter and identification and preparation of renal vasculature; **B)** Precise identification of multiple renal veins draining the normal lower pole of the right kidney; **C)** Transection of the upper pole ureter; **D)** Suspension of the renal vein and transposition of the upper pole ureter through the renal vasculature; **E and F)** The upper pole ureter is completely mobilized and transposed, the vascular supply of the upper pole was identified and controlled using clips and vascular sealing devices when appropriate; **G and H)** Resection of the upper pole and repair of the lower pole perforation.

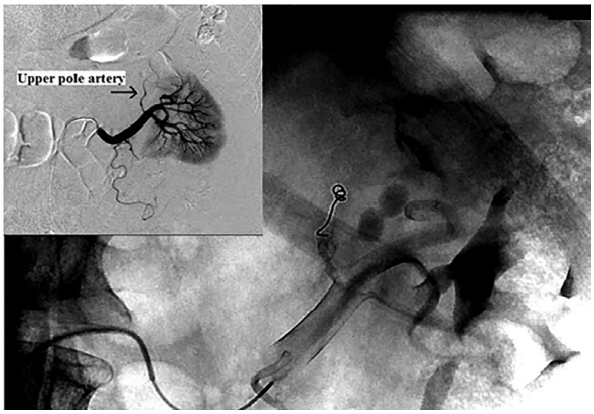

Figure 3. Successful angioembolization of the upper pole artery.

The ureteral catheters were removed before removing the patient from the operating room. The urinary catheters were removed 24 h after surgery in all patients while drains were generally removed on postoperative day 2. The mean hospital stay after surgery was around 60 h excluding the 2 patients with prolonged hospital stay. Patients were not discharged in the case of absent flatus. Subsequently, none of our patients showed delayed flatus. Pathology reports revealed active chronic inflammatory fibrosis and granulation tissue in all patients.

Hemostasis was achieved with bipolar and monopolar cautery. Argon laser was used in one patient with pyonephrosis on lower pole moiety through the dissection line to control oozing from the inflammatory parenchyma. The ureters of the effected system were dissected as far as possible and ligated; however, in one case, in which a refluxing cecal ureterocele was present, the ureter was adequately dissected and left open. Dissection was not continued in the pelvis to prevent the disruption of neurogenic and vascular structures that would cause voiding problems. Two patients with UTI received antibacterial therapy for 10 days. The postoperative period was uneventful except for two patients. Both presented with extensive drainage. One showed minimal extravasation from the normal ureter on post-operative day 1, which was thought to be injured during dissection and was successfully managed with an internal stent (double J ureteral stent) insertion, the patient was discharged the other day. Patient number 10 had a huge dilated upper pole segment and presented with an abdominal mass. Although an extensive dissection was performed, the vascular supply could not be identified. Due to the prolonged urine drainage and the lack of vascular supply visualization preoperatively, a selective renal angiography was planned. The angiography revealed two extra renal segmental arteries arising from the main renal arteries, which were embolized at the same time. Subsequently, drainage decreased and the patient was discharged after removal of the drain (**Figure 3**). None of the patients required blood transfusions.

DISCUSSION

In adults, treatment of the non-functioning upper pole of complete duplex kidneys is indicated in patients with recurrent UTI and/or side or abdominal pain. Since the first laparoscopic heminephrectomy by Jordan and Winslow,[3] there has been a high incidence of pediatric use of laparoscopy in treatment of duplex systems. Nevertheless, there are limited data and studies focusing on heminephrectomy in adults. This study was conducted to increase the amount of data available in laparoscopic upper pole heminephrectomies in duplex kidneys.

Laparoscopy offers better visualization of the vasculature and parenchyma, shorter hospital stay and diminished postoperative pain. Regardless from the approach, both retroperitoneal and transperitoneal heminephrectomy offers classical advantages of laparoscopic surgery. The advantages of transperitoneal approach are as follows: having a larger working space, better exposure of the hilum and easy manipulation of the ureter when necessary.

Table. Characteristics of patients who have undergone laparoscopic upper pole heminephrectomy for treatment of duplex kidney.

Patients	Age/Gender	Side/Symptom	Approach / Trocar Number	Operation Time (min)	Drain Removal Time / Discharge Time (h)	Complications (Clavien Grade)	Management
1	42/M	R/Abdominal pain	Retroperitoneal / 4	150	26/30	-----	-----
2	36/F	R/Abdominal pain-UTI	Transperitoneal / 5	300	40/96	-----	-----
3	53/M	L/Abdominal pain	Transperitoneal / 4	255	36/72	-----	-----
4	50/F	R/Abdominal pain	Retroperitoneal / 3	270	16/20	-----	-----
5	27/M	R/Abdominal pain	Transperitoneal / 4	150	72/96	Chest pain (Grade I)	Conservative
6	44/M	L/Abdominal pain	Transperitoneal / 3	150	24/26	----- -----	
7	42/F	L/Abdominal pain	Transperitoneal / 4	225	72/96	Lower pole perforation (Grade III)	Intracorporeal suture
8	36/F	R/Abdominal pain-UTI	Transperitoneal / 5	350	72/336	UTI (Grade II)	Antibiotics
9	28/M	L/Abdominal pain	Transperitoneal / 4	180	44/48	Urinary extravasation (Grade III)	Double J ureteral catheter insertion
10	54/M	L/Abdominal pain	Transperitoneal / 4	270	440/460	Prolonged drainage (Grade III)	Angioemboliza-tion

Abbreviations: M, male; F, female; R, right; L, left; UTI, urinary tract infection.

The retroperitoneal heminephrectomy has its own benefits, such as less dissection to reach the renal pedicle, reduced risk of intra-abdominal organ injury and shorter bowel movement recovery time; however, it has a limited working space compared to the transperitoneal approach. With regard to duplex kidneys, transperitoneal approach was thought to be better in anatomically complicated and/or infected systems, which were preoperatively diagnosed using imaging modalities and in patients with massive hydronephrosis. Surely, in patients without these factors, retroperitoneal approach is feasible without an increase in complications.

Reported postoperative complications in the literature are prolonged urinary drainage, urinoma, recurrent UTI due to incomplete excision of the ureteric stump, loss of function of the lower pole and hypertension regardless from the approach. We encountered a 50% complication rate. Although we did not perform complete ureteral excision, none had urinoma formation or extravasation. In the literature, it is not recommended to manipulate infected systems; however, our approach is to insert a percutaneous nephrostomy preoperatively to reduce the risk of postoperative sepsis in patients with pyonephrosis. As shown in **Table**, the patients who had UTI prior to surgery, had the longest operation time, which were also done by five trocars. It should be remembered that surgery of infected organs requires meticulous dissection because antibiotic treatment might not eliminate adhesions.

An anomalous urinary tract suggests an anomalous vasculature; therefore, preoperative appropriate evaluation of the vascular supply of the kidney should be performed to reduce both intra and postoperative complications and it should be remembered that a transperitoneal approach will be easier to recognize the vasculature in these cases. Even the arteries, which seem non-vital, must be carefully dissected and ligated to minimize the risk for bleeding. Ureters with vesicoureteral reflux should be followed up to the bladder and ligated to prevent a source for recurrent UTI; otherwise, ureteric dissection should be performed as far as possible without compromising the comfort of the surgeon. We use preoperative insertion of a ureteral catheter to identify the normal ureter however different alternatives have been suggested for preserving the ureter.[7]

Different techniques regarding hemi/partial nephrectomies have been suggested in the literature.[8] This study is a retrospective review of our results rather than a technical analysis. We aimed to publish our operative findings with regard to a rare operation in adult age group. The relatively high complication rate indicates the difficult nature of the procedure. Furthermore, infected urinary system prior to surgery might be challenging in some cases.

The negative aspect of our study is the lack of long term follow-up and post-operative imaging regarding the function of the residual kidneys. Although the data on long-term follow-up in the literature is limited on adult laparoscopic heminephrectomies, it still provides classical advantages of laparoscopic surgery. Nevertheless, the complexity of the technique of heminephrectomy requires a sufficient laparoscopy expertise.

CONCLUSION

As previously proven for the pediatric population, laparoscopic upper-pole heminephrectomy for ectopic ureter in duplex kidneys is safe, reproducible and offers typical preoperative and postoperative benefits of laparoscopic surgery in adults with acceptable complications. These advantages are obvious even in patients with complicated UTI.

CONFLICT OF INTEREST

None declared.

REFERENCES

1. Janetschek G, Seibold J, Radmayr C, Bartsch G. Laparoscopic heminephroureterectomy in pediatric patients. J Urol. 1997;158:1928-30.
2. Malek RS, Kelalis PP, Stickler GB, Burke EC. Observations on ureteral ectopy in children. J Urol. 1972;107:308-13.
3. Jordan GH, Winslow BH. Laparoendoscopic upper pole partial nephrectomy with ureterectomy. J Urol. 1993;150:940-3.
4. Prabhakaran K, Lingaraj K. Laparoscopic nephroureterectomy in children. J Pediatr Surg. 1999;34:556-8.
5. Yao D and Poppas DP. A clinical series of laparoscopic nephrectomy, nephroureterectomy and heminephroureterectomy in the pediatric population. J Urol. 2000;163:1531-5.
6. Wang DS, Bird VG, Cooper CS, Austin JC, Winfield HN. Laparoscopic upper pole heminephrectomy for ectopic ureter: initial experience. Can J Urol. 2004;11:2141-5.
7. Kumar S, Singh SK, Pandya S, Acharya N, Mandal A. Laparoscopic pyeloureterostomy in ureteral duplication with lower polar ureteropelvic junction obstruction: easy and effective. J Laparoendosc Adv Surg Tech A. 2007;17:785-8.
8. Nouralizadeh A, Ziaee SA, Basiri A, et al. Transperitoneal laparoscopic partial nephrectomy using a new technique. Urol J. 2009;6:176-81.