Laparoscopic upper pole heminephrectomy for ectopic ureter: initial experience

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WANG DS, BIRD VG, COOPER CS, AUSTIN JC, WINFIELD HN. Laparoscopic upper pole heminephrectomy for ectopic ureter: initial experience. THE CANADIAN JOURNAL OF UROLOGY. 2004;11(1):2141-2145.

Objectives: *To determine the feasibility, clinical outcomes, and complications of laparoscopic upper pole heminephrectomy for ectopic ureter. The standard treatment for a duplex kidney with a poorly functioning upper pole moiety is an upper pole heminephrectomy. We review our technique and experience with laparoscopic upper pole heminephrectomy. A brief review of the literature is provided.*

Methods: *A retrospective review of clinical records from three patients who underwent laparoscopic upper pole heminephrectomy was performed. Two of the three patients presented with lifelong urinary incontinence and were diagnosed with an ectopic ureter associated with a poorly functioning upper pole moiety. The third patient presented with recurrent episodes of pyelonephritis and was found to have a duplex kidney with a poorly functioning upper pole segment draining into a ureterocele.*

Results: *All three patients underwent laparoscopic upper pole heminephrectomy through the transperitoneal approach. Mean operative time, including ureteral stent insertion, was 198 minutes. Two of the three patients were discharged within 24 hours of surgery. The third patient had a urinary leak secondary to a small amount of residual upper pole parenchyma which resolved with superselective renal arterial embolization. All three patients are well at 5.3 months follow-up.*

Conclusions: *Laparoscopic upper pole heminephrectomy for ectopic ureter is safe and reproducible and offers the patient the typical postoperative benefits of laparoscopic surgery.*

Key Words: laparoscopy, heminephrectomy, ectopic ureter

Introduction

Complete duplication of the collecting system is a relatively common congenital anomaly.[1] When present, duplex kidneys can be associated with ectopic ureters, ureteroceles, and vesicoureteral reflux. Clinical manifestations of ectopic ureters and ureteroceles include incontinence, voiding dysfunction, and urinary tract infections.[2] An ectopic ureter can present as lifelong continuous incontinence.

Ectopic ureters frequently occur in association with a dysplastic upper pole renal moiety. When a poorly functioning upper pole segment is present, a standard surgical treatment is upper pole heminephrectomy.[2] This operation usually employs a flank incision. However, there is significant morbidity associated with a large flank incision.

More than a decade ago, Winfield et al[3] performed the first laparoscopic partial nephrectomy. Since then,

Accepted for publication September 2003

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advances in surgical technique, equipment, and instrumentation have expanded the role of laparoscopy to include more complex renal surgery. Several centers have reported success with laparoscopic partial nephrectomy.[4-6] The laparoscopic approach provides decreased patient morbidity while duplicating the results from open surgery. Experience with laparoscopic partial nephrectomy has allowed surgeons to perform laparoscopic heminephrectomies. Herein we describe our technique for laparoscopic upper pole heminephrectomy in association with an ectopic ureter, which has been used successfully in three patients. In addition, to update the current status of laparoscopic upper pole heminephrectomy for ectopic ureter, the worldwide series are reviewed.

Methods

Case presentations

Case one

A 13-year-old girl presented with a lifelong history of enuresis and daytime continuous urinary leakage. She had failed all pharmacologic therapeutic approaches. Renal ultrasound demonstrated a duplex left kidney with a hydronephrotic upper pole segment. Renal perfusion scan showed poor function of the left upper pole moiety. Genitourinary examination revealed an ectopic orifice just lateral to the urethral meatus. Retrograde pyelogram through the ectopic orifice confirmed an ectopic upper pole ureter. The patient underwent a left laparoscopic upper pole heminephrectomy.

Case two

A 5-year-old girl presented with a history of lifelong continuous incontinence. She had failed all medical management. Voiding cystourethrogram was normal. IVP suggested a duplex left kidney with a poorly functioning upper pole moiety. Magnetic resonance (MR) urography confirmed a hydronephrotic upper pole moiety with several calculi in the left upper pole distal ureter. The patient underwent a left laparoscopic upper pole heminephrectomy with intraoperative laparoendoscopic stone retrieval.

Case three

A 38-year-old woman presented with a 2 year history of recurrent right pyelonephritis. Intravenous pyelography (IVP) and computerized tomographic (CT) scan demonstrated a duplex right kidney with minimal function of the upper pole segment. Nuclear renography showed poor function of the right upper pole moiety. Cystoscopy revealed a right ureterocele. MR angiography with three dimensional reconstruction images showed a hydronephrotic right upper pole renal segment with an accessory artery with branches into both the upper pole segment and into normal lower moiety renal parenchyma. The patient underwent a right laparoscopic upper pole heminephrectomy.

Operative technique

The patient receives a full mechanical bowel preparation the day before surgery. Antibiotics such as a first-generation cephalosporin are given peri-operatively. The patient is then induced with a general anesthetic, and an orogastric tube is placed. After successful anesthesia, flexible cystoscopy is performed and a guidewire and a 5 French ureteral catheter are placed into the normal lower pole ureter. This aids in intra-operative identification of the normal lower pole ureter to reduce the risk of injury.

The patient is placed in the modified flank position with the affected side elevated approximately seventy degrees. Full flank and abdominal preparation is performed, taking care to include the ureteral catheter in the operative field to allow for intra-operative manipulation. Peritoneal access is obtained using a Veress needle inserted subcostally at the midclavicular line (MCL) and pneumoperitoneum established. A four-port transperitoneal technique is used (Figure 1)

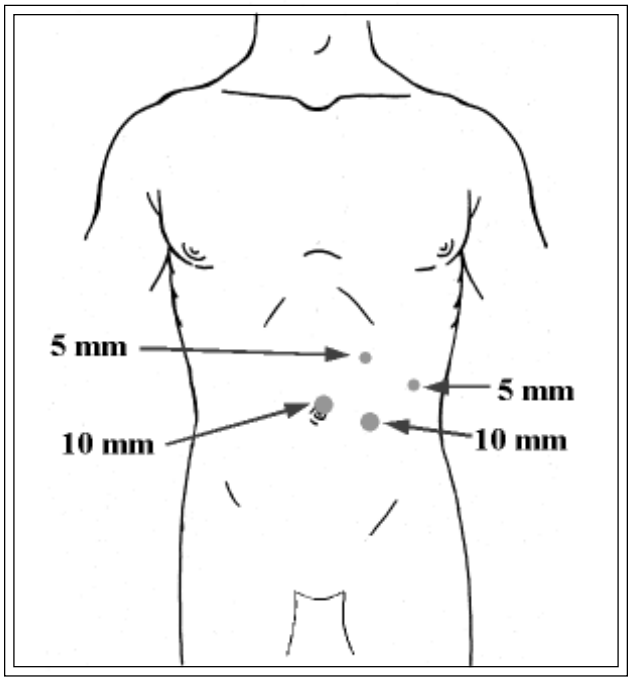

Figure 1. Port placement for left laparoscopic upper pole heminephrectomy.

with a 10 mm trocar at the umbilicus, a 10 mm port at the MCL just below the umbilicus, and the third port (5 or 10 mm) subcostally at the MCL. The third port may be shifted to the midline in a thin patient. An optional fourth port (5 mm) may be placed just above the umbilical level in the midaxillary line.

The colon is reflected medially by incising along the line of Toldt to enter the retroperitoneum. The kidney is identified and the upper pole dysplastic segment is visualized. Distally, the dilated upper pole ureter is identified. Manipulation of the ureteral catheter helps to distinguish the upper from the lower pole ureter. The dilated upper pole ureter is traced back and mobilized proximally towards the renal hilum. The hilar vessels are identified and dissected away from the upper pole ureter. At this point, branch vessels supplying the upper pole segment are clipped and divided. The upper pole ureter typically courses posterior to the renal hilar vessels and requires mobilization from these vessels prior to transection. The upper pole ureter is transected close to the hilum and carefully passed posterior and cephalad to the renal hilum.

The ureter is then traced back proximally towards the upper pole dysplastic segment. Hook electrocautery is used to score the renal capsule between the upper pole segment and the remaining kidney. The harmonic scalpel is useful to fully transect the upper pole moiety. Hemostasis is usually sufficient but use of tissue sealants and/or the argon beam coagulator can be helpful. The specimen is removed through a 10 mm port site using a standard specimen retrieval bag. A Jackson-Pratt or penrose drain is inserted and the port sites closed using the Carter-Thomason (Inlet Medical, Eden Prairie, Minnesota) fascial closure device.

The orogastric tube is removed at the conclusion of the case. The Foley catheter is removed on the first postoperative day. Assuming no urine leak, the drain is removed on the first or second postoperative day. Discharge is usually within 24 to 48 hours.

Results

In cases one and two, total operative time including stent placement was 186 and 244 minutes, respectively, with estimated blood loss of 100 ml and 40 ml. Neither patient required any blood transfusion. In both cases the upper pole heminephrectomy was performed without complication. In case two, the dilated upper pole ureter contained six small stone fragments in the distal ureter. The stones were successfully removed using laparoendoscopic means with a 15 French flexible cystoscope inserted through a 10 mm port site. Stones were basketed using a Segura basket. Also, in case two, we were unable to place an open-ended ureteral catheter into the normal lower pole ureter because the small size of the ureteral orifice precluded stent placement. However, there was no difficulty identifying the massively dilated upper pole ureter intra-operatively; the normal lower pole ureter was also identified. Hospital stay was 1 and 2 days, respectively. There were no postoperative complications and both patients are well at 4 and 3 months, respectively.

In case three, right laparoscopic upper pole heminephrectomy was performed. Total operative time was 165 minutes with an estimated blood loss of less than 50 cc. Intraoperatively, the accessory vessel seen on MR angiogram was identified; because it appeared to be supplying normal parenchyma, it was kept intact. The patient's postoperative course was notable for a persistent urinary fistula. Retrograde pyelography through the normal lower pole ureter revealed no evidence of extravasation. It was felt that there was a small amount of upper pole parenchyma remaining, which was causing the urinary leak. The patient underwent angiography with super-selective embolization of the upper pole segment, and the urine leak resolved promptly. The patient was discharged on the sixth postoperative day and is doing well at 9 months follow-up without recurrent pyelonephritis.

Discussion

Duplicated collecting systems are among the most common congenital urologic anomalies. They are associated with ureteroceles, ectopic ureters, and vesicoureteral reflux. Most ectopic ureters drain the upper pole moiety of a duplex kidney and manifest clinically as continuous or intermittent incontinence, voiding dysfunction, and urinary tract infections. The diagnosis is made on clinical suspicion and confirmed by ultrasound and renal scan. High resolution MR angiography with three dimensional reconstruction images can further define the anatomy and facilitate pre-operative planning. When the upper pole moiety is poorly functioning, upper pole heminephrectomy is the usual treatment, resulting in virtually 100% cure. The high success rate of upper pole heminephrectomy for ectopic ureter has made this the surgical procedure of choice. Given the relatively complex nature of this procedure, there are few reports in the literature of the laparoscopic approach. As experience with laparoscopic renal surgery has increased, so have the indications. When there is a reasonable amount of

function remaining on the upper pole moiety, alternatives to upper pole heminephrectomy include ureteral reimplantation and ureteropyelostomy from the upper to lower pole ureter.

The first laparoscopic partial nephrectomy was performed in 1992.[3] Since that time, laparoscopic partial nephrectomy has been performed successfully in several centers.[4-6] The advantages of the laparoscopic approach are clear. With increasing experience with laparoscopic partial nephrectomies, laparoscopic upper pole heminephrectomy is becoming more standard.

Laparoscopic upper pole heminephrectomy has been previously described. The first laparoscopic upper pole heminephrectomy for ureteral ectopia was performed in 1993 by Jordan and Winslow[7] on a 14-year-old girl. The patient was discharged on the second postoperative day and was able to return to school on the fifth postoperative day. Janetschek et al[8] reported on 14 cases of laparoscopic heminphroureterectomy. Average operative time was 222 minutes with minimal blood loss. There were no complications. Yao et al[9] reported on five patients who underwent laparoscopic heminephroureterectomy. Mean operative time was 223 minutes. Two patients were discharged home on the day of surgery and the remaining three were discharged on the first postoperative day. There were no complications.

In the most recent series, Horotwitz et al[10] performed 14 laparoscopic upper pole heminephrectomies in 13 patients. The mean operative time was 104 minutes with mean estimated blood loss less than 30 ml. Mean hospital stay was 2.6 days. There were no significant complications. At present, most surgeons prefer the transperitoneal approach to performing upper pole heminephrectomy due to easier identification of anatomic landmarks. Recently, Miyazato et al[11] reported a laparoscopic heminephrectomy performed through the retroperitoneal approach in a 5-year-old girl with an ectopic ureter.

In our series, none of our patients had evidence of vesicoureteral reflux and therefore only a partial ureterectomy was performed in order to avoid ischemic injury to the normal lower pole ureter. We had one patient with a persistent urinary leak, which resulted from a small amount of residual upper pole parenchyma that continued to produce urine. Superselective angiographic embolization of a small upper pole vessel resulted in immediate cessation of the urinary extravasation. In retrospect, the small accessory vessel appeared to contain branches supplying both the upper pole and lower pole moieties. Laparoscopy does provide improved visualization of small accessory vessels; in retrospect, the small vessel visualized intra-operatively should have been sacrificed. It is possible that advanced radiologic imaging techniques such as CT and MR angiography with image reconstruction may provide better pre-operative definition of renal hilar anatomy to minimize the risk of this complication.

Although the laparoscopic approach offers the patient a shorter hospital stay and more rapid recovery, the operative time is longer and the intra-operative cost higher. The equipment used during laparoscopic upper pole heminephrectomy, consisting of many disposable items, is more expensive than the open approach. Additionally, the longer operative time adds to increased intra-operative cost. In our series, average total operative time was 165 minutes. On reviewing the last 10 open upper pole heminephrectomies done at our institution, average operative time was approximately 120 minutes. Thus, it appears that some of the financial benefit of shortened hospitalization for the laparoscopic approach is offset by the higher intra-operative cost. However, we expect that the operative time for the laparoscopic approach should continue to decrease as surgeon experience increases, hence decreasing intra-operative cost.

We have routinely performed a mechanical bowel preparation in all patients undergoing laparoscopic renal surgery, including upper pole heminephrectomy. Although this adds slightly to the morbidity of the procedure compared to the open approach, we feel that the decompressed bowel allows improved visualization during transperitoneal laparoscopic surgery. It is possible that a more limited or no bowel preparation may be sufficient, but we did not investigate this option during this study.

With increasing experience with laparoscopic partial nephrectomy, laparoscopic upper pole heminephrectomy has become an accepted technique. There are several key points of the technique which should be emphasized. The placement of a ureteral catheter into the normal lower pole ureter can greatly assist with intra-operative identification and avert injury to the normal ureter, which may be closely adherent to the upper pole ureter. Although ideally the lower pole ureter should be identified during dissection, manipulation of the ureteral catheter can distinguish the upper from lower pole ureter even if the lower pole ureter is not visualized. Dissection should be maintained along the wall of the upper pole ureter to minimize the chance of injury to the lower pole. Even though some surgeons do not place a ureteral catheter prior to embarking upon the

laparoscopic portion of the procedure, we feel that the ureteral catheter allows for an expeditious and reliable way to distinguish the upper and lower pole ureters. It also permits instillation of indigo carmine if there is any question of violation to the lower pole calyces. The dilated upper pole ureter must be fully mobilized away from the renal hilum prior to transection. Finally, the upper pole ureter must be delivered underneath the renal hilar vessels in order to fully trace it back proximally towards the upper pole moiety.

Laparoscopy provides magnification and superior visualization of key anatomic structures. The risk of uncontrollable bleeding is relatively low as long as the structures are handled gently to minimize trauma and caution is exercised near the hilum. The most challenging portion of upper pole heminephrectomy is the renal hilar dissection, but with experience this can be performed safely.

In summary, laparoscopic upper pole heminephrectomy is an effective treatment for upper pole ureter associated with a dysplastic upper pole renal segment. The improved intra-operative anatomic visualization and reduced patient morbidity are clear cut advantages. The laparoscopic approach should be considered an alternative to the traditional open approach, but should be performed only by surgeons who already have significant experience with laparoscopic renal surgery. □

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