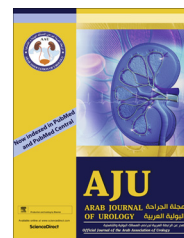




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LAPAROSCOPY/ROBOTICS

ORIGINAL ARTICLE

# Outcome of laparoscopic upper pole heminephroureterectomy in children: A two-centre experience



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## KEYWORDS

Duplication;  
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Transperitoneal;  
Laparoscopy

## ABBREVIATIONS

DMSA, dimercapto-succinic acid;  
HN, heminephrectomy;  
HNU, heminephroureterectomy;  
US, ultrasonography

**Abstract Objective:** To report our multicentre experience and outcomes with laparoscopic transperitoneal and retroperitoneal upper pole heminephroureterectomy (HNU) in children with renal duplex systems and impaired upper pole.

**Patients and methods:** Laparoscopic HNU was performed in 22 children (15 girls, seven boys) with a mean age of 5.9 years. A retroperitoneal approach was used in 17 patients and a transperitoneal approach in the remaining five, between 2005 and 2010. Urinary tract infection was the initial presenting symptom in all children except for one with urinary retention caused by a large ureterocele. Voiding cystourethrography and renal scintigraphy revealed dual collecting systems on the right side in 11 and on the left in 11 cases. The upper pole collecting system was non-functioning in all cases. Postoperative ultrasonography was done at 1 and 3 months, with renal scintigraphy at 3 months, to check the remaining function of the lower moiety.

**Results:** Overall, the mean operation time was 152 min (144 min for retroperitoneal and 160 min for transperitoneal). Blood loss was 10–50 mL and there were no intraoperative complications. The mean (SD) hospitalisation and postoperative

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follow-up were 3.5 (1.25) days and 22 (9.83) months, respectively. Postoperative recovery was uneventful and at the 3-month follow-up renal scintigraphy revealed no parenchymal loss of the remaining renal moiety.

**Conclusion:** Laparoscopic HNU in children can be performed via transperitoneal or retroperitoneal approach, both with low morbidity and with the typical benefits of laparoscopic surgery.

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## Introduction

Laparoscopic procedures have increased generally in the last decade and also became more common in urology. However, laparoscopy in the paediatric age group is still less common with slower acquisition than that in adults. Growing evidence suggests that laparoscopic urological surgery can be safely performed in the paediatric population [1].

After the encouraging results of initial laparoscopic nephrectomy series, most operative procedures in paediatric urology can be safely performed via laparoscopic approaches. With enhanced surgical experience and improvements in technology the indication range of laparoscopic procedures expanded and advanced procedures like heminephroureterectomy (HNU) could be successfully attempted in children [2]. However, minimally invasive techniques have not expanded so widely in the paediatric surgical community for HNUs. The technique seems to remain confined to the hands of experienced teams, with a limited number of reports including relatively few cases [3].

Today, laparoscopic management of obstructing or refluxing upper pole with HNU, using a retroperitoneal or transperitoneal approach and incomplete or complete ureterectomy is not well established, with no consensus for management due to limited and heterogeneous laparoscopic series.

The present retrospective review aimed to assess our experience and evaluate the efficacy of transperitoneal or retroperitoneal laparoscopic management of non-functioning upper pole in two centres.

## Patients and methods

In all, 15 girls and seven boys underwent laparoscopic upper pole HNU between 2005 and 2010, in the SLK Kliniken, Heilbronn, Germany (13 patients) and the Main University Hospital, Alexandria, Egypt (nine patients). Recurrent UTI was the first presenting symptom in all children except for one with urinary retention caused by a large ureterocele. A non-functioning upper pole with refluxing ureter was the underlying cause in 21 patients. Routine physical examination and blood samples showed normal findings. Voiding

cystourethrography and dimercaptosuccinic acid (DMSA) renal scans identified dual collecting systems and advanced hydroureteronephrosis. All children underwent renal ultrasonography (US) with Doppler imaging and DMSA renal scan at 3 months postoperatively to evaluate the remaining moiety.

### *Surgical technique*

#### *Transperitoneal approach*

A urethral catheter was placed preoperatively and the patient placed in a 45° lateral flank position with the ipsilateral side up and lumbar region slightly flexed. A transperitoneal three- or four-ports approach was initiated. A 5- or 10-mm camera with a 30° lens is placed in a para-umbilical position using a Veress needle and pneumoperitoneum was established with 10–12 mmHg pressure. Two ports (5 and 3 mm) were introduced under direct vision. The white line of Toldt was incised and the colon was reflected medially. Keeping in mind that there are duplicated vascular supplies, the dilated ureter was dissected and prepared caudally till the common iliac vessels cross and separated carefully from the normal ureter. Care was taken here to preserve the peri-ureteric arterial supply of the normal ureter.

The dilated ureter of the upper pole was dissected cranially. The artery and vein supplying the upper pole were clipped and divided. The dysplastic parenchyma was transected depending on its thickness using standard bipolar diathermy or Gyrus plasma Trisector (Olympus, USA) and the divided cut parenchymal surface was covered and sealed with Tachosil® fibrin sealant (Baxter International Inc., Deerfield, IL, USA) if necessary. The dilated distal ureter was either clipped with Hem-o-Lok clips or ligated with a polypropylene suture loop (Prolene®, Ethicon Inc., Somerville, NJ, USA) close to the bladder. The ablated upper pole and ureter are removed through the right 10-mm trocar incision or placed in a lap-sac and removed through the optic trocar incision.

#### *Retroperitoneal approach*

The patient is placed in a lateral flank position with a pillow beneath the child to open the lumbar space; in all children a lateral retroperitoneal approach was

performed. The optic Hasson trocar is inserted ~1.9 cm (one fingerbreadth) below the last rib after creating the space using a balloon. Insufflation to a pressure of 10–12 mmHg is done. Two 5-mm trocars are inserted; one in the costovertebral angle and the other in the anterior axillary line above the iliac crest. Gerota's fascia is opened and the ureters are identified at the lower pole of the kidney and separated. The ureter of the upper moiety is dissected till its origin and the dysplastic upper moiety is dissected free from the peritoneal attachment. Cutting the ureter of the upper moiety and traction on it helps in identifying the vessels of the upper moiety that are controlled by bipolar, LigaSure or harmonic scalpel (Ethicon Inc.). Extraction of the ablated upper pole and ureter is via the optic trocar incision.

Ureteric dissection is important to catch the ureter of the upper moiety separating it from that of the lower moiety, whilst preserving the blood supply of the lower moiety, then the ureter of the upper moiety is used as a lever for traction to reach the line of demarcation between lower and upper moieties. In the transperitoneal approach the ureter has to be passed behind the dissected renal pedicle; however, in the retroperitoneal approach there is no need for manipulation of the ureter in relation to the renal pedicle, which is already anterior to the ureter.

It is of paramount importance to recognise the difference between the retroperitoneal and transperitoneal approaches in the dissection of the upper moiety and ureter, and for the ureter it has been described above. For the upper moiety, in the retroperitoneal approach, we tend not to dissect at all the lower moiety from the peritoneum, we go directly at the line of cleavage and then the polar vessels appear, and then they are controlled. However, in the transperitoneal approach, we dissect the kidney from the peritoneum, then the renal pedicle has to be dissected to be able to pass the ureter from beneath it tracing it to the upper moiety and then the vessels identified, and then cutting of the moiety is performed.

#### *Postoperative controls and follow-up*

The mean (range) follow-up was 22 (6–36) months. The first follow-up at 1 month included renal US and at the 3-month follow-up renal US with DMSA renal scintigraphy.

#### **Results**

Table 1 shows the demographic distribution of the patients, diagnosis, and surgical approach. The mean (range) patient age was 5.9 (0.25–17) years. A transperitoneal upper pole HNU was performed in five patients and a retroperitoneal upper pole HNU in 17 patients. The mean (range) operative time was 152 (110–200) min.

All procedures were successfully performed without any open conversions with an estimated blood loss of 10–40 mL and there were no intraoperative complications. The mean hospital stay was 3.5 days. After a mean follow-up period of 22 months, all the remaining lower poles moieties were functioning in the control renal scintigraphy at 3 months.

#### **Discussion**

A duplex collecting system is a commonly seen anomaly of the urinary tract with an incidence of one in 125 births [4]. Indications for surgery in duplex systems are a subject of debate, but ureterocele, ectopic ureter, and reflux nephropathy are the major indications.

During the last decade the indications for laparoscopy in paediatric urology have been expanding [1]. Reported advantages of the laparoscopic approach compared with an open procedure include lower analgesic requirements, improved cosmesis, and reduced hospital stay [5–7].

Some authors reported that laparoscopic nephrectomy and nephroureterectomy are more easily performed in paediatric patients than in adults [8]. HNU via a laparoscopic route is technically more difficult than simple or partial nephrectomy. The important point in HNU, either open or laparoscopic, is to protect the vascular supply of the remaining kidney, as well as the ureter. In order to have good exposure to the upper part of the kidney, it is often necessary to dissect the renal hilum and perirenal space. So, isolated HNU as much as possible is mandatory.

One of the arguable subjects in laparoscopic heminephrectomy (HN) is to decide whether the laparoscopic approach should be retroperitoneal or transperitoneal. Since transperitoneal laparoscopic HN was performed by Jordan and Winslow in 1993 [9], this technique has been the main choice due to the large working space for such a difficult operation. But in 2000, the success of the retroperitoneal approach was also reported [10]. Owing to the limited number of published series for either approach, there is no exact answer as to which approach is best suited for laparoscopic HN in regard to upper or lower pole HN.

The transperitoneal approach has the benefit of excellent exposure of the kidney and its vasculature due to a bigger working space. Also, this approach allows the surgeon to perform a complete ureterectomy when needed. In the transperitoneal approach, three to four abdominal ports are enough to complete partial nephrectomy and ureterectomy. In the Janetschek et al. [11] series, a fifth trocar was needed for liver retraction on the right side in only a few cases. In our present patients, no additional port was needed to complete the operation.

**Table 1** Demographics of the studied children.

Patients	Age, years/sex	Diagnosis	Procedure approach	Operative time, min
1	4/F	Reflux	Transperitoneal	160
2	11/M	Ureterocele + reflux	Transperitoneal	140
3	10/F	Reflux	Transperitoneal	200
4	3/F	Reflux	Transperitoneal	170
5	4/M	Reflux	Retroperitoneal	180
6	5/M	Ureterocele + reflux	Retroperitoneal	140
7	2/M	Reflux	Retroperitoneal	100
8	5/F	Reflux	Retroperitoneal	170
9	4/F	Reflux	Retroperitoneal	190
10	6/F	Reflux	Retroperitoneal	160
11	7/F	Reflux	Retroperitoneal	140
12	6/M	Reflux	Retroperitoneal	190
13	1/F	Reflux	Transperitoneal	160
14	16/M	Ureterocele	Retroperitoneal	180
15	15/F	Ectopic ureter	Retroperitoneal	150
16	2/F	Ureterocele + reflux	Retroperitoneal	140
17	3/F	Ureterocele	Retroperitoneal	150
18	1/F	Ureterocele	Retroperitoneal	120
19*	0.25/F	Ureterocele	Retroperitoneal	120
20	3/F	Ureterocele + reflux	Retroperitoneal	115
21	17/M	Duplex	Retroperitoneal	120
22	5/F	Ectopic ureter	Retroperitoneal	110

F, female; M, male.

\* A 3-month-old girl with prolapsing ureterocele.

Magnified anatomical vision in laparoscopic surgery can be offered as an advantage. In our present patients, magnification and a multi-angle view with a 30° optic lens were helpful during the isolation of ureter without any morbidity, even in the distal part. Also, the retroperitoneal approach avoids dissection of the renal pedicle of the lower moiety and gives direct access to the vessels of the upper moiety. We followed all our patients with MAG3 renal scintigraphy, and there were no differences in the lower moiety functions.

Miranda et al. [12] successfully used the transperitoneal approach for upper pole HN with complete ureterectomy in infants. Castellan et al. [13] compared transperitoneal with retroperitoneal laparoscopic HN and concluded that the main advantage of the transperitoneal approach was a wide working space allowing excision of the ureter up to the level of the bladder. Although, Borzi and Yeung [14] reported that a longer ureteric segment was excised via a posterior retroperitoneal approach, the ureter can actually be dissected up to the level to where it crosses the iliac vessels. As a result, the residual stump can only be excised via a lower abdominal incision to accomplish complete ureterectomy in the retroperitoneal approach.

Complete ureterectomy in open surgery needs an additional lower abdominal incision. The main problem in distal ureterectomy is the common sheath enclosing both ureters. Consequently, avoidance in the distal ureter dissection was recommended to avoid damage

to the healthy ureter vasculature [15]. Ade-Ajayi et al. [16] evaluated open surgery for upper pole HN whether complete ureterectomy was necessary or not. In his study, 56 children were evaluated and he calculated the re-operation rate as 8% for redundant ureteric stump. In other series this rate was as high as 9–12% [17,18]. Similarly, some authors also reported a high rate of complications in cases of incomplete ureterectomy and they emphasised the importance of complete ureterectomy to avoid stump-related problems [19]. In contrast, Androulakakis et al. [15] found no postoperative stump problem in his non-refluxing non-functioning upper pole HN. The common point in all three series was that complete ureterectomy caused minimal related problems in cases of an obstructed non-functioning upper pole. A limitation of the present study is the retrospective nature of the study and the small number of cases in both centres; however, the study addresses a major concern about the safety and efficacy of the laparoscopic procedure in the management of children with renal duplication and demonstrated equal efficacy of both transperitoneal and retroperitoneal approaches in managing the non-functioning upper pole.

Finally it is noteworthy to ask an important question as to whether it is time to declare laparoscopic partial nephrectomy either by a transperitoneal or retroperitoneal approach as the ‘gold standard’ procedure.

The answer to this question demands a definition of what is the ‘gold standard’ procedure, which will be that



laparoscopic procedure performed in a large enough number of cases and at multiple centres with a high index of safety and efficacy compared to the open counterpart.

It is clear in our two-centre experience that safety of laparoscopic upper pole HN is high using both transperitoneal and retroperitoneal approaches. Moreover, safety is also demonstrated in younger age groups compared to older children. We did not have any complication concerning the lower functioning renal moiety with both approaches and no conversions to open surgery. Our present series demonstrates shorter hospital stay, rapid recovery, minimal blood loss, and excellent cosmetic outcomes. Moreover, we have shown the safety and feasibility of both approaches, even in small children.

The results of our present series compare favourably to those reported by an increasing number of centres. Laparoscopic partial nephrectomy proved to be safe and effective vs its open standard counterpart in many retrospective comparative studies. Moreover, laparoscopic partial nephrectomy has a rapid learning curve and operative time becomes shorter with the learning curve, making it comparable to that of open surgery with all advantages of laparoscopy [6,7,20,21].

However, from our present study alone we cannot answer the question of a 'gold standard' procedure because of the small number of cases; however, we can support the increasing body of literature showing the safety and efficacy of the procedure in children, paving the way for the procedure to be declared as a 'gold standard' technique in paediatric urology.

## Conclusion

Upper pole HNU with refluxing ureter can be safely performed in children using a transperitoneal or retroperitoneal laparoscopic approach with low morbidity. A long ureteric segment can also be excised without any additional port placement. A short hospital stay is a clear advantage of the procedure.

## Conflicts of interest

None.

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