Laparoscopic retroperitoneoscopic nephrectomy and partial nephrectomy in children

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Abstract

Objectives: The aim was to evaluate our experience in the retroperitoneal laparoscopic approach in total and partial nephrectomies in children.

Materials and Methods: We retrospectively reviewed the medical records of 41 patients who underwent retroperitoneal laparoscopic total or partial nephrectomies performed in our center from 2004 to 2012. We looked at the demographic data, age at surgery, indication, operative time, surgical complications, conversion to open surgery and operative complications.

Results: Thirty-five total and six partial nephrectomies (upper pole) were performed. The mean age was 84 months (7-175). Vesicoureteric reflux, pelviureteric junction obstruction, and multicystic dysplastic kidney disease were the main underlying pathologies.

The mean operative time was 158 min (60-280). There were no intraoperative complications (surgical and anesthetic), and no significant blood loss was observed. Conversion to open surgery was necessary in two cases caused by failure to progress due to difficult anatomy during the partial nephrectomies. No major postoperative complications were noted. The mean hospital stay was 2.5 days (1-5). A drain was used in 12 cases and was removed after a mean of 2 days.

Conclusions: Laparoscopic retroperitoneoscopic renal surgery can be carried out safely and effectively in children. Still, this procedure is more challenging and requires an excellent image of the retroperitoneal space, especially when partial nephrectomies are concerned.

Key Words: Children, laparoscopy, nephrectomy, partial nephrectomy, retroperitoneal

INTRODUCTION

Minimally invasive surgery has been essential in the practice of pediatric urology for many years, offering a better quality-of-life due to fewer hospital stay days, less pain, and faster recovery.[1-3]

Laparoscopic renal surgery is well-established in the pediatric age group.[1,3,4] This operation can be performed using either transperitoneal or retroperitoneal techniques.[1,3,5] Although the retroperitoneal approach is challenging, it has the advantage of not opening the peritoneal cavity.[2,5]

Our aim is to share our experience with retroperitoneal laparoscopic total and partial nephrectomies (in duplex systems).

MATERIALS AND METHODS

We retrospectively reviewed our experience with all pediatric nephrectomies including partial nephrectomies performed

using a retroperitoneal laparoscopic approach, between 2004 and 2012 after we got approval from the ethical committee. We completed 41 procedures, comprising 35 total and six partial nephrectomies in 41 children. In the records of these patients, we looked at their demographic data, age at surgery, indications, operative time, surgical complications, conversion to open surgery and post-operative complications.

Two pediatric urologists with good experience in laparoscopy performed all the procedures.

All patients underwent dimercaptosuccinic acid (DMSA) scans to confirm the diagnosis of nonfunctional kidney.

The procedures were performed using a lateral retroperitoneal approach, in the same way, as that described by El-Ghoneimi et al.[1,2] After general anesthesia, the patient was positioned laterally on the side of the table, with the operation side at a 90° angle to the table [Figure 1]. The first incision site was marked approximately 20 mm or one fingerbreadth from the tip of the 12th rib to place the camera. Another two 5 mm incision sites were made for the working elements, one in anterior axillary line a fingerbreadth above the top of the iliac crest and the other, at the costovertebral angle [Figure 2]. The 20 mm incision was opened in layers, and Gerota's fascia was opened under direct vision. A working space was created by gas insufflation and dissection using the camera after the introduction of the first 10 mm trocar. Next, the other two 5 mm trocars were introduced under direct vision using a sharp introducer. The dissection was completed while keeping the anterior surface of the kidney attached to the peritoneum, and the renal pedicle was approached posteriorly. Our anatomical landmarks were the psoas muscle at the bottom of the screen and the kidney at the top of the screen. The renal pedicle was identified, and then the renal artery and renal vein were clipped or coagulated by ligature. Next, the ureters were identified and dissected distally as possible before either being coagulated (if not refluxing) or ligated with the Endoloop (ENDOLOOP Ligature, Ethicon, Cincinnati, OH, USA). The anterior surface of the kidney was freed from the peritoneum and became freely mobile in the retroperitoneal space. The kidney was removed from the main port (20 mm) after we removed the 10 mm camera, and we used a 5 mm camera through one of the other trocar sites. The kidney was retrieved either directly through the trocar if it was small or after the evacuation of the hydronephrotic kidney or grossly large cyst of MCDK [Figure 3]. If the kidney was large, we placed it in a 10 mm extraction bag and then divided it under direct vision after pulling and opening the neck of the bag. We did not leave a drain unless we encountered difficulty during the dissection in the case of an inflamed kidney. Next, all of the trocars were removed, and the trocar sites were closed with interrupted sutures.

Figure 1: Positioning of the patient

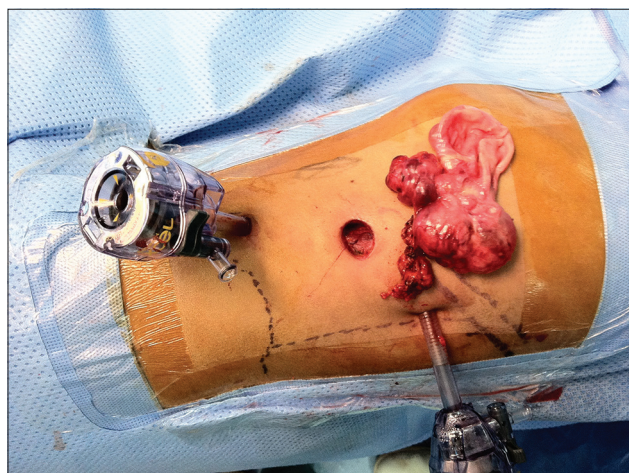**Figure 2:** Sites of trocars insertion

Figure 3: Multicystic dysplastic kidney after extraction

For thepartial retroperitoneal laparoscopic nephrectomy (RPLN), we started with cystoscopy and retrograde pyelography, and we then inserted a ureteric catheter into the normal ureter to drain the normal functioning moiety

of the kidney. A similar approach was used for the total nephrectomy. After entering the retroperitoneal space, the ureter draining the nonfunctioning section of the kidney was identified and dissected close to its wall to avoid injuring the vascularity of the other ureter. The nonfunctioning region was ligated, facilitating the dissection of the nonfunctioning part of the kidney from the normal part. The line of demarcation was identified between the two poles based on the color difference between the two parts and ligature used to separate the poles. The excised section was retrieved, in the same way, for the total nephrectomies, and Jackson-Pratt Drains were used.

Patient who underwent partial nephrectomies were followed up after 3-6 months by DMSA scan to assess functionality of remaining moiety.

RESULTS

Of 41 patients, there were 19 females and 19 right sided nephrectomies [Table 1].

The mean age at time of operation for all cases was 84 months (range 7-175), and the mean age of the laparoscopic partial nephrectomy patients was 92.6 months. The main underlying pathologies causing nonfunctional renal units were pelviureteric junction obstruction in eight patients (19.5%) (one case secondary to high grade vesicoureteric reflux [VUR]), multicystic dysplastic kidney (MCDK) in nine (22%), high grade VUR in 13 (31.7%), and nonfunctioning upper pole in six (14.6%) (three cases of obstructions secondary to ectopic ureter, two cases of ureterocele, and one case of VUR) [Table 2].

The diagnosis of a nonfunctional renal unit was confirmed by nuclear radiology in all patients. All patients had symptoms indicating the need for a removal, including febrile urinary tract infection in 61%, abdominal pain in 14.6%, hypertension (HTN) in 9.7%, palpable mass with hematuria in 2.4%, UTI with pain or HTN in 7.3%, abdominal pain with HTN in 2.4%, isolated hematuria in 2.4% and increase in the size of the renal cysts in MCDK in 2.4% of patients.

The mean operative time for all cases between inserting the trocars and exsufflation was 158 min (range 60-280), but the mean operative times for retroperitoneal partial laparoscopic nephrectomy (RPPLN) and total laparoscopic nephrectomy were 161 min (90-210) and 157 min (60-280), respectively [Table 3].

There were no intraoperative complications (surgical or anesthetic) and no significant intraoperative blood loss.

Table 1: Demographic data and general findings

Parameters	Number	Percentage
Female/male	19/22	
Left side/right side	22/19	
Patients who had drain	12	29.3
Rate of conversion	2	4.9
Time of drain removal*	2 days range (1-5)	
Mean hospital stay	2.5 days range (1-5)	
Mean preoperative HB	12.8 g/dl	
Mean postoperative HB	11.4 g/dl	

*How many days the drain stays postoperative before removal.
HB: Hemoglobin

Table 2: Underlying diagnosis distribution

Diagnosis	Frequency	Valid percent	Cumulative percent
Vesicoureteric reflux	13	31.7	31.7
Vesicoureteric reflux and secondary PUJ stenosis	1	2.4	34.1
Obstructed megaureter	2	4.9	39.0
MCDKD*	9	22.0	61.0
PUJ stenosis	7	17.1	78.0
Nonfunctioning upper pole in duplex system	6	14.6	92.7
Renal artery stenosis	1	2.4	95.1
Renal stones	2	4.9	100.0
Total	41	100.0	

*Multicystic dysplastic kidney disease, PUJ: Pelviureteric junction

Table 3: Comparison between total and partial nephrectomy

Parameters	Total nephrectomy (%)	Partial nephrectomy (%)
Number/percentage	35 (85)	6 (15)
Male/female	20:15 (57.1)	2:4 (33.3)
Right/left	16:19 (45.7)	3:3 (50)
Age at surgery (months)	83.4 (7-175)	92.6 (8-168)
Weight at surgery (kg)	24 (6.5-66)	25.3 (6.5-45)
Operative time (min)	157 (60-280)	161.6 (90-210)
Conversion to open	0 (0)	2 (33.3)
Hospital stay (days)	2.2 (1-4)	3.8 (3-5)

No conversion to open surgery was necessary during total nephrectomy, although we had conversions in two of the six cases of partial nephrectomies. The reason for these conversions was failure to progress due to difficult anatomy. Jackson-Pratt Drains were used in 12 cases and were removed after a mean of 2 days (range 1-5). In most cases of partial nephrectomy, we had to place a drain. In total nephrectomy, we used drains in the first six cases after we had started using the retroperitoneal approach. Usually, we removed the drain after removing the urethral catheter 24 h postoperatively if no sign of significant drainage in the bag of the drain was found. All patients had uneventful postoperative courses without significant complications. The mean hospital stay was 2.5 days (range 1-5) for all cases but 3.8 days post-partial laparoscopic nephrectomy [Table 3].

All patients had a regular followup without significant complications. DMSA scans, taken 3-6 months postoperatively,

showed a good viability of the remaining lower moiety of all six patients who underwent laparoscopic partial nephrectomies.

DISCUSSION

In children, reaching the upper urinary tract by laparoscopy can be achieved using transperitoneal, retroperitoneal, lateral or posterior approaches.[1-7] The aim of a retroperitoneal approach is to strictly adhere to the principles of open surgery for benign lesions and to ensure a high level of cosmesis after the surgical incisions are made.[2,5]

Retroperitoneal laparoscopic nephrectomy in pediatric urology was reported for the first time by Chandhoke et al. in 1993,[6] and has since been described in different centers.[7-10] Its first mention in adults occurred in 1992 and was by Gaur;[11] today, RPLN is widely used in different centers. The main difficulty of this approach is its limitations of the working space and the need for a good imaging of the anatomy of the retroperitoneal space.[2] We used the same retroperitoneal laparoscopic approach as that described by El-Ghoneimi et al.[1,2]

Transperitoneal laparoscopic nephrectomy (TPLN) provides a wide operative space but requires the mobilization of the bowel to reach the Hilar structures. On the other hand, RPLN provides narrower working space, but easier access to the renal hilum.[12]

RPLN for benign renal disease in children has been shown to be safe and effective.[13-15] The operative times were comparable to those for open surgery, but less need for postoperative analgesia and hospitalization was encountered.[13] EL-Ghoneimi et al. found that RPLN was advantageous in the older population of children (median age of 5 years).[14]

Indications for this procedure commonly include nephrological causes, such as renal artery HTN, nephrotic syndrome, and hemolytic uremic syndrome, as well as urological causes, such as obstructive or refluxing ectopic ureters, MCDKD, VUR, and obstructive uropathy.[1,16] In our series, VUR, PUJ stenosis, MCDKD and obstruction or reflux in the upper moiety represented >88% of cases. Stone disease, renal artery HTN and megaureter represented the rest of cases, with UTI, abdominal pain and HTN representing most of the indications.

Baez et al. had mean operative time 121 min (range 60-200) in a series of 18 patients submitting to the RP approach, compared to 92.2 min in 10 patient series receiving TP. The mean hospital stays in the RP and TP approaches were 28.8 h and 36.5 h, respectively.[12] Kim et al. reviewed 51 articles, including 401 RPLN and 288 TPLN; they found a mean age, operative time, and hospital stay of 5.4 years, 129 min,

and 2.5 days, respectively, in the RPLN group, compared with 4.8 years, 154 min, and 2.5 days, respectively, in the TPLN group.[17] In addition, they reported two vascular injuries in the RPLN group and one bowel injury in the TPLN group.[17] El-Ghoneimi et al. had a mean operative time of 97 min for unilateral cases and 260 min for bilateral cases, including mean age of 5 years and a mean hospital stay of 1.9 days under urological indications.[1] Skinner et al. found a decreasing trend in operative time with advancing years, as the operative times dropped from 104 min in 1997 to 90 min in 2007. These authors also noted that anatomical factors, such as a grossly dilated kidney, could increase operative times significantly.[18]

In our series, 35 patients underwent total RPLN with a mean age 83.4 months, the mean operative time of 157 min, which was slightly longer than that found in other studies.[17] There was no need for conversion, no significant complications or blood loss. We achieved average hospital stay was 2.2 days that was shorter than that found in some other studies.[17] RPPLN is also a safe, effective procedure that had operative times ranging from 120 to 193 min, and hospital stays, from three to 4.7 days.[4,13,19]

Transperitoneal partial laparoscopic nephrectomy had a mean operative time and hospital stay of 182 min and 2.4 days, respectively, compared with the 152 min and 4.38 days for open partial nephrectomy found in the series of Aparicio et al.[20] Schneider et al. achieved a mean operative time of 123 min and a hospital stay of 2.9 days in their series on partial nephrectomies using a TP approach.[3]

Leclair et al. experienced a 21% conversion rate in their RPPLN series, most of which occurred in the first 20 cases due to either difficult parenchymal sections or difficult exposures.[4] On the other hand, Jayram et al. had a conversion rate of 7.7%, and most of these cases occurred earlier in the learning curve.[19]

In our study, out of the six patients in the RPPLN group, two (33.3%) converted to open surgery due to too-narrow spaces and difficult anatomies. The mean operative time was 161.6 min, which was comparable to other studies.[13,20] The mean hospital stay was 3.8 days, although more experience with RPPLN is needed to better meet its challenges.

Significant loss of function in the remaining moiety was observed after partial nephrectomies in seven patients (4.9%) in the series of Jayram et al. during follow up; three of their patients ultimately required a complete nephrectomy.[19] We did not encounter any significant complications in our patients, and none of the partial nephrectomy patients presented with a nonfunctioning remaining moiety during follow-up.

Although our study was retrospective, included a small number of cases over a relatively long time and represented a single center, we believe our data in combination with those of another center could provide much stronger, more meaningful results. With the increasing number of cases we encounter on a yearly basis, we hope to develop a prospective study in the near future to assess retroperitoneal approach in partial nephrectomy cases in comparison to transperitoneal approach.

Furthermore, all cases of partial nephrectomies were only in duplex systems and not included conventional partial nephrectomies and hence we cannot have a general conclusion regarding partial nephrectomy cases.

CONCLUSION

Laparoscopic retroperitoneoscopic renal surgery can be performed safely and effectively in children. Still, this procedure is more challenging and requires excellent imaging of the retroperitoneal space, especially when partial nephrectomies are involved.

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