

ARTICLE



Perioperative morbidity of paediatric laparoscopic nephrectomy by transperitoneal and retroperitoneal approaches- any difference?

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ABSTRACT

Aim: Minimal invasive approaches for paediatric nephrectomy include transperitoneal (TP) and retroperitoneal (RP); both having advantages and disadvantages. We aimed to ascertain if there was any difference in perioperative morbidities between these two approaches.

Methods: We performed a retrospective review of laparoscopic TP and RP nephrectomies performed in our institution over 10 years from May 2009 till May 2019. Outcome measures included intraoperative complications, prolonged requirement of opioid analgesics (more than 24 h), hospital stay, incidence of wound infection and urinary tract infections. Data were analysed using Fisher's exact test and Mann Whitney test.

Results: A total of 152 nephrectomies were performed in 139 patients; 81 were TP and 71 were RP. Age ranged from 8 months to 16 years. Median hospital stay was 2 days in both groups. There were no intraoperative complications. Outcome measures were sub-categorised as follows. Requirement of opioid analgesia for more than 24 h was documented in 2 patients in each group, leading to longer hospital stay of 3 days. A febrile urinary tract infection requiring antibiotics was detected in 4; 1 in TP and 3 in RP. Wound infection requiring antibiotics occurred in 1 patient (in RP group). No statistically significant difference was found between the two groups in any of the subcategories.

Conclusion: TP and RP nephrectomy have similar perioperative morbidity. The decision to utilise either approach should be dependent on the surgeon's skills and experience and appropriately tailored to individual patient needs

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Introduction

Laparoscopic renal surgery is now routinely adopted for benign kidney diseases in the paediatric population [1–3]. Transperitoneal (TP) and retroperitoneal (RP) are the two main adopted approaches each with reported benefits. Multiple series have been published demonstrating that both TP and RP laparoscopic techniques are safe alternatives to conventional open approach [1–3] and few articles have reported a direct comparison between these two approaches [4–8].

Our aim was to compare the two approaches with regards to perioperative complications and outcomes.

Materials and methods

We retrospectively reviewed data of all children and adolescents who had laparoscopic TP and RP nephrectomy for benign pathology performed in our institution over a 10-year period (from May 2009 till May 2019). Details of both procedures are as follows.

TP nephrectomy is carried out with the patient in a semi-lateral position; access is by standard three port technique with open insertion of the primary umbilical port for the

telescope. The secondary ports are normally placed near the midclavicular line (Figure 1). In children with vesico-ureteric reflux (VUR), the ureter is ligated as close to the bladder as possible with Vicryl endo-loops. In all other cases, the ureter is transected with a sealing device and left open. A Foley catheter is placed intraoperatively to decompress the bladder. The kidney is extracted through the umbilical port using an endocatch bag.

When performing RP nephrectomy, the patient is positioned prone. Two approaches to the retroperitoneal space are used in our center. In the first, a custom-made balloon is made to help with an initial retroperitoneal dissection; the primary port site (for a 5 mm or 10 mm telescope) is positioned midway between the iliac crest and the 12th rib, just lateral to the outer border of the Sacrospinalis muscle. Blunt dissection is performed with a Kelly clamp and the balloon is then inflated to create the retroperitoneal space. A second (5 mm) port is placed, under vision, on the midaxillary line, at the conjunction between the projection of the tip of the 11th rib and in line with the first port. A third, optional, port is placed medially in case of difficult dissection or for haemostasis [9] (Figure 2). In the second, an optic trocar is used and the access to the retroperitoneum is achieved under vision [10].

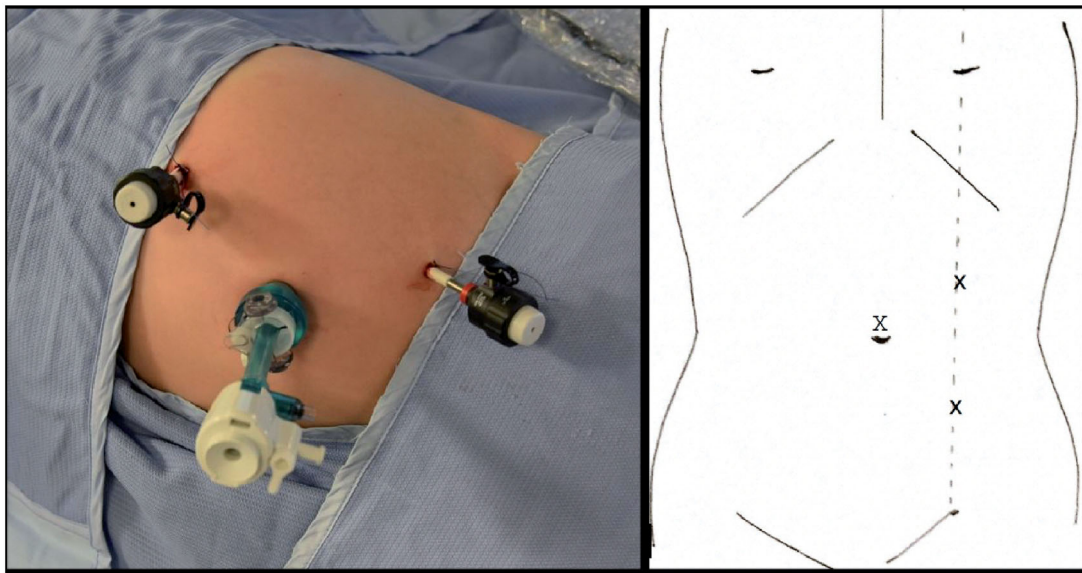


Figure 1. Illustration of trocar position for Transperitoneal laparoscopic nephrectomy. Patient is positioned in a semi-lateral position; camera port is placed trans-umbilical and 2 working ports are normally placed near the midclavicular line.

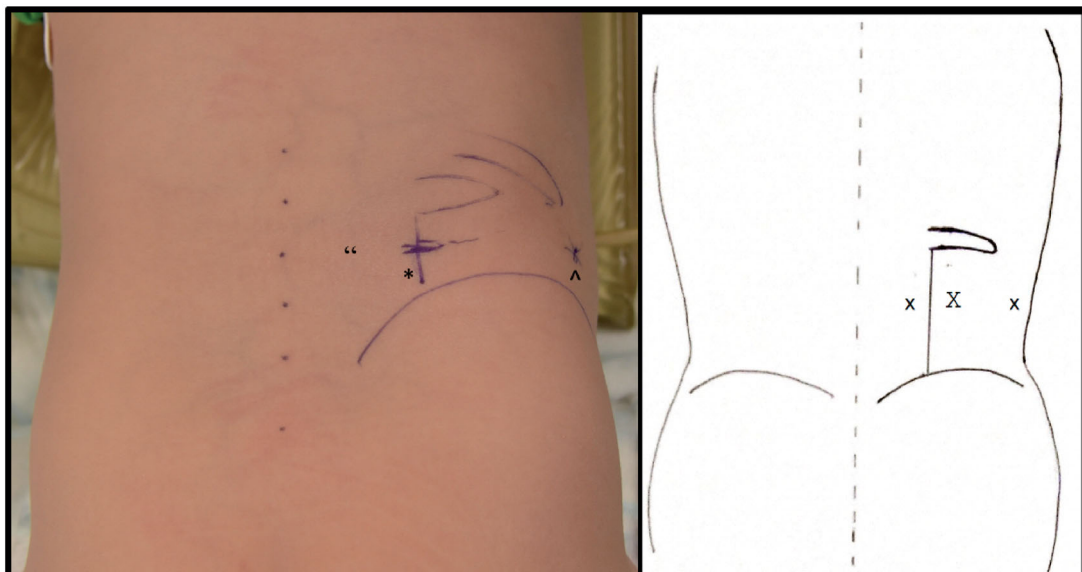


Figure 2. Illustration of trocar position for Retroperitoneal nephrectomy. Patient is positioned prone; the camera port (*) site is midway between the iliac crest and the 12th rib, just lateral to the outer border of the sacrospinalis muscle and second port (^) is placed at the conjunction between the projection of the tip of the 11th rib and in line with the first port under vision. A 3rd, optional, port (") is placed halfway between the camera port and the spine.

Following discharge, all patients are routinely followed up in outpatient clinic in about 3 months' time with a renal tract USS.

Outcome measures recorded were: (1) intraoperative complications, (2) conversion, (3) length of surgery, (4) hospital stay, and (5) postoperative complications, which included (a) requirement of opioid analgesics for more than 24 h, (b) incidence of wound infections and (c) incidence of urinary tract infections. The complications were graded according to the Clavien-Dindo classification [11]. Data were analysed using Fisher's exact test and Mann Whitney test.

Results

In the analysed period, a total of 152 nephrectomies were performed in 139 patients. Indications for nephrectomy are

summarized in Table 1. TP approach was used in 81 and RP approach in 71 patients. Bilateral nephrectomies were performed by the RP approach in 13 patients. Of these, 9 were performed on the same day (synchronous nephrectomies). The right kidney was removed in 60 patients (39%). Age ranged from 8 months to 16 years (median age of 5 years). There were 80 males (53%).

Patients with ectopic pelvic kidneys (two patients) and post failed pyeloplasty (two patients) had nephrectomies by TP approach. All patients who had renal transplant or were candidates for transplant on peritoneal dialysis ($n=21$) had nephrectomy by RP approach. Median hospital stay was 2 days in both groups (range 1–3 days). The intraoperative complications are summarized in Table 2. There were no intraoperative complications in either group. There were three conversions in the TP group, all in the earlier part of

Table 1. Underlying diagnosis and indications for nephrectomy.

Diagnoses	Total (n = 152)	TP (n = 81)	RP (n = 71)
Posterior urethral valves	83 (55%)	43 (53%)	40 (56%)
Preparation for transplant	21 (14%)	0	21 (30%)
Multicystic dysplastic kidney	20 (13%)	20 (25%)	0
Vesicoureteric reflux (VUR)	11 (7%)	11 (14%)	0
Recurrent UTIs, Ureterocele	7 (5%)	3 (4%)	4 (6%)
Hypertensive nephropathy	4 (3%)	0	4 (6%)
Nephrogenic diabetes insipidus	2 (1%)	0	2 (3%)
Recurrent Pelviureteric junction obstruction (Post failed pyeloplasty)	2 (1%)	2 (2%)	0
Non-functioning remaining moiety post heminephrectomy for duplex system	2 (1%)	2 (2%)	0

n: number of nephrectomies.

Table 2. Outcomes.

Outcome	Total (n = 152)	TP (n = 81)	RP (n = 71)	p Value
Intraoperative complications	0	0	0	/
Conversion n (%)	3 (2%)	3 (4%)	0	0.248
Average length of surgery in minutes (range)	152 (73–370)	145 (82–360)	156 (73–370)	0.144
Average length of stay in days (range)	2 (1–3)	2 (1–3)	2 (1–3)	1

n: number of nephrectomies.

Table 3. Postoperative complications.

Complications	Total (n = 152)	TP (n = 81)	RP (n = 71)	p Value
Postoperative pain requiring opioids longer than 24 h n (%)	4 (3%)	2 (3%)	2 (3%)	1
Wound infection n (%)	1 (0.7%)	0	1 (1%)	0.469
Urinary Tract Infections n (%)	4 (3%)	1 (1%)	3 (4%)	0.339
Total	9 (6%)	3 (4%)	6 (8%)	0.305

n: number of nephrectomies.

the series. There were no conversions in the RP group. There was no difference in the operating time between the two groups: median of 145 min (range 82–360 min) in the TP group and median of 156 min (range 73–370 min) in the RP group.

Postoperative complications have been summarized in Table 3. Two patients in each group (TP 3% and RP 3%) required opioids for more than 24 h. This led to a longer hospital stay of 3 days in all children. A febrile urinary tract infection was detected within 24 h from discharge in one in patient after TP (1%) and in three following RP (4%). All of these patients required antibiotics. Wound infection requiring antibiotics occurred in one patient (1%) only in the RP group. All encountered complications were either grade 1 or 2 according to the Clavien-Dindo classification [11]. None of the analysed outcome measures achieved statistical significance between the two groups.

Discussion

The laparoscopic approach to nephrectomy for benign disease has become the standard of care worldwide [3,4]. Numerous studies have compared minimally invasive approaches to open procedures [1–3] showing that minimal invasive nephrectomy is associated with rapid recovery, reduced need for postoperative analgesia and improved cosmesis. However, they do come at the expense of a longer operative time, increased costs and a steep learning curve [1–3,6]. The retroperitoneal approach was popularized by Gaur in 1992 [12] and others have confirmed its utility in

children afterwards [13–16]. This approach has also been used for partial nephrectomy in children [2,14]. The incidence of adhesions after laparoscopic urological procedures is found to be lower when compared to an open procedure [8,17].

Studies have confirmed adoption of both approaches for nephrectomy and partial nephrectomy for benign disease in children with minimal morbidity and acceptable complication rate irrespective of the type of approach [4–8]. In our institution we utilize both transperitoneal and retroperitoneal approach for performing a nephrectomy for benign disease. The procedures included in our analysis have been performed by three surgeons that routinely perform laparoscopic procedures. All three surgeons are confident performing both approaches with minor difference in terms of preferences among the three. The choice of the approach, therefore, mainly depends on operator experience and preference but also reflects underlying condition, indication for surgery and patient's background. This includes a significant number of children who are on peritoneal dialysis awaiting renal transplant or have already been transplanted. We feel that the RP approach is definitely preferable in those cases as it avoids violating the peritoneal space. On the other hand, a transperitoneal approach is preferred for ectopic location of kidneys and those requiring complete ureterectomy (e.g. presence of VUR).

Some authors have claimed one approach being easier or superior to the other based on personal experience and indication [7,8]. In our experience both approaches have demonstrated being valid and no difference has been

demonstrated in operating times. Other studies have echoed our findings [4,6]. Comparing the two approaches for laparoscopic nephrectomy, the TP provides an excellent exposure of the kidney along with its vasculature due to a larger working space. This approach also helps to perform a complete ureterectomy in children with VUR [4,6,8]. The retroperitoneal approach on the other hand, is a technique which is more similar to the conventional open renal surgery. The main advantage is that it provides a rapid and easy exposure of the renal pedicle [13–15]. This approach also avoids violating the intraperitoneal cavity lessening the risks of injury to intraperitoneal organs and formation of postoperative adhesions. For that reason, the RP is our preferred approach in children undergoing peritoneal dialysis as this permits its continuation in the immediate postoperative period [15]. This approach is also recommended in case of previous abdominal surgery as it obviates the possible difficulties and risks associated with post-surgical abdominal adhesions [17]. There is a further theoretical advantage, in that potential urinomas or hematomas would be confined to the retroperitoneal space so reduce the chance of ileus. A disadvantage of the RP approach could be considered the limited working space [4–7,13] and a more difficult learning curve. The use of a single or two working instruments for performing RP is related to surgeon experience and preference [18–20].

Influence of anaesthetic and impact of CO₂ absorption during the procedure have also been considered but neither of the approaches has been demonstrated superior or associated with greater risks [21]. In the present study we found that the operative time, hospital stay, and complications were similar in both approaches; those data are also comparable to published literature.

In line with our results, in fact, a systematic review published in 2009 found no significant advantage gained by either approach for laparoscopic nephrectomy [4]. Compared to the articles included in the systematic review, our series represents the largest cohort of nephrectomies performed in a single-center with the two approaches. It is interesting to note that multicystic dysplastic kidneys (MCDK) represented the most common indication for nephrectomy in the 2009 systematic review, while in our series it has significantly reduced (13% of the total), confirming a shift in the management of MCDK which occurred in the recent years [22,23].

Conclusion

TP and RP nephrectomy have similar minimal perioperative morbidity. Both approaches can be performed for benign disease in children with all the advantages of minimally invasive surgery. The RP approach gives a more direct access to the renal hilum. The disadvantage is the limited working space and the difficulty to remove the whole ureter. We did not find any statistically significant differences in the perioperative complication rates between two groups. In our unit we prefer a TP approach when a total excision of the ureter is necessary and in those with ectopic kidneys. We favour the RP approach in children who are on peritoneal dialysis and candidates for renal transplant.

We feel that the decision between these two approaches should depend on the surgeon's preference and experience but should also be tailored towards the individual patient's need and their associated co-morbidities.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

- [1] Harrell WB, Snow BW. Minimally invasive pediatric nephrectomy. *Curr Opin Urol.* 2005;15(4):277–281.
- [2] Yao D, Poppas DP. A clinical series of laparoscopic nephrectomy, nephroureterectomy and heminephroureterectomy in the paediatric population. *J Urol.* 2000;163(5):1531–1535.
- [3] Hamilton BD, Gatti JM, Cartwright PC, et al. Comparison of laparoscopic versus open nephrectomy in the paediatric population. *J Urol.* 2000;163(3):937–939.
- [4] Kim C, McKay K, Docimo SG. Laparoscopic nephrectomy in children: systematic review of transperitoneal and retroperitoneal approaches. *Urology.* 2009;73(2):280–284.
- [5] Benoit T, Peyronnet B, Roumiguié M, et al. Laparoscopic nephrectomy for polycystic kidney: comparison of the transperitoneal and retroperitoneal approaches. *World J Urol.* 2016;34(7):901–906.
- [6] Antoniou D, Karetos C. Laparoscopy or retroperitoneoscopy: which is the best approach in pediatric urology? *Transl Pediatr.* 2016;5(4):205–213.
- [7] Gundeti MS, Patel Y, Duffy PG, et al. An initial experience of 100 paediatric laparoscopic nephrectomies with transperitoneal or posterior prone retroperitoneoscopic approach. *Pediatr Surg Int.* 2007;23(8):795–799.
- [8] Esposito C, Escolino M, Corcione F, et al. Twenty-year experience with laparoscopic and retroperitoneoscopic nephrectomy in children: considerations and details of technique. *Surg Endosc.* 2016;30(5):2114–2118.
- [9] Cho A, Asimakidou M, Mushtaq I. Access for retroperitoneoscopic surgery. *J Pediatr Urol.* 2019;15(3):287–288.
- [10] Cherian A, Paul A, De Win G, et al. Prone posterior retroperitoneoscopic access to the kidney in children: the controlled optical trocar approach. *J Pediatr Urol.* 2019;15(5):580–581.
- [11] Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg.* 2009;250(2):187–196.
- [12] Gaur DD. Laparoscopic operative retroperitoneoscopy: use of a new device. *J Urol.* 1992;148(4):1137–1139.
- [13] El-Ghoneimi A, Valla JS, Steyaert H, et al. Laparoscopic renal surgery via a retroperitoneal approach in children. *J Urol.* 1998;160(3 Part 2):1138–1141.
- [14] Castellan M, Gosalbez R, Carmack AJ, et al. Transperitoneal and retroperitoneal laparoscopic heminephrectomy-what approach for which patient? *J Urol.* 2006;176(6 Pt 1):2636–2639.
- [15] Gundeti MS, Taghizaedh A, Mushtaq I. Bilateral synchronous posterior prone retroperitoneoscopic nephrectomy with simultaneous peritoneal dialysis: a new management for end-stage renal disease in children. *BJU Int.* 2007;99(4):904–906.
- [16] Szymanski KM, Bitzan M, Capolicchio JP. Is retroperitoneoscopy the gold standard for endoscopic nephrectomy in children on peritoneal dialysis? *J Urol.* 2010;184(4 Suppl):1631–1637.
- [17] Moore RG, Kavoussi LR, Bloom DA, et al. Postoperative adhesion formation after urological laparoscopy in the pediatric population. *J Urol.* 1995;153(3 Pt 1):792–795.

- [18] Garg S, Gundeti M, Mushtaq I. The single instrument port laparoscopic (SIMPL) nephrectomy. *J Pediatr Urol.* 2006;2(3):194–196.
- [19] Msezane LP, Mushtaq I, Gundeti MS. Gundeti MS an update on experience with the single-instrument port laparoscopic nephrectomy. *BJU Int.* 2009;103(10):1406–1408.
- [20] Featherstone NC, De Win G, Undre S, et al. Single incision prone retroperitoneoscopic paediatric nephrectomy. *J Pediatr Urol.* 2015;11(5):283–284.
- [21] Bhardwaj NJ. Retroperitoneal versus transperitoneal approach for nephrectomy in children: anesthetic implications. *J Anaesthesiol Clin Pharmacol.* 2015;31(1):25–26.
- [22] Chang A, Sivananthan D, Nataraja RM, et al. Evidence-based treatment of multicystic dysplastic kidney: a systematic review. *J Pediatr Urol.* 2018;14(6):510–519. Epub 2018 Oct 10.
- [23] Brown CT, Sebastião YV, McLeod DJ. Trends in surgical management of multicystic dysplastic kidney at USA children's hospitals. *J Pediatr Urol.* 2019;15(4):368–373. Epub 2019 Apr 30.