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Retroperitoneoscopic partial nephrectomy in children: a multicentric international comparative study between lateral versus prone approach

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Abstract

Background Very limited informations are currently available about the best approach to perform retroperitoneoscopic surgery. This multicentric international study aimed to compare the outcome of lateral versus prone approach for retroperitoneoscopic partial nephrectomy (RPN) in children.

Methods The records of 164 patients underwent RPN in 7 international centers of pediatric surgery over the last 5 years were retrospectively reviewed. Sixty-one patients (42 girls and 19 boys, average age 3.8 years) were operated using lateral approach (G1), whereas 103 patients (66 girls and 37 boys, average age 3.0 years) underwent prone RPN (G2). The two groups were compared in regard to operative time, postoperative outcome, postoperative complications, and re-operations.

Results The average operative time was significantly shorter in G2 (99 min) compared to G1 (160 min) ($p=0.001$). Only 2 lateral RPN required conversion to open surgery. There was no significant difference between the two groups as for intraoperative complications (G1:2/61, 3.3%; G2:6/103, 5.8%; $p=0.48$), postoperative complications (G1:9/61, 14.7%; G2:17/103, 16.5%; $p=0.80$), and re-operations (G1:2/61, 3.3%; G2:4/103, 3.8%; $p=0.85$). Regarding postoperative complications, the incidence of symptomatic residual distal ureteric stumps (RDUS) was significantly higher in G2 (7/103, 6.8%) compared to G1 (1/61, 1.6%) ($p=0.001$). Most re-operations (4/6, 66.6%) were performed to remove a RDUS .

Conclusions Both lateral and prone approach are feasible and reasonably safe to perform RPN in children but the superiority of one approach over another is not still confirmed. Although prone technique resulted faster compared to lateral approach, the choice of the technique remains dependent on the surgeon's personal preference and experience. Our results would suggest that the lateral approach should be preferred to the prone technique when a longer ureterectomy is required, for example in cases of vesico-ureteral reflux into the affected kidney moiety, in order to avoid to leave a long ureteric stump that could become symptomatic and require a re-intervention.

Keywords Partial nephrectomy · Retroperitoneoscopy · Technique · Prone · Lateral · Children

After the first description of a laparoscopic partial nephrectomy in children by Jordan and Winslow in 1993, minimally invasive surgery (MIS) has gained wide acceptance by pediatric urologists as the standard approach to the kidney for nephrectomy and partial nephrectomy [1, 2]. The main indications for partial nephrectomy in children include

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dysplastic non-functioning upper moiety associated with a ureterocele or an ectopic ureter, or high-grade vesico-ureteral reflux (VUR) in dysplastic lower moiety. This procedure can be carried out either through a retroperitoneal or transperitoneal approach [3].

Retroperitoneoscopic partial nephrectomy (RPN) is still not generally favored by pediatric surgeons or pediatric urologists for several reasons, such as lack of experience with retroperitoneal anatomy, long operative times, and related complications [4]. Leclair et al. published in 2009 a retrospective series of 48 patients underwent partial nephrectomy using retroperitoneoscopic lateral or prone approach with a conversion rate of 21% [5].

RPN in children has still a limited diffusion among pediatric surgeons and pediatric urologists because it is technically demanding in particular due to a limited operative working space [6, 7]. In the recent years, after introduction of hemostatic and sealing devices, the procedure has become faster, safer, and technically easier to perform [8, 9].

The traditional "lateral" retroperitoneoscopic approach has been widely applied in nephrectomy and partial nephrectomy in adults and children [10]. In the last years, also a "posterior" approach with the patient in the prone position has been described in children and has stimulated recent interest [11, 12]. However, very limited informations are currently available about which approach, between lateral versus prone, is preferable to perform retroperitoneoscopic surgery in children [13].

This multicentric international study aimed to compare the outcome of lateral versus prone approach to perform RPN in children.

Patients and methods

The records of 164 patients underwent RPN in 7 international centers of pediatric surgery over the last 5 years were retrospectively reviewed. The patients were grouped according to the surgical approach: lateral or prone. In Group 1 (G1), 61 patients (42 girls and 19 boys), with an average age of 3.8 years [range 1.2–8] and an average weight of 17.9 kg [range 10.5–28.5], operated using lateral approach (37 upper-pole and 24 lower-pole partial nephrectomies) were included. In Group 2 (G2), 103 patients (66 girls and 37 boys), with an average age of 3.0 years [range 1.8–5.2] and an average weight of 12.7 kg [range 9.0–19.5], underwent prone RPN (88 upper-pole and 15 lower-pole partial nephrectomies), were included.

The main indications for surgery were represented in both groups by recurrent urinary tract infections (UTIs) in 43.3% of cases, followed by (pseudo)incontinence due to ectopic ureters in 35.3% of cases and loss of kidney moiety function in 24.4% of cases. The choice of the retroperitoneal approach, between lateral and prone, was only dependent on the surgeon's personal preference and experience in our series.

All centers adopted the same postoperative follow-up protocol. The follow-up (average length 4.8 years, range 1–5 years) was based on clinical controls once a year for 5 years after surgery and echo-color Doppler (ECD) renal ultrasound (US) 1 month and 1 year after surgery. A DMSA renal scan was performed 1 year after surgery in all operated patients.

The two groups were compared in regard to operative time, postoperative outcome, postoperative complications, and re-operations. Postoperative complications were graded according to the Clavien–Dindo classification system [14]. Statistical analysis was carried out by using the Statistical Package for Social Sciences (SPSS Inc., Chicago, Illinois, USA), version 13.0. Data were compared using the Student's t test and the χ^2 test or Fisher's exact test. Significance was defined as $p < 0.05$.

The appropriate Institute Review Board (IRB) approval was obtained at each of the seven participating centers.

Surgical technique

In regard to the prone approach, after the induction of general anesthesia and the insertion of an indwelling catheter into the bladder, the patient was placed in a fully prone position, with pelvic and chest support to allow the abdominal contents to fall away in a dependent position (Fig. 1). A transverse 12-mm incision was made lateral to the sacrospinalis muscle, midway between the 12th rib and the iliac crest. A 12-mm trocar was placed through the incision and the retroperitoneal space was insufflated with carbon dioxide to a pressure of 10 or 12 mmHg, according to the patient's age. A second 5-mm trocar was placed under direct vision on the lateral aspect of the retroperitoneal space on the anterior axillary line. Gerota's fascia was incised, and the kidney was mobilized on its medial aspect to clearly identify the upper- and lower-pole ureters

Fig. 1 Patient's position in prone RPN

and the vascular pedicle. A third 5-mm trocar was placed medial to the 12-mm trocar through the sacrospinalis muscle.

In the lateral approach, the patient was placed in a lateral decubitus position, with a kidney break or roll accentuating the operative field (Fig. 2). A flank renal access was used. A transverse 5-mm skin incision was made below the tip of the 12th rib. A homemade dissecting balloon was used to develop the retroperitoneal space. Gerota's fascia was approached by a muscle-splitting incision with blunt dissection, then opened under direct vision and the first trocar (12-mm) was introduced inside the opened Gerota's fascia. The second 5-mm trocar was inserted posteriorly in front of the lumbosacral muscle. The third 5-mm trocar was inserted in the anterior axillary line, 10–15 mm from the top of the iliac crest. An additional 4th trocar may be placed in case of technical challenges. A 30° optic was always adopted in all centers. Sealing devices (starion, ligasure, ultracision, harmonic) were used to perform dissection and parenchymal section in all centers.

The ureter to the non-functioning moiety was divided and used for countertraction to visualize the vessels to the affected moiety. The polar vessels were divided under vision either with the sealing devices or using clips. After division of the feeding vessels, the moiety to be removed revealed a clear line of demarcation for transection. The parenchymal section was performed using sealing devices or with the endoloop technique [15]. The ureter of the removed moiety, isolated as far down toward the bladder level as possible, was tied using endoloops in all cases. The excised moiety was finally removed through the 12-mm trocar.

The trocars orifices were closed using resorbable sutures. An indwelling perirenal drain was placed in most cases for 24–48 h after surgery.

All details of operative practices of the separate centers are reported in Tables 1 and 2.

Fig. 2 Patient's position in lateral RPN

Results

All surgical procedures were performed by senior surgeons in each participating center.

The average operative time was significantly shorter in G2 (99 min; range 75–150) compared to G1 (160 min; range 74–272) ($p = 0.001$). Only 2 lateral RPN required conversion to open surgery, due to technical challenges related to the small operative field.

Postoperative outcome was similar in both groups without any significant difference in regard to average analgesic requirement (G1:36 h; G2:38 h; $p = 0.30$), average time to full oral feeding (G1:16.2 h; G2:14.9 h; $p = 0.55$), and average length of hospital stay (G1:2.5 days; G2:2.8 days; $p = 0.55$).

There was no significant difference between the two groups as for intraoperative complications (G1:2/61, 3.3%; G2:6/103, 5.8%; $p = 0.48$), postoperative complications (G1:9/61, 14.7%; G2:17/103, 16.5%; $p = 0.80$), and re-operations (G1:2/61, 3.3%; G2:4/103, 3.8%; $p = 0.85$).

Regarding intraoperative complications, two openings of the calyceal system occurred in G1, whereas five openings of the calyceal system and one peritoneal perforation occurred in G2. All complications were managed and solved intraoperatively without any problem.

Regarding postoperative complications, the incidence of symptomatic residual distal ureteric stumps (RDUS) was significantly higher in G2 (7/103, 6.8%) compared to G1 (1/61, 1.6%) ($p = 0.001$). Most re-operations (4/6, 66.6%) were performed to remove a RDUS (IIIb Clavien) (3 G2 patients and one G1 patient). One G1 patient with a postoperative urinoma was re-operated; the urinoma was drained and a residual upper-pole nephrectomy was performed (IIIb Clavien). Another G2 patient presented postoperative loss of function of the remaining kidney and he underwent a total nephrectomy (IIIb Clavien).

All patients' demographics and outcome parameters are reported in Table 3.

In addition, we separately analyzed details of operative technique and outcomes by center for each approach, lateral and prone (Tables 1, 2). This separate analysis showed that all centers adhered to a similar and comparable surgical protocol: same optic, same number of trocars, same patient's position for each approach, similar modality of parenchymal section (use of sealing devices), same modality of ligation of distal ureter (use of endoloop), postoperative positioning of a perirenal drain in most cases (5/6 centers for lateral RPN and 1/2 centers for prone RPN). In addition, analyzing the surgical outcome by center, we found that operative time was significantly shorter for both approaches ($p = 0.001$), whereas postoperative complications rate was significantly lower ($p = 0.001$) for

Table 1 Practices and outcomes of separate centers for lateral RPN

	Center 1	Center 2	Center 3	Center 4	Center 5	Center 6
Patients' demographics						
Total number of patients	27	5	4	3	13	9
Average age (years)	8	1.2	4.7	5.3	2.5	1.2
Average weight (kg)	17	10.5	22.8	28.5	18.5	10.5
Upper-pole RPN	9	4	4	3	10	7
Lower-pole RPN	18	1	0	0	3	2
Operative technique						
Optic	30°	30°	30°	30°	30°	30°
Number of trocars	3	3	3	3	3	3
Sealing device used for parenchymal section	Harmonic	Ligasure, ultracision	Harmonic	Starion TLS3	Ultracision	Ligasure
Ligation of distal ureter and modality	Yes (2 endoloops)	Yes (1 endoloop)	Yes (1 endoloop)	Yes (1 endoloop)	Yes (1 endoloop)	Yes (1 endoloop)
Perirenal drain	No	Yes	Yes	Yes	Yes	Yes
Operative outcome						
Average operative time (min)	74	140	131	185	158	272
Conversions to open surgery (n =)	0	0	0	0	2	0
Intraoperative complications (n =)	2	0	0	0	0	0
Average time to full oral feeding (h)	14.8	18	15.8	16	14.5	18.1
Average analgesic requirement (h)	28	40	38	36.8	37.5	35.7
Average length of hospital stay (days)	1.8	3.0	2.2	3.2	2.3	2.5
Postoperative complications						
Residual distal ureteric stump (RDUS) (n =)	0	0	1	0	0	0
Urinoma (n =)	0	0	0	1	1	1
Loss of function of the other hemikidney (n =)	0	1	0	0	1	0
Febrile UTIs (n =)	2	0	1	0	0	0
Others (n =)	0	0	0	0	0	0
Re-operations (n =)	0	0	1 Stumpectomy	0	1 Urinoma drainage	0

Center 1 = Division of Pediatric Surgery, Mater and Royal Children's Hospitals, Brisbane, Australia

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prone RPN in center 1 that had the highest volume practice compared to the other participating centers. No other significant difference emerged between the single centers in regard to the other parameters of the operative outcome.

Discussion

Although minimally invasive techniques have proven beneficial in several indications in children, it seems that the diffusion of laparoscopic partial nephrectomy remains limited to centers with advanced laparoscopic experience [5]. This may be related to the procedure's high level of technical difficulty combined with a relatively small number of indications. The level of technical challenge of laparoscopic partial nephrectomy is different according to the age of the child, the entity of the upper tract dilatation and the renal moiety considered. Lower-pole partial nephrectomies are usually performed in older children with refluxing non-functioning moieties, in whom dilatation of the pelvis and the ureter is rarely an issue. Upper-pole partial nephrectomies may be very challenging procedures, especially when performed on a massively dilated upper tract in young infants. This procedure can be carried out either through a retroperitoneal

Table 2 Practices and outcomes of separate centers for prone RPN

	Center 1	Center 2
Patients' demographics		
Total number of patients	65	38
Average age (years)	1.8	5.2
Average weight (kg)	9.0	19.5
Upper-pole RPN	58	30
Lower-pole RPN	7	8
Operative technique		
Optic	30°	30°
Number of trocars	3	3
Sealing device used for parenchymal section	Harmonic	Harmonic, ligasure, endoloop
Ligation of distal ureter and modality	Yes (2 endoloops)	Yes (1 endoloop)
Perirenal drain	Yes	No
Operative outcome		
Average operative time (min)	76	122
Conversions to open surgery (n =)	0	0
Intraoperative complications (n =)	5	1
Average time to full oral feeding (h)	14.3	15.5
Average analgesic requirement (h)	36	40
Average length of hospital stay (days)	2.7	2.9
Postoperative complications		
Residual distal ureteric stump (RDUS) (n =)	2	5
Urinoma (n =)	0	3
Loss of function of the other hemi-kidney (n =)	0	1
Febrile UTIs (n =)	4	2
Others (n =)	0	0
Re-operations (n =)	2 Stumpectomy	1 Total nephrectomy 1 Urinoma drainage

Center 1 = Division of Pediatric Surgery, Mater and Royal Children's Hospitals, Brisbane, Australia

Center 2 = Division of Pediatric Urology, Great Ormond Street Hospital, London, United Kingdom

or transperitoneal approach [3]. The best approach between laparoscopy and retroperitoneoscopy to perform partial nephrectomy in children is still under debate [3, 16–18]. The retroperitoneal approach, although technically more challenging, has been reported as the most proper route to organs situated retroperitoneally. This approach offers the advantages of a direct access to the kidney, minimal mobilization of the kidney and surrounding structures and a decreased risk of intraperitoneal organs injury and postoperative adhesions [19]. In addition, the retroperitoneal approach is not precluded by previous abdominal procedures. Drawbacks are the spatial limitations of the narrow retroperitoneal working space, especially in smaller children (younger than 12 months) and the difficulty to remove the entire ureter near the bladder dome [20].

However, very limited informations are currently available and no consensus has been reached about which approach, between lateral versus prone, is preferable to perform retroperitoneoscopic surgery [13]. For this reason, we decided to compare the outcome of both approaches to perform RPN in children.

Partial nephrectomy in duplex kidneys requires careful identification of polar or accessory vessels to the pathological moiety. The lateral RPN requires constant lateral traction to the renal pelvis and kidney to maintain visual access to the renal vessels. Conversely, the posterior approach in a fully prone position allows the surgeon to take full advantage of gravity, as the abdominal contents and peritoneum fall ventrally, thus facilitating hilar dissection and vascular control and reducing the risk of a peritoneal tear and subsequent pneumoperitoneum [21]. This aspect may be considered an advantage of the prone approach compared to the lateral one. Another reported advantage of the prone position is in case of conversion to open surgery. In this last evenience, the procedure can be converted through a dorsal lumbotomy incision by simply extending the longitudinal incision for the first trocar caudally [11]. In our series, the prone approach was associated with a shorter operative time

Table 3 Patients' demographics and outcome parameters in G1 and G2 groups

	G1 (lateral RPN) $n=61$	G2 (prone RPN) $n=103$	Statistical analysis (p)
Patients' demographics			
Number boys	19	37	
Number girls	42	66	
Average age (years)	3.8 [1.2–8]	3.0 [1.8–5.2]	0.20
Average weight (kg)	17.9 [10.5–28.5]	12.7 [9.0–19.5]	0.20
Upper-pole RPN	37	88	0.001
Lower-pole RPN	24	15	0.41
Operative outcome			
Average operative time (min)	160 [74–272]	99 [76–122]	0.001
Conversions to open surgery (n =)	2 (3.2%)	0	0.001
Intraoperative complications (n =)	2 (3.3%)	6 (5.8%)	0.48
Average time to full oral feeding (h)	16.2	14.9	0.55
Average analgesic requirement (h)	36	38	0.30
Average length of hospital stay (days)	2.5	2.8	0.55
Postoperative complications			
Overall rate (%)	9 (14.7%)	17 (16.5%)	0.80
Residual distal ureteric stump (RDUS)	1 (1.6%)	7 (6.8%)	0.0001
Urinoma	3 (4.9%)	3 (2.9%)	0.30
Loss of function of the remaining hemi-kidney	2 (3.2%)	1 (0.9%)	0.20
Febrile UTIs	3 (4.9%)	6 (5.8%)	0.55
Others	0	0	
Re-operations rate (%)	2 (3.3%)	4 (3.8%)	0.85
Stumpectomy (n =)	1	3	
Urinoma drain (n =)	1	0	
Total nephrectomy (n =)	0	1	

compared to the lateral approach; probably, this result was related to the better exposition of the kidney vasculature that made the procedure faster. However, the prone positioning of the patient is more challenging compared to the lateral positioning and the correct placement of the patient on the operative table is one of the key steps to safely accomplish the procedure. In addition, the anatomical view is different in the prone approach and this aspect may be associated with a longer learning curve of the prone technique compared to the lateral approach. The previous series [13] reported a higher incidence of peritoneal tears with the lateral approach that was not confirmed in our series. In fact, we reported only one case of peritoneal perforation with the lateral approach that was easily solved with needle decompression and the procedure continued accordingly.

One of the most discussed points of the retroperitoneoscopic approach is the extent of the ureterectomy and the risk to leave a symptomatic residual distal ureteric stump (RDUS). Some authors recommended to always adopt the transperitoneal approach to perform a complete ureterectomy in patients with associated VUR into the affected kidney moiety [3]. Previous studies reported that the ureter can be dissected deep to the bifurcation of the iliac vessels with the prone approach, leaving in place the last 3–6 cm of its length, whereas the possibility to leave a RDUS is minimized using the lateral approach in children older than 5 years [13, 22]. Our results confirmed this evidence; in fact, the incidence of symptomatic RDUS was significantly higher with the prone technique compared to the lateral approach and most re-operations (4/6, 66.6%) were performed to remove a symptomatic RDUS. Our recommendation is to section the ureter as proximally to the bladder as possible and to always ligate it in refluxing systems. Another consideration emerging from our study is that advanced MIS procedures and in particular partial nephrectomy are strictly linked to the advanced technology and instrumentation now available on the market. As already reported, the sealing and hemostatic devices (starion, ligasure, ultracision) are fundamental tools to perform RPN [8, 9], as they allow a fast tissue dissection, a safe vascular control and an easy resection of the non-functioning moiety and of the ureter without any bleeding. All centers involved in our study adopted these sealing devices and no intraoperative major bleeding was reported in our series.

Our study showed that RPN still remains a challenging procedure performed only in experienced pediatric centers

Table 4 Published series of prone and lateral retroperitoneoscopic partial nephrectomies (RPN) in children

Reference	Number of patients	Prone RPN	Lateral RPN	Average operative time (min)	Conversion rate (%)	Postoperative complications rate (%)
Borzi [13]	19	12	7	80	2 (11%)	9 (47.3%)
El-Ghoneimi et al. [23]	15	0	15	152	1 (7%)	1 (7%)
Valla et al. [24]	24	0	24	160	3 (12.5%)	5 (20%)
Lee et al. [25]	14	11	3	194	0	1 (7.1%)
Wallis et al. [26]	22	0	22	174	4 (18%)	7 (31.8%)
Mushtaq et al. [15]	54	54	0	105	0	11 (20.3%)
Leclair et al. [5]	48	17	31	120	10 (21%)	2 (4.1%)
Cascio et al. [12]	15	15	0	150	0	2 (13%)
Present series	164	103	61	129.5	2 (1.2%)	26 (15.8%)

and analyzing the international literature our series is one of the largest ones published (Table 4). We reported the lowest conversion rate among all published series [5, 12, 13, 15, 23–26]. Probably, this result may be due to the high experience of the participating surgeons with retroperitoneoscopic surgery. In fact, all surgeons that participated to this study had a long experience (> 20 years) in MIS and in particular in retroperitoneal surgery. Each center had a high volume practice in MIS (more than 500 MIS procedures/year and at least 50 retroperitoneal procedures/year). The separate outcome analysis by center supported our hypothesis that the reported outcomes largely depend on the experience of the surgeon with this procedure. In particular, operative time was significantly shorter for both approaches ($p = 0.0001$), whereas postoperative complications rate was significantly lower ($p = 0.0001$) for prone RPN in center 1 that had the highest volume practice compared to the other participating centers (Tables 1, 2).

In conclusion, our results showed that both lateral and prone approach are feasible and reasonably safe in experienced hands to perform RPN in children but the clear superiority of one approach over another is not still confirmed. Although prone technique resulted faster compared to lateral approach, the choice of the technique remains dependent on the surgeon's personal preference and experience. However, the comparative analysis of the outcomes of both approaches that was performed in this study allowed to better define selection criteria for a surgical approach over another. In fact, our results would suggest that the lateral approach should be preferred to the prone technique when a longer ureterectomy is required, for example in cases of VUR into the affected kidney moiety, in order to avoid to leave a long ureteric stump that could become symptomatic and require a re-intervention.

Finally, we believe that advanced retroperitoneoscopic skills, appropriate instrumentation, and new devices are all critical points for the success of this surgery in infants and children.

Compliance with ethical standards

Disclosure Drs Maria Escolino, Giovanna Riccipetitoni, Atsuyuki Yamataka, Imran Mushtaq, Go Miyano, Paolo Caione, Fabio Chiarenza, Peter Borzi, and Ciro Esposito declare that they have no conflicts of interest or financial ties to disclose.

References

1. Jordan GH, Winslow BH (1993) Laparoendoscopic upper pole partial nephrectomy with ureterectomy. J Urol 150:940–943
2. Robinson BC, Snow BW, Cartwright PC, de Vries CR, Hamilton BD, Anderson JB (2003) Comparison of laparoscopic versus open partial nephrectomy in a pediatric series. J Urol 169:638–640
3. Esposito C, Escolino M, Miyano G, Caione P, Chiarenza F, Riccipetitoni G, Yamataka A, Savanelli A, Settimi A, Varlet F, Patkowski D, Cerulo M, Castagnetti M, Till H, Marotta R, La Manna A, Valla JS (2016) A comparison between laparoscopic and retroperitoneoscopic approach for partial nephrectomy in children with duplex kidney: a multicentric survey. World J Urol 34(7):939–948
4. Esposito C, Miyano G, Caione P, Escolino M, Chiarenza F, Riccipetitoni G, Yamataka A, Cerulo M, Savanelli A, Settimi A, Valla JS (2015) Retroperitoneoscopic heminephrectomy in duplex kidney in infants and children: results of a multicentric survey. J Laparoendosc Adv Surg Tech A 25(10):864–869
5. Leclair MD, Vidal I, Suply E, Podevin G, Heloury Y (2009) Retroperitoneal laparoscopic heminephrectomy in duplex kidney in infants and children: a 15-year experience. Eur Urol 56:385–389
6. Valla JS (2007) Retroperitoneoscopic surgery in children. Semin Ped Surg 16:270–273
7. El Ghoneimi A, Abou-Hashim H, Bonnard A, Verkauskas G, Macher MA, Huot O, Aigrain Y (2006) Retroperitoneal laparoscopic nephrectomy in children: at last the gold standard? J Pediatr Urol 2(4):357–363
8. Jackman SV, Caddeddu JA, Chen RN, Micali S, Bishoff JT, Lee BR, Moore RG, Kavoussi LR (1998) Utility of the harmonic scalpel for laparoscopic partial nephrectomy. J Endourol 12:441–444

9. Esposito C, Iaquinto M, Escolino M, Farina A, La Manna A, Savanelli A, Settimi A, Di Mezza A (2014) Is retroperitoneoscopic renal ablative surgery easier and safer using a new hemostatic device compared with clips and monopolar coagulation? A comparative study. Minerva Urol Nefrol 66(2):101–105
10. El Ghoneimi A, Valla JS, Steyaert H, Grainy AI (1998) Renal surgery via a retroperitoneal approach in children. J Urol 160:1138–1141
11. Urbanowicz W, Wieczorek M, Sulislawski J (2002) Retroperitoneoscopic nephrectomy in the prone position in children (point of technique). Eur Urol 42:516–519
12. Cascio S, Winning J, Flett ME, Fyfe AH, O'Toole S (2011) Open versus prone retroperitoneoscopic partial nephrectomy in children: a comparative study. J Pediatr Urol 7:61–64
13. Borzi PA (2001) A comparison of the lateral and posterior retroperitoneoscopic approach for complete and partial nephroureterectomy in children. BJU Int 87:517–520
14. Dindo D, Demartines N, Clavien PA (2004) Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 240:205–213
15. Mushtaq I, Haleblian G (2007) Laparoscopic heminephrectomy in infants and children: first 54 cases. J Pediatr Urol 3:100–103
16. Castellan M, Gosalbez R, Carmack AJ, Prieto JC, Perez-Brayfield M, Labbie A (2006) Transperitoneal and retroperitoneal laparoscopic heminephrectomy- what approach for which patient? J Urol 176:2636–2639
17. Marszalek M, Chromecki T, Al-Ali BM, Meixl H, Madersbacher S, Jeschke K, Pummer K, Zigeuner R (2011) Laparoscopic partial nephrectomy: a matched-pair comparison of the transperitoneal versus the retroperitoneal approach. Urology 77:109–113
18. Esposito C, Escolino M, Castagnetti M, Savanelli A, La Manna A, Farina A, Turrà F, Roberti A, Settimi A, Varlet F, Till H, Valla JS (2016) Retroperitoneal and laparoscopic heminephrectomy in duplex kidney in infants and children. Transl Pediatr 5(4):245–250
19. Kawauchi A, Fujito A, Naito Y, Soh J, Ukimura O, Yoneda K, Mizutani Y, Miki T (2004) Retroperitoneoscopic heminephroureterectomy for children with duplex anomaly: initial experience. Int J Urol 11:7–10
20. Schneider A, Ripepi M, Henry-Florence C, Geiss S (2010) Laparoscopic transperitoneal partial nephrectomy in children under 2 years old: a single-centre experience. J Pediatr Urol 6(2):166–170
21. Goyal A, Hennayake S (2010) Prone retroperitoneoscopic approach for heminephrectomy: specific advantages relating to access to vascular pedicle. J Pediatr Urol 6:153–156
22. Iaquinto M, Esposito C, Escolino M, Farina A, Settimi A, Cigliano B (2014) Symptomatic refluxing distal ureteral stump after retroperitoneoscopic nephrectomy. APSP J Case Rep 5(1):14
23. El Ghoneimi A, Farhat W, Bolduc S, Bagli D, McLorie G, Khoury A (2003) Retroperitoneal laparoscopic vs open partial nephroureterectomy in children. BJU Int 91:532–535
24. Valla JS, Breaud J, Carfagna L, Tursini S, Steyaert H (2003) Treatment of ureterocele on duplex ureter: upper pole nephrectomy by retroperitoneoscopy in children based on a series of 24 cases. Eur Urol 43:426–429
25. Lee RS, Retik AB, Borer JG, Diamond DA, Peters CA (2005) Pediatric retroperitoneal laparoscopic partial nephrectomy: comparison with an age-matched cohort of open surgery. J Urol 174:708–712
26. Wallis MC, Khoury AE, Lorenzo AJ, Pippe-Salle JL, Bagli DJ, Farhat WA (2006) Outcomes analysis of retroperitoneal laparoscopic heminephrectomy in children. J Urol 175:2277–2282