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Original Article

Comparison of Videolaparoscopic *Versus* Open Surgery for Benign Renal Diseases in Children

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ABSTRACT

Introduction: Laparoscopic nephrectomy in children has become a reasonable alternative to open nephrectomy and has replaced open surgery for many renal diseases. The purpose of our study is to evaluate transperitoneal videolaparoscopic procedures in renal benign diseases in comparison to an open surgery approach. Patients and **Methods:** Thirty-four children aged between 17 days and 15 years old (mean 6.14) were divided into two groups in order to be submitted to nephrectomy. The first one underwent transperitoneal videolaparoscopic nephrectomy and was composed by 21 patients aged from 2 months to 15 years (mean 7.42), from which 12 were females and 9 males. The second group was submitted to open nephrectomy and was composed by 13 patients aged from 17 days to 11 years (mean 3.91), 6 females and 7 males. The groups were compared regarding anesthesic time, operative time, length of hospital stay, postoperative pain and time of reintroduction of oral intake. Short and long term complications were also evaluated. Statistical analysis was performed by Student t-test with the level of significance set at $P < 0.05$. The study was previously approved by the Committee on Ethics in Research of our institution. **Results:** Significant statistical difference was observed only for the variable length of hospital stay. No laparoscopy group case was converted to open surgery. There was no immediate or late complication. Blood loss was negligible and no transfusion was required. **Conclusion:** In our experience, transperitoneal videolaparoscopic nephrectomy has similar results to open nephrectomy, except for time of hospitalization.

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INTRODUCTION

Not a long time ago, urological laparoscopic procedures in children were performed almost exclusively for diagnostic purposes, like in cryptorchidism and inter-sex, or in minor ablative procedures such as gonadectomy. [1,2]

In 1992 the first nephrectomy and nephroureterectomy cases in children were reported.[3]

Since then hundreds of nephrectomies were reported in the literature by many groups around the world. [4] The technique was refined and the indications were extended to partial nephrectomies, nephroureterectomies, radical nephrectomies and nephrectomies in donors for kidneys transplantation [3,5]. Some authors have published their experience in videolaparoscopic nephrectomy in pediatric patients with less than 1 year of age [6,7], so that today laparoscopic nephrectomy in children has become a reasonable alternative to open nephrectomy and has replaced open surgery for many renal diseases.

Many comparisons between laparoscopic and open nephrectomy in children have been performed.[7, 8, 9, 10] However, there is no concrete evidence that one is indeed superior to the other, even though the laparoscopic technique seems to be secure and applicable for almost all pediatric cases with slightly better results.

The purpose of our study is to evaluate transperitoneal videolaparoscopic procedures in renal benign diseases in comparison to open surgery approach within our institution.

PATIENTS AND METHODS

Between 1996 and 1998, 34 children aged from 17 days to 15 years (average 7.42), 18 males and 17 females, who had circulatory or urinary symptoms, along with over 90% loss of renal function assessed by renogram with DTPA were selected to be submitted to unilateral nephrectomy, either partial or total, with or without uretectomy. The patients were divided in two groups: the first one underwent videolaparoscopic nephrectomy and was composed by 21 patients (cases 1 to 21) aged from 2 months to 15 years (mean 7.42), from which 12 were females and 9 males. The second group was submitted to open nephrectomy and was composed by 13 patients (ca-

ses 22 to 35) aged from 17 days to 11 years (mean 3.91), 6 females and 7 males.

All cases were previously assessed by ultrasound of the urinary tract, urography, voiding cystogram, DMSA study and laboratory tests. Patients without kidney function at urography and without vesicoureteral reflux underwent a CT scan. The kidneys removed had minimal or no function. Patients with renovascular hypertension underwent a selective angiographic study and plasmatic renin levels were measured. No patient had past history of renal or ureteral surgery at the side to be operated. Only in one case an angioplasty of the renal artery was attempted a few days before surgery, but was unsuccessful. The indications for each procedure are shown on tables 1 and 2.

In all cases the adrenal glands were preserved. Neither drainage of the surgical area nor

Table 1 – *Patient characteristics in group 1.*

Case	Gender	Age(mos)	Diagnosis	Procedure	Operative time (min)
1	F	97	Right UPJ obstruction	Right Nephrectomy	150
2	M	121	Left UPJ obstruction	Left Nephrectomy + Bilateral Orquidopexy	165
3	F	49	Right duplicated system	Right Heminephrectomy	180
4	F	161	Dysplastic right kidney with hypertension	Right Nephrectomy	165
5	M	13	Ureterohydronephrosis	Left Nephroureterectomy + Partial cistectomy + Hérnia correction	185
6	M	58	Multicystic dysplastic left kidney	Left Nephrectomy	85
7	M	121	Right renal artery stenosis with hypertension	Right Nephrectomy	125
8	F	152	Right renal artery stenosis with hypertension	Right Nephrectomy	210
9	M	149	Dysplastic right kidney with hypertension	Right Nephrectomy	105
10	M	36	Left UPJ obstruction	Left Nephrectomy + Left Orquiectomy	75
11	F	92	Nonfunctioning left kidney with reflux	Left Nephroureterectomy	105
12	M	115	Iatrogenic ligation of right ureter	Right Nephroureterectomy	90
13	F	117	Atrophic left kidney with reflux and chronic pyelonephritis	Left Nephroureterectomy	145
14	F	121	Nonfuntioning right kidney with hydronephrosis and hypertension	Right Nephrectomy	90
15	F	67	Nonfunctioning left dysplastic kidney	Left Nephrectomy	70
16	F	118	Left duplicated system	Heminefrectomia polar superior E	110
17	M	6	Left duplicated system with left ureterocele	Left Nephroureterectomy + Ureterocelectomy	255
18	F	182	Nonfunctioning left dysplastic kidney with hypertension	Left Nephrectomy	90
19	F	74	Left duplicated system with ectopic ureter	Left Heminephrectomy	135
20	F	2	Multicystic dysplastic left kidney with ureterocele	Right Nephroureterectomy + vesical withdrawal	175
21	M	20	Nonfunctioning right dysplastic kidney with hydronephrosis	Right Nephrectomy	75

Table 2 – *Patient characteristics in group 2.*

Case	Gender	Age(mos)	Diagnosis	Procedure	Operative time (min)
22	F	73	Left ectopic duplicated system	Right upper pole nephrectomy	105
23	M	44	Nonfunctioning right dysplastic kidney with hydronephrosis and Prune-Belly syndrome	Left Nephrectomy + Bilateral Orquidopexy	180
24	F	11	Left duplicated system with nonfunctioning left upper pole	Left upper pole nephrectomy	120
25	M	88	Nonfunctioning right dysplastic kidney with coraliform calculus	Right Nephrectomy	130
26	F	126	Left duplicated system	Left upper pole nephrectomy + Left ureterectomy	300
27	M	58	Left duplicated system	Left upper pole nephrectomy + Circunsion+ Hidrocele correction	180
28	F	71	Right duplicated system	Right upper pole nephrectomy	225
29	F	49	Right duplicated system	Right upper pole nephrectomy + ureterocele aspiration	135
30	M	24	Nonfunctioning right kidney with reflux	Right Nephrectomy + Bilateral ureteral reimplantation	140
31	M	0.56	Right UPJ obstruction	Right Nephrectomy	100
32	F	5	Right duplicated system	Right upper pole nephrectomy	65
33	M	2	Multicystic dysplastic left kidney	Left Nephrectomy	105
34	M	13	Left duplicated system	Left upper pole nephrectomy	125

ureteral catheterization was performed. All patients were monitored with pulse oximeter and capnography during surgery. The nasogastric and bladder catheters were removed either on the same day of surgery or on the following morning.

The parents were informed about the laparoscopy and open surgery procedures and informed consent was obtained in all cases. The possibility of conversion to open surgery was explained to all parents in the laparoscopic group.

Laparoscopic nephrectomies were performed using the transperitoneal approach, in which patients under general anesthesia and without any special preoperative preparation other than prophylactic antibiotics and fasting; nasogastric and vesical catheters were placed in a 45-degree lateral position. After the introduction of the Veress needle in the upper lip of the umbilical scar, creating a pneumoperitoneum with carbon dioxide under 15 mm Hg of pressure, 4 ports were introduced. The videocamera was introduced through the umbilical port. The intraperitoneal pressure was reduced to 12 mm Hg and the procedure followed the following sequence: 1 - incision of the parietocolic recess and medial mobilization of the colon, especially its hepatic and splenic angle, in order to expose renal hilar vessels and fascia of Gerota, 2 - the opening of Gerota fascia and exposure of the kidney and the proximal ureter; 3 - section of the ureter and traction of his proximal segment to reach the vessels, 4 - section of hilar vessels with separate metal clipping, 5 - dissection around the kidney from its capsule, to release it fully from neighbour structures, 6 - bagging and mechanical fragmentation of the specimen before removal though the biggest port incision (11 mm); 7 - cavity review and surgical closure of injuries. In cases of nephroureterectomy, the ureter was ligated only after completion of the nephrectomy with two chromic catgut stitches at the level of their insertion to the bladder. In cases where partial nephrectomy was performed, all regular steps were followed, with the additional care to empty the hydronephrotic unit first, in order to facilitate its separation.

Postoperatively, analgesics were prescribed as needed. Patients were encouraged to resume oral intake after the return of bowel function was confirmed. Patients were discharged when complete bowel function was restored. After hospitalization,

patients were followed at the clinic through clinical evaluation and laboratory analysis.

We obtained data on perioperative data, including anesthetic time, operative time, length of hospital stay, postoperative pain, and time of reintroduction of oral intake. Short and long term complications were also evaluated.

Statistical analysis was performed by Student *t*-test with the level of significance set at $P < 0.05$. The study was previously approved by the Committee on Ethics in Research of our institution.

RESULTS

The operative time in group 1 ranged from 75 to 255 minutes (mean 132.62), while in group 2 the time varied from 65 to 300 minutes (mean 146.92). The total time required for anesthesia (anesthesic time) in Group 1 ranged from 125 to 315 minutes (mean 187.62 minutes), whereas in group 2, the anesthetic time had a mean of 225 minutes, ranging from 120 to 380 minutes.

Some patients had to undergo another procedure during the nephrectomy. The associated surgical procedures in group 1 were: bilateral orchiopexy (case 2), inguinal and umbilical hernia repair (case 5), and left orquiectomy (case 10). These procedures added to the surgical time, 60 minutes, 30 minutes and 30 minutes respectively for cases 2, 5, 10. In two patients (17 and 20), Pfannenstiel incisions were made in order to facilitate transvesical withdrawal of the specimen.

The associated surgical procedures in group 2 were: bilateral orchiopexy (case 23), postectomy and hydrocelectomy (case 27) and bilateral ureteral reimplantation (case 30). These procedures added to the surgical time, 60 minutes, 30 minutes and 75 minutes respectively for cases 2, 6, 9. In cases of duplicated system, a small Pfannenstiel incision was necessary to conduct the withdrawal of the lower end of the ureter, except in the case 29, which was held only the aspiration of ureterocele.

There were no significant changes in blood pressure heart rate or the partial pressure of oxygen and carbon dioxide during anesthesia in both groups. The bleeding in all cases was irrelevant (<50ml) and no blood transfusion was needed. In group 1, all cases were successfully completed by laparoscopic access, without conversion to open surgery.

Most patients were admitted in the evening before the surgical procedure, except two children (cases 17 and 20) who were previously admitted. The duration of hospital stay was calculated from the admission day to the moment of urologic discharge, regardless of the fact if the patient remains for another reason, which happened in cases 17 and 21. The average length of hospital stay in Group 1 was 2.66 days, ranging between one and six days. The average length of hospital stay in group 2 was 5.54 days, ranging between two and fourteen days.

All children were allowed to have a liquid intake after 6 hours of the procedure, reaching solid content in the end of the first post-operative day. The exception occurred in cases 17 and 20, whose diet was restricted to breastfeeding considering their ages, and in case 23, whose solid ingestion occurred on the second post-operative day. Most children were able to walk short distances on the first postoperative day,

Table 3 - *Operative and convalescence parameters for laparoscopic and open groups.*

Analyzed criteria	Group 1		Group 2		p
	Mean	SD	Mean	SD	
Age	7,12	4,73	3,72	3,40	0,0315*
Operative time (min)	132,62	50,33	146,92	61,79	0,5915
Anesthesic time (min)	187,62	48,72	225	76,18	0,5543
Hospitalar Stay (days)	2,66	1,20	5,54	3,04	0,0064*
Time to oral intake (days)	0,62	0,59	0,84	0,55	0,2728
Overall analgesic medication (number of doses)	3,42	3,31	3,00	1,41	0,6625
Right after the surgery	1,76	1,41	1,38	1,04	0,4503
First Postoperative Day	1,23	1,54	1,15	0,55	0,8519
Second Postoperative Day	0,24	0,62	0,38	0,50	0,4817
Third Postoperative Day	0,19	0,87	0,08	0,27	0,6537

except for those who weren't old enough and for case 10, who suffered from chronic encephalopathy.

The post-operative pain was measured indirectly by the number of painkillers doses used postoperatively, as previously estimated in other studies. In group 1 the average amount was 1.76 doses for the immediate postoperative period, 1.23 doses for the first postoperative day, 0.24 doses for the second day and 0.19 doses for the third day. Altogether the mean reached 3.42 doses of analgesic. In group 2 the average consisted of 1.38 doses for the immediate postoperative period, 1.15 doses for the first postoperative day, 0.38 doses for the second day and 0.08 doses for the third day. Children of this group had a mean use of 3.00 doses of analgesic. In all cases, the medication used consisted of either acetaminophen or similar was indicated exclusively for the treatment of pain, and not for other conditions such as hyperthermia. The comparative results of all analyzed data are shown in Table 3. Significant statistical differences between groups were observed only for variables of age and length of hospital stay.

All patients had a postoperative follow-up at the Division of Pediatric Urology at São Paulo University. The patients were evaluated between 45 and 789 days (mean 231 days). Cases 1,2,3,4,5,13 and 15 were discharged shortly after surgery. Cases 4,7,8,9 and 14 had hypertension detected before being submitted to nephrectomy. From those, only case 14 remained with elevated blood pressure levels after surgery. Cases 10, 12, 16, 17 and 20 had to undergo longer follow-up treatment due to their more complex urologic conditions. The cosmetic late sequelae were minimal in all cases. No incisional hernias or any other sequelae related to the surgical procedures performed were noted.

DISCUSSION

There are a large number of published series that have shown urologic laparoscopy to be safe and efficacious in the pediatric population.[3,7] The major described advantages of laparoscopic surgery are less postoperative pain, reduced wound complications, minimal scarring, a shorter hospital stay, and an earlier return to normal activities, such as feeding, bowel movements, and work or school.[10] However, even today laparoscopic surgeries are more extensively used in adults than in children, and the exact explanation for that remains uncertain. Some possible reasons are: (1) the fact that most open nephrectomies in children may be performed through a relatively small incision and follow a satisfactory postoperative course, (2) most studies have shown that the expected postoperative result and course are similar to those of laparoscopy, (3) as children recover faster than adults from most open surgical procedures, these patients may have less to gain from a minimally invasive approach.

When comparing the two analyzed groups in our study, it was observed that they differ in the variable of age, in which the mean age of 7.12 for the laparoscopic group was significantly higher than the 3.40 mean age found in the open surgery group (p=0.0315). This difference should be regarded as a possible advantage for group 2, contributing for the lack of statistical difference in the studied variables, once it is expected that younger children may have a faster recovery and less fat around the organs, making the surgery technically easier.[6]

There was no difference regarding the gender in the groups, even though there is no evidence that the variable of sex plays an important role in surgery outcomes.

The estimated time of laparoscopic surgery mentioned in the literature varies from less than 1 hour to 5 hours [6, 11-3]. The average time observed in this study was 132.62 minutes and it is very similar to the time reported in the literature using the same transperitoneal technique. [21]

In laparoscopy timing does matter, once it was observed that oliguria, hypercarbia, pulmonary edema, cardiac decompensation, postoperative peritoneal irritation caused by the formation of carbonic acid and abdominal discomfort postoperative are relatively proportional to the time of surgery.[14]

Both transperitoneal and retroperitoneal laparoscopic approach may be used, once studies have shown that they have similar results. However, to our knowledge there is no study comparing these two entities in the pediatric population.[15,16]

The complications described in the literature consist of intestinal perforation, pre-peritoneal insufflations and vascular injury. We have not had any early or late complications, which is in accordance to the data from the literature. In our review we did not find significant complication rates with laparoscopic nephrectomy in children. In adults the incidence of complications for laparoscopy is around 12% when

considering only benign diseases, which is lower than complications caused by open surgery [17].

The performance of open laparoscopy through the cannula of Hasson, advocated by some authors to reduce the risk of visceral injury, was not followed in our study [18]. We prefer the use of Veress needle, which we have a great experience, without any complication. The employment of 4 trocars shortens the time of the procedure and does not add any morbidity to the patient. The use of 3 trocars in easier cases is possible.[18,19]

Despite the similarity of groups when considering postoperative pain. Our subjective impression; however, is that in laparoscopic nephrectomy pain is decreased when compared to open surgery, which has already been proven in adult patients.[20]

Cosmetic and psychological sequelae of nephrectomy in children have not been assessed so far. However, we have no doubt about the cosmetic superiority of laparoscopic nephrectomy to open nephrectomy, once the whole procedure involves two scars of 11 mm and two of 5 mm, without any muscle damage.

Many comparisons between open and laparoscopic nephrectomy in children have been reported and all of them provide evidence of the safety and efficacy of laparoscopy in pediatric patients. However, they do not preclude the open nephrectomy as a valid choice in places where experience in laparoscopic procedures is not well established, or the resources are scarce. Our study provides extra evidence that both methods are secure, and the choice should follow the surgeon experience.

CONCLUSION

Transperitoneal laparoscopic nephrectomy was performed successfully on 21 children, without any complication. The results obtained by us and some other authors can say that the transperitoneal laparoscopic technique is applicable to children in nephrectomies.

In this study, we compared the results of transperitoneal laparoscopic nephrectomy and open nephrectomy for benign renal diseases in children. Even though there was no significant statistical difference between both groups when comparing surgery time, anesthesic time, transperitoneal laparoscopic nephrectomy and nephroureterectomy may be performed for benign disease in children with minimal morbidity, improved cosmetic results, and a shorter hospital stay.

Our personal experience indicates that transperitoneal laparoscopic nephrectomy is appropriate in children and superior, in some instances, to open surgery.

Retroperitoneal laparoscopic nephrectomy and nephroureterectomy may be performed

Further studies, including multicentric prospective comparative randomized trials, are required to make this controversy come to an end.

REFERENCES

1. Castilho LN, Ferreira U, Rodrigues Netto NJr, Ikari O, Valim CA, Andrade LAL, Esteves SC. Laparoscopic pediatric orchiectomy - J Endourol, 1992; 6:155-7.
2. Ferreira U, Esteves SC, Castilho LN, Rodrigues Netto NJr. Laparoscopy in the management of nonpalpable testes and intersex states. Arch Esp Urol, 1993; 46:638-41.
3. Ehrlich RM, Gershman A, Mee S, Fuchs G. Laparoscopic nephrectomy in a child: expanding horizons for laparoscopy in pediatric urology. J Endourol, 1992; 6:463-5.
4. Eraky I, El-Kappany HA, Ghoneim MA. Laparoscopic nephrectomy: Mansura experience with 106 cases. Br J Urol, 1995; 75:271-5.
5. Mitsui H, Nakane H, Kamata S, Nasu T, Hayashida T. Experiences on the laparoscopic nephroureterectomy for 6 cases with renal pelvis carcinoma. J Endourol, 1994; 8:S80.
6. Koyle MA, Woo HH, Kavoussi LR. Laparoscopic nephrectomy in the first year of life. J Pediatr Surg, 1993; 28:693-5.
7. Mulholland TL, Kropp BP, Wong C.Laparoscopic renal surgery in infants 10 kg or less. J Endourol. 2005 Apr;19(3):397-400.
8. Robinson BC, Snow BW, Cartwright PC, De Vries CR, Hamilton BD, Anderson JB. Comparison of laparoscopic versus open partial nephrectomy in a pediatric series. J Urol. 2003 Feb;169(2):638-40.Hamilton BD, Gatti JM, Cartwright PC, Snow BW.
9. Comparison of laparoscopic versus open nephrectomy in the pediatric population. J Urol. 2000 Mar;163(3):937-9.Zerhau P, Hnilicka B. Comparison of laparoscopic and open nephrectomy in children. Rozhl Chir. 2001 Mar;80(3):147-50.
10. Ku JH, Yeo WG, Choi H, Kim HH. Comparison of retroperitoneal laparoscopic and open nephrectomy for benign renal diseases in children. Urology. 2004 Mar;63(3):566-70; discussion 570.
11. Das S, Keizur JJ, Tashima M. Laparoscopic nephroureterectomy for end-stage reflux nephropathy in a child. Surg Laparosc Endosc, 1993; 3:462-5.

12. Jordan GH, Winslow BH. Laparoendoscopic upper pole partial nephrectomy with ureterectomy. J Urol, 1993; 150:940-3.
13. Figenshau RS, Clayman RV, Kerbl K, McDougall EM, Colberg JW. Laparoscopic nephroureterectomy in the child: initial case report. J Urol, 1994; 151:740-1.
14. Hamilton BD, Gatti JM, Cartwright PC, et al: Comparison of laparoscopic versus open nephrectomy in the pediatric population. J Urol 163: 937–939, 2000.
15. Ng CS, Gill IS, Ramani AP, Steinberg AP, Spaliviero M, Abreu SC, Kaouk JH, Desai MM.Transperitoneal versus retroperitoneal laparoscopic partial nephrectomy: patient selection and perioperative outcomes. J Urol. 2005 Sep;174(3):846-9.
16. Berdjis N, Hakenberg OW, Leike S, Zastrow S, Manseck A, Oehlschläger S, Wirth MP. Comparison of transperitoneal versus retroperitoneal approach in laparoscopic radical nephrectomy for renal cell carcinoma: a single-center experience of 63 cases. Urol Int. 2006;77(2):166-9.
17. Gill IS, Kavoussi LR, Clayman RV, Ehrlich R, Evans R, Fuchs G, Gersham A, Hulbert JC, McDougall EM, Rosenthal T, Schuessler WW, Shepard T. Complications of laparoscopic nephrectomy in 185 patients: a multi-institutional review. J Urol, 1995; 154:479-83.
18. Ehrlich RM, Gershman A, Fuchs G. Laparoscopic renal surgery in children. J Urol, 1994; 151:735-9.
19. Averch TG, Chen RN, Kavoussi LR, Llorens AS, Moore RG. Laparoscopic nephrectomy using a three port technique. J Urol, 1997; 157:S546.
20. Kerbl K, Clayman RV, McDougll EM, Gill IS, Wilson B, Chandhoke PS, Albala DM, Kavoussi LR. Transperitoneal nephrectomy for benign disease of the kidney: a comparison of laparoscopic and open techniques. Urology, 1994; 43:607-13.
21. Dénes FT, Danilovic A, Srougi M.Outcome of laparoscopic upper-pole nephrectomy in children with duplex systems. J Endourol. 2007 Feb;21(2):162-8.
22. Seibold J, Janetschek G, Bartsch G. Laparoscopic surgery in pediatric urology. Eur Urol, 1996; 30:395-9.
23. Clayman RV, Kavoussi LR, Soper NJ, Dierks SM, Meretyk S, Darcy MD, Roemer FD, Pingleton ED, Thomson PG, Long SR. Laparoscopic nephrectomy: initial case report. J Urol, 1991; 146:278-82.

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