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Research paper

Heminephrectomy in the pediatric population – single-center comparison of the open versus transperitoneal laparoscopic approach

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Abstract

Introduction: Heminephrectomy is considered the method of choice in the treatment of symptomatic or poorly working moiety of a duplex kidney as well as in oncology.

Aim: The study aims to retrospectively analyze the laparoscopic approach to heminephrectomy (LHN) in comparison with the open approach (OHN).

Material and methods: From 2011 to 2020, 28 heminephrectomies were performed in the Clinical Ward of Pediatric Surgery and Urology of the Regional Specialized Children's Hospital in Olsztyn: 10 with the laparoscopic transperitoneal method (LHN), and 18 with the open method (OHN). The mean age was 37.4 months (1–197 months). In total, 20 patients were female, and 8 were male. Loss of function of the moiety was a prerequisite for surgery. Hydronephrosis, dysplasia of the moiety, and vesicoureteral reflux were the most prevalent in both groups. Data regarding patients were collected based on available medical documentation and retrospectively analyzed.

Results and discussion: There was no significant difference between the LHN and OHN groups regarding mean operating time (157 vs 128 minutes; $P = 0.226$) and mean postoperative hospital stay (5.20 vs 6.53; $P = 0.64$). The refeeding time is comparable and not statistically significant (1.90 vs 1.83 days; $P = 0.555$). Postoperative analgesic intake was found to be significantly lower (10.4 vs 17.5 doses, $P = 0.004$).

Conclusions: Both open and laparoscopic approaches are safe and feasible in the pediatric population. Both are comparable in operative time, hospital stay and refeeding time. LHN displays a better cosmetic effect and requires significantly lesser analgesic use.

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1. INTRODUCTION

The first laparoscopic heminephrectomy conducted in the pediatric population was reported in 1993 by Jordan and Winslow.[1] It rapidly became the method of choice both in the treatment of symptomatic and poorly working moiety of a duplex kidney as well as in oncology.[2,3] Laparoscopy, in comparison with open surgery, displays similar or shorter operating time and hospital stay, better cosmesis, and reduction of analgetic use.[4–8] Its safety and efficacy were proven in both children and infants.[7,9] Rapid advancements in minimally invasive surgery brought the implementation of single-incision and robotic methods to heminephrectomy in pediatric urology.[8,10–13] However, minimally invasive surgery remains technically challenging and involves a learning curve.[14–16] Implementation of such methods is limited to specialized centers, which reduces the scope of its usability despite the obvious benefits. Few studies had been published in recent years comparing transperitoneal laparoscopic and open approaches.

2. AIM

The study aims to retrospectively review the single-center experience in the laparoscopic approach to heminephrectomy (LHN) in comparison with the open approach (OHN).

3. MATERIAL AND METHODS

From 2011 to 2020, 28 heminephrectomies were performed in the Clinical Ward of Pediatric Surgery and Urology of the Regional Specialized Children's Hospital in Olsztyn – 10 with the laparoscopic transperitoneal (LHN) method, and 18 with the open (OHN) method. Ultrasonography, scintigraphy, voiding cystourethrography, and in selected cases, magnetic resonance urography were used for diagnosis and evaluation. Loss of function of the moiety was a prerequisite for surgery. Surgical indications accompanying the loss of function are presented in Table 1. Hydronephrosis, dysplasia of the moiety, and vesicoureteral reflux were the most prevalent in both groups. In choosing the surgical method, both the advantages and limited experience in performing laparoscopic surgery were considered during the decision-making process. Each method was presented to the patient's parents or legal guardians, their advantages and disadvantages were explained.

Table 1. Surgical indications

Surgical indications	OHN, points	LHN, points
Upper moiety		
Hydronephrosis	8	3
Dysplasia of the moiety	6	2
Urinary incontinence	2	0
Ureterocele	0	1
Intrarenal abscess	1	0
Lower moiety		
Vesicoureteral reflux	4	4
Recurrent urinary tract infections	2	0
Megaureter	1	1

Table 2. Demographic and clinical data

Demographic and clinical data	OHN	LHN
Mean age and range, months	27.3 (2–159)	55.5 (1–197)
Sex (female/male), *n*	13/5	7/3
Moeity (lower/upper), *n*	5/13	1/9
Side (left/right), *n*	5/13	5/5
Mean follow-up time, months	36.9 (0–83)	31.2 (0–99)

3.1. Patients

The mean age was 37.4 months (1–197). In total, 20 patients were female, and 8 were male. All surgeries performed were unilateral; 18 were performed on the right kidney, and 10 on the left. The upper pole was affected in 22 cases, the lower in 6. Data regarding patients are presented in Table 2. Information about sex, age, indications, operation time, refeeding time, postoperative analgesic use, and follow-up time were collected based on available medical documentation and retrospectively analyzed. Statistical analysis was performed in SPSS 27.0 using the Mann-Whitney *U* test.

3.2. Surgical methods

3.2.1. Open method

The patient was placed in the lateral decubitus position. Bergmann-Israel or Simon's approach was used to access the kidney. Ureters were dissected. After ligation, the ureteric stump was left with vasculature intact. Bipolar coagulation or a harmonic scalpel was used to close the vessels of the moiety. The demarcation line was used to resect the moiety using a harmonic or electric scalpel. A hemostatic sponge and drain were applied.

3.2.2. Laparoscopic transperitoneal method

The patient was placed in the 30° lateral decubitus position. Hasson's method was used to insert the 5 mm trocar in the umbilical area. Pneumoperitoneum was established with a target pressure of 8 mm Hg. Two additional trocars were placed under visual control in the midclavicular line: in the epigastric region, and in the iliac fossa. The colon was mobilized and retracted. The kidney was exposed. Bipolar coagulation was used to selectively cauterize vessels of the nonfunctioning moiety. Following the demarcation line, the pole was excised. Typically, two-thirds of the ureteric stump was preserved. The resected specimen was removed in the entrapment sack through the umbilicus.

4. RESULTS

There was no significant difference between the LHN and OHN groups regarding mean operating time (157 vs 128 minutes; $P = 0.226$) and mean postoperative hospital stay (5.20 vs 6.53 days; $P = 0.64$). The refeeding time was com-

Table 3. Demographic and clinical data.

Postoperative data	OHN	LHN	*P*
Mean operative time, minutes	128(75–165)	157(90–320)	0.226
Mean hospital stay, days	6.53(2–13)	5.2(3–6)	0.64
Mean refeeding time, days	1.83(1–6)	1.9(1–3)	0.555
Mean analgesic use, doses	17.5(9–22)	10.4(3–16)	0.004

parable and not statistically significant (1.90 vs 1.83 days; $P = 0.555$). Postoperative analgesic intake was found to be significantly lower (10.4 vs 17.5 doses, $P = 0.004$). The postoperative results are illustrated in Table 3.

The length of stay for 2 OHN patients was extended due to reoperation and urinary tract infection: 13 and 10 days, respectively. One intraoperative complication was recorded – bleeding resulting in conversion to open surgery. Postoperative complications included 4 cases of recurrent urinary tract infection, 2 ureteral stump empyemas, 1 of which required resection, and 1 postoperative respiratory failure.

5. DISCUSSION

Since the first laparoscopic heminephrectomy reported in the pediatric population,[1] the advancement of minimally invasive surgery has laid the foundations for implementing and comparing different surgical methods. Evidence points toward their safety in infants.[9] Neheman et al.[8] compared 59 patients who underwent heminephrectomy: 24 with the open method (OPN), 7 with the laparoscopic retroperitoneal method (LPN), 10 with the single-site laparoscopic method (LESS-PN), and 18 with the robot-assisted method (RPN). The study suggests that minimally invasive surgical techniques may be associated with lesser analgesic use, shorter hospital stays, lower blood loss, and lesser drain use. The operation time in the single-site method proved to be shorter than other minimally invasive methods (LESS-PN 140 minutes; LPN 190 minutes; RPN 256 minutes; LESS-PN vs. LPN $P = 0.02$; LESS-PN vs. RPN $P = 0.005$).

The international multicenter study conducted by Esposito et al.[14] analyzed the transperitoneal and retroperitoneal methods among 102 patients (52 and 50, respectively). The transperitoneal method had a shorter operation time (166 vs 255 minutes; $P < 0.001$) and hospital stay (3.5 vs 4.1 days; $P < 0.001$). Moreover, it was associated with a lower percentage of postoperative complications (19% vs 30%; $\chi^2 = 0.05$). No further differences were found regarding other studied parameters.

Zhou et al.[11] compared single-site transumbilical and conventional transperitoneal laparoscopic methods in two groups of 34 patients matched both demographically and in regards of surgical indications. No significant difference was found in terms of the mean operation time (105 vs 97 minutes; $P = 0.06$), blood loss (22 vs 25 mL; $P = 0.91$), interval for oral intake (12 vs 12 h; $P = 0.69$), postoperative analgesic requirement (26.5% vs 17.6%; $P = 0.38$), transfusion rate (0% vs 0%; $P = 1.00$), perioperative complications (2.9% vs 0%; $P = 1.00$), postoperative hospital stay (5.0 vs 4.5 days; $P = 0.59$) and renal functional loss of the operated site (5.4% vs 5.2%; $P = 0.60$). The single-site method displayed better cosmetic results.

Despite the difficulties of laparoscopic heminephrectomy in the pediatric population, it demonstrates equal efficacy and provides several benefits in comparison with the open approach. Golebiewski et al.[7] compared the two methods in upper pole heminephrectomy among 27 patients: 15 laparoscopic and 12 open. The laparoscopic approach proved to be comparable to the open approach in terms of operative time (148 vs 124 minutes; $P = 0.52$), return to regular diet (2.3 vs 2.2 days; $P = 0.81$), hospital stay (4 vs 5.1 days; $P = 0.48$), whereas the time of analgesic requirement was shorter (2.8 vs 3.7 days; $P = 0.005$).

In a study by Garcia-Aparicio et al.[17] 9 patients underwent laparoscopic surgery: 8 transperitoneal, and 1 retroperitoneal, while the open group included 8 patients. The mean hospital stay was significantly shorter for the laparoscopic approach (2.44 vs 4.38 days; $P = 0.021$), while the operating time was comparable (182 vs 152 minutes; $P > 0.05$).

Choi et al.[18] published a study analyzing the data of 109 performed heminephrectomies. After excluding bilateral procedures, the laparoscopic and open groups consisted of 30 and 61 patients, respectively. Both in the group below and above 3 years of age, the mean hospital stay was significantly shorter for the laparoscopic approach (1.69 vs 2.84 days; $P = 0.004$; and 1.43 vs 3.06 days; $P = 0.001$), while the operating time was longer (165 vs 107 minutes; $P = 0.006$; and 193 vs 136 minutes; $P = 0.008$). Postoperative analgesia was not included in both of the above-mentioned studies.

In all the studies cited the minimally invasive surgical methods (including laparoscopy) are linked with lesser analgesic use in comparison with OHN (if analyzed) which coincides with the results of this study. Their use is also associated with a better cosmetic outcome which remains a significant benefit. It should be noted that in the group of modern minimally invasive surgical methods the differences to LHN are slight and lacking in patient-focused benefits with a demanding learning process.[19] Furthermore, many authors report reduced visibility in the retroperitoneal method.[14,17]

The study presents several limitations. The patient groups are not age-matched, the sample size is limited, and the study is retrospective and non-randomized, which limits its clinical use. Despite those disadvantages, it reflects the benefits of the laparoscopic approach in heminephrectomy. What is more, the operations were carried out by different surgeons. However, the analysis of the available documentation displays similar pre- and intraoperative procedures, which suggest the homogeneity of the groups. We believe that laparoscopic heminephrectomy is a safe and effective method in institutions with professionals untrained to perform more advanced minimally invasive surgical methods.

6. CONCLUSIONS

(1) Both open and laparoscopic approaches are safe and feasible in the pediatric population.
(2) Both are comparable in operative time, hospital stay and refeeding time.
(3) LHN displays a better cosmetic effect and requires significantly lesser analgesic use.

Conflict of interest
None declared.

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