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## Comparative Evaluation of Transperitoneal and Retroperitoneal Laparoscopic Operations in Children

### Analiza porównawcza przezotrzewnowych i zaotrzewnowych operacji laparoskopowych u dzieci

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#### Abstract

**Background.** The introduction of laparoscopic surgery in the treatment of urological diseases in children has decreased both the psychological and the physical trauma connected with open operations. Many publications indicate that retroperitoneal operations are much safer and produce lower costs, although they require much experience in laparoscopy.

**Material and Methods.** Between 1996 and 2006, 181 laparoscopic operations in children aged 1.5–18 years (average: 12.2 years) were performed in this hospital. In 145 (80.1%) operations the transperitoneal approach was applied (group I) and in 36 (19.9%) the retroperitoneal (group II). Group I was divided into subgroups Ia with 88 (48.6%) children who underwent varicocelectomy and Ib with 57 (31.5%) children with other diseases. For an objective evaluation of the results, the Polish Score of Operative Difficulty (PSPOTOL) was used. Eleven different types of laparoscopic operations qualified within the three lowest PSPOTOL groups were analyzed. The results of surgery were also evaluated depending on the children's age. Follow-up ranged from 3 to 132 months after surgery (average: 55.8 months).

**Results.** The shortest operation, hospitalization, and recovery time was observed in group Ia, with the lowest PSPOTOL score. In groups with comparable PSPOTOL scores, the retroperitoneal approach revealed better results than in group Ib. In younger children the results were better than in older children although the PSPOTOL rate in the younger children was higher. The complication and conversion rates for the particular types of laparoscopic surgery were PSPOTOL dependent but did not correlate with the number of laparoscopic operations performed (the learning curve).

**Conclusions.** 1. Retroperitoneal laparoscopic operations revealed better results than transperitoneal with similar PSPOTOL scores. 2. Urological operation results in children correlated with their group of laparoscopic operations defined by PSPOTOL score. 3. The unfavorable event rate of laparoscopic surgery increased together with the child's age, which was inversely proportional to the PSPOTOL score (*Adv Clin Exp Med* 2009, 18, 1, 47–53).

**Key words:** laparoscopic operations, children, retroperitoneal, transperitoneal.

#### Streszczenie

**Wprowadzenie.** Liczne doniesienia wskazują na to, że dostęp zaotrzewnowy jest bezpieczniejszy i rodzi mniejsze koszty, ale wymaga większego doświadczenia i dłuższej nauki technik laparoskopowych.

**Materiał i metody.** W latach 1996–2006 wykonano 181 operacji laparoskopowych (o.l.) u dzieci w wieku 1,5–18 lat. U 145 zastosowano dostęp przezotrzewnowy – I grupa chorych, u 36 zaotrzewnowy – II grupa. Oceniano zależność wyników o.l. od wieku dziecka i drogi dostępu. W celu obiektywizacji wyników użyto polskiej skali punktowej oceny trudności operacyjnych w laparoskopii. Kontrolne badania przeprowadzono w czasie 3–132 miesięcy od o.l.

**Wyniki.** W grupie I obserwowano krótszy czas operacji, hospitalizacji i rekonwalescencji oraz najmniejszy koszt okołooperacyjny. W grupie dzieci najmłodszych wyniki o.l. były lepsze od wyników w grupie dzieci starszych. Odsetek konwersji i reoperacji poszczególnych rodzajów o.l. zależał od ich trudności.

**Wnioski.** Zaotrzewnowe o.l. pozwalają uzyskać lepsze wyniki od pozaotrzewnowych o.l. o porównywalnym stopniu trudności operacyjnych. Oprócz nielicznych wyjątków, niezależnie od drogi dostępu, skala trudności operacyjnych koreluje z wynikami o.l. (*Adv Clin Exp Med* 2009, 18, 1, 47–53).

**Słowa kluczowe:** operacje laparoskopowe, dzieci, pozaotrzewnowy, przezotrzewnowy.

Due to considerations of minimizing the load on the child's organism, healing extensive surgical wounds, and shortening hospitalization and recovery time (time to achieve preoperative organ function) as well as the time of separation from parents, laparoscopic operations are being more frequently introduced, also in urology [1, 2]. Because of the extraperitoneal location of many urogenital organs, extraperitoneal access is safer in open operations. However, in laparoscopic operations an exact duplication of the activities typical of open techniques is limited. The technical possibilities of the laparoscopic method as such are limited and there are different conditions, such as homodynamic and thermal ventilation, which affect the course of laparoscopic operations, particularly in small children [3–5]. Together with the increased technical possibilities (miniaturization of tools, more dependable means of hemostasis) as well as increased experience of surgeons, the number of factors limiting the possibility of performing laparoscopic operations for urological diseases in children is decreasing [5, 6]. The larger operative area, better visibility, and wider tool maneuvering possibilities in transperitoneal laparoscopic operations are set against the lower risk of intestinal, homodynamic, and ventilating organ complications in retroperitoneal laparoscopic operations [7–9]. These facts do not give a clear answer regarding the better way of access.

## Material and Methods

Between September 1995 and December 2006, 181 laparoscopic operations were performed on children in this hospital. The children were divided into two groups depending on the way of access to the operated organ. Group I consisted of 145 (80.1%) children with transperitoneal laparoscopic operations and group II of 36 (19.9%) children with retroperitoneal laparoscopic operations. In both groups the operation, hospitalization, and recovery times were compared. The percentages of complications, conversions, and reoperations were determined.

To objectify operative difficulties, the Polish Score of Operating Difficulty (PSPOTOL) published in 2004 [10] was used. On the basis of the European Score [11], in the PSPOTOL retroperitoneal laparoscopic operations with the same degree of difficulty as transperitoneal laparoscopic operations have 1 point more. A state forcing a patient to stay in the hospital ward for more than 8 days or stay in an intensive care unit as well as a state requiring additional medicinal activities during the first 24 hours after the laparoscopic

operation were all defined as complications. The score of operating difficulty consists of five levels. In the analyzed group of children the operations were qualified within the first three groups, i.e. very easy (group A, 5–7 points), easy (B, 7–10 points), and difficult (C, 11–14 points). Operations defined as very or extremely difficult (15–22 points) were not performed.

The effect of the child's age as well as the duration of the laparoscopic operation and the experience of the operating surgeon (learning curve) on the result of the laparoscopic operation were also analyzed. Follow-up observations were conducted in the 3<sup>rd</sup>, 6<sup>th</sup>, and 12<sup>th</sup> months after the laparoscopic surgery and later once a year. They consisted of routine USG tests and CT with reference to the kidney and adrenal gland. Follow-up ranged from 3 to 132 months (average: 55.8 months).

Operative and postoperative management were consolidated. To compare the costs of both ways of access, the costs of antibiotic and analgesic therapy were analyzed. In group I the patients were injected with 25–30 mg/kg biofazolin (cefazolin sodium) for the first two days and in group II only during the first 24 hours. During the next days of hospitalization the antibiotic was administered orally, except for patients in subgroup Ia (see below). In children over the age of 14 years, 25–50 mg of pethidine was used as an analgesic in group I during the first two days and in group II during the first 24 hours, while in younger children, 10–15 mg/kg Paracetamol (acetaminophen) was administered up to and including the third day.

The statistical analysis of the results was performed with the Statistica software package (Soft Star v. 8) using one-tailed and two-tailed Fisher's exact, chi-squared, and Student's *t* tests. Statistical significance was assumed with  $p < 0.05$ .

## Results

Between September 1995 and September 2006, 181 laparoscopic operations were performed on children aged 1.5–18 years (average: 12.2 years). The group consisted of 37 (20.4%) girls and 144 (79.6%) boys. A retroperitoneal laparoscopic operation was performed on 36 (19.9%) and a transperitoneal on 145 (80.1%) children, including 88 (48.6%) boys with varicocele (subgroup Ia), with the other 57 (31.5%) children of group I constituting the remaining transperitoneal laparoscopic operations (subgroup Ib). The average follow-up in group I was 57 months and in group II 39.7 months. The analysis of both ways of access showed that retroperitoneal laparoscopic

**Table 1.** Comparison of laparoscopic operation difficulty in children according to point score  
**Tabela 1.** Porównanie trudności operacji laparoskopowych u dzieci w zależności od skali punktowej

Operation difficulty group (Grupa trudności operacyjnych)	No. (Liczba)	Type of laparoscopic surgery (Rodzaj operacji laparoskopowej)	Score value (Wartość punktowa)	Transperitoneal LA (Operacje przezotrzewnowe)		Retroperitoneal LA (Operacje pozaotrzewnowe)		Totals (Suma)	
				no. of patients	score sum	no. of patients	score sum		unfavorable event
A	1	varicelectomy	5-6	88	440	-	-	10 (2.1%)	
	2	nephropexy	6-7	1	6	3	21		
B	3	renal cyst decortication	7-8	2	14	2	16	4 (14.8%)	
	4	uretero pyelolithotomy	8-9	2	16	3	27		
	5	orchidopexy	7-8	9	63	-	-		
	6	gonads extirpation	8-9	6	45	3	27		
C	7	kidney suture after trauma	11-12	1	11	-	-	7 (12.3%)	
	8	simple nephrectomy	12-13	19	228	15	195		
	9	adrenalectomy	12-13	-	-	3	42		
	10	nephroureterectomy	13-14	2	26	2	26		
	11	pyeloplast	13-14	15	195	5	70		
Totals				145	1044 (mean: 7.2)	36	424 (mean: 11.8)	3 (8.3%)	21 (11.6%)

**Table 2.** Results of trans- and retroperitoneal laparoscopic operation in children**Tabela 2.** Wyniki operacji laparoskopowych przezotrzewnowych i pozaotrzewnowych u dzieci

LA characteristic (Charakterystyka operacji laparoskopowych)	Transperitoneal LA (Operacje pozaotrzewnowe)				Retroperitoneal LA (Operacje pozaotrzewnowe)	P value (Wartość P)
	Ia varicoceles	Ib other LA	total	P value		
No. of patients (Liczba pacjentów)	88 (48.6%)	57 (31.5%)	145 (80.1%)	–	36 (19.9%)	–
Operation time – min (Czas operacji – min)	35	121	68	< 0.001	108	< 0.01
Hospitalization time – days (Czas hospitalizacji – dni)	2.2	6.0	4.1	< 0.001	4.0	–
Reconvalescence time – days (Czas rekonwalescencji – dni)	7.0	12.0	8.8	< 0.001	8.0	–
Conversions (Konwersje)	2 (2.3%)	2 (3.5%)	4 (2.8%)	–	0	–
Reoperations (Reoperacje)	3 (3.4%)	2 (3.5%)	5 (3.4%)	–	1 (2.8%)	–
Complications (Powikłania)	5 (5.7%)	4 (7.0%)	9 (6.2%)	–	2 (5.9%)	–
Mean operation score – points (Średni wynik operacji – punkty)	5.0	10.6	7.2	< 0.001	11.8	< 0.05
Cost of antibiotics – PLN (Koszt antybiotykoterapii – PLN)	16.3	29.8	21.9	< 0.001	16.5	< 0.05
Cost of analgesics – PLN (Koszt znieczulenia – PLN)	2.8	4.4	3.4	< 0.001	2.6	< 0.01
Blood loss (Utrata krwi)	20	65	40.1	–	45	–
Observation time – months (Czas obserwacji – miesiące)	66.2	42.7	57.0	0	39.7	–

operations had a higher mean PSPOTOL score (11.8 vs. 7.2 points,  $p < 0.01$ ), while the mean PSPOTOL score for the entire group of analyzed children was 8.1 points (Table 1).

The rates of unfavorable events, complications, conversions, and reoperations depending on the difficulty score of the laparoscopic operation in group I were subgroup A 2.2%, B 15.8%, and C 13.5%, with a total average of 12.4%. In group II these figures were A 0%, B 12.5%, and C 8.0%, with a total average of 8.3%. Statistical differences occurred between the laparoscopic operations in subgroup A and the remaining ones as well as in C between the transperitoneal and retroperitoneal approaches ( $p < 0.05$ ).

In relation to the particular operations, the highest rates of unfavorable events occurred in operation nos. 4 (60%) and 11 (30%). There were 4 (2.7%) conversions in group I, none in group II, and there were 3.4% and 2.8% reoperations in groups I and II, respectively (insignificant difference).

Neither hospitalization nor recovery time showed any difference between the groups; however, they were substantially longer in subgroup Ib

and substantially shorter in subgroup Ia. The operation time was considerably longer in retroperitoneal laparoscopic operations and the PSPOTOL score was higher. Conversions were observed only in group I, while neither reoperations nor complications showed significant differences. Antibiotic and analgesia costs were lower in the retroperitoneal laparoscopic operations. The highest costs occurred in subgroup Ib.

Evaluating the influence of the child's age on the results of the laparoscopic operations, it was observed that the highest level of difficulty occurred in the youngest age group and was 11.4 points, 9.7 points in the middle group, and 6.1 in the oldest group. The greatest number of complications, conversions, and reoperations occurred in the oldest subgroup, although the follow-up was shortest.

Table 4 shows that the passage of time in learning the laparoscopic surgical technique did not result in statistically significant decreases in either operation time or the rate of complications and conversions.

**Table 3.** Influence of children's age on laparoscopic operation results**Tabela 3.** Wpływ wieku dziecka na wyniki operacji laparoskopowych

Age – years (Wiek – lata)	Number of patients (Liczba pacjentów)	Difficulty score – points (Skala trudności – punkty)	Observation time – months (Czas obserwacji – miesiące)	Laparoscopy results (Wyniki operacji laparoskopowych)		
				complications	conversions	reoperations
1.5–5	7	11.4	56.1	–	–	–
6–11	41	9.7	59.4	2 (4.8%)	–	1 (2.4%)
12–18	133	6.1	43.7	9 (7.5%)	4 (3.0%)	5 (3.8%)
Total (Suma)	181	7.7	54.3	11 (6.1%)	4 (2.2%)	6 (3.3%)
<i>P</i> value (Wartość <i>P</i> )	–	< 0.01	–	< 0.01	–	–

**Table 4.** Learning curve in urological laparoscopic surgery in children**Tabela 4.** Krzywa nauki operacji laparoskopowych u dzieci

Period of surgery – years (Okres operacji – lata)	1996–1999	2000–2003	2004–2006	Statistical difference (Różnice istotne statystycznie)
No. of patients (Liczba pacjentów)	39	79	63	–
Surgery time – minutes (Czas operacji – minuty)	93.6	77.0	65.2	–
Complications (Powikłania)	4 (10.2%)	5 (6.3%)	2 (3.1%)	0.34
Conversions (Konwersje)	2 (5.1%)	1 (1.3%)	1 (1.5%)	0.37
Reoperations (Reoperacje)	1 (2.6%)	3 (3.8%)	2 (3.2%)	0.93

## Discussion

Rapid progress in the treatment of urological diseases has been made since the introduction of laparoscopic surgery, which decreased both the physical and the psychological trauma connected with the operation. This is particularly important in children and adolescents, for whom the shortening of hospitalization time and faster return to normal life connected with the lack of extensive surgical wounds make this type of surgery the procedure of choice in numerous diseases [1, 12].

Performing laparoscopic surgery requires more time than a traditional operation and it was not significantly shortened with increased experience in laparoscopy (the learning curve). The reason for this is that the operations were conducted by various surgeons. Longer exposure to the carbon dioxide which is introduced into body cavities under high pressure can lead to changes in lung ventilation, body temperature, and, in small children, also heart activity [7, 13]. Therefore, some children do not qualify for laparoscopic surgery, irrespective of the urological disease type [14].

The ongoing revision of the list of urological diseases subject to laparoscopic surgery does not currently allow one to define the limits of the possibilities of laparoscopic surgery in children and adults [15]. Searching for optimal solutions in this field of medicine comprises, apart from good cosmetic results, the advantages and disadvantages resulting from the way of accessing the operated organ [8, 16]. It has to be decided whether the lower operation costs connected with, among others, lower antibiotic and analgesic consumption, shorter hospitalization time, and faster return to psychophysical efficiency are capable of offsetting the costs for using the expensive equipment necessary in laparoscopic surgery. Therefore, many centers of laparoscopic surgery are trying to evaluate which laparoscopic operations can be qualified as the procedure of choice and which can be performed more safely using traditional methods.

Analysis of relatively small groups of patients undergoing homogenous laparoscopic surgery shows that a low rate of unfavorable events has been observed in laparoscopic operations of varic-

ocele, non-neoplastic nephrectomy, and gonad diseases in boys [17, 18]. Other laparoscopic operations, such as nephro-ureterolithiasis and pyeloplasty in hydronephrosis, are characterized by high rates of unfavorable events. The rate is higher than in open operations of that type performed in this center. It seems that since other authors have better results in the same laparoscopic operations, the small number of laparoscopic operations performed and the lack of experience in the laparoscopic treatment of the diseases can be seen as disadvantageous for the surgeons of the present study (the learning curve) [2, 19, 20]. Taking into account 11 types of laparoscopic operations, an actual evaluation of the value of laparoscopic surgery can only be made for three types [1, 8, 11], whose number exceeded the limit of the learning curve [1, 6, 10].

The European score of the operative difficulty of laparoscopic surgery introduced in 2002 and its modification worked out in 2004 by Mieczysław Fryczkowski and coauthors allow one to objectify the evaluation of different types of laparoscopic surgery performed in different centers by operators with different levels of operative skill [10, 11]. Table 1 shows that the PSPOTOL score influenced the rate of unfavorable events. Clear statistical differences between groups A on the one hand and B and C on the other are visible. There was no difference between groups B and C. This can be due to the fact that not a single type of laparoscopic surgery in group B reached the number defined for the learning curve, while in group C two types of laparoscopic surgery [8, 11] reached the limit. On the basis of other authors' data it can be assumed that the results of the laparoscopic operations in group B are the consequence of the operators' lack of experience and cannot be treated as proof supporting open operations in these diseases. However, the results suggest increased caution while gaining experience in laparoscopic surgery in the aforementioned group of diseases [13].

Depending on the operative access of transperitoneal laparoscopic surgery, the complication,

conversion, and reoperation rate was highest in transperitoneal laparoscopic operations in the analyzed group of children. The lowest rate of unfavorable events was observed in group II, despite the fact that none of the laparoscopic operations in this group reached the borderline number for the learning curve [7]. However, the conversion and reoperation rate was quite low compared with those of Esposito et al. and Peter, with 5–7 unfavorable events in laparoscopic operations with the same PSPOTOL score [6, 13]. With almost the same PSPOTOL score, the results of the children in group II were better than those in group Ib.

While the assessment of laparoscopic surgery results depending on the operative access indicates dependence on the PSPOTOL score, comparison of laparoscopic surgery results depending on the child's age did not confirm the dependence. Laparoscopic operations turned out to be safest in the youngest children, who at the same time had the highest PSPOTOL score (11.4 points). The worst results were observed in the oldest children, with a PSPOTOL score of 6.1 points. This involves complications as well as reoperations and conversions. This is difficult to explain, the more so because many authors indicate the largest number of complications in the youngest group of children [3, 4, 16]. Therefore the phenomenon cannot be logically explained. However, attention must be paid to the fact that small children were operated on by the most experienced laparoscopic surgeons, while the operations with a low PSPOTOL rate were also performed by less experienced doctors.

The authors concluded that 1) retroperitoneal laparoscopic operations showed better results than transperitoneal laparoscopic operations with similar PSPOTOL scores, 2) urological operation results in children correlated with their group of laparoscopic operations defined by PSPOTOL rate, 3) the unfavorable event rate of laparoscopic surgery increased with children's age, which was inversely proportional to PSPOTOL score.

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