

INTRA AND POSTOPERATIVE ADVANTAGES OF LAPAROSCOPY IN THE TREATMENT OF COMPLICATED APPENDICITIS

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ABSTRACT

Aim: To determine and define the advantages of the laparoscopic appendectomy in the treatment of complicated appendicitis by comparing it with the open appendectomy.

Material and Methods: In this prospective interventional clinical study we compared the intraoperative data and the postoperative outcome of 77 patients presented with complicated appendicitis, operated with open and laparoscopic appendectomy within a period of 20 months. One surgeon performed all of the laparoscopic procedures and two other senior surgeons performed the open procedures.

Results: Operative time was shorter in the laparoscopic group ($p = 0.033$). Conversion rate was 2.3%. Overall postoperative morbidity was 25.97%. There was one operative revision due to postoperative small bowel obstruction in the laparoscopic group. Appendicular stump leakage occurred in one patient in the open group. One intra-abdominal abscess occurred in the laparoscopic group ($p = 0.38$). Wound infection occurred only in the open group ($p = 0.018$). Length of stay was shorter in the laparoscopic group ($p = 0.0052$). One patient from the laparoscopic group was readmitted.

Conclusions: Laparoscopy is a reliable method in the treatment of complicated appendicitis. It offers a shorter operative time, low conversion rate, an acceptable rate of major postoperative complications and a shorter length of stay.

Keywords: complicated appendicitis; laparoscopy; appendectomy

INTRODUCTION

Complicated appendicitis (CA) is a serious condition that can lead to death if not treated. Surgery represents the mainstay of the treatment of CA. Both open and laparoscopic appendectomy are widely used, yet there is a predominance of the minimally invasive method in the past two decades because of its well-known advantages

[1]. According to the current recommendations of the World Society of Emergency Surgery (WSES), laparoscopic appendectomy is a safe alternative for the non-operative treatment of CA in experienced hands [2]. It certainly implies that one must first master the learning curve for laparoscopic appendectomy (LA) and appropriate laparoscopic equipment [3, 4].

MATERIALS AND METHODS

Study Design

In this prospective interventional clinical study, conducted over a period of 20 months, we compared the intraoperative data and the postoperative outcomes of 77 patients who presented and were operated on for complicated appendicitis. The study was approved by the ethical committee of the Medical Faculty in Skopje.

Population and Methods

Patients above 15 years of age with intraoperatively diagnosed complicated appendicitis were included in the study. The patients were divided in two groups (open and laparoscopic, OG and LG, respectively). Randomization on the operative technique was not used. Hence, one surgeon who had mastered the learning curve for laparoscopic appendectomy performed all the laparoscopies, while the other two senior surgeons (not performing laparoscopic appendectomy at all) performed the open appendectomies. The technique choice, therefore, was based on the emergency shift duties schedule. The intraoperative finding was graded into four groups:

- Gangrenous appendix without macroscopically visible perforation;
- Appendicular perforation/rupture;
- Periappendicular abscess and
- Diffuse secondary peritonitis.

Open (Mc Burney access) and standard three-port laparoscopic appendectomy were used. In the open technique, after the Mc Burney approach, a wound protector was not used due to the inconsistent availability. The appendicular artery was either ligated with suture or a bipolar cautery device was used. The appendicular stump was double ligated and never inverted. In-

tra-abdominal drainage was optional (according to the surgeons' choice).

In the laparoscopic method, an optic trocar (11 mm) was placed above the umbilicus and the two working trocars were positioned above the pubis (5 mm) and medial to the left anterior superior iliac spine (10 mm with 5 mm reducer). A bipolar cautery device was used for hemostasis control. Endo-loop suture or clips were used for appendicular ligation.

Statistical Analysis

SPSS for Windows v. 23.0 was used for statistical analysis. Normality was tested with the Kolmogorov-Smirnov test. Bivariate analysis of numerical data was tested with Student and Mann-Whitney tests. The chi-square test was used for qualitative data comparison. A *p* value less than 0.05 was considered statistically significant.

RESULTS

Out of the 77 patients who presented with some of the grades of CA, 52 (67.5%) were male and 25 (32.5%) were female patients. The ages ranged from 15 – 76 years (40.4 ± 16.2). An American Society of Anesthesiology score (ASA) of 1 was registered in 39 (50.6%), ASA 2 in 26 (33.8%) and ASA score of 3 in 12 (15.6%) of the patients.

Average operative time measured from skin incision to the last skin suture in both groups was 72 ± 21.4 minutes (range: 24 – 112 minutes, $p = 0.003$). One laparoscopic attempt finished in converted appendectomy due to hard local inflammation in a female patient with a perforated appendix (2.3%). (Table 1).

Table 1. Demography and intraoperative data

	<i>n</i>	<i>LG</i>	<i>OG</i>	<i>p</i>
<i>Sex male/female</i>	52/25	31/13	21/12	0.53
<i>Age - mean ± SD (range)</i>	40.36 ± 16.2 (15 – 76)	39.4 ± 16.2 (15 – 74)	41.6 ± 16.3 (15 – 76)	0.56
<i>ASA</i>				
<i>1</i>	39	25	14	0.36
<i>2</i>	26	12	14	
<i>3</i>	12	7	5	
<i>Operative time (minutes) mean ± SD (min – max)</i>	71.99 ± 21.4 (24 – 112)	67.4 ± 22.9 (27 – 112)	77.9 ± 17.9 (24 – 110)	0.033
<i>Conversion (rate %)</i>	1 (2.3%)	1 (2.3%)	-	-

Table 2. Grade of intraoperative finding in both groups

Intraoperative finding	Group			p value
	n	LG n (%)	OG n (%)	
1 – gangrene	14	8 (18.18)	6 (18.18)	X ² = 0.94 p = 0.81
2 - perforation	34	18 (40.91)	16 (48.48)	
3 - abscess	11	6 (13.64)	5 (15.15)	
4 - peritonitis	18	12 (27.27)	6 (18.18)	

Overall postoperative morbidity was 25.9%. Complications occurred in 10 patients (20.8%) in the LG and in 10 patients (30.3%) in the OG.

One male patient from the LG was revised surgically due to an early postoperative intestinal obstruction. His post revision period was uneventful. A female patient from the OG manifested an appendicular stump leakage which spontaneously subsided. Postoperative intra-abdominal abscess (IAA) was diagnosed in one patient from the LG. The same patient was readmitted and treated successfully with percutaneous evacuation and drainage of the abscess.

Wound seroma/hematoma occurred in the LG in 4 patients and in the OG in 3 patients. Wound infection was noted only in the OG in 4 patients (p = 0.018). Other minor complications occurred sporadically in both groups without statistical significance (Table 3).

Table 3. Postoperative data

	LG	OG	p
Seroma/hematoma	4	3	1,0
Wound infection	0	4	0.018
IAA	1	0	0.38
Postoperative ileus	1	0	0.38
Postoperative intestinal obstruction	1	0	0.38
Pirexy	2	1	0.73
Appendicular stump leak	0	1	0.38
Abdominal wall phlegmon	1	0	0.38
Allergic dermatitis	0	1	0.38
Operative revision	1	0	0.38
Readmission	1	0	0.38
Length of stay	4.3 ± 2.2 (2 – 13)	5.7 ± 2.1 (2 – 13)	0.0052

DISCUSSION

Laparoscopic appendectomy for complicated appendicitis offers certain intra and post-operative advantages.

The first series of complicated appendicitis treatment with LA was published in 2001 [5]. The first prospective study that proves a positive trend of feasibility of LA was published in 2006 [6]. Many relevant publications have confirmed that laparoscopy has secured its position as a modern and safe method for the treatment of CA [7-10].

The inflammation process in CA can prolong the operative time by requiring additional adhesiolysis, partial omental resection and irrigation and suction of the abdominal cavity. Often the position of the operating table must be changed [11, 12].

No matter the intraoperative finding, the experience of the surgeon and his/her skills are important factors that influence the operative time. Certainly, mastering the learning curve of the technique reduces operative time. According to the European Association for Endoscopic Surgeons, a minimum of 20 laparoscopic procedures are required for gaining accreditation in the field of general surgery [13]. Our study was conducted by a single surgeon who performed all the laparoscopic procedures; one who has previously mastered the learning curve with more than 50 LA.

A large series for complicated appendicitis treatment report converting appendectomies between 4 – 19.9% [14-16]. One patient was subjected to a converting appendectomy because of technical difficulties due to heavy inflammation and her safety.

The rate of postoperative morbidity in CA is significantly higher than that of simple appendicitis, and it is reported to be up to 35.5%.¹ Reported factors that are associated with a higher occurrence of postoperative complications are the female gender, an operative time of more than 90 minutes, patients living in rural areas, the presence of periappendicular abscess and diffuse peritonitis [3, 14, 17].

Although minor, wound infection is still an inevitable postoperative complication of the appendectomy in CA. Most of the series reveal lower rates of wound infection in the laparoscopic groups with statistical significance when compared with the open method [1, 6, 8-10, 15, 18]. In our study there was no case of wound infection in the laparoscopic group.

Prolonged postoperative ileus is a common post appendectomy complication. It is defined by two or more episodes of nausea/vomiting, abdominal distension and radiological confirmatory signs on and after postoperative day 4. The treatment is conservative (pharmacological) [19]. Garg reports a lower rate of postoperative ileus in the laparoscopic group (4.1%) versus in the open surgery (11.5%) ($p = 0.294$). In Garg's study, 110 patients presented with CA and were operated on [20]. Similar results in favor of the laparoscopic method, also without statistical significance, are reported by Quezada (2.1% vs. 6.9%), Wu (5.4% vs. 20.3%), Mohamed (1.5% vs. 3.6%), Minutolo (1 vs. 3 patents) and Horvath (0.17% vs. 0.5%) [11, 21, 22-24]. To the contrary, Lim reports a higher incidence of postoperative ileus in the laparoscopic group of patients presented exclusively with periappendicular abscess (16.7% vs. 8.3%; $p = 0.028$) [25]. In our series there was one case of postoperative ileus in the open group. This patient was successfully treated pharmacologically.

Early postoperative small bowel obstruction represents a serious non-infectious complication and a major surgical problem. Its reported incidence is between 1 – 2.8% [26, 27]. Masoomi reports it in patients with perforated appendicitis, with a lower incidence rate in the laparoscopic group (1.56% vs. 3.72%, $p < 0.01$) [1]. Eskandaros shows early postoperative small bowel obstruction to occur only in the open group with an incidence of 1.8% [28]. In a randomized controlled trial, Taguchi reports this complication to be present only in the laparoscopic group in 2 patients out of 42 operated on for CA (4.8%; p

$= 0.494$) [29]. We report that one male patient operated on for perforated appendicitis in the LG has presented with early postoperative small bowel obstruction. After the operative open revision (laparotomy and adhesiolysis), the patient had an uneventful postoperative period.

Postoperative intraabdominal abscess occurrence is always analyzed due to the need for additional intervention (operative and non-operative). The average reported incidence of IAA occurrence is between 1.5 – 20% [30-32]. According to Schlottman, one of the risk factors for the occurrence of IAA is complicated appendicitis [33]. Reports of IAA incidence between the laparoscopic and open appendectomy for CA are opposed. But, several systematic reviews and meta-analyses do not report any statistical difference when comparing the two methods [12, 30]. In 51 randomized controlled trials, Ukai shows a statistically significant difference in IAA occurrence in favor of the OA up until the year 2001. In the following years, this difference decreased and finally, in the last year of the analysis (2010) its occurrence in the laparoscopic groups is shown to be reduced (statistically non-significant: OR = 1.32; 95% CI 0.84 – 2.10) [34]. We report one case of the occurrence of IAA in the LG, without statistical significance.

Most of the published data show statistically significant shorter lengths of stay in the laparoscopic groups [11, 30, 35-37]. Similarly, the LG in our study presented with a statistically significant shorter length of stay.

Limitations

This is non-randomized single-institution study. Its sample is small and some results may not be in accordance to other larger series.

CONCLUSION

This study proved significantly shorter operative times for laparoscopy and a low rate of conversion. Overall morbidity was confined within the previously reported series. Major complications were with low and acceptable rates. Wound infections were present only in the open group. The length of hospital stay was significantly shorter in the laparoscopic group. Laparoscopic appendectomy is a reliable and safe

method in the treatment of all grades of complicated appendicitis.

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Резиме

ИНТРА- И ПОСТОПЕРАТИВНИ ПРЕДНОСТИ НА ЛАПАРОСКОПИЈАТА ПРИ ТРЕТМАН НА КОМПЛИЦИРАН АПЕНДИЦИТИС

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Цел: Одредување и дефинирање на предностите на лапароскопската апендектомија во третманот на комплициран апендицитис преку споредба со отворена апендектомија.

Материјал и методи: Во оваа проспективна интревентна клиничка студија се споредени интраоперативните податоци и постоперативниот исход кај 77 пациенти, кои се презентираа со комплициран апендицитис и беа оперирани со отворена и лапароскопска апендектомија во период од 20 месеци. Еден хирург ги изведе сите лапароскопски процедури, додека други двајца постари хирурзи ги изведоа отворените.

Резултати: Оперативното време беше пократко во лапароскопската група ($p = 0,033$). Стапката на конверзија беше 2,3 %. Вкупниот постоперативен морбидитет беше 25,97 %. Се изведе една оперативна ревизија заради постоперативна тенкоцревна опструкција во лапароскопската група. Попуштање на пендикуларната чкунка се јави кај една пациентка во отворената група. Еден случај на интраабдоминален апсцес се појави во лапароскопската група ($p = 0,38$). Инфекција на оперативната рана се јави само во отворената група ($p = 0,018$). Должината на болничкиот престој беше пократка во лапароскопската група ($p = 0,0052$). Еден пациент од лапароскопската група беше примен повторно во болница.

Заклучок: Лапароскопијата во третманот на комплициран апендицитис е сигурна метода. Таа нуди пократко оперативно време, ниска стапка на оперативна конверзија, прифатлива стапка на мајорни постоперативни компликации и пократок болнички престој.

Клучни зборови: комплициран апендицитис, лапароскопија, апендектомија