

## Laparoscopic versus open appendectomy for the treatment of complicated appendicitis

F. FERRANTI, F. CORONA, L.M. SIANI, A. STEFANUTO, D. AGUZZI, E. SANTORO

**SUMMARY:** Laparoscopic versus open appendectomy for the treatment of complicated appendicitis.

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*Aim.* Laparoscopic Appendectomy (LA) is widely performed for the treatment of acute appendicitis. However the use of laparoscopic approach for complicated appendicitis is controversial, in particular because it has been reported an increased risk of postoperative IntraAbdominal Abscess (IAA). The aim of this study was to compare the outcomes of LA versus Open Appendectomy (OA) in the treatment of complicated appendicitis, especially with regard to the incidence of postoperative IAA.

*Patients and Methods.* A retrospective study of all patients treated at our institution for complicated appendicitis, from May 2004 to June 2009, was performed. Data collection included demographic characteristics, postoperative complications, conversion rate, and length of hospital stay.

*Results.* Thirty-eight patients with complicated appendicitis were analysed. Among these, 18 (47,3%) had LA and 20 (52,7%) had OA. There were no statistical differences in characteristics between the two groups. The incidence of postoperative IAA was higher (16,6%), although not statistically significant, in the LA compared with OA group (5%). On the other hand the rate of wound infection was lower (5%) in the LA versus OA (20%).

*Conclusion.* Our study indicated that LA should be utilised with caution in case of perforated appendicitis, because it is associated with an increased risk of postoperative IAA compared with OA.

**RIASSUNTO:** Appendicectomia laparoscopica versus appendicectomia laparotomica nel trattamento dell'appendicite acuta complicata.

F. FERRANTI, F. CORONA, L.M. SIANI, A. STEFANUTO, D. AGUZZI, E. SANTORO

*Obiettivo.* L'appendicectomia laparoscopica è diffusamente utilizzata nel trattamento dell'appendicite acuta. Tuttavia l'approccio laparoscopico, nei casi di appendicite acuta complicata, è controverso, in particolare per il maggiore rischio di infezioni addominali postoperatorie. Lo scopo di questo studio è quello di comparare i risultati dell'appendicectomia laparoscopica versus l'appendicectomia laparotomica, in particolare per quanto riguarda l'incidenza delle infezioni addominali postoperatorie.

*Pazienti e metodi.* È stato condotto uno studio retrospettivo, analizzando i pazienti affetti da appendicite acuta complicata, da noi trattati nel periodo maggio 2004 – giugno 2009. Sono stati presi in considerazione i seguenti dati: caratteristiche demografiche dei pazienti, complicanze postoperatorie, tasso di conversione e degenza post-operatoria.

*Risultati.* Sono stati analizzati, complessivamente, 38 pazienti con appendicite complicata. Tra questi, 18 (47,3%) sono stati sottoposti ad appendicectomia laparoscopica e 20 (52,7%) ad appendicectomia laparotomica. È stata riscontrata una maggiore incidenza (16,6%), statisticamente non significativa, di infezioni addominali postoperatorie nel gruppo laparoscopico rispetto al gruppo open. Al contrario, l'incidenza di infezione del sito chirurgico è risultata essere inferiore (5%) nei pazienti operati con approccio laparoscopico, rispetto a quelli sottoposti ad appendicectomia laparotomica (20%).

*Conclusioni.* Il nostro studio indica che l'appendicectomia laparoscopica va scelta con cautela nel trattamento dell'appendicite acuta complicata poiché tale tecnica è associata ad una maggiore incidenza di infezioni addominali postoperatorie rispetto all'approccio laparotomico.

**KEY WORDS:** Laparoscopic appendectomy - Complicated appendicitis - Postoperative intraabdominal abscesses. Appendicectomia laparoscopica - Appendicite complicata - Infezioni addominali postoperatorie.

### Introduction

Acute appendicitis represents the most common abdominal condition requiring an urgent operation (1). It has been estimated, that in the United States, approximately 250,000 appendectomies are performed yearly (2). Open Appendectomy (OA) has been considered for

"San Paolo" Hospital, ASL RM/F, Civitavecchia (Rome), Italy  
Department of General and Mini-invasive Surgery

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decades the gold standard treatment for acute appendicitis with excellent results (3). The introduction of laparoscopy opened new surgical options and minimally invasive approach has become the standard technique for most surgical diseases (4, 5).

Laparoscopic Appendectomy (LA) was quickly utilized for the treatment of acute appendicitis (6) but this procedure, in contrast to other surgical laparoscopic operations, has not gained widespread acceptance and its role is under debate. In fact, while some studies (7-13) have shown numerous advantages of LA compared to OA, such as decreased postoperative complications, faster recovery and better cosmetic results, other reports (14-19) have failed to demonstrate the same benefits.

The purpose of this retrospective study was to compare the outcomes of laparoscopic and open appendectomy for the treatment of complicated appendicitis with emphasis on postoperative infectious complications.

### Patients and methods

Records of all patients who underwent appendectomy for acute appendicitis at our institution, between May 2004 and June 2009, were retrospectively reviewed. Among these patients, we selected the subgroup affected by complicated appendicitis, who represented the study population. Patients younger than 15 years were excluded from the study. Data were analysed for age, sex, conversion rate, postoperative infectious complications and length of hospital stay. Wound infection and IntraAbdominal Abscess (IAA) were defined according to National Nosocomial Infection Surveillance (NNIS) System Classification (20). The diagnosis of appendicitis was established by the surgeon at the time of surgery and later confirmed with histology. Complicated appendicitis was defined as gangrenous or perforated appendix with or without collection or abscess (21).

Preoperatively, all patients received standard intravenous regimen of broad-spectrum antibiotics. After surgery antibiotic was continued for at least 48 hours after the patient became afebrile. The decision about the type of technique, either laparoscopic or open, was made on the basis of surgeon preference. However, on principle, women in the fertile age and obese patients are preferably operated on by laparoscopic approach.

Laparoscopic procedure was performed with a 3-trocar techni-

que. Pneumoperitoneum was obtained by a Veress needle, positioned in the left hypocondrium. The mesoappendix was divided using either bipolar coagulation or clips. The appendix was ligated at its base with reabsorbable Endoloops (Ethicon, Cincinnati, OH, USA), or transected by stapler with a portion of caecum, in the cases of necrosis at the base of appendix. The specimen was removed from the abdomen in a plastic bag (Endocatch, USSC, Norwalk, USA) through 10-mm cannula site. All the patients underwent peritoneal irrigation using normal warming saline and a drain was always left in place, both, in the laparoscopic and open groups. Open appendectomy was performed through a right lower quadrant muscle-splitting incision and the operation performed in the standard method.

Statistical analysis was performed using SPSS, Statistical software version 17.0 (SPSS Inc, Chicago, IL, USA). All continuous data were expressed as mean ± Standard Deviation (SD). The Chi-squared test or Fisher test, as appropriate were used to compare the differences between LA and OA. The continuous variables were analysed with Student's t-test. A P value less than 0.05 was considered statistically significant. All data were analysed on an intention-to-treat basis, so that all converted cases were included in the laparoscopic group.

### Results

A total of 152 patients underwent appendectomy during the study period; 114 (75%) patients had uncomplicated appendicitis and 38 (25%) patients had complicated appendicitis. Among these, 18 (47.3%) underwent LA and 20 (52.7%) OA. Both groups of patients were comparable in age and gender (Table 1). The female constituted 61% of the laparoscopic group and 45% of the open group. The mean age for the OA was 23.1 ± 9.46 years, as compared with 23.5 ± 10.78 years for the LA group. Perforated appendicitis was diagnosed in 6 (33.3%) patients in the LA group and in 8 (40%) in the OA group.

The postoperative complications for the two groups are summarized in Table 2. The most common complication in the patients who underwent OA was wound infection, which developed in 4 (20%) patients of this group. In the LA group this complication developed in 1 (5.5%) patient and the infection was located

TABLE 1 - DEMOGRAPHIC AND PERIOPERATIVE PARAMETERS OF THE PATIENTS WITH COMPLICATED APPENDICITIS.

	LA	OA	P value
Total patients, n	18 (47%)	20 (53%)	
Gender, n			NS
Females	11 (61%)	9 (45%)	
Males	7 (39%)	11 (55%)	
Mean age, years ± SD	23.5±10.78	23.1±9.46	NS
Mean hospital stay, days ± SD	7.2±2.2	7.9±2.2	NS
Perforation, n	6 (33%)	8 (40%)	NS
Conversion, n	2 (11.1%)		

LA, laparoscopic appendectomy; OA, open appendectomy; NS, not significant.

TABLE 2 - POSTOPERATIVE INFECTIOUS COMPLICATIONS.

Complication	LA (n=18)	OA (n=20)
Wound infection, n	1 (5.5%)	4 (20%)
IAA, n	3 (16.6%)	1 (5%)
Total, n	4 (22%)	5 (25%)

LA, laparoscopic appendectomy; OA, open appendectomy.

at the umbilical trocar site. On the contrary, the rate of postoperative IAA was higher in the laparoscopic group (16.6%) compared to open group (5%). The difference rate of IAA and wound infection between the groups was not statistically significant. Out of a patient in the laparoscopic group who required a reoperation for drainage of the abscess, all the patients with IAA were successfully treated with CT drainage of the collection and antibiotics. All the abscesses occurred in the cases of perforated appendicitis and were confined to the right lower quadrant and pelvis.

A stapler was used 3 times (16.6%) in the LA.

Two patients (11.1%) were converted to open procedure due to extensive caecal adhesions and technical difficulties in mobilising the appendix. The length of hospital stay was similar for the two groups, respectively,  $7.9 \pm 2.2$  days for the OA group, and  $7.2 \pm 2.2$  days for the LA group.

There was no mortality in the series.

## Discussion

In recent years LA has become a common procedure for the treatment of acute appendicitis (12). However the role of the laparoscopy in the cases of complicated appendicitis is still under debate and the subject of controversy regards, in particular the risk of postoperative infectious complications. It has been reported in the literature (22-25), that LA for complicated appendicitis is associated with an increases risk of IAA. With this regard, a recent review of Cochrane Database revealed that the incidence of IAA was 3 times higher after LA compared to OA. Furthermore a study (26) reported that the rate of IAA in the children underwent LA for perforated appendicitis was as high as 42%. For these reasons, it has been suggested that LA should not be performed for the treatment of complicated appendicitis (27-29).

Various theories have been proposed in order to explain the occurrence of postoperative IAA following LA. It has been suggested that pneumoperitoneum disperses infected contents throughout the peritoneal cavity

(30) and that carbon dioxide creates a favourable environment inside the abdomen for survival of anaerobic bacteria (31). Furthermore, intraperitoneal contamination can also caused by the aggressive manipulation and division of the inflamed appendix within the peritoneal cavity (32). However such theories can be confuted by the fact that the abscesses are primarily located in the right lower quadrant or pelvis, and that the flora of abscesses are similar in both the laparoscopic and open procedures (33). Furthermore recent studies (8, 34-37) have shown no significant differences in the occurrence of postoperative IAA. On the basis of these considerations, the supporters of laparoscopic approach (38, 39) consider LA appendectomy a safe and effective alternative to the open approach in the patients with complicated appendicitis.

In our study the incidence of postoperative IAA was higher in the group of LA compared with OA group (16.6% versus 5%), although the difference was not statistically significant. We point out the fact that all the cases of IAA, either those following laparoscopic or open procedures, occurred in the patients with perforated appendicitis. Considering the contradictories literature data (40, 19) about the incidence of postoperative IAA, we believe that the choice of technique to be utilised, either laparoscopy or open, is based on personal surgeon's preference rather than on the literature evidence. Various reports (7, 8, 15, 24) have documented that LA is associated with a lower incidence of wound infection compared with OA. Our series is consistent with the literature, and in fact we found that the infection wound was lower, although not statistically significant, following LA compared with OA (5.5% versus 20%). It has been suggested (41, 9) that the low incidence of wound infection following laparoscopic appendectomy can be due to the fact that the inflamed appendix is removed from the abdominal cavity through a port, without any contact with the abdominal wall.

One significant drawback of LA is the reported high rate of conversion to open procedure, whose incidence ranges from 8% to 47% (35, 37). Conversion should not be considered a complication of the procedure, but its occurrence, inevitably, increases the costs and influences the outcome of the operation (9, 21). In the presence of complicated appendicitis, laparoscopic approach is technically demanding, so the surgeon's experience may play a role in reducing the conversion rate and improving the results (42). With this regard it has been suggested (43) that the learning curve for a surgeon to be accredited to perform laparoscopic appendectomy should be 20 cases at least.

There was no mortality in our series and this is consistent with the majority of publications. Mortality of appendectomy for uncomplicated cases is very low, ranging from 0.05% to 0.3%, regardless the procedure utilized (44). The mortality rate increases in complicated ap-

pendicitis, and in the elderly (45). These findings demonstrate that appendectomy, either laparoscopic or open, is a safe operation, and that the mortality is related to the stage of the disease, rather than to the type of surgical technique utilized (46).

Many reports (47, 9, 11) have shown that the length of postoperative hospital stay is shorter in LA compared to OA. In our study, the length of postoperative hospital stay was similar in both groups respectively,  $7.9 \pm 2.2$  days for the OA group and  $7.2 \pm 2.2$  days for the LA group. This is longer than the postoperative hospital stay reported in the literature (40), but the difference can be explained by the fact that we prefer, according with other Authors (42,21) to keep in the patients for administration of intravenous antibiotic and until they have become afebrile.

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## Conclusions

Although there is no consensus with regard to the advantages of LA compared to OA, today there is a trend toward laparoscopic approach for the treatment of acute appendicitis (48). However our study showed that the incidence of postoperative IAA was higher, although not statistically significant, in the LA compared to OA. Furthermore we found no difference in term of postoperative length of hospital stay between the two techniques.

In the light of these findings we consider laparoscopic approach a safe procedure for the treatment of uncomplicated appendicitis, but LA should be used with caution, or even avoided, in the cases of perforated appendicitis.

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