



## Laparoscopic appendectomy: Which factors are predictors of conversion? A high-volume prospective cohort study



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### HIGHLIGHTS

- Indications and results for laparoscopic appendectomy are conflicting because of few data about results and conversion.
- In our study the experience in laparoscopy did not affect safety and effectiveness even for less experienced laparoscopist.
- When a resident performed the intervention first stool passage and resumption of solid diet occurred significantly earlier.

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### ABSTRACT

Appendicitis represents one of the most frequent condition requiring surgery. In Italy almost 0.2% of the population will be affected by acute appendicitis every year. Laparoscopic appendectomy (LA) has gained acceptance over the past years and despite several meta-analyses, randomized studies and retrospective studies have been conducted, the indications and results are still conflicting especially in cases of complicated appendicitis. The aim of our study is to evaluate which factors are related to conversion to open appendectomy (OA) during laparoscopic appendectomy (LA).

**Materials and methods:** From September 2011 to May 2013, appendectomy for acute appendicitis was performed on 434 patients in our Surgical Unit at S. Orsola-Malpighi Hospital, Bologna, Italy. Of these, 369 patients (85%) underwent LA. The clinical, demographic, surgical and pathological data of these patients were included in a prospective database. To note, only laparoscopic appendectomies were considered to be included in the analysis. The following factors were analyzed in order to identify which were associated with the conversion: age, sex, body mass index (BMI), previous abdominal surgery, comorbidities, clinical and laboratory parameters including Alvarado score, PCR, intraoperative findings such as anatomy and degree of inflammation. During our study period, laparoscopic appendectomies were performed by different surgeons both residents and attending surgeons. The decision to convert the intervention in an open procedure was taken by the individual surgeon. Regarding the postoperative period, were considered the time of hospitalization and related costs, time of oral intake of liquid and solid, time of passage of stool, readmissions and reoperations.

**Results:** At univariate analysis, the factors significantly related to the conversion were the presence of comorbidities ( $p < 0.001$ ) and, among these, the presence of arterial hypertension ( $p = 0.006$ ) or other cardiovascular diseases ( $p = 0.031$ ) and the history of previous abdominal surgery ( $p = 0.023$ ). Patients with higher mean age ( $33.9 \pm 15.4$  vs.  $46.0 \pm 19.3$ ,  $p = 0.001$ ) and higher body mass index (BMI) ( $23.5 \pm 4.3$  vs  $25.8 \pm 4.9$  kg/m<sup>2</sup>,  $p = 0.006$ ) had a higher risk of conversion.

Multivariate analysis finally showed that factors significantly related to the conversion were the presence of comorbidities ( $p = 0.029$ ), the presence of an appendiceal perforation ( $p = 0.003$ ), a retrocecal appendix ( $p = 0.004$ ), the presence of appendicular abscess ( $p = 0.023$ ) and the presence of diffuse peritonitis ( $p = 0.008$ ).

**Conclusion:** The majority of patients with acute appendicitis can be successfully managed with laparoscopy. We found that the only preoperative independent factor related to conversion during

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laparoscopic appendectomy is the presence of comorbidities. Nevertheless surgeons should take into account that presence of peri-appendicular abscess and diffuse peritonitis are both independently related not only to higher rate of conversion but also to higher risk of postoperative complication.

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## 1. Introduction

Traditionally, open appendectomy (OA) has been the standard intervention for acute appendicitis over the years [1]. Introduced by Semm in 1983 [2] laparoscopic appendectomy (LA) has gained popularity among surgeons in the last decades.

Laparoscopic surgery has several advantages, including the use of small incisions and rapid postoperative recovery [3]. Several studies have been conducted, but the indications and results are still conflicting because of the poor quality of data.

In 1994, the European Association of Endoscopic Surgeons (EAES), drafted guidelines based on a consensus meeting, which left many issues unresolved because of the absence of high-level evidence studies [4].

The conversion from laparoscopic appendectomy (LA) to an open procedure (OA) can occur if intraoperative complications arise during LA or if the severity of the disease does not permit to perform a safe laparoscopy. It is known that the conversion increases costs and operative times and, in addition, the benefits of the laparoscopic approach and outcomes will be lost [5]. For these reasons it could be useful to determinate preoperative criteria that could predict factors related to conversion and be used to decide the ideal approach for individual patients and disease.

The aim of our study is to evaluate which factors are related to conversion to open appendectomy (OA) during laparoscopy both related to the severity of the disease and with the characteristics of the patients. Secondary end-points, such demographic age, sex, body mass index (BMI) and clinical characteristic (previous abdominal surgery, comorbidities, clinical and laboratory parameters including Alvarado score, PCR, intraoperative findings such as anatomy and degree of inflammation) were also analyzed.

## 2. Materials and methods

From September 2011 to May 2013, appendectomy for acute appendicitis was performed on 434 patients in our Surgical Unit at S. Orsola-Malpighi Hospital, Bologna, Italy.

Of these, 369 patients (85%) underwent LA. The clinical, demographic, surgical and pathological data of these patients were included in a prospective database. To note, only laparoscopic appendectomies were considered to be included in the analysis. The following factors were analyzed in order to identify which were associated with the conversion from LA to OA: age, sex, body mass index (BMI), previous abdominal surgery, comorbidities, clinical and laboratory parameters including Alvarado score, CRP, intraoperative findings such as anatomy and degree of inflammation. During our study period, laparoscopic appendectomies were performed by different surgeons both residents and attending surgeons. The decision to convert the intervention in an open procedure was made by the individual surgeon. Regarding the postoperative period, were considered the time of hospitalization and related costs, time of oral intake of liquid and solid, time of passage of stool, readmissions and reoperations.

## 3. Statistical analysis

Continuous variables were reported as mean and standard deviation. The discrete variable as absolute frequency and percentage. The analysis was conducted using the Pearson chi-square test, the Fischer's exact test, the Student's t-test when necessary. Multivariate analysis was performed with logistic regression. Two-sided p values < 0.05 were considered statistically significant. All data were analyzed with SPSS version 13.0.

## 4. Surgeons

Surgical procedures were performed by the attending surgeon and/or residents. Residents were always assisted by an attending surgeon who had experience in laparoscopic and open surgical techniques.

**Table 1**  
Patients' demographics.

	No/%
Sex	
Male (%)	173 (46.9)
Female (%)	196 (53.1)
Age (mean ± SD)	37.1 ± 17.8
Comorbidities	
One or more (%)	59 (16.0)
None (%)	310 (84.0)
Type of comorbidities	
Arterial hypertension (%)	31 (8.4)
Cardiovascular diseases (%)	24 (6.5)
Chronic obstructive pulmonary disease – COPD (%)	12 (3.3)
Diabetes mellitus (%)	7 (1.9)
BMI (Kg/m <sup>2</sup> , mean ± SD)	24.6 ± 15.8
Previous abdominal surgery	
Yes (%)	39 (10.6)
No (%)	330 (89.4)
Migration of pain	
Yes (%)	79 (21.4)
No (%)	290 (78.6)
Right iliac fossa pain	
Yes (%)	360 (97.6)
No (%)	9 (2.4)
Nausea and/or vomiting	
Yes (%)	187 (50.7)
No (%)	182 (49.3)
Anorexia	
Yes (%)	9 (2.4)
No (%)	360 (97.6)
Blumberg's sign	
Yes (%)	186 (50.4)
No (%)	183 (49.6)
Fever (>37.3 °C)	
Yes (%)	96 (26.0)
No (%)	273 (74.0)
WBC count (>10.000/mm <sup>3</sup> )	
Yes (%)	291 (79.9)
No (%)	78 (21.1)
Leukocytosis (10 <sup>3</sup> /mm <sup>3</sup> , mean ± SD)	13.1 ± 4.5
Alvarado score (mean ± SD)	5.4 ± 1.7
CRP (mg/dL) (mean ± SD)	6.5 ± 9.0

**Table 2**  
Surgical and anatomical characteristics.

	No/%
Surgeon	
Attending surgeon (%)	292 (79.1)
Resident (%)	77 (20.9)
Retrocecal appendix	
Yes (%)	79 (21.4)
No (%)	290 (78.6)
Edematous inflammation	
Yes (%)	116 (31.4)
No (%)	253 (68.6)
Phlegmonous inflammation	
Yes (%)	169 (45.8)
No (%)	200 (54.2)
Gangrenous inflammation	
Yes (%)	108 (29.3)
No (%)	261 (70.7)
Perforated appendicitis	
Yes (%)	57 (15.4)
No (%)	312 (84.6)
Appendicular abscess	
Yes (%)	65 (17.6)
No (%)	304 (82.4)
Peritonitis	
Circumscribed (%)	97 (26.3)
Diffuse (%)	36 (9.8)
No (%)	236 (64.0)
Peritoneal lavage	
Yes (%)	237 (64.2)
No (%)	132 (35.8)
Conversion	
Yes (%)	29 (7.9)
No (%)	340 (92.1)
Cause of conversion	
Peritoneal adhesions (%)	7 (24.1)
Severity of peritonitis (%)	14 (48.3)
Other complications (%)	1 (3.4)
Inflammation + adhesions (%)	7 (24.1)
Surgery time (minutes, mean $\pm$ SD)	68.5 $\pm$ 24.1

## 5. Technique of laparoscopic appendectomy (LA)

Under general anesthesia, LA was performed using a 3-trocar approach (umbilical, 10–12 mm port; suprapubic, 5 mm port; lower-left quadrant, 10–12 mm port). With the patient in the Trendelenburg position and right side-up, the small bowel was retracted away from the lower right quadrant. The appendix was divided using two loops (*Endoloops*, *Ethicon*, *Johnson and Johnson*, *Arlington, TX, USA*) or an intestinal stapler (*Endo-GIA 30*, *US Surgical Corp*, *Norwalk, CT, USA*) and removed through one of the two 10–12 mm ports with use of a specimen bag. Before the end of intervention intraperitoneal irrigation with physiological saline solution was made. Drainage of peritoneal cavity was considered in cases of diffuse peritonitis and/or appendicular abscess.

## 6. Technique of open appendectomy (OA)

OA was performed via Mc-Burney's incision or by a lower-right para-rectal incision. Drainage was considered as for the LA group.

## 7. Results

Demographic, clinical and pathological data of the 369 patients considered in the analysis are summarized in [Tables 1 and 2](#). One or more comorbidities were present in 16% of cases and 39 patients (10.6%) had undergone previous abdominal surgery. 340 (78.3%) procedures were successfully performed laparoscopically and 29 (6.7%) were converted to conventional open procedure.

The presence of a severe inflammatory process has been the

**Table 3**  
Post-op course and morbidity.

	No/%
Hospital stay (days, mean $\pm$ SD)	3.6 $\pm$ 2.6
Time to oral intake (liquid) (days, mean $\pm$ SD)	1.4 $\pm$ 1.0
Time to oral intake (solid) (days, mean $\pm$ SD)	2.0 $\pm$ 1.3
First stool passage (days, mean $\pm$ SD)	1.8 $\pm$ 0.9
Postoperative complications	
Yes (%)	18 (4.9)
No (%)	351 (95.1)
Medical complications	
Yes (%)	13 (3.5)
No (%)	356 (96.5)
Surgical complications	
Yes (%)	8 (2.2)
No (%)	361 (97.8)
Readmissions (within 30-days)	
Yes (%)	0 (0)
No (%)	369 (100)
Reinterventions	
Yes (%)	6 (1.6)
No (%)	363 (98.4)
Causes of reinterventions	
Dehiscence of appendiceal stump (%)	2 (33.3)
Bleeding (%)	1 (16.7)
Infection (%)	3 (50.0)
Histological data	
Catarrhal (%)	92 (24.9)
Phlegmonous (%)	126 (34.1)
Gangrenous (%)	51 (13.8)
Perforated (%)	30 (8.1)
Chronic inflammation (%)	56 (15.2)
Other (%)	12 (3.3)
Neoplasm (%)	2 (0.5)
Costs of hospital stay (€, mean $\pm$ SD)	1363.4 $\pm$ 977.6

most common reason (14 of 29 patients, 48.3%); 7 patients (24.1%) were converted due to the presence of peritoneal adhesions. In one case the conversion was the result of an intraoperative complication (appendix detachment from the caecum during its preparation).

Surgical interventions were performed by resident surgeons in 20.9% (77/369) of cases and in 79.1% (292/369) by attending surgeons. Among the latter, we further distinguished those with adequate training in laparoscopic surgery (224 operations, 76.7%) than non-experts in laparoscopy (68 interventions, 23.3%).

Regarding anatomic and surgical data, in 79 cases (21.4%), the appendix was found to be in retrocecal position, in 116 cases (31.4%) was catarrhal, in 169 cases (45.8%) phlegmonous, in 108 cases (29.3%) gangrenous and in 57 cases (15.4%) was perforated. In 2 cases (0.5%) a neoplasm was found at histological examination.

With regard to the degree of inflammation, in 65 cases (17.6%) had documented the presence of an appendicular abscess and in 97 cases (26.3%) a circumscribed peritonitis while 36 cases (9.8%) had a diffuse peritonitis.

The postoperative course ([Table 3](#)) was characterized by an average length of stay of  $3.6 \pm 2.6$  days and was uneventful in the majority of patients (351 patients, 95.1%).

The mean time of oral re-feeding (liquid) was  $1.4 \pm 1.0$  days and  $2.0 \pm 1.3$  days (solid); the mean time of first stool passage was  $1.8 \pm 0.9$  days.

No patient was readmitted; 6 patients (1.6%), however, were re-operated due to infective complication in 3 cases (50%), dehiscence of the appendiceal stump in 2 cases (33.3%) and bleeding in only one case (16.7%).

The univariate analysis of factors related to conversion is shown in [Tables 4 and 5](#).

A multivariate analysis ([Table 6](#)) was then conducted to assess which of these factors were independently related to the decision to convert the intervention. The factors statistically predictive of

**Table 4**  
Univariate analysis on demographics and clinical factors related to conversion.

	Laparoscopic group	Laparoscopic converted to open	p value
Sex			
Male (%)	158 (91.3)	15 (8.7)	0.699
Female (%)	182 (92.9)	14 (7.1)	
Mean age (age, mean $\pm$ SD)	33.9 $\pm$ 15.4	46.0 $\pm$ 19.3	0.001
Comorbidity			
One or more (%)	46 (78.0)	13 (22.0)	<0.001
None (%)	294 (94.8)	16 (5.2)	
Arterial hypertension			
Yes (%)	24 (77.4)	7 (22.6)	0.006
No (%)	316 (93.5)	22 (6.5)	
Cardiovascular diseases			
Yes (%)	19 (79.2)	5 (20.8)	0.031
No (%)	321 (93.0)	24 (7.0)	
COPD			
Yes (%)	12 (100)	0 (0)	0.610
No (%)	328 (91.9)	29 (8.1)	
Diabetes mellitus (DM)			
Yes (%)	7 (100.0)	0 (0.0)	1.000
No (%)	333 (92.0)	29 (8.0)	
Previous abdominal surgery			
Yes (%)	32 (82.1)	7 (17.9)	0.023
No (%)	308 (93.3)	22 (6.7)	
BMI (Kg/m <sup>2</sup> ; mean $\pm$ SD)	23.5 $\pm$ 4.3	25.8 $\pm$ 4.9	0.006
Migration of pain			
Yes (%)	71 (92.8)	8 (10.1)	0.478
No (%)	269 (89.9)	21 (7.2)	
Right iliac fossa pain			
Yes (%)	332 (92.2)	28 (7.8)	0.525
No (%)	8 (88.9)	1 (11.1)	
Nausea and/or vomiting			
Yes (%)	175 (93.6)	12 (6.4)	0.337
No (%)	165 (90.7)	17 (9.3)	
Anorexia			
Yes (%)	8 (88.9)	1 (11.1)	0.525
No (%)	332 (92.2)	28 (7.8)	
Blumberg's sign			
Yes (%)	175 (94.1)	11 (5.9)	0.180
No (%)	165 (90.2)	18 (9.8)	
Fever (>37.3 °C)			
Yes (%)	41 (73.2)	15 (26.8)	<0.001
No (%)	299 (95.5)	14 (4.5)	
Leukocytosis (WBC > 10.000/mm <sup>3</sup> )			
Yes (%)	270 (92.8)	21 (7.2)	0.352
No (%)	70 (89.7)	8 (10.3)	
Neutrophilia (>75%)			
Yes (%)	128 (90.1)	14 (9.9)	0.236
No (%)	204 (93.6)	14 (6.4)	
Alvarado score	5.3 $\pm$ 1.6	5.5 $\pm$ 1.9	0.795
CRP	4.9 $\pm$ 6.7	13.8 $\pm$ 11	<0.001

conversion were: presence of comorbidities (OR 3.1, 95% CI 1.1–8.8,  $p = 0.029$ ), a finding of an appendiceal perforation (OR 5.1, 95% CI 1.8–15.0,  $p = 0.003$ ), retrocecal appendix (OR 5.0, 95% CI 1.7–14.8,  $p = 0.004$ ), the presence of appendicular abscess (OR 3.6, 95% CI 1.2–11.1,  $p = 0.023$ ) and the presence of a diffuse peritonitis (OR 9.2, 95% CI 1.8–47.8,  $p = 0.008$ ).

In Table 7, the same factors mentioned above were analyzed in order to evaluate which of them could determinate a greater risk of developing post-operative complications. In this case the only parameters that showed statistical significance was related to the degree of intra-abdominal inflammation, specifically the presence of peri-appendicular abscess (OR 3.3, 95% CI 1.4–7.9,  $p = 0.006$ ) or the presence of diffuse peritonitis (OR 2.1, 95% CI 1.1–3.8,  $p = 0.013$ ).

## 8. Discussion

In our series of 369 patients undergoing laparoscopic appendectomy, the conversion to conventional open surgery was necessary in 29 cases, with a conversion rate of 7.9%, less than the 10%

rate reported in a meta-analysis of 54 randomized trials [6].

Univariate analysis revealed 16 factors significantly associated with conversion. Among these, however, only 5 are independently related to the risk of conversion. Multivariate analysis reveals in fact that factors statistically predictive of conversion were presence of comorbidities, a finding of an appendiceal perforation, retrocecal appendix, the presence of appendicular abscess and the presence of a diffuse peritonitis. These factors were strongly related to the risk of conversion also in many papers in literature [7–9].

Considering the risk of developing post-operative complications, the only parameters that showed statistical significance was related to the degree of intra-abdominal inflammation, specifically the presence of peri-appendicular abscess (OR 3.3, 95% CI 1.4–7.9,  $p = 0.006$ ) or the presence of diffuse peritonitis (OR 2.1, 95% CI 1.1–3.8,  $p = 0.013$ ).

For these reasons we can say that our results confirmed that there are multiple factors related to the decision to convert laparoscopic procedure to open surgery, related both to characteristics of the patient and severity of the disease.

**Table 5**  
Univariate analysis on surgical and pathological factors related to conversion.

	Laparoscopic group	Laparoscopic converted to open	p value
Surgeon			
Attending (%)	265 (90.8)	27 (9.2)	0.058
Resident (%)	75 (97.4)	2 (2.6)	
Retrocecal appendix			
Yes (%)	67 (84.8)	12 (15.2)	0.016
No (%)	273 (94.1)	17 (5.9)	
Catarrhal			
Yes (%)	116 (100)	0 (0)	<0.001
No (%)	224 (88.5)	29 (11.5)	
Phlegmonous			
Yes (%)	156 (92.3)	13 (7.7)	1.000
No (%)	184 (92.0)	16 (8.0)	
Gangrenous			
Yes (%)	87 (80.6)	21 (19.4)	<0.001
No (%)	253 (96.9)	8 (3.1)	
Perforated			
Yes (%)	42 (73.7)	15 (26.3)	<0.001
No (%)	298 (95.5)	14 (4.5)	
Abscess			
Yes (%)	47 (72.3)	18 (27.7)	<0.001
No (%)	293 (96.4)	11 (3.6)	
Peritonitis			
Circumscribed (%)	81 (83.5)	16 (16.5)	<0.001
Diffuse (%)	26 (72.2)	10 (27.8)	
No (%)	233 (98.7)	3 (1.3)	

**Table 6**  
Multivariate analysis of factors related to conversion.

Factors	OR (IC 95%)	p value
Comorbidities	3.1 (1.1–8.8)	0.029
Appendiceal perforation	5.1 (1.8–15.0)	0.003
Retrocecal appendix	5.0 (1.7–14.8)	0.004
Appendicular abscess	3.6 (1.2–11.1)	0.023
Diffuse peritonitis	9.2 (1.8–47.8)	0.008

**Table 7**  
Multivariate analysis of factors influencing post-op complication.

Factors	OR (IC 95%)	p value
Appendicular abscess	3.3 (1.4–7.9)	0.006
Diffuse peritonitis	2.1 (1.1–3.8)	0.013

## 9. Conclusion

In conclusion, the majority of patients with acute appendicitis can be successfully managed with laparoscopy. We found that the only preoperative independent factor related to conversion during laparoscopic appendectomy is the presence of comorbidities. Nevertheless surgeons should take into account that presence of peri-appendicular abscess and diffuse peritonitis are both independently related not only to higher rate of conversion but also to higher risk of postoperative complication.

## Ethical approval

Not required.

## Sources of funding

None.

## Author contribution

Study design: Nicola Antonacci, Claudio Ricci, Francesco Monari, Minni Francesco, Bruno Cola.

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Antonio Leone.

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## Conflicts of interest

None.

## Guarantor

Antonacci Nicola, MD.

## Disclosures

Antonacci Nicola, Ricci Claudio, Giovanni Taffurelli, Francesco Monari, Marco Del Governatore, Antonello Caira, Antonio Leone, Cervellera Maurizio, Minni Francesco and Bruno Cola have no conflict of interests or financial ties to disclose.

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## References

- [1] J. Berry Jr., R.A. Malt, Appendicitis near its centenary, *Ann. Surg.* 200 (5) (1984) 567–575.
- [2] K. Semm, Endoscopic appendectomy, *Endoscopy* 15 (2) (1983) 59–64.
- [3] C.P. Garg, B.B. Vaidya, M.M. Chengalath, Efficacy of laparoscopy in complicated appendicitis, *Int. J. Surg.* 7 (3) (2009) 250–252.
- [4] E. Neugebauer, H. Troidl, C.K. Kum, E. Eypasch, M. Miserez, A. Paul, The E.A.E.S. consensus development conferences on laparoscopic cholecystectomy, appendectomy, and hernia repair. Consensus statements – September 1994. The educational committee of the European association for endoscopic surgery, *Surg. Endosc.* 9 (1995) 550–563.
- [5] A.M. Nana, C.N. Ouandji, C. Simoens, D. Smets, P. Mendes da Costa, Laparoscopic appendectomies: results of a monocentric prospective and non-randomized study, *Hepatogastroenterology* 54 (76) (2007) 1146–1152.
- [6] S. Sauerland, T. Jaschinski, E.A. Neugebauer, Laparoscopic versus open surgery for suspected appendicitis, *Cochrane Database Syst. Rev.* (2010) CD001546. Online, n. 10.
- [7] S.-I. Liu, B. Siewert, V. Raptopoulos, R.A. Hodin, Factors associated with conversion to laparotomy in patients undergoing laparoscopic appendectomy, *J. Am. Coll. Surg.* 194 (2002) 298–305.
- [8] P.L. Wagner, S.R. Eachempati, A. Aronova, L.J. Hydo, F.M. Pieracci, M. Bartholdi, B.-P.N. Umunna, J. Shou, P.S. Barie, Contemporary predictors of conversion from laparoscopic to open appendectomy, *Surg. Infect.* 12 (n. 4) (2011) 261–266.
- [9] A. Hellberg, C. Rudberg, L. Enochsson, T. Gudbjartson, J. Wenner, E. Kullman, G. Fenyö, I. Ringqvist, S. Sörensen, Conversion from laparoscopic to open appendectomy: a possible drawback of the laparoscopic technique? *Eur. J. Surg. Acta Chir.* 167 (n. 3) (mar. 2001) 209–213.