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Original research

Laparoscopic versus open approach in the management of appendicitis complicated exclusively with peritonitis: A single center experience<sup>☆</sup>Felipe Quezada<sup>1</sup>, Nicolas Quezada<sup>\*1</sup>, Ricardo Mejia, Alejandro Brañes, Oslando Padilla, Nicolas Jarufe, Fernando Pimentel

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## H I G H L I G H T S

- Controversy exists regarding the use of laparoscopy in complicated appendicitis.
- This study compared laparoscopic versus open approach in appendicular peritonitis.
- There were no differences between groups in general and specific complications.
- Our results supports laparoscopy in cases of appendicular peritonitis.

## A R T I C L E I N F O

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## A B S T R A C T

**Background:** Controversial evidence exists regarding the laparoscopic approach in patients with acute appendicitis complicated with peritonitis due to a higher rate of surgical complications. The aim of this study was to compare post-operative outcomes in patients with acute appendicitis complicated exclusively with peritonitis approached by laparoscopy versus open surgery. **Methods:** Single center retrospective analysis of clinical records of patients with appendicitis complicated with peritonitis operated from January 2003 until October 2013. Demographic data, intra-operative variables, length of stay, surgical complications, mortality, readmissions and reoperations were retrieved. **Results:** 227 patients were identified, 43% males, mean age  $39 \pm 17$  years (range: 12–85 years). Ninety-seven patients (43%) underwent laparoscopic appendectomy, 13 of them were converted to open surgery (13%). Ninety-four patients presented with diffuse peritonitis (41.4%). Laparoscopic appendectomy showed longer operative time but shorter hospital stay ( $p < 0.05$ ). There were no differences in post-operative complications (intra-abdominal abscess, surgical site infection and prolonged ileus). Laparoscopic appendectomy was associated with lower odds for developing any surgical complication in the multivariate analysis (OR 0.301,  $p = 0.036$ ). **Conclusion:** Both approaches showed no differences in complications in the management of appendicitis complicated exclusively with peritonitis. In our experience, laparoscopic appendectomy is a safe approach in cases of appendicitis complicated exclusively with peritonitis.

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## 1. Introduction

Laparoscopy has been introduced in the treatment of many elective and emergency surgeries with comparable results to open approach.

Since the initial McBurney's description [1], open appendectomy (OA) has been considered the gold standard procedure for this disease. Nevertheless, in recent years laparoscopic appendectomy (LA) has demonstrated to be as safe as OA [2]. Moreover, LA has showed diminished post-operative pain, lower rates of wound

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infection, it has a clear diagnostic role in young women in reproductive ages and, in addition, it facilitates the management of obese patients [3].

Despite these benefits, there are controversial data regarding the use of LA in acute appendicitis complicated with peritonitis, since LA has been associated with higher rates of post-operative intra-abdominal abscesses [4] (POIAA). However, other series have shown the same rate of POIAA and lower rates of wound infection [5–7]. These results are supported by a systematic revision of retrospective series, which showed no differences in POIAA when comparing OA versus LA (Odds Ratio (OR) 1.24; IC 95% 0.84–1.84), and LA was associated with lower wound infection rate [8].

Therefore, the aim of this study is to compare LA versus OA in the management of appendicitis complicated exclusively with peritonitis (ACP) in the 10-year period of our institution in which both approaches were available, in terms of development of any surgical complication and also specific complications as POIAA.

## 2. Methods

### 2.1. Study design

Retrospective analysis of a single-center prospectively collected electronic database including 227 patients with the diagnosis of ACP from January 2003 until October 2013. Pre-operative demographic variables were retrieved as well as the presence of any comorbidity. Complete white blood cell (WBC) count and C-reactive protein (CRP) levels were registered before surgery.

### 2.2. Inclusion criteria

All patients with post-operative diagnose of ACP were included. Patients with absence of histological confirmation of appendicitis and pregnancy were excluded.

### 2.3. Surgical technique

All surgeries were performed by an attending member (Staff or Fellow) of the department of digestive surgery of our institution with a senior general surgery resident. The surgical approach was determined according to surgeon's preference and criteria. LA was performed using a Veress needle for abdominal insufflation and a 3-port technique was used (5- and 12-mm). A fourth additional port was used according to surgeon's preference. Mesoappendix was cauterized with bipolar laparoscopic forceps before cutting it. The appendix was ligated in the base with an external tied polydioxanone laparoscopic ligature and extraction was made using a plastic bag. Warm saline solution lavage and drainage were used according to surgeon preference.

### 2.4. Intraoperative data

Peritonitis was defined as the presence of pus in the abdominal cavity described in the surgical protocol and classified according to the extension as localized if pus was present only in one quadrant or the pelvis, or diffuse when 2 or more quadrants were involved. Conversion to open surgery was decided by each surgeon according to his own criteria. OA was done by a median infra-umbilical laparotomy, right paramedian laparotomy or wide extended McBurney's laparotomy.

### 2.5. Post operative variables

The primary end point was the development of any surgical complication (SC), defined as any deviation of the expected post-operative course and categorized according to the Clavien–Dindo Classification [9]. Specific SC such as POIAA, surgical site infection (SSI) and prolonged ileus (PI) were analyzed separately.

Secondary end points analyzed were operative time, length of hospitalization and 30-days mortality.

### 2.6. Long term follow up

All patients were followed by revision of our clinical records and a telephone interview was attempted with all the patients. Mortality was confirmed using the National Database of Death. Readmissions and reoperations were registered and specific long term SC such as incisional hernia and mechanical bowel obstruction episodes were also retrieved.

### 2.7. Statistical analysis

Analysis was done by intention to treat. Categorical variables were analyzed with Chi-square and Fisher exact test. For variables with a normal distribution a t-student was used. For variables with a non-normal distribution a non-parametric test was used (Mann-Whitney). Logistic regression was made for the presence of SC using the variables described above.

## 3. Results

Two hundred and twenty seven patients with ACP were identified, 97 of them were operated by laparoscopic approach. There were no differences in mean age, comorbidities, ASA classification and WBC count between groups. Pre-operative CRP was lower in the LA group (Table 1).

There were no differences in the ratio of diffuse peritonitis between groups, being 48 out of 130 for OA (36.9%) versus 46 out of 97 for LA (47.4%,  $p = 0.13$ ). There were 13 conversions in the LA group (13/97; 13.4%) all due to the presence of intra-abdominal adhesions and inflammatory cecum, which did not allow a safe ligation of the appendix base (Table 1).

There were no differences in complications between groups when categorized according to Clavien–Dindo classification. Nevertheless, there was a tendency to lower global SC, lower SSI,

**Table 1**  
Demographic variables and perioperative variables.

Variables	OA (n = 130)	LA (n = 97)	p
Age (median ± SD)	38 ± 17.5	39 ± 17.1	0.91
Male (%)	49 (37.7)	49 (50.5)	0.06
Comorbidities (%)	45 (34.6)	33 (34)	NS
ASA (%)			
I	80 (61.5)	62 (63.9)	0.07
II	37 (28.4)	29 (29.9)	
III	7 (5.4)	0	
IV	0	0	
V	0	0	
WBC (U/dl) (mean ± SD)	15,672 ± 6492	14,736 ± 4737	0.26
CRP (mg/dl) (mean ± SD)	17 ± 13.5	11 ± 10.4	0.002
Diffuse peritonitis (%)	48 (36.9)	46 (47.4)	0.13
Surgical approach			
Complete laparoscopic		84 (86.6)	
Conversion		13 (13.4)	
McBurney	56 (43.1)	4 (4.1)	
Median	70 (53.8)	8 (8.2)	
Other	4 (3.1)	1 (0.4)	

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