

## Laparoscopic versus open approach in acute appendicitis

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### Abstract

Appendicitis is a pathology characterized by the obstruction of the lumen of the vermiform appendix and is considered one of the first causes of acute abdomen that requires emergency surgery to avoid patient mortality, which is why two surgical management alternatives are used: open appendectomy and laparoscopic appendectomy. There are controversies about which is the best approach, but according to various studies it is reported that there is no significant evidence to say which is the best approach, however, it is also established that laparoscopy outperforms the open approach due to its better aesthetic result and less days of hospital stay in the postoperative period, there is less postoperative pain but greater surgical time and probability of residual abscesses in the laparoscopic group, with no difference in mortality in both groups, in addition to this it is reported that in patients approached by laparoscopy presenting a rapid return to daily activities and daily work, presenting a lower frequency of infections at the level of the surgical wound and also a lower rate of postoperative adhesions, with the consequent directly proportional decrease in postoperative complications such as, for example, occlusion by girlfriends and suture dehiscence's.

**Keywords:** Appendectomy; Acute Appendicitis; Laparoscopic; Open Appendectomy

### 1. Introduction

Appendicitis is defined as the inflammation of the vermiform appendix and represents the most common cause of acute abdomen with an emergency surgical indication in the world (1).

We found that this represents the most frequent indication for emergency non-traumatic abdominal surgery in the world; and that in turn is an entity that occurs with greater incidence between the second and third decade of life. The risk of presenting it is 16.33% in men and 16.34% in women. Its annual incidence is 139.54 per 100,000 inhabitants; it is associated with overweight in 18.5% and obesity in 81.5% (2, 3).

It is determined that about 6 to 8% of the population in Western countries will develop acute appendicitis (AA) at some point in their lives. However, the extremes of life are not exempt from this pathology, with a higher rate of complications derived from late diagnosis being observed (4, 5).

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The pathogenesis establishes a central event which is based on the obstruction of the appendicular lumen, secondary to fecaliths, lymphoid hyperplasia, foreign bodies, parasites and primary tumors (carcinoid, adenocarcinoma, Kaposi's sarcoma, lymphoma, etc.) or metastatic (colon and mom); inflammation of the appendicular wall is the initial phenomenon, followed by vascular congestion, ischemia, perforation and, rarely, localized abscesses or generalized peritonitis. During these phenomena, bacterial proliferation occurs, where, in the early course of the disease, aerobic microorganisms appear, and to later have a mixed presentation (aerobic and anaerobic).

Abdominal pain represents the most frequent symptom in the clinical presentation of these patients, although other relevant symptoms have also been described, such as anorexia, nausea, constipation/diarrhea and fever. Taking this into account, the pain is typically located in the periumbilical and epigastric region, and subsequently migrates to the right lower quadrant; however, despite being considered a classic symptom, migratory pain occurs in only 50% to 60% of patients with acute appendicitis. The presentation of nausea and vomiting occurs after the onset of pain, and the fever is usually evident around six hours after the clinical picture; this varies considerably from one person to another, which, in some cases, is directly attributable to the location of the tip of the appendix. For example, an anteriorly located appendix produces marked, localized right lower quadrant pain, whereas a retrocecal appendix may cause dull abdominal and lower back pain. Likewise, due to the irritation produced by the appendix, other symptoms may occur, such as urinary urgency, dysuria, or rectal symptoms such as tenesmus or diarrhea (6).

Current treatment consists of surgical modalities to conservative management. The main management is surgical, ideally using the laparoscopic approach technique; however, the open modality will always be a window of choice when the conditions and means to perform laparoscopic approaches are not available.

Laparoscopic appendectomy (LA) is generally accepted to outperform open surgery (ACA), due to its better aesthetic result and fewer days of hospital stay in the postoperative period. On the other hand, the open approach demonstrates a shorter transoperative time and a lower rate of postoperative complications. There are different studies that confirm the effectiveness and the growing preference for laparoscopic surgery in Western countries.

In 1983, Semm was the first surgeon to perform a laparoscopic appendectomy (LA). Since then, a new minimally invasive approach has emerged for the treatment of acute appendicitis, whose use has gained popularity in recent decades and is performed more and more frequently in various hospitals (7).

Randomized studies have shown some advantages of laparoscopic appendectomy, such as less postoperative pain, smaller incisions, shorter hospital stays and rapid return to daily activities and daily work, present a lower frequency of infections at the of the operative wound and also, a lower rate of postoperative adhesions, with the consequent directly proportional decrease in postoperative complications, such as occlusion by flanges. A better view of the abdominal cavity and intraoperative resolution capacity of other pathologies that are differential diagnoses such as gynecological pathology are also described. Some of these advantages would be even greater in obese patients due to the reduction in parietal morbidity. For some, laparoscopic appendectomy is today the "Gold Standard" or Gold Pattern. This technique requires, for its performance, duly trained personnel, adequate laparoscopic material, and availability of this in the emergency block 24 hours a day. However, it has also been associated with complications such as an increased frequency of residual intra-abdominal abscesses and a high risk of rare but important injuries, such as vascular injuries or intestinal perforations associated with the technique involved. All this has delayed its acceptance by some surgeons and some centers (8,9).

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## 2. Methodology

To carry out this document, a systematic search of original articles, case reports and bibliographic reviews was carried out in the different databases such as pubmed, ScienceDirect Elsevier, Scielo, Ovid, and Medline, from 2010 to 2022, selecting articles related to the laparoscopic vs open approach in acute appendicitis, likewise the MeSH terms and Boolean operators and and or were used, obtaining an approximate result of more than 50 articles related to the subject to be addressed, in English and Spanish, discarding those articles that did not deal directly with the subject and did not provide important information to write the manuscript, finally using 27 articles to write this document.

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## 3. Results

Acute appendicitis is one of the most common surgical emergencies in daily medical practice, so its adequate and effective diagnosis and treatment is essential when we have this pathology; Therefore, for several years, the best management of this has been sought, having mainly two surgical approaches, which are the laparoscopic approach and

the open approach; Different studies have been carried out comparing the effectiveness, complications, in addition to the costs and benefits between these two surgical procedures. In a study conducted at the ABC Medical Center in Mexico City for 23 months, between January 2014 and November 2015, where a total population of 713 patients diagnosed with acute appendicitis was studied; of which 647 underwent laparoscopic appendectomy and 66 open approach appendectomy, which corresponded to 90.74 and 9.26%, respectively, in this study it was found that Of the group of patients treated with laparoscopic surgery (647), 41 (6.34 %) had complicated disease, that is, acute appendicitis phase 4 or 5, with a Mannheim index of 5-38 points. Eight cases (1.24%) presented postoperative complications that were direct and indirect, and one conversion to open surgery. Within the direct ones, with a Mannheim index of 15-23, there were two residual abscesses; The average number of days of hospital stay in the group with uncomplicated disease was 2.03 days (from one to 10 days), and the cost was the equivalent of the baseline by the factor of increase by 2.20 (x 2.20), in the subgroup with complicated disease, the stay was 7.4 days (from five to 15 days) and the cost had an increase factor x 5.91; Regarding the group treated with open surgery (66 patients), six (9.09%) presented complicated disease, with a Mannheim index of 10-26, four (6.06%) had direct postoperative complications, with a Mannheim index of 16-26: three with residual abscess and one with infection and wound dehiscence, all required reoperation, the number of days of hospital stay in the group with uncomplicated disease was 2.42 days (from one to seven days), and the cost of stay on average, equivalent to baseline without increase factor x 1.00; in the subgroup with complicated disease, the stay was 15.5 days (from 12 to 22 days) and the average cost was equivalent to baseline by 7.70 (10,11).

A study carried out in Uruguay where all the patients operated on at the Maciel Hospital who underwent an appendectomy between June 1, 2013 and June 30, 2016, both laparoscopically and laparotomically, were included, and of which A sample of 426 patients was obtained, it was found that 128 patients had edematous appendicitis (30%), 157 phlegmonous appendicitis (36.9%), 76 patients gangrenous appendicitis (17.8%) and abscess or plastron in 37 patients. Drains were left in 32 patients (7.5%) Of these 10 in laparotomic surgery and 22 in laparoscopic surgery. However, 7 of 22 patients with a laparoscopic approach had been converted to open surgery prior to drain placement. Residual abscesses presented clinically with fever and postoperative abdominal pain; there were no statistically significant differences in our series between the laparoscopic or laparotomic approach, and the appearance of residual abscesses; Twenty-four laparoscopic appendectomies were converted, representing a conversion rate of 8.7%. Of these 24, 10 were converted due to infectious causes, 3 had peritonitis, and 7 had localized abscesses. Six of the laparoscopic appendectomies were converted by location (retrocecal, subserosal, subhepatic), four of these were converted for the correct management of the appendicular base, and three of these for perforated gangrenous appendicitis, and one for extracorporeal knot slippage. Two were converted by plastron-adhesions. One required laparotomy due to bleeding due to an incidental mesial injury and one patient had to be converted due to poor tolerance to pneumoperitoneum; Taking the above into account, the authors of this study concluded that residual abscesses are rare, with no statistically significant differences in the frequency of presentation according to the approach, even in the presence of appendiceal abscesses, plastron or appendiceal peritonitis (12).

**Table 1** Post-surgical complications

Post-surgical complications			
Postoperative complication	Group (n = 70) (%)	Group 2 (n = 21) (%)	p
Wound dehiscence	4(5.71)	0(0)	0.538**
Infection of the surgical wound	3(4.28)	2(9.52)	0.434**
Residual abscess	5(7.14)	2(9.52)	0.262**
Bowel obstruction	5(7.14)	0(0)	0.434**
Abdominal sepsis	1(1.42)	0(0)	0.902**

Comparative study of open and laparoscopic approaches for complicated acute appendicitis in pediatric patients.

In a study conducted in Mexico and published in 2018, which included 91 patients who underwent emergency appendectomy, with a diagnosis of complicated acute appendicitis or acute abdomen secondary to appendicitis, and these were divided into two groups according to the surgical approach used; From these, it was obtained that, in terms of surgical time, the mean was 77 minutes for the open approach group and 70 minutes for the laparoscopic approach group. There were no conversions to open surgery in the laparoscopic group; Regarding the postoperative period, in group 1 with the open approach, a percentage of complications of 25.7% (18 patients) was observed, and in group 2 with the laparoscopic approach, the percentage was 19.04% (four patients) [p = 0.426]. Group 1 showed the following complications: Superficial wound dehiscence in four patients, which represented 5.71%, surgical wound infection in

three patients, which corresponded to 4.28%, Residual abscess in five patients (7.14%), appearing on average 14 days after treatment. Postoperative, five patients evolved with intestinal obstruction (7.14%) and finally there was a single case with abdominal sepsis (1.42%). In group 2, 21 patients were studied, in whom the only complications that arose in the intervention were two patients with infection of the surgical wound with an average appearance of five days at the site where the surgical piece was extracted and the Residual abscess occurred in two patients, manifesting 12 days after surgery (13).

#### 4. Discussion

More than 20 years have passed since the introduction of laparoscopic appendectomy by Semm. Different investigations show that it is an effective tool for the definitive treatment of appendicitis, having the ability to reduce the risk of complications and days of hospital stay. However, although we can still find studies and cases that show the minimum difference between both approaches and, in addition, they showed an exponential increase with laparoscopic appendectomy (14).

With the emergence of the laparoscopic approach in the treatment of acute appendicitis, it was suggested that it carries a higher risk of presenting residual abscesses in the evolution. The mechanisms suggested to explain the greater frequency of these abscesses were the dissemination of infected material by the pneumoperitoneum, prolonged intra-abdominal appendicular manipulation, and the postulation of carbon dioxide as a facilitator for the growth of anaerobic organisms. Others maintain that irrigation with saline solution during lavage could play an important role. Ferranti et al (15) compared laparoscopic and open techniques in patients with perforated appendicitis, and observed that the percentage of residual abscesses was 16.6% and 5%, respectively, Pokala et al. also reported an abscess rate of 14% laparoscopically and 0% laparoscopically. However, other authors were unable to reproduce these results and observed no difference in the formation of residual abscesses after both approaches (16).

The costs reported in the LA exceed the ACA with an increase factor of x2.22, which is similar to that published by Chu; this is undoubtedly associated with factors such as the greater use of supplies and longer surgical time (17) However, unlike what is reported in the literature, it was shown that in cases of complicated acute appendicitis (or when presenting some complication), the cost of ACA exceeded that of LA with an increase factor of 7.70 versus 5.91 (18).

A study of the National University of Colombia obtained 1498 patients with perforated acute appendicitis, of which 81.8% received management with SILS (single incision laparoscopic surgery). An average age of 10 years was obtained, the male gender was the most frequent (56.8%), 10% of the patients were overweight and 5.2% had a BMI in the obesity range. The mean time of evolution was 2 days, 36.2% of the patients had diarrhea on admission and 15.5% of the patients had an intraoperative finding of free fecalith in the cavity, these three variables being risk factors for the outcome of postoperative infectious complications. Associated (OR: 1.16, p: 0.00 CI: 1.09 – 1.23, OR: 1.33 p: 0.024 CI: 1.04-1.71 and OR: 1.97 p: 0.000 CI: 1.46 – 2.67 respectively) (24) (25) No associations were found in relation to surgical or pathological history and the outcome of complications. The global incidence of complications was 32.4%, of which 2.5% of the patients presented infection of the superficial operative site (ISO-S), being more frequent in the group of patients managed with the SILS technique (2.3%). Additionally, 14.5% of the patients presented infection of the operative site organ space (ISO-OE), more frequently in patients managed with the SILS technique (11.9%), and in the same distribution, there was an incidence of intestinal obstruction (OI) postoperative, requiring reintervention (4.34% SILS 4.9%). A lower incidence of reintervention for OI was found in patients with the conventional technique, with a statistically significant difference (p: <0.013), however, no statistically significant associations were found between the SILS technique and the increased risk of reintervention compared to SILS. The other study variables. On the other hand, an increased risk of reintervention due to OI-POP was evidenced with the increase in the mean evolution time of the patients (>2 days) (OR: 1.13, p: 0.023, CI: 1.02 – 1.26) and the intraoperative finding of free fecalith in the cavity (OR: 2.34, p: 0.020, CI: 1.15 – 4.8) (19).

In 2015, Jaschinski<sup>11</sup> concluded that there is less postoperative pain and hospital stay, but greater surgical time and probability of residual abscesses in their laparoscopic group, with no difference in mortality. In 2017, Dai<sup>12</sup>, in a meta-analysis that included the adult and pediatric population, found a lower incidence of general morbidity, hospital stay and time to return to normal activities in patients operated on by laparoscopy, although it also observed a longer surgical time compared to our results in which there was no statistically significant difference in surgical time between the two groups (20,21).

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## 5. Conclusion

Acute appendicitis is a condition that requires urgent surgery to prevent the death of the patient, so two surgical treatments are used: open appendectomy and laparoscopic appendectomy. Various studies have shown that laparoscopy presents better results than open appendectomy, due to the fact that it has better aesthetics, shorter postoperative hospital stay, less postoperative pain, quick return to work activities, daily routines, and it was shown that patients treated with laparoscopy showed a lower frequency of infections at the level of the surgical wound and due to the size of the surgical wound the incidence of postoperative adhesions is reduced, therefore, a direct reduction in the incidence of postoperative complications, however this alternative has a longer operative time and greater probability of residual abscesses. In addition, there are no reports that show that there is higher mortality in either of the two groups and it should be noted that the alternative approach may depend on the audacity of the treating surgeon and the technique that he frequently uses.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

The authors declare no conflicts of interest

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