

Single-incision laparoscopic appendectomy versus conventional laparoscopy in adults. A systematic review¹

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ABSTRACT

PURPOSE: To determine the best treatment option for not complicated acute appendicitis (AA) in adult patients, between single incision laparoscopy (SIL) and conventional laparoscopy (CL), measured by morbidity associated with disease.

METHODS: Systematic review. Articles of adults diagnosed with AA treated by SIL or CL were analyzed. Databases included: MEDLINE, LILACS, IBECS, Web of Science, Scopus and Cochrane, using MeSH terms and free words. The studies were analyzed using the MINCIR methodology. Variables included: conversion rate, morbidity, hospital stay, surgery duration, and methodological quality (MQ) of primary studies. Averages, medians and weighted averages were calculated.

RESULTS: Thirteen articles were analyzed. For SIL and CL the conversion rate were 3.4% and 0.7 %, the morbidity were 8% and 6.5%, the hospital stay were 2.5 and 2.8 days, the surgery duration were 53.4 and 53.8 minutes, and the MQ were 14.3±6.6 and 16.0±6.9 points, respectively.

CONCLUSION: With the exception of the conversion rate, there are no differences between single incision laparoscopy and conventional laparoscopy for the treatment of acute appendicitis in adults.

Key words: Appendicitis. Appendectomy. Laparoscopy. Postoperative Complications. Review.

Introduction

Acute appendicitis (AA) is one of the clinical presentation of acute surgical abdomen most frequently consulted^{1,2}, and corresponds to the condition that goes from appendix inflammation to the cecal appendix perforation. It's treatment consists of the extirpation of the organ itself³.

During many years the treatment was carried out by open appendectomy, but this changed with the advent of the first laparoscopic appendectomy carried out by Semm in 1983⁴⁻⁶. Since then, such procedure would become the treatment of choice for this pathology^{7,8} because the granted benefits, such as shorter hospital stays, faster recovery and less morbidity and post-surgical pain compared to the traditional open surgery⁹⁻¹².

At present, the surgery has evolved towards less invasive techniques, and laparoscopy has not been the exception. Indeed, nowadays the efforts are aimed to reduce the trauma caused by the procedure and to improve the esthetic results on patients¹³. Innovative methods such as NOTES (Natural Orifice Transluminal Endoscopic Surgery) and single incision laparoscopy (SIL) have demonstrated promissory results in various surgical procedures, appendectomy among them^{7,14-16}. There are many articles that report the experience with laparoscopic appendectomy by SIL, the majority of which are series and case reports.

In the last years several systematic reviews (SR) that compares SIL and conventional laparoscopy (CL) have been published⁶. However, all published SR are focused on pediatric or general population and there are no SR comparing both techniques only in adult population. While children and adults share the physiopathology of acute appendicitis, it's clear that have differences arise principally for being completely different terrain. Considering the differences between pediatric and adult in several aspects of AA there is a necessity to analyze the published data in adult patients¹⁷.

The aim of this study is to determine the best treatment option for not complicated AA, in adults patients, between SIL and CL, measured by morbidity associated with disease.

Methods

Target population

Articles on which the population of study was constituted by patients diagnosed with not complicated AA and that have undergone surgery by SIL or CL, published between 2003 and 2013 (both years included).

Eligibility criteria

Inclusion criteria: Clinical research in patients over 18 years of age, without gender restriction, in Spanish or English language. Due to the scarce number of clinical trials (CT), all types of research designs were considered (case series, transversal cohort studies, historic cohorts, concurrent cohort, CT with random assignment, with or without masking and Multicenter CT).

Exclusion criteria: Studies that considered patients with appendix or cecum cancer, pregnant and with diffuse peritonitis, were excluded. Not available full-text articles, editorials, review articles, letters to the Editor, clinical guidelines, SR, *in vitro* studies, case reports and case series with less than 20 patients and articles with contaminated sample by any patient that presented any exclusion criteria mentioned above were excluded.

Source databases

MEDLINE, LILACS, IBECS, Web of Science (WoS), Cochrane Database of Controlled Trials and SCOPUS, between January 2003 and September 2013.

Search strategy

The sensible search was carried out using MeSH terms, free words and word truncation. Latter, a specific search was conducted adding boolean operators (OR/AND) and limits (articles published during the last 10 years on humans, in English or Spanish language, on men and women over 18 years of age). The search algorithm used on the MEDLINE database was: ("Appendicitis" [MeSH] OR Append*) AND (Single) AND ("Appendectomy" [MeSH] OR "Laparoscopy" [MeSH] OR Laparoscop*) AND ("Morbidity" [MeSH] OR "Postoperative Complications" [MeSH]). The search was adapted to each one of the remaining databases according to their respective search language.

Study selection

The articles found, were analyzed by two independent investigators (JM y RC-V), who looked for exclusion criteria on three stages: the first on the title, the second on the abstract and the third on the full-text.

Data extraction

From each article, manually by the two investigators mentioned before, for which an *ad hoc* spreadsheet was design on Microsoft Excel 2007 (Microsoft Corp, Redmond, USA).

Variables

Number of patients treated, rate of conversion, morbidity and mortality associated with the procedure, hospital stay, surgery duration and score of methodological quality (MQ) of the primary studies.

Methodology quality analysis

Through the application of the MINCIR therapy scale, which has been recently validated^{18,19} and used to perform SR with an alternative approach^{20,21} similar to El Dib work proposal²². Methodological quality (MQ) analysis was performed by two independent investigators (JM and RC-V). Calibration for its implementation took place following the instructions for the use of the MINCIR scale²³. Discrepancies were solved by consensus.

Definitions

SIL was defined as laparoscopic appendectomy carried out by a single incision. Includes appendectomies performed with multiport devices and two or three individual ports by a single incision.

Statistical analysis

Includes averages, medians, extreme values and weighted averages (WA) (Figure 1).

$$PP = \frac{\sum Xi * ei}{\sum ei}$$

FIGURE 1 - Calculation of weighted averages.

Calculation of weighted averages. Xi corresponds to the value of the variable in the study i, ei corresponds to the MQ score obtained by the study i, while Σei corresponds to the sum of MQ score of all studies for that variable

Results

336 articles were identified (82 in MEDLINE, 5 in LILACS, 8 in IBECs, 17 in WoS, 16 in the Cochrane Database of Trials and 208 in SCOPUS). Of these, 13 articles met the selection criteria, so were included and analyzed. The flow diagram of the articles according to PRISMA²⁴ is shown in Figure 2.

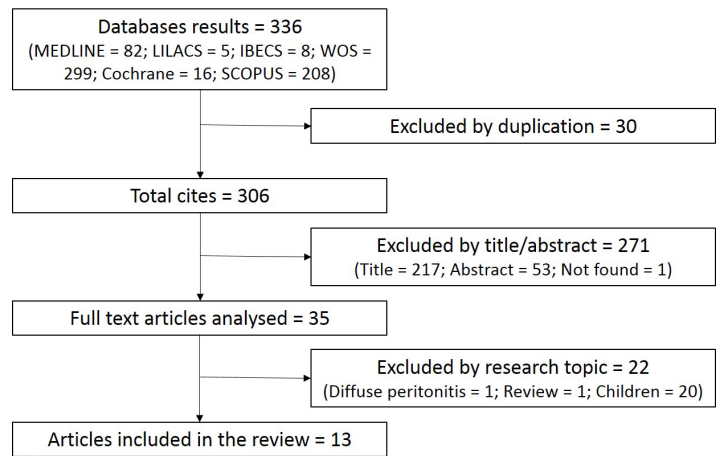


FIGURE 2 - Selection flowchart of articles by PRISMA.

Selected studies correspond to 1 multicenter clinical trial (CT), 4 CT of low quality, 2 cohorts of low quality and 6 case series (3 prospective and 3 retrospective), so it was decided to work with series of patients. In this way, studies that carried out comparisons between 2 groups provided with two series of patients. In total, 13 selected studies contributed with 22 series of patients: 4 articles (30.8%) constituted series of patients treated by SIL^{3,16,25,26} and 9 articles (69.2%) are comparative studies between the 2 techniques^{5,7,8,13,14,15,27,28,29}.

In total, 816 patients were included: 460 for SIL and 356 for CL.

Table 1 shows the number of series, the number of patients treated and demographic characteristics of each of the studies.

TABLE 1 - Methodology quality, series and demographic characteristics of studies.

Study	MINCIR Score	N Series	N patients		Age		Gender (M:W)	
			SIL	CL	SIL	CL	SIL	CL
Sozutek 2013	21	2	25	25	30.6	30	12:13	7:18
Teoh 2012	33	2	98	97	39.2	40.7	58:40	59:38
Raakow 2011	12	2	20	20	27.8	31.8	8:12	10:10
Teoh 2011	13	2	30	60	33	34.9	19:11	38:22
Vidal 2011	9	1	20	-	30	-	12:8	-
Cho 2011	11	2	23	20	44.7	39.2	14:9	11:9
Lee 2010	11	2	35	37	29.6	22.3	19:12	11:21
Vidal 2010	15	2	15	15	30	36	10:5	9:6
Vidal 2010	11	1	52	-	30	-	32:20	-
Park 2012	17	2	42	62	29.9	23.9	14:28	41:21
Feinberg 2011	8	1	25	-	41	-	18:7	-
Chouillard 2010	10	1	55	-	28	-	19:36	-
Park 2010	15	2	20	20	25	27.2	9:11	8:12
Total		22	460	356	32.2	31.7	244:212	194:157

The conversion rate was higher for SIL, which exceeds nearly by 3 percentage points to the CL. With respect to the morbidity associated with the procedure, its weighted average was slightly higher for SIL than CL (8% vs. 6.5%), unlike in mortality which was not reported (no deceases) in any of the studies.

Regarding surgery duration and hospital stay, no significant differences between the two techniques were verified.

Table 2 describes the conversion rate, morbidity associated with the procedure, hospital stay and surgery duration according to type of therapy.

TABLE 2 - Conversion rate weighted average, morbidity associated to the procedure, hospital stay and surgery duration according to the therapy group.

Therapy	Conversion (%)	Morbidity (%)	Hospital stay (days)	Surgery duration (minutes)
SIL	3.4	8	2.5	53.4
CL	0.7	6.5	2.8	53.8

Applying the MINCIR scale for rating MQ, was verified that the average score of SIL and CL articles were 14, 3±6, 6 (8 and 33) and 16, 4±6, 9 (11 and 33) points, respectively.

Discussion

With the passing of years, the surgery has evolved from open surgery to less invasive techniques. One of the landmarks of

this evolution was the development of laparoscopic procedures, which would become the standard of reference for multiple procedures^{7,14-16}. This development has generated various benefits for patients, fact that is observed as evidence during post-surgery²⁰. Laparoscopic surgery has also been subject of evolution: currently, laparoscopic surgery has been developed by a single incision, presenting esthetic unquestionably superior results compared to the conventional laparoscopy. However, there are few studies comparing both techniques in relation with other parameters, such as surgery duration, morbidity associated with the procedure, hospitalization duration, etc. In addition, the existing ones correspond, mostly, to comparative series of retrospective character, in which both pediatric and adult patients are reported. In relation to the above, there is a SR protocol developed by the Cochrane Collaboration, which attempts to compare both techniques in adults, protocol that has been unable to be performed due to the limited availability of CT in this group of patients³⁰. This exemplifies the need for evidence of prospective character about this techniques specifically CT of good MQ that support changes on clinical behavior for patients³¹.

As mentioned above, in the absence of sufficient CT to answer the research question, decides to perform this SR using an alternative methodology to the meta-analysis, which uses the weighted average based on the MQ of each of the articles. This allows, following strict selection criteria, to work with different types of research designs, statistically weighted¹⁸.

It is important to note that there is considerable heterogeneity in the articles included in this SR in relation to techniques applied for SIL. This is due to these techniques include the insertion of 3-port devices with a single incision in the fascia and the insertion of independent ports in multiple fascia incisions; in turn, this last ones can count with 2 or 3 trocars.

The conversion rate was found to be higher for SIL, with a difference of nearly 3 percentage points above the CL, probably because surgeons who performed the procedures are still on the stage of training or on the ascending part of the learning curve of the technique. The above has been source of controversy among surgeons, since many argue that the SIL transgresses the principles of laparoscopic surgery by not counting with triangulation, among other features³².

No significant differences with regard to morbidity and mortality associated with the procedure, hospital stay and surgery duration between both techniques were observed. This suggests that in relation to this variable, SIL would be equivalent to CL for the treatment of acute appendicitis in patients over 18 years of age.

However, it must be taken into account that the studies used to carried out the present SR are heterogeneous with its MQ, point that must be considered when interpreting the results.

Currently there is little evidence on the safety and effectiveness in relation to the appendectomy by SIL in specific groups, like for example, patients with large number of comorbidities, elderly, obese, complicated acute appendicitis, etc., that could open new and interesting lines of research in the future. Another matter of potential interest are late complications, such as incisional hernias that could be increased by the use of multiport devices that require larger fascia incisions than the traditional trocars. Despite the limitations of the study, we hope to contribute to the choice of a particular therapy for the treatment of not complicated AA based on the available evidence.

In conclusion, the findings of this study allows to indicate that the appendectomy by SIL is comparable to the CL in the treatment of the not complicated AA in adult patients over 18 years of age, in terms of morbidity and mortality associated with the procedure, hospital stay and surgery duration. However, and as mentioned before, further comparative studies (ideally CT of good MQ) are necessary to be able to respond in a satisfactory way to the uncertainty that originated this SR.

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