

Laparoscopic versus open appendectomy in men: a prospective randomized trial

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Received: 8 February 2010 / Accepted: 18 May 2010 / Published online: 15 June 2010
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Abstract

Background The role of laparoscopic treatment in acute appendicitis still is unclear. Although some evidence in the literature suggests diagnostic benefits from laparoscopy for young women with suspected acute appendicitis, there is scepticism about the utility of this approach for men. This study aimed to compare open and laparoscopic appendectomy performed for men with suspected acute appendicitis. **Methods** All male patients older than 15 years with an American Society of Anesthesiology (ASA) classification of 3 or less, no previous abdominal surgery, and no contraindication for pneumoperitoneum were prospectively randomized to undergo either open appendectomy (OA) or laparoscopic appendectomy (LA). The primary end point was a detected difference in postoperative hospital length of stay, and the secondary end points were detected differences in postoperative analgesia, morbidity, and length of the recovery period.

Results In this study, 147 men with suspected acute appendicitis were randomized to either OA ($n = 75$) or LA ($n = 72$). It took longer to perform LA (60 min; range, 20–120 min vs. 45 min; range, 20–90 min; $p = 0.0027$), and LA did not result in any significant difference for the parameters evaluated.

Conclusion The postoperative length of hospital stay did not differ significantly between OA and LA for men. Laparoscopic appendectomy required more time and did not offer any advantages compared with OA.

Keywords Appendectomy · Laparoscopic · Men · Open

Acute appendicitis probably is the most common intraabdominal surgical disease requiring emergency surgery, with a lifetime risk of 6% [1]. Open appendectomy (OA) using a small incision in the right iliac fossa has been the gold standard of treatment associated with low mortality and morbidity rates, minimal pain, short hospital stay, and smooth recovery [2–5]. In other words, it has most of the advantages of minimally invasive surgery. Any additional potential benefits resulting from the laparoscopic approach, at the same cost, would be really difficult to prove. Virtually, this is the main reason why laparoscopic appendectomy (LA) has always been a doubtful paradigm and a debatable way of managing acute appendicitis among surgeons in their daily practice.

Several prospective randomized trials comparing OA and LA have been published during the past two decades with conflicting results [2, 3, 6–14]. Even data from the relevant metaanalyses performed remain inconclusive [4, 5, 15]. The vast majority of these trials include a mixed male and female population.

In a previous study [16] we described the differences between the female and male populations with suspected acute appendicitis, emphasising the diagnostic advantage that laparoscopy offers young female patients, among whom a high incidence of wrong diagnosis is well described in the literature [17–19]. In contrast, laparoscopy as a diagnostic tool for men with suspected acute appendicitis does not appear to have any role to play, thus making the value of laparoscopy even more questionable for that group of patients.

Taking all this information into account, we applied different management protocols in the female and male

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populations with suspected acute appendicitis, as previously described [16]. We elected the laparoscopic approach for all young fertile women and randomized open and laparoscopic approaches for the men. This report focuses on the results of the men's management protocol.

Materials and methods

Since September 2002, all male patients older than 15 years with suspected acute appendicitis have been eligible to enter the study protocol. An informed consent was obtained from all patients before participation, and the trial was approved by the institution ethics committee.

The exclusion criteria ruled out patients with an American Society of Anesthesiology (ASA) classification higher than 3, previous lower abdominal surgery, and contraindication to pneumoperitoneum. The provisional diagnosis of acute appendicitis was made on clinical grounds based on symptoms suggestive of appendicitis in combination with pyrexia, positive McBurney's sign, and leucocytosis. Abdominal imaging with either ultrasonography or computed tomography (CT) scan were selectively—and rather exceptionally—performed at the discretion of the surgeon, primarily in equivocal cases (i.e., atypical presentation, older patients). Patients were randomized to undergo either OA or LA using the previously described technique [16].

All the procedures were performed or supervised by a consultant surgeon experienced in both open and laparoscopic surgery. Randomization was created by a computer-generated list in blocks of 20 patients. Numbered and sealed envelopes were placed in the operating room and opened only at patients' arrival, so that both the patient and the involved physicians were unaware of the randomization arm beforehand. With the assumption of a 15% difference in length of hospital stay for the two groups, a minimum sample size of 72 patients per randomization arm was estimated to obtain a power of 80% in detecting this difference at the 5% level.

The patients in the two groups were managed by the same principles. They were given standard perioperative management including gastric protection (omeprazole 40 mg administered intravenously [IV] once daily), deep vein thrombosis (DVT) prophylaxis (enoxaparin 2,000 IU administered subcutaneously once daily), and antibiotic therapy (cefuroxim 750 mg and metronidazole 500 mg IV every 8 h) for at least 24 h. However, the type and duration of antibiotics were directed by the clinical course of the individual patient.

Postoperative analgesia was given on demand, starting with nonsteroid antiinflammatory agents and moving to opioids as required. Patients were mobilized and fed as

early as possible and discharged as soon as oral feedings were resumed provided they were mobilized, had a temperature lower than 37.5°C, and had experienced no complication. They were followed up as outpatients 7 to 10 days and 1 month postoperatively either at the outpatient clinic or by telephone interview. The parameters evaluated were the duration of the postoperative hospital stay (primary end point), the needs for analgesia postoperatively, the 30-day morbidity, and the time until resumption of normal activities, calculated from the day of discharge (secondary end points).

An intention-to-treat statistical analysis was performed using the Arcus QuickStat Biomedical statistical package (Research Solutions, Cambridge, UK). The median values for continuous variables are presented with ranges in parentheses. Fisher's exact test and the Mann–Whitney *U* test were used as appropriate to compare the groups with each other. Differences were considered significant at a *p* value less than 0.05 (two-tailed test).

Results

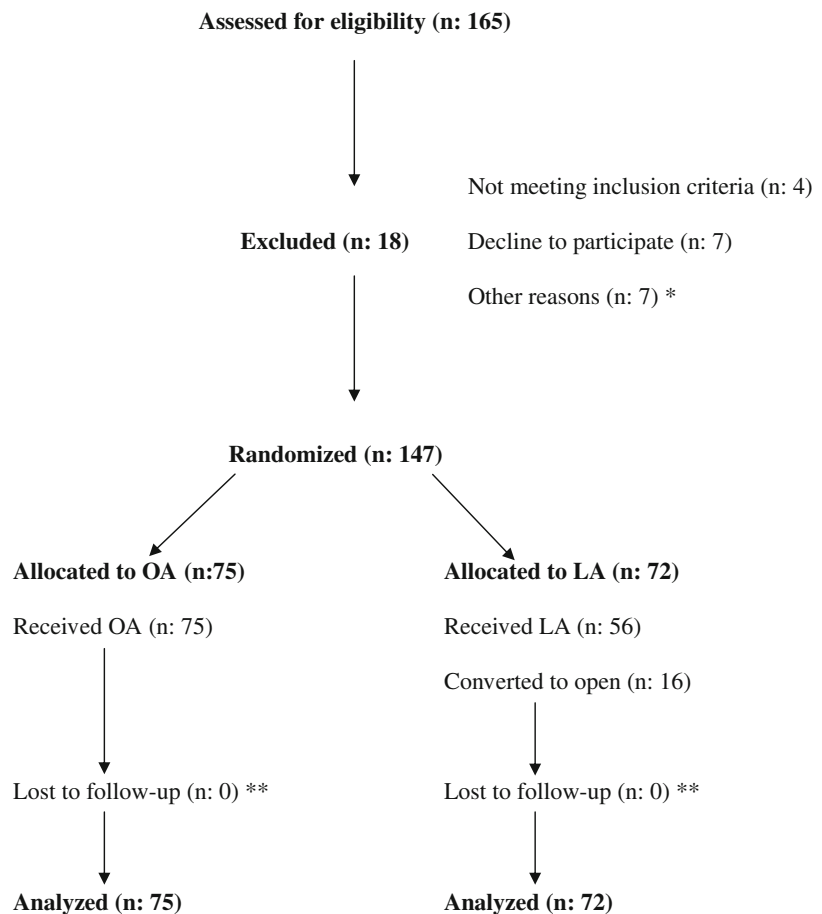
Between September 2002 and September 2008, 147 male patients were randomized to either OA (*n* = 75) or LA (*n* = 72) (Fig. 1). No statistically significant differences were noted between the two groups in terms of demographics, as shown in Table 1. Preoperative imaging was used for seven patients (9.3%) subsequently randomized to the open group and five patients (7%) subsequently randomized to the laparoscopic group. The severity of inflammation, as depicted by the incidence of gangrenous appendicitis, also did not differ significantly between the two groups (Table 1).

Conversion to OA was performed for 16 patients (22.2%) initially randomized to have LA. The reason for this conversion was a wrong diagnosis in 2 cases (small bowel perforation induced by a foreign body and omental necrosis, respectively), bleeding in 1 case, and inability to identify or dissect the appendix with safety in the

Table 1 Demographics and clinicopathologic characteristics of patients with suspected appendicitis randomized to have open or laparoscopic treatment (*n* = 147)

	Open (<i>n</i> = 75)	Laparoscopic (<i>n</i> = 72)
Age: years (range)	22 (14–65)	26 (15–68)
BMI (range)	24 (18–36)	26 (18–35)
ASA 1/2/3	65/8/2	64/7/1
Gangrenous	19	21
Wrong diagnosis: <i>n</i> (%)	2 (2.7)	2 (2.8)
Conversions: <i>n</i> (%)	0	16 (22.2)

BMI body mass index, *ASA* American Society of Anesthesiology

Fig. 1 Consort flow diagram

* in 4 patients a diagnosis other than appendicitis was confirmed preoperatively by imaging, while 3 other patients were not randomized as the Surgeon-on-call decided arbitrarily to proceed to his preferred approach without randomization

** follow-up either as outpatients or by telephone interview, as described in Methods.

remaining 13 cases, most of which presented with severe inflammation or an inflammatory mass (the so-called “plastron”).

From the parameters evaluated for differences between the two groups using intention-to-treat analysis, only the duration of the surgical procedure differed significantly in favor of the OA group (Table 2). Especially concerning the primary end point, there was no statistically significant difference in postoperative hospital stay between OA and LA. The incidence of wrong diagnosis also did not differ significantly between OA (2.7%) and LA (2.8%).

No mortality occurred in this study, and the overall 30-day morbidity rate was 7.48%, equally divided between the two arms. Notably, most of the complications in the laparoscopic group occurred in cases that required conversion to open procedure, sometimes through a midline laparotomy. The complications are presented in Table 3. Wound

infections were treated with wound opening, drainage, and dressing. The patient with persistent postoperative ileus after conversion of laparoscopy to a midline laparotomy was settled conservatively. One patient in the LA group for whom the procedure was converted again to a rather extended McBurney’s incision experienced an enterocutaneous fistula at the drain site, presumably from a friable cecal wall at the appendiceal base. This complication also was managed conservatively. Two patients with small symptomatic (pyrexial) pelvic collections after LA settled on antibiotics, and no further treatment (by any means of drainage) was required.

When per protocol analysis was considered (Table 4), by exclusion of the converted cases from the laparoscopic group, again, no statistically significant differences were found in any of the end points evaluated, either primary or secondary, between the open and laparoscopic groups. The

Table 2 Comparison of primary and secondary end points between the two groups: intention-to-treat analysis

	Open (<i>n</i> = 75)	Laparoscopic (<i>n</i> = 72)
Procedure duration: min (range)	45 (20–90)	60 (20–120)*
NSAID needs: doses (range)	1.5 (0–8)	1.5 (0–6)
Opioid needs: doses (range)	0.5 (0–14)	0.5 (0–9)
Postop hospital stay: days (range)	2 (1–7)	2 (1–12)
Return to normal activities: days (range)	7 (3–15)	6 (2–15)
Mortality	0	0
Morbidity: <i>n</i> (%)	5 (6.6)	6 (8.3)

NSAID nonsteroidal antiinflammatory drug, *Postop* postoperative

* $p = 0.0027$, Mann–Whitney *U* test

Table 3 Postoperative complications

	Open (<i>n</i> = 75)	Laparoscopic (<i>n</i> = 72)
Wound infection	4	2 ^a
Enterocutaneous fistula		1 ^a
Urinary retention	1	
Postoperative ileus		1 ^a
Pelvic collections		2

^a Laparoscopic cases converted to open procedures

only change noted by per protocol analysis compared with intention-to-treat analysis was the absence of any statistically significant difference in operative times between the two groups.

Discussion

Existing data in the literature are weak to support the superiority of laparoscopic management of acute appendicitis over the classic OA. One reason for the conflicting results of the published randomized trials may be that most trials include both male and female patients. As we and others have previously shown [16–19], men and women with suspected acute appendicitis differ in certain ways. Women benefit from the diagnostic properties of the laparoscopic approach because the incidence of wrong diagnosis and subsequently the rate of unnecessary appendectomies are high among young fertile women,

whereas the same is not implied for the male population. Therefore, clinicians have more scepticism about using laparoscopic management for acute appendicitis in men.

To our knowledge, three other randomized trials in the literature have focused on this issue [2, 3, 20]. However, these were small trials (the largest included a total of 100 patients), and their results also were contradictory. The first trial showed a shorter hospital stay and a faster recovery for the laparoscopic group, whereas the other two trials failed to demonstrate any advantage for the laparoscopic approach, which in turn took longer to perform at a higher overall cost.

Our trial, the largest relevant trial in the literature, also failed to demonstrate any benefit from the laparoscopic approach for men. In contrast, LA took longer to perform. The operative time is reported by several authors to be longer in the laparoscopic group [2, 3, 20–22], and this actually was the only statistically significant difference in the current trial, in the intention-to-treat analysis. Although the learning curve generally is thought to be responsible for that, we believe this does not apply to our study because all the participating surgeons had sufficient experience with laparoscopic procedures, and no trend toward reducing operative time throughout the period of the trial was recorded.

An alternative explanation for the longer duration of surgery in the laparoscopic group could be the relatively high number of converted cases. This actually was shown by per protocol analysis, in which no statistically

Table 4 Comparison of primary and secondary end points between the two groups: per protocol analysis

	Open (<i>n</i> = 75)	Laparoscopic (<i>n</i> = 56)
Procedure duration: min (range)	45 (20–90)	52 (20–90)
NSAID needs: doses (range)	1.5 (0–8)	1.5 (0–6)
Opioid needs: doses (range)	0.5 (0–14)	0.5 (0–6)
Postop hospital stay: days (range)	2 (1–7)	2 (1–6)
Return to normal activities: days (range)	7 (3–15)	6 (2–15)
Mortality	0	0
Morbidity: <i>n</i> (%)	5 (6.6)	2 (3.6)

significant difference in operative time was observed between the open and laparoscopic groups after exclusion of the converted cases. Indeed, the conversion rate in this study was higher than previously reported (12–15%) [3, 20]. This probably is related to the severity of the inflammation, as indicated by a 30% incidence of gangrenous appendicitis and the resulting technical difficulties, rather than to the surgeon's experience.

The same group of surgeons achieved a significantly lower conversion rate (5.5%) in the young female population with suspected appendicitis [16]. In fact, the procedure for almost one in five male patients in the laparoscopic arm of the current trial underwent conversion to open procedure, some with a lower midline incision. These cases also may account for the longer postoperative recovery period than expected, theoretically at least, for a laparoscopic procedure, although this was not demonstrated by per protocol analysis.

Interestingly, and in addition to the previous discussion on the morbidity among the converted cases, the morbidity in the laparoscopic arm of this trial was related primarily to the converted appendectomy, although per protocol analysis failed to demonstrate a significantly lower morbidity in the laparoscopic group after exclusion of conversions from analysis. However, four of the six complications in the laparoscopic group were recorded in the converted LAs. It might be assumed that laparoscopic completion of these cases could have resulted in a lower complication rate. We must accept, however, that conversions generally are related to difficult cases [23] and, as such, are prone to complications.

It has been suggested that one disadvantage of LA is the higher incidence of intraabdominal abscess compared with OA [15]. However, in a recent international retrospective review of 1,017 patients with complicated appendicitis (perforated or gangrenous) between eight centers in six countries, the incidence of intraabdominal abscess after LA was only 2.8% [24]. This rate compares favorably with the incidence after OA reported in the literature and is of more importance considering that it refers to a subgroup of patients with complicated appendicitis in which morbidity generally is expected to be higher.

In the current trial, we had two cases (2.7%) with small symptomatic pelvic collections. However, this was not a problem because both patients were settled conservatively with antibiotics.

Although cost was not evaluated in this trial, the failure of the laparoscopic approach to reduce hospital stay and recovery is expected to result in higher overall cost, considering the cost of the procedure and the disposables used.

In conclusion, LA for men takes longer to perform without any advantages compared with OA. However, because LA is not worse, the decision as to which approach

is justifiable seems left to the surgeon's discretion, recognizing the potentially higher cost of laparoscopy.

Disclosures George Tzovaras, Ioannis Baloyiannis, Vassilios Kouritas, Dimitris Symeonidis, Michael Spyridakis, Antigoni Poultsidi, Konstantinos Tepetes, and Dimitris Zacharoulis have no conflicts of interest or financial ties to disclose.

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