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Original Research Article

Laparoscopic Versus Open Appendicectomy: A Clinical Observation

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ABSTRACT

Background: Acute appendicitis is a common indication for abdominal surgery with a life time incidence between 7-9% and appendicectomy is one of the most common surgical procedures. Open appendicectomy (OA) performed through the right lower quadrant incision was first described in 1894. It has become the standard treatment of choice for acute appendicitis, remaining mainly unchanged for 100 years due to its favorable efficacy and safety. Laparoscopic appendicectomy (LA), first performed by Semm in 1983, has gradually gained acceptance. However, there remains a continuining controversy in the literature regarding the most appropriate method of removing the inflamed appendix.

Methods: In a hospital based single center observation on laparoscopic versus open appendicectomy, 224 out of 355 consecutive patients consented to participate. 132 patients were allocated for open procedure and remaining 92 patients under went laparoscopic procedure.18 patients out of 92 needed to be converted to open appendicectomy.131 patients did not participated. Length of stay in hospital was the primary consideration, while operating time, postoperative morbidity, duration of convalescence and cosmesis were secondary consideration.

Results: Intention-to-treat analysis revealed an equally short hospital stay in the two groups (average median 2 days though most patients could discharge after 1 day in laparoscopic group). The median time to return to normal activity (7 versus 10 days) and work (10 *versus* 16 days) was significantly shorter following laparoscopy. Laparoscopy was associated with fewer wound infections and improved cosmesis but the operating time was longer (60 versus 40min). Laparoscopy was associated with more intraperitoneal abscesses (5 *versus* 1 per cent) but, adjusted for a greater number of gangrenous or perforated appendices in this group, the difference failed to reach statistical significance.

Conclusion: Though hospital stay was equally short in open and laparoscopic most patients could go home on 2nd post-operative day after laparoscopic appendicectomy. Laparoscopic appendicectomy was associated with fewer wound infections, faster recovery, earlier return to work, less post operative pain and improved cosmesis though slight and negligible higher intra-abdominal abscess.

Keywords: Laparoscopic appendicectomy; Cosmesis; Converted.

INTRODUCTION

Although laparoscopic surgery has been available for a long time and laparoscopic cholecystectomy has been performed universally, it is still not clear whether open appendicectomy (OP) or laparoscopic appendicectomy (LA) is the most appropriate surgical approach to acute appendicitis.

Laparoscopic appendicectomy has been shown to be both feasible and safe in randomized comparisons with open appendicectomy. In addition to improved diagnostic accuracy, laparoscopic

appendicectomy confers advantages to the patient in terms of fewer wound infections, [1-4] less pain, [5-9] faster recovery and earlier return to work. [9,10-13] However, In comparison to open procedure laparoscopic appendicectomy is more time consuming [9,11,12,14-16] and is associated with increased hospital costs. [13] It has been argued that the advantages of laparoscopic appendicectomy achieved by experienced laparoscopic surgeons are marginal compared with open appendicectomy, which can also be performed by surgeons in training through a short, cosmetically acceptable incision with minimal complications and a short hospital stay. Even than it may that the widespread use of LA is due to its better therapeutic effect.

Following a calculation of sample size based on the results of a pilot study, a prospective single center hospital based trial was undertaken to compare the outcome of laparoscopic appendicectomy with that of open appendicectomy performed out of hours by surgeons of comparable experience (trainees and senior registrars on duty). This was based on the hypothesis that laparoscopic appendicectomy would prove superior to open appendicectomy in terms of hospital stay (primary endpoint), with operating time, postoperative morbidity, cosmesis and time to resume normal activity and work as secondary endpoints.

MATERIALS AND METHODS

Over 25 months, 355 consecutive patients with a clinical diagnosis of acute appendicitis, in the absence of contra-indications to creation of a carbon dioxide pneumoperitoneum, were included in the study. One hundred and thirty one patients were not randomized (Table 1) and underwent a conventional open appendicect-omy, but were included in the analysis.

Two hundred and twenty four patients consented to go for study (Table 2). Patients were stratified by age and sex into eight groups: 2-14, 15-44, 45-64 and 65 or more years for each department. Despite study there were significantly fewer patients with gangrenous or perforated appendicitis desired to open surgery than to laparoscopy or non-consented for study (Table2). Histological examination was performed on all removed appendices.

Open appendicectomy was performed through a horizontal muscle-splitting incision or Mc Burney's incision in the right iliac fossa. Non-inflamed appendices if encountered were removed in.

Table 1- Reasons for non-randomization (not given consent for lap) in 131 patients:

	No. of patients
Lack of consent	92
Non-adherence to the protocol Suspicion of peritonitis for reasons other than	4
appendicitis	12
Previous abdominal surgery	4
Inability to understand information*	8
Exclusion after entry	2
Medically unfit for pneumoperitoneum	7
Equipment/surgeon not available	1
Unknown	1

For laparoscopic appendicectomy, pneumoperitoneum to a pressure of 10-12 mmHg carbon dioxide was obtained with a Veress needle through an incision in or at the umbilicus. Infraumbilical a 10-mm laparoscope (30 degree) was introduced and a 5-mm instrumental port was guided visually through the right iliac fossa just below the point of base of appendix. If laparoscopy revealed acute appendicitis, a second 10-mm instrumental port was sited in the suprapubic region. This port was used as camera port in subsequent dissection. The appendicular artery was dissected and divided by harmonic or bipolar instruments. The appendix was secured at the base with three pre-tied endoloop (2-0 chromic catgut) ligatures from proximal to distal in such a way that distance of Ist two proximal is about 5 mm and distance between 3rd distal most and middle one is about 1 cm and divided between the two distal ligatures, and removed through the 10mm port.Fig1, 2 The base of the appendix was not invaginated. Laparoscopy was converted to open appendicectomy if technical difficulties, uncertain anatomy or bleeding were encountered.

In both groups broad spectrum antibiotics were administered according to departmental protocols. As in comparable trials, the operating time was recorded as the time from the first incision to the placement of the last suture in the skin. The length of hospital stay was recorded as number of days in hospital after the day of surgery.

Table 2- Profile of 355 consecutive patients with acute appendicitis:

	Participated		Not participated
	Open appendicectomy	Laparoscopic appendicectomy	
	(*n* = 132)	(n = 92)	(*n* = 131)
Age (years)	15-45	15-40	15-49
Sex ratio (M : F)	52 : 80	39 : 53	53 : 78
Weight (kg)	54-80	56-80	57-80
Pathology of appendix!			
Pathologic(probe tender +)	3	9	11
Phlegmonous	91	61	97
Gangrenous/perforated	14	20	29
Unknown	0	0	2

Patients in both study groups were discharged as soon as possible, i.e. when fully mobilized without need for analgesics, and when assistance from a nurse to secure personal hygiene or to dress was no longer required. They were similarly encouraged to resume normal activity and work as soon as they felt fit. Normal activity was defined as return to usual activity of domestic and social life at the discretion of the patient. For registration of postoperative morbidity, days until return to normal activity, work and cosmetic score. All patients were invited to the outpatient clinic after 7 days and 4 weeks after discharge. Eighty five per cent of the patients responded after 4 weeks.100% patients responded after 7 days.

Wound infection was defined as discharge of pus that required surgical drainage. Intraperitoneal abscess was defined as a fluid collection diagnosed at ultrasonography or computed tomography which contained pus at ultra-sonographically guided aspiration. Cosmesis was recorded by the patient on a visual analogue scale (VAS) graded from 0 (excellent) to 10 (poor).

Post operative pain can be assessed quantitatively by the daily requirements for analgesics. Nevertheless, the various kinds of analgesics and routes of administration make it difficult to estimate pain relief. We quantitatively assessed pain on the first postoperative day by means of a VAS.

RESULTS

Of the 92 patients randomized to laparoscopy the procedure was completed successfully in 74 patients, while 18 patients (20 per cent) had the procedure converted to open surgery. Reasons for conversion were mainly difficulties in visualization and dissection of the appendix, but peritonitis, abscess contributed in 6 patients. 12 patients showed non inflamed in laparoscopic group. Of the 132 patients randomized to open appendicectomy, 24 patients had a non-inflamed appendix macroscopically that were also removed (Table 2).

Primary endpoints-

The median hospital stay of 2 days was equally short in both groups (Table 3).

Secondary endpoints-

Postoperative morbidity

Patients randomized to laparoscopy had significantly fewer wound infections but more intraperitoneal abscesses than patients randomized to open appendicectomy *(Table 4).* All but one of the pelvic abscesses was treated by ultrasonographically guided percutaneous aspiration or drainage .One patient randomized to open appendicectomy required drainage by open surgery.

There was no injury to the intestine or blood vessels related to the laparoscopic procedure, but there was one caecal leak closed spontaneously within after 2 days. The outcome in 131 non-randomized (not

participated) patients is presented in (*Table 4).*

Operating time:

There was a significantly shorter operating time in patients randomized to open appendicectomy compared with laparoscopic appendicectomy (40 versus 60 min; Table 4).

Table 3- Results of intention-to-treat analysis of hospital stay (primary endpoint) and convalescence (secondary endpoint):

	Open appendicectomy (n = 132)	Laparoscopic appendicectomy (*n* = 92)
1.Hospital stay (days)	2(2-4)	2(1-3)
2.Time to resuming Normal activity (days)	10 (7-16)	7 (4-14)
3.Work (days)	16 (10-30)	10 (7-20)

Table 4- Results of secondary endpoints:

	Randomized (Participated)		
	Open appendicectomy	Laparoscopic appendicectomy	Not participated
	(n = 132)	(*n* =92)	(*n* = 131)
Operation time	40 (30-60)	60 (40-75)f	Not available
Postoperative morbidity			
Wound infection	7	3	9
Intraperitoneal abscess	2	4	5
Caecal leak	0	0	0
Adhesive ileus	1	2	2
Wound dehiscence	0	0	1
Pneumonia	1	0	0
Cosmesis (VAS)	2 (1-3)	All satisfactory	Not available
Death	0	0	1

Table 5- Intraperitoneal abscess in relation to pathology of appendix (intention-to-treat analysis) in randomized patients-

	Open appendicectomy	Laparoscopic appendicectomy
Pathology of appendix	Abscess	Abscess
Non-inflamed	1	4
Phlegmonous	0	1
Gangrenous/perforated	3	6 (2 were converted).

Convalescence-

There was a significantly shorter period of convalescence in the laparoscopic group.

Cosmesis-

Judged on a VAS, both groups scored well, but patients randomized to laparoscopy were more satisfied with the cosmetic result *(Table 4).*

Diagnostic outcome in randomized patients:

In 7 of 24 patients with a non-inflamed appendix (5of 53 women and 2 of 39 men) though laparoscopy disclosed conditions that required no further surgical treatment yet 5 were executed laparoscopic because of pre-operative diagnosis. Three patients with diverticulitis required conversion to an open operation through an appropriate incision. In the following 4 weeks none of the 2 patients with a macroscopically non-inflamed appendix left in place at laparoscopy developed clinical signs of appendicitis. In patients randomized to open surgery, 5 of 24 patients with a non-inflamed appendix required surgical treatment of appendix.

DISCUSSION

The results of the present study are in keeping with several previous studies. Most studies report a median hospital stay of 2-5 days irrespective of laparoscopic or open surgery [2,4,6,9,12-14,16,17] other studies claim a shorter stay following laparoscopy. [1,3,5,7,10,11,15] In none of these studies were either patients or assessor blinded to the operative technique employed, constituting a possible source of bias.

In the present study it is conceivable that the occurrence of more severely inflamed appendices in patients randomized to laparoscopy adversely affected hospital stay. In a recent large series of 4950 patients, perforated appendicitis was

associated with a significantly longer hospital stay than non-perforated appendicitis (7 versus 3 days). [18]

The operating time, as in ten of 17 other controlled trials, was significantly shorter in patients randomized to open surgery. [3-9,12,15,16] In six trials with relatively small numbers of patients no difference was found. [1,2,10,11,13,17] These studies failed to state the level of surgical experience of the primary operator. By adhering to the principles of intention to treat, the relatively high conversion rate in the present study undoubtedly influenced the operating time. In another study based on a prospective protocol, a similarly high conversion rate was reported, primarily resulting from laparoscopic inexperience. [19] In experienced hands, conversion rates approximating 5 per cent have been claimed. [2,5-7,13]

It is difficult to judge the impact of an increased operating time. Patients in whom laparoscopy reveals a non-inflamed appendix benefit from the laparoscopic approach, with avoidance of open surgery as in the present study in a substantial number of patients. In patients randomized to open appendicectomy 5 of 24 patients required surgery for pathology for appendix.

The substantial number of conversions to open surgery in patients randomized to laparoscopy constitutes an inter-pretational challenge as patients who required conversion to open surgery eventually received the same treatment modality as patients in the comparative group. Analyzing data on an intention-to-treat basis could mask possible benefits in 74 patients in whom laparoscopy was completed successfully. From a statistical point of view, however, there is no alternative. Of 17 published randomized controlled studies, no more than four studies adhered to the principle of intention to treat. [2,9,10,16] Furthermore, only four trials stated the level of surgical experience, ensuring the same level in each group. [4,12,14,15] None of the studies provided information as to whether the surgeon was designated before randomization.

In accordance with other studies [1,20] there were significantly fewer wound infections in the laparoscopy group. Theoretically, a reduction in wound infection rate can be achieved by extraction of the specimen through a port or with use of an endobag, or leaving a non-inflamed appendix in place. This has been confirmed in the present intention-to-treat analysis on a large number of patients, in spite of the higher proportion of severely inflamed appendices in the group randomized to laparoscopy, which is expected to increase the number of wound infections, [18] and the relatively high conversion rate to open surgery.

The prevalence of intraperitoneal abscess formation following open appendicectomy approximates 2-3 per cent [21,22] principally in patients with perforated appendicitis. [18,22] In one retrospective review, laparoscopic appendicectomy was claimed to be associated with a higher rate of intra-abdominal abscess. In another retrospective study that addressed the pathology of the appendix, there was a trend towards a higher rate of abscess formation after laparoscopic removal of perforated appendices, but not for acute phlegmonous appendices. [22]

In the present study there were significantly more intraperitoneal abscesses in patients randomized to laparoscopy. There are a number of possible reasons to consider. Although laparoscopy offers the possibility of adequate irrigation and suction of fluid in the peritoneal cavity, it may increase the risk of spreading infected material in the peritoneal cavity. Furthermore, it is possible that the finding is a result of improper laparoscopic technique, for example crushing a gangrenous or perforated appendix instead of grasping its mesentery or failure to clean the peritoneal cavity. This may reflect the level of experience with the procedure among a large number of young surgeons relatively inexperienced with laparoscopy. Most

importantly, there were significantly more severely inflamed appendices in patients randomized to laparoscopy. The difference in pathology does not reflect a difference in clinical or operative diagnosis, as the pathology was based on histological examination of all removed appendices. It is therefore most likely that the difference is random.

In the present study the incidence of severely inflamed appendices in non-randomized patients did not differ from that in patients randomized to laparoscopy, nor did the rate of intraperitoneal abscess formation. In addressing this particular complication, six randomized controlled trials, [3,8,9,12,14,15] including one intention-to-treat study, [9] failed to show any significant increase following laparoscopy.

In the present study all but one abscess were managed by ultrasonographically guided aspiration or drainage, with an uneventful recovery. In a recently published study of appendicectomy in 1024 children, 21 of 23 intraperitoneal abscesses resolved with antibiotic therapy alone. [23]

In 11 of 13 controlled trials that have studied postoperative convalescence, convalescence was found to be shorter in patients treated by a laparoscopic approach. [2,6,8,13] In the present study, patients were not blinded to the surgical technique employed, but were equally informed to resume normal activity and work as soon as possible at their discretion. The results show that time to work was reduced from 16 to 10 days by the laparoscopic approach. Less pain in the postoperative period is probably a major contributing factor, as reported in nine of 16 trials [1,9] none in favor of open surgery. Furthermore, one randomized trial indicated that laparoscopic appendicectomy can be cost effective, with a substantial saving of total costs in working patients. [13]

Laparoscopic appendicectomy is associated with increased operating time. The general perception is that it has marginal advantages and may not be worth the trouble. [24] However, wound infections are fewer and subjective outcome measures, such as convalescence and cosmesis, are improved. In addition, the diagnostic gain of laparoscopy is indisputable, obviating laparotomy in a substantial number of patients, both men and women. Disorders other than appendicitis that require surgical treatment can be approached through an appropriate incision. Laparoscopic appendicectomy also provides an appropriate procedure for training young surgeons, and may be a safer introduction to laparoscopic skills than laparoscopic cholecystectomy.

CONCLUSIONS

Though hospital stay was equally short in open and laparoscopic most patients could go home on 2nd post-operative day after laparoscopic appendicectomy. Laparoscopic appendicectomy was associated with fewer wound infections, faster recovery, earlier return to work and improved cosmesis. Shorter hospital stay, less postoperative pain, a faster recovery, and a lower complication rate except reasonable postoperative abscess compared with open procedure. Our study demonstrates that laparoscopic appendicectomy is a safe and effective treatment alternative for patients with acute appendicitis, and is recommended for those hospitals where laparoscopic expertise and equipment are available. Although laparoscopic appendicectomy was associated with slightly more operating time than open appendicectomy, some analysis revealed that this difference has been diminishing.

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