Research Article

A comparative study of laparoscopic appendicectomy versus open appendicectomy

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ABSTRACT

Background: Open appendicectomy has been safe and effective for acute appendicitis for more than a century. Recently, several authors proposed that the new technique of laparoscopic appendicectomy should be the treatment for acute appendicitis. Therefore, the aim of this study is to evaluate and compare laparoscopic appendicectomy with open appendicectomy in general surgical practice.

Methods: This prospective randomized controlled study was carried out over a period from October 2012 to October 2015 in the department of general surgery K.P.C. Medical College and Hospital, Kolkata. Patients between 18 years and 60 years of age were candidates for randomization. The total population group included 144 patients with a mean age of 39 years.

Results: Comparative studies of laparoscopic and open appendicectomy shows that hospital stay and wound infection rates are significantly lower after laparoscopic appendicectomy. As compared to laparoscopic appendicectomy prevalence of intra-abdominal abscess was less in open appendicectomy. Similarly, shorter operating time was found in patients randomized to open appendicectomy compared with laparoscopic appendicectomy. There were shorter period of convalescence and better cosmesis observed in the laparoscopic group. However, no single case of pneumonia was reported in the post-operative period in both appendicectomy.

Conclusions: From the present study, we can conclude that laparoscopic appendicectomy has been shown to be both feasible and safe in comparison with open appendicectomy. However, because of the competition of laparoscopic and open appendicectomy, open appendicectomy has improved greatly. The benefit of laparoscopic appendicectomy over the open appendicectomy will be a question.

Keywords: Open appendicectomy, Laparoscopic appendicectomy, Comparative study

INTRODUCTION

The human vermiform appendix is usually referred to as "A vestigial organ with no known function". Currently available evidence suggests that appendix is a highly specialized part of the alimentary tract. Lymphoid tissue first appears in the human appendix about 2 weeks after birth.

Laparoscopic appendicectomy has been shown to be both feasible and safe in randomized comparisons with open appendicectomy, in addition to improve diagnostic accuracy.¹ It confers advantages to the patient in terms of

fewer wound infections, less pain, faster recovery and earlier return to work.^{1,2}

Open appendicectomy was based on the hypothesis that laparoscopic appendicectomy would prove superior to open appendicectomy in terms of hospital stay, post-operative morbidity like pain, complication like wound infections, intra-abdominal abscess, ileus, cosmesis, operating time, earlier return to normal activity and work.²⁻⁴

Acute appendicitis is the most frequent cause of persisting progressive abdominal pain in all ages. The

concept of recurrent appendicitis is gradually being accepted and patients often describe previous episodes of pain that were the same as the present in all aspect except severity. However, there is no way to prevent the development of appendicitis, the only way to reduce the morbidity and to prevent the development of appendicitis, is to perform appendectomy before perforation or gangrene has occurred.

Open appendectomy has been safe and effective for acute appendicitis for more than a century. Recently, several authors proposed that the new technique of laparoscopic appendectomy should be the treatment for acute appendicitis.⁵

Therefore, the aim of this study is to evaluate and compare laparoscopic appendectomy with open appendectomy in general surgical practice.

METHODS

This prospective randomized controlled study was carried out over a period from October 2012 to October 2015 in the department of General Surgery K.P.C. Medical College and Hospital, Kolkata.

Patients

Patients between 18 years and 60 years of age were candidates for randomization. The total population group included 144 patients with a mean age of 39 years.

Design

The study was carried out as an open randomized single centre study.

Every 3rd patient was planned for open appendectomy and every 4th patients was planned for laparoscopic appendectomy. The patients were explained in details about the operative modalities both laparoscopic and open appendectomies. Patients were not given the opportunity to voluntarily opt for the operative procedure they would like to undergo and this was probably the main cause in the exclusion criteria.

Out of 144 patients the total numbers of patients after randomization were 73. Of these, 33 patients underwent laparoscopic appendectomy and 40 patients underwent open appendectomy finally. The two treatment groups were well matched with regard to age, sex but not for severity of appendiceal pathology. Histological examination was performed on all removed appendix.

Each patient underwent through clinical history taking and physical examination. In clinical history details of onset, duration, radiation and severity of pain, nausea, vomiting and fever was noted. In females of child bearing age (18 to 44 years) a detailed account of menstrual history was noted to exclude pelvic inflammatory disease.

All male patients with right iliac fossa pain, a history of burning sensation during micturition and or haematuria were noted to exclude the diagnosis of ureteric colic.

General survey was performed with special emphasis on recording of pulse, temperature and blood pressure.

Abdominal examination to note McBurney's point tenderness Psosa test, obturator test, cough sign, pain on straight leg rising, localized rigidity of right iliac fossa and rebound tenderness was performed.

Per rectal examination was mandatory in all the patients. Per vaginal examination was performed in females after proper consent. After having diagnosed the patient provisionally as a case appendicitis further examination to confirm the diagnosis included^{6,7}-total count to note leucocytosis.

Biochemical examination^{6,7} to note blood sugar, urea and creatinine, straight X-Ray abdomen and ultrasonography. Coagulation profile of every individual was done to rule out any coagulopathy.

Cases were scored by Alvarado scoring system during admission and later reviewed after 6-8 hrs for a second scoring when leucocyte count, neutrophil percentage and CRP level are simultaneously normal.

A final decision regarding operative intervention was made for all cases of appendicitis. The patients were explained in details about the operative modalities and an informed consent was taken for laparoscopic appendectomy and open appendectomy.

All the patients underwent through preanesthetic check-up for general anaesthesia. All the patients were thoroughly explained preoperatively likely post-operative pain and methods of analgesia available.

The histopathological findings of acute appendicitis were based on the gross and microscopic appearance reports examination performed in the pathology department of our institution R.M.S.P. VIMS.

Exclusion criteria⁸

Patients with severe cardiopulmonary disease, pregnancy, generalized peritonitis were excluded from the study.

Furthermore, patients who were chosen to undergo laparoscopic appendectomy but had contraindication i.e. ASA IV and physiologically compromised having to creation of carbon dioxide were also exclude from the study. Some patients have refused to undergo operation because of personal problems and financial problems and refused to give consent were also excluded from the study.

Statistical analysis

The end point data was analysed according to intention to treat principle. χ^2 test (Chi-square test) was used to compare categorical data like post-operative morbidity, wound infection, intra-abdominal abscess, cecal leak, adhesive ileus, pneumonia.

Mann-Whitney U test was applied to compare ordinal data like operating time, hospital stay, time required to return to normal activity and heavy work, VAS score for cosmesis and pain at 12 as well as 24 hrs.

RESULTS

The study group (n=73) included 50.6% of the population group.

Out of 73 patients, 33 patients were randomized to laparoscopy and 40 patients randomized to open appendicectomy. Demographic profile of the patients is given in Table 1.

Table 1: Demographic profile of the patients.

Variable	Laparoscopic appendicectomy N=33	Open appendicectomy N = 40
Mean age (years)	34.9 years	35.4 years
Sex ratio (F:M)	12:21	17 : 23

Post-operative morbidity

Wound infections

Patients randomized to laparoscopy had significantly fewer wound infections but more intra-abdominal abscess than patients randomized to open appendicectomy (Figure 1, Table 2).

In open appendicectomy, wound infections were present in patients during the post-operative period. All these patients included the subgroup of patients with gangrenous or perforated appendicitis (Figure 1, Table 2).

Intra-abdominal abscess

There were three cases of intra-abdominal collection after laparoscopic appendicectomy and one case after open operation. Two patients had persistent fever after operation and a third discharged on day 4, presented on the 8th day with local signs. None of the patients had a mass. But ultrasonography showed a pericaecal fluid collection in each case the largest collection measured 2x 4 cm. Two patients were treated by needle aspiration and one was managed conservatively. Resolution was

confirmed by follow-up ultrasonography in all cases (Figure 2, Table 2).

One patient with open appendicectomy group had a pelvic abscess. This was successfully treated by ultrasonography guided transvaginal aspiration and drainage.

Figure 1: Numbers of patients having wound infection.

Figure 2: Number of patients showing intra-abdominal abscess.

Caecal leak

There was one case of perforation related to the laparoscopic procedure which required conversion and underwent, right hemi colectomy (Figure 3, Table 2).

Figure 3: Number of patients with caecal leak.

Operating time

There was a significantly shorter operating time in patients randomized to open appendicectomy (30 min) compared with laparoscopic appendicectomy (60 minutes) (Table 2).

Convalesces

There was a significantly shorter period of convalescence in the laparoscopic group (Table 2).

Cosmesis

It was judged on a visual analogue scale that both groups scored well, but patients randomised to laparoscopy were more satisfied with the cosmetic result (Table 2).

Pain

From the VAS score, it was observed that a minimum clinically significant difference in visual analogue scale did not differ much after 12 hours. After operation median value (MCSD) for laparoscopy appendicectomy was 12 and median value (MCSD) for open appendicectomy was 11 ($P < 0.05$). However, there was difference in pain found 24 hours after operation.

The number of pethidine (1 mg/kg) required in the immediate postoperative period did not differ between

the two groups but the number of doses of oral analgesics required was less in patients undergoing laparoscopic Appendicectomy after 24 hours (Table 2).

Hospital stay

The median value for hospital stay after laparoscopic appendicectomy was 3 as compared to hospital stay after open appendicectomy was 5. Thus, reintroduction of normal diet and discharge from the hospital occurred earlier after laparoscopic than open surgery ($P < 0.1$) (Table 2).

Adhesive ileus

There were two cases of adhesive ileus after laparoscopic appendicectomy and one case of adhesive ileus after open appendicectomy ($p < 0.05$) (Table 2).

Pneumonia

However, no single case of pneumonia was reported in the post-operative period.

There was no report of mortality i.e. death in the study. All the patients followed up in the OPD as advised after 5 days from the day of discharge or earlier if required for any emergency (Table 2).

Table 2: Comparison between laparoscopic appendicectomy and open appendicectomy.

Randomized	Laparoscopic appendicectomy	Open appendicectomy, (n=40)	Probability
Operation time	60 (15-100)	30 (30-60) Minutes	<0.001
Post-operative morbidity			
Wound infection	3	8	<0.05
Intra-abdominal abscess	3	1	<0.05
Caecal leak	0	1	Non-significant
Adhesive ileus	2	1	<0.05
Pneumonia	0	0	Non-significant
Cosmesis (VAS)*	1 (0-3)	2 (1-8)	<0.01
Pain (VAS)*			
After 12 hours	12 (MCSD) (12-20)	11 (MCSD) (9-15)	>0.05 not significant
After 24 hours	10 (5-20)	10 (5-25)	>0.05 not significant
Hospital stay*	3 (3-8)	5 (3-10)	<0.1
Convalescence			
Normal activity**	5 (4 -14)	5 (2-10)	<0.05
Heavy work**	10 (10-21)	9 (2-20)	<0.01
Death	Nil	Nil	Nil

**Values are median, VAS-Visual Analogue scale, Tests used: χ^2 Chi-square test, Mann-Whitney U test; MCSD-Minimum clinically significant Difference.

Pathology of the appendix

A comparison was done between the pathology of the appendix based upon gross appearance noted during operation and histopathological reports. It was grouped under the two headings i.e. operation performed open appendectomy and laparoscopic appendectomy.

Table 3: Pathology of appendix.

Types	Laparoscopic appendectomy N =33	Open appendectomy N = 40
Phlegmonous	17	14
Gangrenous	8	10
Perforated	4	6

It was found that a substantial number of patients with acute appendicitis underwent laparoscopic appendectomy.

DISCUSSION

Acute appendicitis is one of the most frequent causes of abdominal emergency in nearly all age groups and is notorious in its ability to stimulate other condition.

Most studies report a median hospital stay of 2-5 days of laparoscopic or open surgery. Although, some recent retrospective cohort studies or chart reviews found laparoscopic appendectomy associated with significantly shorter hospital stay. Other retrospective investigations reported non-significant difference. However, others reports do not show significant difference between laparoscopic appendectomy and open appendectomy.

Saurland and associate summarized the result of 28 randomized controlled trials and almost 3000 patients had reported a significant decrease in length of hospital stay.

Another meta-analysis failed to show a statistically significant difference between laparoscopic appendectomy and open appendectomy.^{2,9}

The present study revealed a significantly shorter hospital stay for patients undergoing laparoscopic appendectomy ($P < 0.1$).

In the present study more operating time was noted for laparoscopic appendectomy ($P < 0.001$). Significant variation in operating times was noted in various controlled studies. The difference in mean (or median) operating time ranged from 8.3 to 29 minutes and was longer for laparoscopic appendectomy in all studies. In five of seven studies the difference was statistically significant.¹⁰⁻¹³ Some studies revealed no difference in the operating time.^{14,15}

In accordance to a study on conversion of laparoscopic appendectomy to open appendectomy by Hellberg A;¹⁶ similar results was found in the present study of conversion rate. The main reason for conversion was difficult anatomy due to dense parietal adhesions due to previous lower abdominal surgery. In one case there was an associated caecal perforation so a right hemicolectomy had to be performed.

In experienced hands, conversion rates approximating 5 percent have been claimed.^{3,10,15,17}

In accordance with other studies there were significantly fewer wound infections in the laparoscopy group ($P < 0.05$). Theoretically, a reduction in wound infection rate can be achieved by extraction of the specimen through a port or leaving non-inflamed appendix in place or with the use of an endobag. This has been confirmed in the present intention to treat analysis on a large number of patients^{10,14,18-20} have shown that wound infection are lower in case of laparoscopic appendectomy.

The prevalence of intra-abdominal abscess following laparoscopic appendectomy was found to be higher as compared to open appendectomy the higher rates of abscess formation was seen after laparoscopic removal of perforated appendices.²¹⁻²³ This correlates with the present study in which there were significantly more intra-abdominal abscess in patients randomized to laparoscopy. It was mostly associated with gangrenous and perforated appendicitis than with acute phlegmonous appendices.

Analgesics requirement were significantly less after laparoscopic appendectomy in three intention to tract studies.^{10,11} Whereas the converse was found in none post-operative pain was assessed in a variety of ways. In study by Ortega et al linear analogue pain scores, were recorded in a subgroup of 135 patients. Pain scores were significantly lower after 24 hours and 48 hours. A similar retrospective study of assessment of post-operative pain by visual analogue scale⁸ showed no significant difference in pain scores both for open appendectomy and laparoscopic appendectomy.

In another retrospective study³ showed that the number of pethidine doses (1 mg per kg body weight) required in the immediate post-operative period did not differ between the two groups but the mean number of doses of oral analgesics required was less in patients undergoing laparoscopic appendectomy ($P < 0.05$).

In the present study, post-operative pain was assessed after 12 hours and 24 hours. In the immediate post-operative period opiate analgesics were used in both. A visual analogue scale was used to assess the post-operative pain, was found to be less in the laparoscopy group with the same dose of parenteral analgesics per kg body weight as compared to open appendectomy.

In reported controlled trials in which post-operative convalescence was studied, was found to be shorter in patients treated by a laparoscopic approach^{3,11}. In a retrospective study, by Call⁹ post-operative convalescence was found to be similar in both groups.

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 return to heavy work was significantly reduced by the laparoscopic approach. Less pain in the post-operative period was the major contributing factor.

In accordance to retrospective study small bowel obstruction was statistically less common after laparoscopic appendicectomy than open appendicectomy.²⁴

According to Jalujan Mompean²⁵ early bowel obstruction was seen in 4 after laparoscopic appendicectomy and 5 cases after open appendicectomy incidence of bowel obstruction did not differ between laparoscopic appendicectomy and open appendicectomy in either group.

In the present study, adhesive ileus after laparoscopic appendicectomy was found to be more than after open appendicectomy ($P < 0.05$). The main cause was found to be band obstruction. Adhesive ileus after open appendicectomy was relieved by medical treatment and did not require operation.

Adhesion related complication such as intestinal obstruction remains the main source of long term morbidity from open appendicectomy.

According to Pedersen AG laparoscopy was associated with improved cosmesis ($P < 0.001$).² A cosmesis was recorded on a visual analogue scale by the patient from (0) excellent to poor (10). According to Mustafa Kamal²⁶ laparoscopy procedure gives us a small scar which is more cosmetic and acceptable. In the present study, laparoscopic appendicectomy was associated with improved cosmesis when compared with open appendicectomy ($P < 0.01$).

Although post-operative pneumonia was included as a criteria of complications, no cases of post-operative pneumonia was reported in laparoscopic appendicectomy and open appendicectomy groups.

Laparoscopic appendicectomy is a safe procedure with lower morbidity it is also an excellent training tool in laparoscopic technique and with sufficient experience takes no longer than open appendicectomy.²⁷

Laparoscopy is a safe, predictable easily learnt operation and an ideal model for learning the skills and principles

required for more advanced laparoscopic colorectal interventions in particular right hemicolectomy.²⁸

CONCLUSION

From the present study, we concluded that laparoscopic appendicectomy has been shown to be both feasible and safe in comparison with open appendicectomy.

Laparoscopic appendicectomy and open appendicectomy are comparable for complications, post-operative pain control, length of hospitalization and recovery time. Laparoscopic appendicectomy is associated with increased operating time. The general perception is that it has marginal advantages and may not be worth the trouble. Hospital stay and wound infection rates are significantly lower after laparoscopic appendicectomy. Reintroduction of normal diet and discharge from hospital was earlier after laparoscopic appendicectomy faster recovery and earlier return to work was also seen after laparoscopic appendicectomy. Less post-operative pain and improved cosmesis was seen after laparoscopic appendicectomy than open appendicectomy.

In addition, the diagnostic gain is indisputable obviating negative 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. Because of the competition of laparoscopic and open appendicectomy, open appendicectomy has improved greatly. More and more questions are being raised as to the benefit of laparoscopic appendicectomy.

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