

Open Versus Laparoscopic Surgery for Acute Appendicitis: Clinical Comparative Outcomes at Single Academic Centre (VIMS-Kolkata)

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ABSTRACT

Introduction: Laparoscopic appendectomy is emerging as a popular treatment modality for acute appendicitis but it is still far from attaining the status of “gold standard”. The aim of this study was to compare and evaluate the results of open and laparoscopic treatment for acute appendicitis in a prospective randomized unicentre study.

Material and Methods: Sixtythree patients underwent for operative interventions after stratified random sampling; 30 patients underwent for laparoscopic appendectomy (LA) and 33 patients underwent open appendectomy (OA) with diagnosis of suspected acute appendicitis. The two groups were compared in terms of duration of surgery, length of hospital stay, intra-operative and post-operative complications. For statistical analysis; Chi-square (x²) and Mann-whitney U test were used.

Result: As compared to open appendectomy, laparoscopic appendectomy was associated with shorter hospital stay (3vs5 days, p<0.05) with low incidence of wound infection (3%vs18%, p<0.05). The incidence of intra-abdominal abscess formation and adhesive ileus was more in LA group statistically insignificant. (p>0.05). The mean time for post-operative duration of i.v. fluid infusion [LA:8.63hrs, OA:22hrs, p<0.01] and requirement of analgesic either by parenteral route[2 doses Vs 4 doses, p<0.01] or by oral route[LA:2 doses, OA:6 doses, p<0.01] and return to normal activity was less in LA group as compared to OA group. Conversion to open was necessary in two cases only and an incisional hernia case was also reported in follow up period.

Conclusion: We conclude that routine laparoscopy and laparoscopic appendectomy for suspected acute appendicitis is safe and clinically beneficial operative procedure and post operative outcomes including hospital stay was significantly short. Laparoscopic appendectomy was associated with fewer wound infection, faster recovery, earlier return to bowel sounds, normal activity with less pain and improved cosmesis.

Keywords: Acute Appendicitis, Open Appendectomy (OA), Laparoscopic Appendectomy (LA), Visual Analogue Scale (VAS)

(OA) for simple acute appendicitis.⁶

In the present study, we have done a prospective, evaluative study to compare the outcomes of LA with that of OA in acute appendicitis in our hospital; touching upon return to normal activity and various intra and postoperative complications. This study was based on hypothesis that LA would prove superior to OA in terms of above variables⁷⁻¹⁸

MATERIAL AND METHODS

This randomized single centre study was carried out during thirty months period from august-2007 to January-2010 included patients with the clinical diagnosis of acute appendicitis with age group between 16-55 years. From a population of 136 patients; the total number of patients after randomization were 69. Six patients were further excluded after randomization. Total sixty three patients underwent for operative intervention; out of which 30 patients (46.08%) underwent for LA and 33 patients (53.92%) for OA finally. The two treatment groups were well matched regarding age, sex but not for severity of appendiceal pathology. All the cases with clinical diagnosis of acute appendicitis with or without radiological confirmation were included in this study.

The patients with generalized peritonitis, severe comorbid illness like congestive heart failure (CHF), Chronic obstructive pulmonary disease (COPD), appendicular lump and abscesses, suspicion of malignancy and pregnancy were excluded from this study.

The parameters of comparison includes incidence of complications, duration of surgery, hospital stay, number of analgesics doses (inj tramadol) required, mean duration of i.v. fluids, appearance of bowel sounds, time return to liquid diet, normal diet, normal activity and assessment of pain according to visual analogue scale (VAS) and comparison of scar cosmesis in both groups

Each patient underwent thorough history taking and clinical examination regarding starting of pain, vomiting, fever, anorexia, and menstrual cycle history in child bearing female

INTRODUCTION

The importance of appendix in surgery results only from its tendency for inflammation, which results in clinical syndrome known as acute appendicitis. It will affect a 7% of population during their life time.^{1,2} For almost a century, open appendectomy (OA) was the gold standard treatment for appendicitis as described by McBurney in 1894.³ Laparoscopic appendectomy (LA) was described for the first time by Semm in 1983.⁴ Patients with acute appendicitis present with abdominal pain starting in right iliac fossa with associated nausea, vomiting, anorexia& some times low grade fever. Diagnosis is mainly clinical.⁵ Acute appendicitis needs surgical intervention as soon as possible. Recently laparoscopic appendectomy has become a safe alternative to conventional open appendectomy

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age groups. Superficial and deep palpation of abdomen to look for McBurney point tenderness along with emphasis on Cope psoas test, obturator test and pain on straight leg rising test done. In every patient per rectal examination was done. After provisional diagnosis of acute appendicitis; all the patients were subjected to confirm the diagnosis by routine investigations like complete blood counts, urea, creatinine, blood sugar, plain x-ray abdomen and USG. An informed consent was taken from all the patients undergoing for surgery.

In our study patients undergoing for LA were performed using three ports; umbilical (10 mm), right lower quadrant (5 mm) and left lower quadrant (10 mm) under general anaesthesia. A 30° telescope attached with 3chip camera was inserted through umbilical port examining all quadrants of abdomen specially right iliac fossa for caecum and appendix to rule out other possible diagnosis. Once the appendix, mesoappendix and its base was identified clearly; mesoappendix was divided by using bipolar diathermy followed by clipping of appendicular artery dividing in between them. The base was ligated proximally by two pretied catgut endoloop ligatures and distally about 1cm away from proximal one. The appendix was divided in between them and send for histopathological examination. The appendix stump was not routinely buried.

In uncomplicated cases of open appendectomy a transverse skin crease incision (Lanz, s incision) was preferred over the area of maximum tenderness. In some patients Mc Burney Arthur Gridiron incision was also used. In complicated cases these incisions were converted in to muscle cutting (Rutherford Morison) incision. After removing appendix, drain was put in pelvis and abdomen was closed in layers.

The drain was removed when drainage was serous and <30 ml in 24hrs in both groups

The postoperative management of laparoscopic and open appendectomy was similar in view of i.v. fluid infusion, control of pain and diet was gradually introduced. In both groups, all patients were treated prophylactically with antibiotics; given 30 minutes prior to surgery intravenously included a single dose of third generation cephalosporin.

For complicated cases (gangrenous and perforated appendicitis) a third generation cephalosporin antibiotic along with metronidazole and amikacin were continued intravenously for next 24 hours or until the white blood counts was with in normal limits or patients become afebrile.

In both groups, opioids (inj tramadol; 50-100mg/dose) analgesics were used parenterally in post operative period followed by orally when patients start to take feed. Pain was measured by VAS (visual analogue scale), a score of integrated numbers ranging from 0 to 100.

In this study, comparison of two groups in view of operating time (time from the first incision to the placement of the last suture in the skin), length of hospital stay (number of days in hospital after the day of surgery), cosmesis and complications like wound infection, intra-abdominal abscess formation, caecal leak, adhesive ileus, incisional hernia and others were made. Patients in both groups were discharged as soon as they resume normal activity (usual activity of domestic and social life at the discretion of the patients).

VAS score was also used for recording the cosmesis in the follow-up when the patient visited at OPD with grade 0 as

excellent and grade 10 as poor.

The patients were followed-up monthly for three months after stich removal. Patients having complications were admitted in ward and investigated for blood examination and managed accordingly.

STATISTICAL ANALYSIS

For comparison of two groups Chi-square test was used to compare frequency of qualitative variables like wound infection, intra-abdominal abscess, caecal leak, adhesive ileus and incisional hernia. Mann-Whitney u statistics was used to compare ordinal data like operating time, post-op i.v. fluid, analgesic requirement, hospital stay, VAS score, cosmesis, appearance of bowel sounds, time to return to liquid diet, normal diet and normal activity.

For all tests a probability (p value) less than 0.05 was considered significant.

RESULTS

In this study the mean age for laparoscopic appendectomy (LA) was 33.5 years and for open appendectomy (OA); (34.3 years) and F:M ratio (14:16 versus 15:18) respectively. The female:male percentage sex distribution was (47%:53%) for LA where as for OA; (45%:55%); (Table-1). The pathological features of appendix was also noted during both laparoscopic and open appendectomy based upon gross intraoperative as well as histopathological findings (Table-2).

Wound infection was reported only 3% (one case) in LA where as in OA it was 18% (6 cases). The incidence of wound infection was more in patients diagnosed as gangrenous or perforated appendicitis during surgery. In our study; intra-abdominal abscess formation in postoperative period was present in three cases (10%) in LA where as only one case (3%) in OA. All these cases were managed conservatively by USG guided aspiration, adequate antibiotic coverage and regular follow up (Table-3).

Caecal perforation seen during laparoscopic appendectomy in one case only for which conversion to open followed by right hemicolectomy done. Adhesive ileus seen in two cases (7%) of LA and one case (3%) of OA during follow up with no significant differences in between two groups (p>0.05). Incisional hernia was reported in open appendectomy group in one case (3%) during postoperative follow up period. It was

Variables	Laparoscopic Appendectomy (LA) (n=30)	Open Appendectomy (OA) (n=33)
Mean Age (years)	33.5 Years	34.3 Years
Sex Ratio(F:M)	14:16	15:18
Percentage sex distribution (F:M)	47%:53%	45%:55%

Table-1: Demographic profile of patient

Pathological features	Laparoscopic Appendectomy (LA), (n=30)	Open Appendectomy (OA), (n=33)
Normal	2	3
Inflamed	22	25
Gangrenous	4	2
Perforated	2	3

Table-2: Pathological features of appendix

managed by subaponeurotic prolene mesh hernioplasty later. (Table-3).

During LA only two patients were converted to open because of ill defined anatomy in first case and another due to caecal perforation as mentioned above.

In both groups in post-operative period no case of significant haemorrhage and pneumonia was reported.

In our study, median operating time was significantly shorter in patients undergoing open appendicectomy (OA:32 minutes) as compared to laparoscopic appendicectomy (LA:54 minutes) where as median length of hospital stay was significantly shorter after laparoscopic appendicectomy (3 days after LA, 5 days after OA, $p<0.05$) as compared to OA. The mean duration of postoperative intravenous (i.v.) fluid therapy was less in LA group (8.63 hours) as compared to OA group (22.0 hours) in postoperative period so liquid and normal diet was started earlier in laparoscopic appendicectomy group; (Table-4).

It was also observed that in LA group minimum time for appearance of bowel sound was 4 hours and maximum time was 16 hours where as in OA group the minimum time was 10 hours and maximum was 40 hours. The mean time to return to liquid diet, normal diet and normal activity was significantly shorter after laparoscopic appendicectomy (LA) as compared to open appendicectomy (OA). The minimum time to return to normal activity was two days for LA where as five days for OA (Table-4).

The median requirement of analgesic by parenteral (i.v.) route as well as oral route was significantly less in LA group (2 doses) as compared to OA group (4 doses by parenteral route and 6 doses by oral route, $p<0.01$). Pain assessment was done on visual

analogue scale in both laparoscopic and open appendicectomy group. It was observed that the mean value for pain assessment after LA was (12.93), where as for OA was (11.47) after 12 hours of operation ($p>0.05$). But there was some differences in pain assessment after 24 hours after operation (Table-4).

Cosmesis was well achieved and satisfactory for patients underwent for LA as compared to OA.

DISCUSSION

Acute appendicitis is one of the most common surgical condition of the abdomen and should be included in the differential diagnosis of every patients presenting with acute abdomen at any age group.

The median hospital stay was 2-5 days in most of the studies irrespective of laparoscopic or open procedure. Although some cohort studies found LA associated with shorter hospital stay as compared to OA significantly.^{22,15} In 1998 Sauerland and associates studied the result of twenty eight randomized controlled trials reporting a significant decrease in length of hospital stay in LA patients. Similar results were found by several other investigators [Attwood et al 1992, Frazee et al 1994, Ortega et al 1995].^{17,16,21} But there are few meta-analysis study which failed to show shorter hospital stay significantly in patients undergoing LA.⁷ It has been well understood now hospital factors or social habits are responsible for above differences rather than operative technique itself.

Longer hospital stay in European studies could be the consequence of different standards and insurance systems as mentioned in previous studies. The hospital stay in our study was significantly short for patients undergoing LA (<0.05).

Several previous studies had found that LA takes a longer time

Variables	Laparoscopic Appendicectomy (LA) (n=30)	Open Appendicectomy (OA) (n=33)	P-value
Wound Infection	1 (3%)	6 (18%)	$p<0.05$
Intra-abdominal Abscess	3 (10%)	1 (3%)	$p>0.05$
Caecal leak	1 (3%)	0 (0%)	$p>0.05$
Adhesive ileus	2 (7%)	1 (3%)	$p>0.05$
Incisional hernia	0 (0%)	1 (3%)	$p>0.05$
Haemorrhage	0	0	NA
Pneumonia	0	0	NA

Table-3: Post-operative complications

Variables	Laparoscopic Appendicectomy (LA), (n=30)	Open Appendicectomy (OA), (n=33)	p-value
Hospital stay (days)*	3(2-7)	5(3-12)	$P<0.05$
Operating time (minutes)*	54(20-95)	32(30-65)	$P<0.05$
Analgesic requirement* (Number of parenteral i.v. doses) (Number of oral- doses)	2(2-4) 2(2-6)	4(4-10) 6(6-14)	$p<0.01$ $p<0.01$
Postoperative iv fluid Duration (hours)	8.63(4-12)	22.00(10-46)	$P<0.01$
Appearance of bowel sound (hours)	9.83(4-16)	20.00(10-40)	$P<0.01$
Time to return to liquid diet (hours)	11.00(8-18)	19.13(10-45)	$P<0.01$
Time to return to normal diet (hours)	34(20-42)	40(26-56)	$P<0.01$
Time to return to normal activity (days)	5.67(2-12)	7.90(5-14)	$P<0.01$
Pain according to VAS scale After 12 hours After 24 hours	12.93(10-22) 10.07(5-20)	11.47(8-15) 10.13(6-26)	$p>0.05$ $p>0.05$
Cosmesis	1(0-3)	2(1-7)	$P<0.01$

*values are median

Table-4: Comparative outcome of different parameters of study

to perform as compared to OA. In five of seven studies the difference was statistically significant.^{17,16} Some studies have confirmed that operating time was similar for both laparoscopic and open appendectomy group in past. In the present study the median operating time was significantly more for LA (54 minutes) as compared OA (32 minutes); ($p < 0.05$). The main reason for delay, which we noted was during operation; positioning the patient, adjusting different tubes, cables and video around the patients.

According to this study, the main reason for conversion was difficult anatomy due to dense adhesion & appendix was embedded in the small bowel mesentery and in another case there was caecal perforation during LA so a right hemicolectomy was done.

In addition, since the surgeons are becoming more skilled in laparoscopic appendectomy so conversion rate especially in patients with complicated appendicitis has dropped. In experienced hands, conversion rates approximating 5% have been claimed.^{8,19,20}

Wound infection incidence was significantly higher in OA groups as revealed in previous randomized controlled trials, chart reviews and meta-analysis.^{21,15,17,22-24} A reduction in wound infection rate can be achieved by extraction of specimen with the use of an endobag or through port. This has been determined in this study. Furthermore, suction and irrigation of intraperitoneal collections as done via a suction devices passed through small size laparoscopic port can further reduce the number of wound infections in various past studies.

In the present study, the incidence of intra-abdominal abscess formation was more in LA as compared to OA group but the results were not statistically significant ($p > 0.05$).³⁰ Where as in few studies were found with statistically significant differences.¹⁶ It is possible to reduce the incidence of intra-abdominal pelvic abscesses formation if the patient placed in trendelenburg position, sigmoid colon is retracted and complete irrigation and aspiration of pelvis done under direct vision. In our study two patients were managed conservatively and one by ultrasonography guided needle aspiration.^{7,25,26}

In previous studies; analgesic requirement was significantly less after LA as compared to OA both for parenteral and oral routes.^{21,27,16,17,28} but in few retrospective study done in past the difference was not significant. In this study, a VAS was used to assessed the post-operative pain; found to be less in the LA group with the same dose of parenteral analgesic per kg body weight as compared to OA group.

The present study result shows that time to return to normal activity was significantly reduced by laparoscopic approach (mean 5.67 days vs 7.90 days, ($p < 0.05$). Less pain in the post-operative period was the major contributing factor.

In different controlled trials that have studied postoperative convalescence, similar results were found.^{8,21,27} But in a retrospective study; postoperative convalescence was found to be similar in both groups.

The post-operative adhesive ileus was seen in two cases after LA and one case after OA with no significant difference in between two groups ($p > 0.05$) in present study. Both patients with adhesive ileus after LA was due to band obstruction of small intestine which was treated by surgical intervention & another case after OA was treated conservatively. The occurrence of

post-operative ileus was correlated with duration of operation but not with laparoscopic appendectomy as reported in a study. Cosmesis was improved and superior after LA as compared to OA ($p < 0.05$) in our study. According to a study⁷, laparoscopy procedure was associated with improved cosmesis.

No case of postoperative pneumonia was reported in either groups and there was no significant haemorrhage seen in intraoperative or postoperative period also in both groups. In a study by Utpal De 2005²⁹, secondary haemorrhage has been reported in 1.1% cases of OA and 5% cases of LA in postoperative period. Incisional hernia was reported in one case after OA in post-operative follow up period in this study. It was treated by subaponeurotic polypropylene mesh repair.

Postoperative iv fluid infusion was continued until patients tolerated clear fluids orally without vomiting & abdominal distension. The mean duration of iv fluid infusion in LA group was 8.63 hours and for OA; 22 hours ($p < 0.01$). Appearance of bowel sound was earlier in LA group (mini-4 hours) as compared to OA (mini-10 hours) group in our study ($p < 0.01$). Oral fluids followed by liquid diet were given to patients of both groups after the IPS was well audible. In our study, mean time for starting liquid diet for LA group was 11 hours and 19.13 hours for OA group.

Normal diet was started as soon as earlier in LA group (mean; 34 hours) as compared to OA group (mean; 40 hours). Thus the difference of mean time to start normal diet between two groups was about 6 hours ($p < 0.01$). In a prospective comparative study on 220 patients, time to return to normal diet was significantly less in LA as compared to OA.³¹

CONCLUSION

In our experience from the present study, we concluded that laparoscopic approach to acute appendicitis can be considered safe and effective with twofold benefits, not only diagnostic in doubtful cases but also therapeutic value in comparison with OA. The results from our study confirm that LA had more operating time but shorter hospital stay, faster recovery due to less postoperative pain, earlier return to routine work and better cosmesis then OA. Post-operative wound infection rates was significantly lower after LA where as intra-abdominal abscess, adhesive ileus was more in LA group. Furthermore, incisional hernia was reported only in one patient underwent for OA.

The laparoscopic approach to acute appendicitis has improved the outcome of appendectomy in our opinion but still requires laparoscopic skills by surgeons and his team. Laparoscopic appendectomy is as fruitful as open procedure for both simple and complicated acute appendicitis having significant clinical advantage over conventional surgery but it is still far from attaining the symbol of "Gold standard". Finally, we can suggest on the basis of our results and analysis that laparoscopic appendectomy is feasible and safe for routine suspected acute appendicitis cases with definite overall advantages allowing a quicker recovery.

ABBREVIATIONS

F:M = Female: Male, IPS = Intermittent peristaltic Sound, i.v. = IntraVenous, LA = Laparoscopic appendectomy, Mini. = minimum, NA = Not Applicable, OA = Open appendectomy,

P = Probability, VAS = Visual Analogue Scale, VIMS = Vivekanand Institute of Medical Sciences

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