Laparoscopic Appendectomy Versus Open Appendectomy for Acute Appendicitis: A Prospective Comparative Study

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ABSTRACT

Background

Appendicitis is the most common cause for acute abdominal pain. Laparoscopic appendectomy is an effective alternative to open appendectomy. It is a minimally invasive results in less postoperative pain, less wound infection, early return to normal work and less morbidity compared to open appendectomy. Both surgical methods are safe but there has been a controversy about which surgical procedure is the most appropriate.

Objective

To compare the outcomes of laparoscopic versus open appendectomy.

Method

In this prospective study, from January 2015 to April 2016, 212 cases of acute appendicitis were included. Diagnosis was based on Alvarado score of seven or above. Patients were distributed into two groups where every alternate patient was operated either open or laparoscopically. The groups were compared in terms of operative time, postoperative pain, postoperative wound infection, other morbidities and length of hospital stay.

Result

Of 212 patients, 106 underwent open and 104 underwent laparoscopic appendectomy. Other two patients, in whom laparoscopy was converted to open procedure, were excluded from the study. The mean operating time in laparoscopic appendectomy group was 44.57 ± 6.68 minutes and in open appendectomy group, was 36.34 ± 7.47 minutes ($p < 0.05$). The visual analog scale scores at 6^{th}, 12^{th}, 24^{th} and 48^{th} hours were higher in open appendectomy group compared to laparoscopic appendectomy group ($p<0.05$). The hospital stay was 2.63 ± 0.60 days in laparoscopic appendectomy group and 3.26 ± 0.68 days in open appendectomy group ($p < 0.05$). Surgical site infection in laparoscopic appendectomy and open appendectomy group were 3.8% and 14 % respectively ($p<0.05$).

Conclusion

In laparoscopic appendectomy group, there is lower incidence of wound infection, lesser postoperative analgesic requirement and shorter hospital stay in comparison to open appendectomy. Though, the operative time is more with laparoscopic appendectomy, it can be considered as the gold standard for surgical treatment of acute appendicitis.

KEY WORDS

Laparoscopic appendectomy, surgical site infection, VAS score

INTRODUCTION

Appendicitis is the most common cause for acute abdominal pain with a lifetime risk of 8.6% for males and 6.7% for females.[1] It is also the most common emergency in abdominal surgery.[2] In 1894, McBurney described surgical removal of inflamed appendix via open approach as the treatment of choice.[3] Later on, in 1983 Semm specified the laparoscopic appendectomy (LA) as another option.[4] In 1991 only, Nowzaradan et al. mentioned LA is minimally invasive and results in less postoperative pain, less wound infection and fewer adhesions compared to conventional open appendectomy (OA).[5] It is associated with superior cosmetic results, a shorter hospital stay, and faster return to normal activities.[5]

OA is widely considered as the gold standard in complicated appendicitis (gangrenous and perforated appendices) and it is used as an intraoperative backup plan for LA in difficult cases where dissection of the appendix is impossible.[6,7] The rate of conversion from LA to OA is 4.16%, but this number is slowly decreasing as surgeons gain more experience with LA.[8] Both surgical methods are safe and well established in clinical practice but there has been a controversy about which surgical procedure is the most appropriate.[1,2]

METHODS

This prospective comparative study was carried out from January 2015 to April 2016 at College of Medical Sciences, Bharatpur, Nepal. The patients admitted with a diagnosis of acute appendicitis and underwent operative procedure were included in the study. After taking written informed consent and clearance from institutional review board patients were divided into two groups for OA or LA alternatively. The diagnosis of appendicitis and decision for operation was made if ALVARADO score > =7. In patients where a clinical diagnosis could not be established, abdominal ultrasound was performed. This study included 212 patients, of which 106 patients underwent open appendectomy and 104 patients underwent LA. Two patients initially to have LA were converted to open procedure and their results were excluded from the study.

Exclusion criteria

1. Any patient in whom laparoscopic procedure was converted to open.

2. Any patient with a history of symptoms for more than 3 days or a palpable mass in the right lower quadrant, suggesting an appendicular lump or abscess.

3. Patients with age of the patient <12 years.

4. Absolute contraindication to laparoscopic surgery or general anesthesia.

Prior to the surgery, all the patients received a standard regimen of intravenous antibiotics (injection ceftriaxone 1 gram). In uncomplicated appendicitis only single dose of preoperative prophylactic antibiotic was given and no antibiotics were given in the postoperative status. Whereas, in patients with complicated appendicitis, antibiotics were continued for five days and modified according to the culture results. OA was performed through the muscle-splitting incision. Following appendectomy, the stump was transfixed with an absorbable suture polyglactin 3-0. LA was performed by three-trocar technique, pneumoperitoneum was produced by the continuous pressure of 10-12 mmHg of carbon dioxide via a hassons technique. Following gas insufflation, a 10 mm trocar for the zero degree laparoscope was placed in the supraumbilical area and two additional trocars, a 5 mm trocar in the suprapubic area and a third 10 mm trocar in the left lower abdominal quadrant were introduced under direct visualization. The patient was placed in a trendelenberg position, with a slight rotation to the left. The mesoappendix was controlled with laparoscopic unipolar cautery, and the appendix base was tied with a single endoloop. The appendix was removed through the left lower abdominal quadrant port or the umbilical port. All specimens were sent for histopathology. Patients converted from laparoscopic to open appendectomies were excluded from the study. Intraoperatively the type of findings whether simple appendicitis, perforated appendicitis, gangrenous appendicitis or appendicitis with lump were noted.

The age, gender, white blood cell count, operating time (from skin incision to wound closure), conversion to open procedure were recorded. In both groups, patients were given injection paracetamol 1 gm eight hourly as the first medication for postoperative pain control for 24 hours and then tablet aceclofenac 100 mg was given per oral twelve hourly. Postoperative pain was assessed by a visual analogue scale (VAS) score at 6^{th}, 12^{th}, 24^{th} and 48^{th} postoperative hours. Initially, patients were kept nil per oral and on intravenous fluids till the retrieval of bowel sounds, followed by sips and liquid diet and then on a soft diet as the patient tolerated. Patients were discharged once there vitals were stable, had good pain control and tolerated soft diet and had no tenderness over the abdomen in physical examination. The length of hospital stay (duration between the date for surgery and the date of discharge) and complications were recorded. After discharge, patients were followed up for four weeks in OPD. Sutures were removed at 7-8 days. Complications were defined as vomiting, fever, pain, diarrhea, abdominal distension, paralytic ileus, surgical site infection (SSI), intra-abdominal abscess, bowel obstruction as well as 30-day readmission for similar complains.

Normally distributed continuous variables were expressed as mean ± standard deviation (SD). Categorical variables were expressed as frequencies and percentages of an appropriate denominator. All of the statistical analyses were performed using SPSS 20.0 software (SPSS Inc., Chicago, Illinois, USA). Student's t-test was used for analysis of normally distributed, descriptive continuous

variables, which were expressed as mean ± SD. Chi-square test, Likelihood ratio test and Mann-Whitney U test were used to compare qualitative variables. Differences were considered statistically significant if the p value was equal to or less than 0.05 with a 95% confidence interval.

RESULTS

From January 2015 to April 2016, 212 cases of acute appendicitis were included in the study. Of which 106(n) underwent OA and 104(n) underwent LA. Other two patients initially to have LA were converted to open procedure and their results were excluded from the study.

There were 107 females (51%) and 103 (49%) males in the study which is statistically not significant (p = 0.583). The mean age of the patient in LA group was 32.51 ± 16.08 years and in OA group was 35.28 ± 19.46 years.

The duration of symptoms in LA and OA group were 1.61 ± 0.66 days and 1.48 ± 0.55 days respectively which was not significant statistically (p = 0.225). The most common complaint was pain abdomen in the periumbilical region that later migrated to right iliac fossa with associated vomiting and anorexia. The mean Alvarado score in LA group was 7.75 ± 0.71 and in OA group was 7.68 ± 0.66 which was not statistically significant (p = 0.529). The following findings were noted intraoperatively. (Table 1) There was no statistically significant difference in the intraoperative findings in LA and OA groups. (p = 0.763)

Table 1. Pattern of cardiac diseases presented in different age groups.

Operative finding	LA(n=104)	OA(n=106)
Normal	3	2
Inflamed	94	92
Perforated	4	6
Gangrenous	2	3
Lump	1	3

*p –value: 0.763 using likelihood ratio test

The mean operating time in LA group was 44.57 ± 6.68 minutes whereas it was 36.34 ± 7.47 minutes in OA group. Overall it took eight minutes more time to perform LA group compared to OA group which was statistically significant (p < 0.001).

VAS scores in LA group were less than that of OA group at 6th, 12th, 24th and 48th hours after surgery. This was significant statistically (Table 2). Patients in the OA group received more total doses of analgesics in first 48 hours after surgery.

The hospital stay was 2.63 ± 0.60 days in LA group and 3.26 ± 0.68 days in OA group. This was also found to be significant statistically (p < 0.001).

Table 2. VAS score in LA group and OA group.

VAS	LA	OA	p valve
6th hours	5.23 ± 1.28	5.73 ± 1.38	p = 0.007
12th hours	3.28 ± 1.03	3.64 ±1.22	p = 0.043
24th hours	3.01 ± 1.00	3.45 ± 1.05	p = 0.004
48th hours	0.38 ± 0.27	1.4 ± 1.24	p< 0.001

Infectious complications were seen in both LA and OA groups. OA was associated with a significantly higher incidence of wound infection compared with the laparoscopic group. The overall SSI was 3.8% in LA group and 14.15% in OA group which was statistically significant (p <0.05). In follow-up period four (3.8 %) patients developed superficial SSI on the left lower abdominal quadrant port site in LA group. As such deep or organ space SSI was not seen in any of the patients in this group. In OA group 13(12%) patients developed superficial SSI and 2(1.8%) patients developed deep SSI. None had organ space SSI. The deep SSI was surgically drained and secondary closure was done once the wound was healthy.

There was no mortality in the early postoperative or the follow-up period. There was no readmission for paralytic ileus, intestinal obstruction, incisional hernia, intra-abdominal abscess or respiratory infection for both groups.

DISCUSSION

Acute appendicitis is the most common intra-abdominal condition requiring emergency surgery.[9] With time the concept of minimal invasive surgery has revolutionized the operative approach in majority of surgeries. Many surgeons now started considering the LA as the treatment of choice for uncomplicated appendicitis.[10] But it is still a topic of discussion and its role needs to be proved.[11]

According to Jaschinski et al., Werkgartner et al. and other authors the duration of surgery was 7.6 to 18.3 minutes longer in laparoscopic appendectomy.[1,10,12,13] Similarly in our study the mean operating time was eight minutes longer in LA group than OA group. This may be because the laparoscopic procedures may take longer times especially during early learning periods or in the case of complicated appendicitis, where the laparoscopic dissection is technically more complex and therefore, more time consuming. With increasing experience, there is significant reduction in operative time for LA.[14,15]

Abe et al. and other authors mentioned the overall conversion rate from LA to OA as 1.6% to 4%.[8,16-18] This was mostly because of dense adhesions, diffuse peritonitis, and difficulties in excision of the appendix due to perforation or severe inflammation. In our experience two (1.8%) cases were converted to open procedure due to extensive adhesions around appendix.

The postoperative pain could be assessed qualitatively by the visual analog scale (VAS) score. Cipe et al. in his study among 241 patients the VAS scores of 1st, 6th and 12th hours were higher in the open appendectomy group.[14] This was not significant at 24th hours. However, in our study the VAS score was higher for OA group compared to LA group at 6th, 12th, 24th and 48th hours postoperatively.

Various studies mentioned the patients after LA return to work earlier as compared to patients after OA.[19-21] According to Schmelzer et al., Costa-Navarro et al. and other authors the postoperative hospital stay for LA is 2 to 2.8 days and for OA is 2.8 to 3.8 days.[22-24] Similar results were seen in our series, the hospital stay was 2.6 days in LA group and 3.2 days in OA group. The length of postoperative hospital stay for LA group was 0.6 days less compared to OA group.

Because of overall improvement in perioperative care during the past century, the mortality rate from acute appendicitis is now nearly zero, but considerable morbidity may occur following OA. Variable wound infection rate is found in different studies. According to Mc Anena et al. the SSI following OA was 10 %.[25] Xiao et al. found SSI after LA was 4.5% and after OA was 6.7 %.[26] Galli et al. mentioned the incidence of incisional SSI as 1.9% in LA group and 22.2% in OA group.[27] In our study the SSI rate in LA was 3.8% and 14% in OA. This low incidence in LA group may be due to extraction of the infected appendix through the lumen of the cannula or with a bag rather than directly through the surgical wound allows no time for the inflamed organ in direct contact with the wound.[15,25]

Some studies mentioned the LA to have a higher rate of intra-abdominal abscesses in comparison to the open approach.[11,28] The recent meta-analysis of randomized controlled trial published shows a low incidence of intra-abdominal infections, with no significant difference between the laparoscopic and the open approach.[15] However, we did not observe any intraperitoneal infections in our LA or OA patients. In our experience this problem was of no concern. The critical issue we stress is that a meticulous irrigation of the peritoneal cavity can be done laparoscopically to decrease the bacterial load and the risk of abscesses as suggested by various authors.[11]

Overall, the clinical outcome of LA was superior to that of open appendectomy. Whenever a surgeon manages a patient with appendicitis, laparoscopic appendectomy should be considered as the procedure of choice.

Our study had some limitations. Some of the results that were seen in our study may not directly reflect the findings seen in the larger studies. It is likely that with increased number of patients, results may meet what was found in the larger population. Cost analysis was not done in our study. Similarly, our follow-up was limited to four weeks postoperatively and thus long term complications were not evaluated.

CONCLUSION

Laparoscopic appendectomy is associated with less morbidity as compared to open appendectomy with increased clinical comfort in terms less analgesic requirement, fewer wound infections, faster recovery and reduced duration of hospital stay. Even though the duration of operation is more in laparoscopic appendectomy it can be considered a better alternative to open appendectomy.

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