ORIGINAL ARTICLE

Clinical Outcomes of Laparoscopic vs Mini-incision Open Appendectomy: A Comparative Study

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Abstract

Introduction: Open appendectomy was first introduced by McBurney and has been considered as the treatment of choice for more than a century for acute appendicitis. However, recently, laparoscopic appendectomy (LA) has become the popular method of treatment for patients with acute appendicitis.

Aims and objectives: The aim of this study was to compare results of LA with mini-incision open appendectomy in terms of various parameters such as time taken to complete the procedure, postoperative pain, need for analgesia, hospital stay, days to return to normal activity cosmetic results, and complications.

Material and methods: This study was a prospective study conducted in the Department of Surgery, SKIMS Medical College, Bemina, Srinagar, Jammu and Kashmir, India, from July 2017 to June 2019. All patients more than 14 years in age admitted in the accident emergency department of the hospital with a clinical diagnosis of acute appendicitis were included in the study.

Results and observations: Total number of patients studied was 101 and were randomly taken either for mini-incision open appendectomy or laparoscopic surgery. The two groups were comparable with respect to age and sex distribution with no statistically significant difference. The average operative time in mini-incision appendectomy (MIA) group was 32.7 ± 2.52 (30–35 years of age) compared to 26.9 ± 2.46 (24–30 years of age) in laparoscopic group, which was statistically significant. The patients with laparoscopic surgery experienced less pain and had less postoperative wound infection as compared to MIA group with p <0.001, which was statistically significant.

Conclusion: Comparison done on the basis of statistical results between the two groups was suggestive of superiority of LA over MIA.

Keywords: Appendectomy, Appendicitis, Laparoscopy, Pneumoperitoneum, Visual analog scale.

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Introduction

Claudius Amyand, a French surgeon performed first successful appendectomy in 1735, on an 11-year-old child. The appendix was found inside the inguinal hernia sac and had been perforated by the pin. The standard technique for removal of appendix by a muscle splitting incision was first described in 1894 by McBurney. Since then, open appendectomy has remained as a treatment of choice for acute appendicitis.[1] The overall mortality and morbidity rate for open appendectomy has been reported as 0.3 and 11%, respectively.

Laparoscopic appendectomy, first described by Kurt Semm in 1983, is now widely accepted as method of choice for management of acute appendicitis among surgeons using a three-port technique. Although laparoscopic cholecystectomy is presently considered as the treatment of choice for gallstone disease,[2] LA has yet not been accepted as a surgery of choice for appendicitis. In several randomized comparisons studies, LA has been proved to be safe and viable method for removal of appendix. Advantages of LA include improved diagnostic accuracy, lesser wound related complications, less pain, fast recovery, and early return to routine work. The disadvantages of laparoscopy include more operating time and increased hospital costs.[3,4] As reported by several comparative studies, laparoscopy is an ideal alternative to open appendectomy for patients with suspected appendicitis.[5] Although LA is associated with lesser postoperative wound infections, in patients with gangrenous and perforated appendicitis, higher incidence of postoperative intra-abdominal sepsis has been reported.[6] Several studies have concluded that although the cost of laparoscopy is high, the benefit is minimal.

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While managing patients with suspected appendicitis, particularly in women of child bearing age, laparoscopy is an important diagnostic tool to rule out other causes of lower abdominal pain.[7] For assessment of benefits of laparoscopy, several prospective randomized trials, meta-analyses[7–9] and systematic reviews[10,11] have been conducted. However, there is no consensus in the literature about whether to take all patients with appendicitis for laparoscopy or to reserve it only for selected cases such as young females in a reproductive age-group, obese patients, and professional workers.[12]

Aims and Objectives

The aim of this study was to compare LA with mini-incision-open appendectomy in terms of operating time from the start of incision and the end of procedure, intraoperative complications if any, postoperative pain score on visual analog scale (VAS), postoperative

analgesic requirement, postoperative complications, number of days in the hospital, time taken to return routine work and cosmetic results.

Materials and Methods

This study was a prospective study conducted from July 2017 to June 2019 in the Department of General and Minimal Invasive Surgery, SKIMS Medical College, Bemina, Srinagar.

The study included all adult patients admitted in the department of surgery with a diagnosis of acute appendicitis. The patients were randomly taken either for LA or MIA. The total number of patients studied was 101. Laparoscopic appendectomy was done in 49 patients while MIA was done in 52 patients. The patients excluded from the study included those who were symptomatic for more than 5 days, those with a palpable right lower abdominal mass, those with features of peritonitis and shock at the time of presentation, patients with large abdominal hernia, patients with previous history of laparotomies, patients with a severe cardiopulmonary disease, patients with coagulation disorders and cirrhotic liver and all pregnant females. All those patients who had to be converted to open appendectomy were not included in the study.

Preoperative Assessment

All adult patients who reported to surgical emergency with features of appendicitis were subjected to detailed history and clinical examination. Baseline investigations, urine examination, and ultrasound examination of abdomen and pelvis was done in all cases. Computed tomography (CT) abdomen was done wherever there was doubt in diagnosis. Once impression of appendicitis was made, informed consent was taken and patients were subjected randomly to either LA or MIA. Consent for conversion from laparoscopic to an open appendectomy was taken from all patients.

Operative Technique

All procedures were performed under general anesthesia. In a laparoscopic group, Veress needle was introduced through a supraumbilical incision to create pneumoperitoneum. After the pneumoperitoneum was created, the same port was used for inserting a 10-mm trocar for telescope. Telescope was placed through this port and peritoneoscopy performed. Two additional 5-mm trocars were inserted, one in the suprapubic area in the midline and another in right hypochondrium in the mid-clavicular line. The appendix was identified and examined. After this the mesoappendix was divided using harmonic energy source, till the base of appendix was reached (Fig. 1). The base of the appendix was ligated with an endoloop constructed with a Roeder's knot on a No. 1 vicryl thread or No. 1 chromic catgut (Fig. 2). The appendectomy was completed using the harmonic energy source. The appendix was delivered through the 10-mm umbilical port without touching abdominal wall. The appendicular stump was not buried. In patients with peritoneal collection or perforated appendix, normal saline irrigation was carried out and suction drain was placed for 12–24 hours.

In the patients who were taken for MIA, preoperative abdominal examination was done and the tenderest point was marked. From that marked point, a 2.5–3-cm oblique incision was used instead of classical McBurney's incision (Fig. 3). Appendix was delivered through the incision using a finger. Mesoappendix was identified and ligated by 2/0 silk sutures and finally divided. The base of appendix was transfixed using 2/0 vicryl suture (Fig. 3). The knot at the base was further secured using 2/0 silk suture to prevent

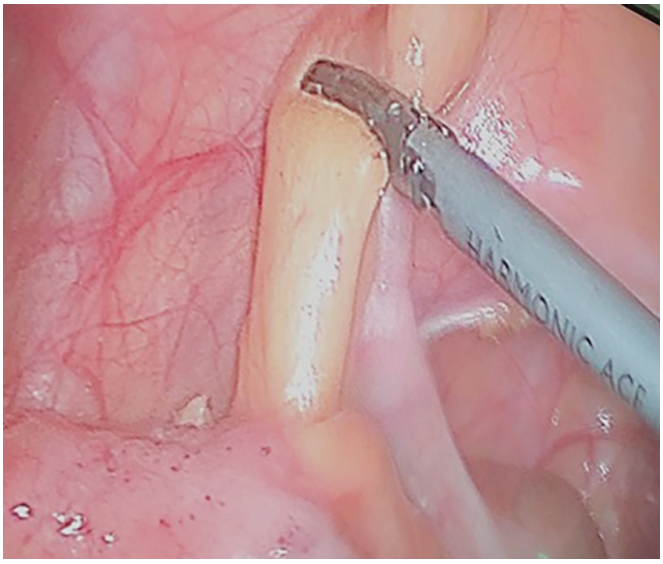

Fig. 1: Dividing mesoappendix with harmonic diathermy

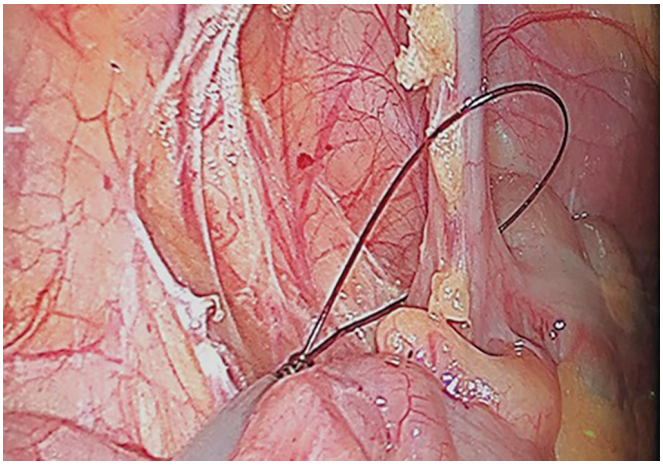

Fig. 2: Endoloop placement during LA

Fig. 3: Appendicular base and cecum as seen through mini-incision

stump leak. The peritoneum and fascia were approximated using 2/0 vicryl sutures. The incision in the skin was closed by using 1/0 non-absorbable suture.

Postoperative Course

In the postoperative period intravenous fluids were continued for 12 hours. All patients were given two doses of third-generation cephalosporin, one dose was given at the time of intubation and another was given 12 hours after surgery. Patients with complicated appendicitis received a combination of third-generation cephalosporin and metronidazole. For purpose of analgesia, all patients were put on paracetamol infusion during the procedure followed by 75-mg intramuscular diclofenac sodium as and when needed.

During the postoperative period, pulse rate, blood pressure, temperature, and respiratory rate were monitored in all patients. All patients were monitored for VAS at 6, 12, and 24 hours after surgery and same was recorded in the already prepared pro forma. The patients were allowed to take a clear liquid diet once the bowel sounds were present, followed by a regular diet. The patients were monitored for various clinical parameters which were recorded in already prepared pro forma. These parameters included total operative time, number of doses of analgesia received in the immediate postoperative period, time taken to resume oral intake, pain score, hospital stay, and complications if any. Pain score was assessed independently by the resident doctors using 10-cm unscaled VAS. The patients were advised to take tablet of aceclofenac 100 mg as an analgesia as and when needed. Total operative time was calculated from the time of incision in the skin till the placement of last suture.

The patients were discharged on oral antibiotics and were advised to take analgesic tablets as and when needed and to keep a record of it. The follow-up was done in the outpatient clinic at weekly intervals for a period of 1 month. During follow-up, a detailed history was taken and thorough examination was done as per the pro forma.

Statistical Analysis

All observed data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of Statistical Package for Social Sciences (SPSS), version 20.0 (SPSS Inc. Chicago, Illinois, USA). Continuous variables were expressed as mean (SD), while categorical variables were expressed as frequencies and percentages. Graphically, the data was presented by bar diagrams. Student's independent *t*-test was used for comparing continuous variables, while Chi-squared test or Fisher's exact test was used for comparing categorical variables. A $p < 0.05$ was considered statistically significant. All *p* values were two-tailed ones.

Results and Observations

The total number of patients studied was 101, out of which 52 were taken for MIA and 49 for LA. We did not convert any of the laparoscopic procedures to open surgery.

The patients who were taken for MIA had a mean age of 31.9 (13.06) years, while the patients who were taken for LA group had a mean age of 32.4 (14.34) years (Table 1). Thus, both groups were comparable as far as the age is concerned, with no statistically significant difference ($p > 0.05$). In MIA group, out of 52 patients, 31 (59.6%) were males and 21 (40.4%) were females, while in LA group, out of 49 patients, 24 (49%) were males and 25 (51%) were females with $p > 0.05$, which is statistically insignificant.

The patients who underwent MIA had an operating time ranging from 30–35 minutes, with a mean of 32.7 (2.52) while patients who were subjected to LA had the operative time ranging from 25–30 minutes, with a mean of 26.9 (2.46). The difference in operating time was statistically significant in favor of LA ($p < 0.001$) (Table 1).

Intraoperative bleeding was seen in 2 (3.84%) patients belonging to MIA group while another 2 (3.84%) patients had an iatrogenic injury to bowel. No such complication was seen in any of the patients taken for laparoscopy ($p > 0.05$) (Table 2).

The patients belonging to LA group experienced less pain in contrast to MIA group on a VAS. The overall pain score in MIA was 2.86 (1.184) in MIA and 2.30 (1.022) in case of LA. This difference in pain between the two groups was statistically significant with a $p < 0.001$ (Table 1).

The number of injectable analgesics needed during the first 24 hours after surgery was significantly higher in MIA group as compared to LA group with $p = 0.002$, which is statistically significant ($p < 0.05$). After discharge from the hospital, the number of analgesic tablets taken by patients who underwent LA was less as compared to patients who underwent MIA, which was again statistically significant (Table 1).

Table 1: Comparison of study variables between two groups

Parameter	*Mini-incision open appendectomy group, N = 52* *Mean (SD)*	*Laparoscopic appendectomy group, N = 49* *Mean (SD)*	*p-value*
Age (years)	31.9 (13.06)	32.4 (14.34)	0.876
Operating time (minutes)	32.7 (2.52) (30–35)	26.9 (2.46) (24–30)	0.001
Intraoperative complications	4	0	0.118
Postoperative pain score on VAS (1–10)	2.86 (1.184)	2.30 (1.022)	0.001
Analgesic injection requirement	2.05 (1.09)	1.41 (0.93)	0.002
Postoperative complication	11	1	<0.008
Hospital stay above 30 hours	52	5	<0.001
Analgesic tablet requirement	5.3 (1.31)	3.2 (1.17)	0.001
Return to routine activities in 1–2 weeks	2 (3.8%)	47 (96%)	<0.001*

*Significant when $p < 0.05$

Table 2: Comparison based on postoperative complications in two groups

	Group MIA		*Group LA*		
Postoperative complications	*Number of patients*	*%*	*Number of patients*	*%*	*p-value*
Wound infection	6	11.5	0	0.0	0.027*
Adhesion obstruction	3	5.8	0	0.0	0.243
Intra-abdominal abscess	2	3.8	1	2.0	1.000
Ileus	4	7.7	0	0	0.118

*Statistically significant difference (p <0.05)

Complications were seen in 11 patients who underwent MIA. It included wound infection in 6 (11.5%), intra-abdominal abscess in 2 (5.8%) and ileus in 3 (7%) patients (Table 2). On the other hand, only one patient with LA had a postoperative complication in the form of intraabdominal abscess. The difference between the two groups as far as the wound infections is concerned was statistically significant with $p = 0.027$ in favor of LA (Table 2).

A total of 36 (73.5%) patients from LA group resumed orals within 12 hours after surgery while more than 84% patients from MIA group resumed orals 24 hours after surgery. The difference was statistically significant with p <0.001 in favor of LA.

All 52 patients belonging to MIA group had hospital stay for more than 30 hours, while out of 49 patients belonging to LA group, 44 (89.8%) had a hospital stay of less than 30 hours, and remaining 5 (10.2%) patients had stay of more than 30 hours, which was statistically significant with p <000.1. The 5 patients from LA group who had hospital stay of more than 30 hours had delayed onset of bowel sounds with postoperative abdominal distension, which was managed conservatively.

In this study, 31 (63.3%) patients from LA group returned to routine work by 1 week while 2 (3.8%) patients from MIA group and 16 (32.7%) patients from LA group returned to routine work by 1–2 weeks. On the other hand, 50 (96.2%) patients from MIA group and 2 (4.1%) patients from LA group returned to routine work after 2 weeks. The p-value was statistically significant (<0.001) in favor of LA.

Discussion

Surgical intervention is the most common modality of management for acute appendicitis. Gridiron incision is the most common approach utilized when diagnosis of appendicitis is reasonably certain. In case the need arises, the gridiron incision may be converted to a muscle cutting Rutherford Morison incision for better exposure. Another popular incision employed widely is a transverse skin incision located approximately 2 cm below the umbilicus with its center on the mid-clavicular-mid-inguinal line. The exposure is better with this type of incision and the incision may be extended medially either by retraction or by division of the rectus abdominis muscle if need arises.[13] Mini-incision appendectomy is done either in general or spinal anesthesia. For the mini-incision approach, an abdominal examination is done and the most painful point is identified and marked preoperatively. From that marked point, a 2.5–3 cm oblique incision is made instead of classical McBurney's incision appendix is delivered through the incision by using an index finger. Mesoappendix is identified and ligated by 2/0 silk suture and finally divided. Base of appendix is transfixed using 2/0 vicryl suture (Fig. 3). The knot at the base is further secured using 2/0 silk suture to prevent stump leak. The peritoneum and fascia are approximated using 2/0 vicryl sutures. The incision in the skin is closed by using 1/0 non-absorbable suture.

Wound infection is the most common postoperative complication seen in 5–10% patients after open appendectomy. The other complications reported include intra-abdominal abscess (8%) and ileus mostly seen following removal of gangrenous appendix. Another rare complication reported is the leakage from appendicular stump, which may occur if the encircling stitch has been put too deeply resulting into a faucal fistula. Subacute intestinal obstruction due to postoperative adhesions is most common late complication of open appendectomy.[4] Laparoscopic appendectomy combines the advantages of diagnosis and treatment in one procedure. With the development of laparoscopic technique, it has been used for both diagnosis and treatment of acute appendicitis.[13] Advantages of LA include lower hospital stays, shorter recovery period, lower postoperative pain, lower postoperative infections, and early return to daily activities.[14–16] Several prospective randomized studies have been carried out to compare outcome of laparoscopic and open appendectomy, and the overall differences have been found to be insignificant. The percentage of appendectomies performed laparoscopically continues to increase.[17] In contrast to open appendectomy, patients with perforated appendicitis have been reported to have lower rates of wound infections following laparoscopic procedure.[18]

In this study, the mean operative time in MIA group was 32.7 (2.52) minutes while in LA group, the mean operative time was 26.9 (2.46) minutes. Laparoscopic appendectomy was less time consuming as compared to MIA with a significant p <0.001. The results of this study were similar and comparable to the results of the study conducted by Özsan et al.[19] with a mean operative time of 21.34 ± 8.39 in LA and a mean operative time of 28.32 ± 5.87 in MIA. This study was also comparable to Islam et al.[18] with an operating time of 33 (5.8) in LA and operating time of 37 (7.5) minutes in MIA. The results of this study were not comparable to the study of Naraintran et al.,[20] in which LA had taken a mean time of 68.5 (20.3) minutes and open appendectomy had taken a mean time of 48.2 (12.4) minutes (p <0.001). In a study by Kushwah et al.,[21] the mean operating time was 60.8 and 45.7 minutes for laparoscopic and open appendectomy, respectively.

In this study, total of four patients from MIA group had bleeding intraoperatively which was managed by electrocoagulation at the same time, while none of the patients from LA group had bleeding intraoperatively, with $p = 0.118$.

In this study, three patients from the MIA group had iatrogenic injury (two had injury to caecum and one to terminal ileum) while handling tissue which were repaired at the same time by primary suturing and putting a drain. None of the patients in LA group had any iatrogenic injury ($p = 0.243$).

In this study, the hospital stay was significantly less in those who underwent laparoscopy as compared to those who underwent MIA group with a statistically significant p <0.001 in favor of LA.

The results of this study were comparable with results of the study conducted by Naraintran et al.[20] and Kushwah et al.[21] In this study, the assessment of the postoperative pain was done by using VAS on day 1 at 6, 12, and 24 hours after surgery followed by further assessment on day 2, 1 week, 2 weeks, 3 weeks, and then 4 weeks after surgery. The postoperative pain score was less in LA group as compared to MIA group and was statistically significant in favor of LA group. This study was comparable with the results of Naraintran et al.[20] Kushwah et al.,[21] and Shaikh et al.[22] In this study, total analgesia required in postoperative period was assessed and calculated as the average number of analgesic injections needed by each patient during the first 24 hours and the need for analgesic tablets after 24 hours. The difference was statistically significant in favor of LA as the average number of analgesic injections needed was 2.05 in MIA group as compared to 1.41 in LA group. The statistically significant difference was also seen in the number of oral analgesic tablets needed by the patients at home. It was 5.3 for the MIA group and 3.2 for the LA group.

Wound infection was not seen in any of the patients who underwent LA. On the other hand, wound infection was seen in six patients who had undergone MIA, which was again statistically significant (p <0.027). Our results are in agreement with the results of other studies conducted by Naraintran et al.[21] and Pedersen et al.[23] This higher rate of wound infection in MIA group was because these cases were operated in emergency theatre where chances of getting infection and developing wound infections are more. While all LAs were performed in main theatre as laparoscope is not available in emergency theatre of our hospital. Those who developed wound infection were managed conservatively with IV antibiotics and daily dressings. Two patients with wound infection had wound dehiscence and needed secondary suturing.

Two patients from MIA group developed intra-abdominal abscess and both patients were managed conservatively with intravenous fluids and intravenous antibiotics and were discharged after complete recovery without any intervention. On the other hand, one patient from LA group reported back to hospital, five days after discharge from hospital with sepsis. The patient was evaluated with ultrasonography and CT abdomen which revealed large intra-abdominal abscess. The patient was taken for diagnostic laparoscopy and about 1 L of pus was drained; normal saline washes were given and drain was placed and finally patient was discharged after five days. The p-value was statistically insignificant ($p = 1$). Our results were comparable with studies of Chung et al.[9] and Garbutt et al.[24] In this study, four patients from MIA group developed ileus, while none of the patients from LA group developed ileus ($p = 0.118$). Results of this study were in contrast to the results of the study done by Shaikh et al.[22]

In this study, 3 patients from MIA group developed intestinal obstruction during a follow-up period of 4 weeks and were managed conservatively. Our results were comparable with the results of the study done by Golub et al.[8] and Biondi et al.[25]

In MIA group, 8 patients resumed orals between 12–24 hours while 44 patients resumed orals 24 hours after surgery. On the other hand, in a LA group, 36 patients resumed orals by 12 hours, 10 patients resumed orals between 12–24 hours and 3 patients resumed orals 24 hours after surgery. This was statistically significant in favor of LA (p <0.001). Our results are in agreement with the results of study conducted by Shaikh et al.[22]

In MIA group, only 2 patients returned to routine work within 2 weeks, while 50 patients resumed normal work after 2 weeks. In LA group, 31 patients resumed their normal activity by 1 week while 16 patients returned to normal work between 1–2 weeks (p <0.001). Our results were in agreement with the results of the studies by Islam et al.,[18] Kushwa et al.,[21] and Shaikh et al.[22]

Conclusion

We conclude that LA is safe and minimally invasive procedure for the management of appendicitis. The main advantages of LA are less intraoperative time, less pain, less analgesic need, early recovery, quick resumption of routine activities, and better cosmetic results.

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