ABSTRACT

Background: Appendectomy is the most common surgical procedure performed in emergency surgery. Because of lack of consensus about the most appropriate technique, appendectomy is still being performed by both open and laparoscopic methods. In this prospective analysis, we aimed to compare the laparoscopic approach and the conventional technique in the treatment of acute appendicitis. Methods: A randomised prospective study done for a period of 2 years from 1st June 2015 to 31st May 2017; Department of Surgery, Anand Hospital Islampur. 200 patients were randomly divided into 2 groups, one undergoing Open Appendisectomy and the other undergoing Laparoscopic Appendisectomy, with each group comprising 100 patients. Duration of surgery, postoperative complications, postoperative hospital stay, postoperative pain and requirement of analgesia, resumption of oral feeds, cost of hospital stay and return to normal activities was compared and noted. Result: Laparoscopic appendisectomy was better than open appendisectomy with respect to the wound infection rate, early resumption of oral feeds, postoperative pain, lesser use of analgesics, postoperative hospital stay (3.13 days after LA, 4.36 days after OA, $P < 0.0001$) and return to normal activities (LA group to OA group; 13.86 days to 19.44 days $P < 0.0001$). Although above mentioned advantages were at the cost of slightly increased duration of surgery (58.29 min in OA group to 74.13 min in LA group $P < 0.000$) and cost of surgery {LA: OA Rs.4225.81: Rs.5560.92 ($P < 0.0001$)}. Conclusion:
Laparoscopic appendectomy was better than open appendectomy with respect to wound infection rate, early resumption of oral feeds, postoperative pain, lesser use of analgesics, postoperative hospital stay and return to normal activities. Although above mentioned advantages were at the cost of slightly increased duration of surgery and cost of surgery.

**KEYWORDS**: Appendisectomy, Laparoscopic, Surgery.

**INTRODUCTION**
Appendicitis is the most common cause of surgical abdomen in all age groups.[1,2] Approximately 7–10 % of the general population develops acute appendicitis with the maximal incidence being in the second and third decades of life.[3] Open appendectomy has been the gold standard for treating patients with acute appendicitis for more than a century, but the efficiency and superiority of laparoscopic approach compared to the open technique is the subject of much debate nowadays.[3-5] There is evidence that minimal surgical trauma through laparoscopic approach resulted in significant shorter hospital stay, less postoperative pain, faster return to daily activities in several settings related with gastrointestinal surgery.[6-7] However, several retrospective studies[3,8-14], several randomized trials[15-20] and meta-analyses[21,22] comparing laparoscopic with open appendisectomy have provided conflicting results. Some of these studies have demonstrated better clinical outcomes with the laparoscopic approach[15-17,20], while other studies have shown marginal or no clinical benefits[18,19] and higher surgical costs.[4,19] Bearing in mind that laparoscopic appendectomy, unlike other laparoscopic procedures, has not been found superior to open surgery for acute appendicitis, we designed the present study to determine any possible benefits of the laparoscopic approach.

The aim of our study was to compare the clinical outcomes on the basis of hospital stay, operating time, postoperative complications, analgesia requirement, time to oral intake and to resume normal activity and the hospital costs between open appendisectomy and laparoscopic appendisectomy.

**METHOD**
A randomised prospective study done for a period of 2 years from 1st June 2015 to 31st May 2017; Department of Surgery, Anand Hospital Islampur. All patients operated for Acute appendicitis and patients who underwent interval appendisectomy were included in the study. 200 patients were randomly divided into 2 groups, one undergoing Open Appendisectomy
and the other undergoing Laparoscopic Appendectomy, with each group comprising 100 patients. Patient diagnosed to have appendicular mass or appendicular abscess either clinically/ultrasound abdomen/intraoperatively were excluded from the study. Patient’s intraoperatively diagnosed to have perforated appendix and intra abdominal abscess were excluded from the study. Patients who underwent any other surgery with appendectomy (Laparoscopic/ Open) were excluded from the study. Patients having any co morbid illness like Tuberculosis, diabetes mellitus, hypertension, bronchial asthma, ischemic heart disease and evaluated for the above diseases were excluded from the study. Patients with ASA category 3, 4 and 5 were excluded. Patients converted from Laparoscopic Appendectomy/Open Appendectomy were considered separately and excluded from the study. All patients were investigated where blood counts, renal parameters and ultrasound abdomen was done. All patients were given pre-operative antibiotics and post-operative antibiotics. Operative time was calculated from the incision to complete closure of the wound. Open appendectomy group underwent through a McBurneys incision. Laparoscopic Appendectomy group was done using a standard 3 trocar approach. Pneumoperitoneum was created with open technique of trocar entry. Sutures used for appendicular stump -Intra corporeal knotting or extra corporeal knotting or using staplers or clips. Intraoperative findings like adhesions, free fluid, dilation, congestion and contents were noted. Position of the appendix was noted. Complications intra-operatively and post-operatively were noted. Determination of length of hospital stay and complications intra-operatively and post-operatively were noted. Post-operative course was monitored for duration of hospital stay in days. Postoperative analgesics which were given were calculated with the number of doses given (Intravenous and Oral). Post-operative pain was assessed daily throughout the patient hospital stay by using a Visual analogue scoring system.

Cost analysis was obtained from hospital billing records. Hospital charges represented the sum of all charges assessed to the patient during their hospitalization. Daily charge represents the fee assessed for bed occupancy, operating room charges (including fees for total time in the operating room and all equipment charges). All Professional charges were deducted. During the follow-up patient was assessed for surgical site infection and pain at the surgical site. Recovery time from returning to the normal activities was also noted.
RESULTS
Two hundred patients were included in the study of which 100 patients underwent laparoscopic appendicectomy (50%) while one hundred fourteen patients underwent open appendicectomy (50%).

Patients were diagnosed to have Acute appendicitis in 118 and Interval group 82. Majority of the patient were in the below 25 yrs constituting 116 patients (58%). Patients were on average 27.18-years-old and ranged from 15 years to 73 years. Mean age for male was 27.7 yrs with the range from 16 yrs to 73 yrs and mean age for female was 26.60 yrs with the range from 15 yrs to 60 yrs (p=0.39).

The mean duration of surgery in open appendicectomy was 58.29 min as compared to 74.13 min in laparoscopic group, which is highly significant (p-0.000). The most common position of the appendix was retrocaecal (37.5%) noted in the study. Intraoperative findings were noted during the procedure and majority had congested and inflamed appendix (83.5%) and distended (36%). In the Open Appendicectomy group, the incision was McBurney incision, 65 patients the stump was buried and 49 patients the stump was transfixed. In Laparoscopic appendicectomy group, 53 patients underwent extracorporeal ligation and 47 patients underwent intracorporeal ligation. There was significant difference in the duration of time in extracorporeal versus intracorporeal ligation (74.53 min to 73.48 min) p-0.000.

Only 2 patients had injury to the bowel in LA group. No uncontrolled bleeding was present. No intra operative complications were encountered in the Open Appendicectomy group. Most common complication noted in the postoperative period was surgical site infection (SSI). It was more common in the Open Appendicectomy group (11 patients- 11%) to no surgical site infection in the Laparoscopic Appendicectomy group (p-<0.000). Paralytic Ileus was the other complication noted in our study groups with 14 patients (Open Appendicectomy - 10{10%}, Laparoscopic Appendicectomy- 4{4%}). Postoperative recovery was noted in early starting of oral feeds, Postoperative pain and postoperative analgesics. Early starting of oral feeds was noted in Laparoscopic Appendicectomy group (15.14 hrs) to Open Appendicectomy group (24.48 hrs) which was highly significant (p-0.000). Postoperative pain was assessed by Visual analogue scale (VAS) in relation to the activity of the patient during rest, normal daily activities and exercise and strenuous work. The pain scoring was less in Laparoscopic Appendicectomy group compared to Open Appendicectomy group (day 1- 6.93 to 5.88; day 2- 5.28 to 3.77; day 3- 4.2 to 3.04; day 4- 3.75 to 2.95) p-<0.000.
Postoperative analgesics requirement was also studied. Diclofenac was the analgesic given to all patients. Laparoscopic Appendisectomy group required less (3.31 IV doses and 2.85 oral doses) doses to Open Appendisectomy group (7.05 IV doses and 4.53 oral doses) which was highly significant (p-0.0001) Table 1.

**Table No 1: Postoperative Analgesia.**

<table>
<thead>
<tr>
<th>Analgesic</th>
<th>Groups</th>
<th>Mean</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral</td>
<td>Laparoscopic Appendisectomy</td>
<td>3.31</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>Open Appendisectomy</td>
<td>7.05</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Laparoscopic Appendisectomy</td>
<td>2.85</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>Open Appendisectomy</td>
<td>4.53</td>
<td></td>
</tr>
</tbody>
</table>

Length of hospital stay ranged from 2 days to 10 days. The length of stay was significantly shorter after Laparoscopic Appendisectomy (3.13 days after LA, 4.36 days after OA, $P < 0.0001$). The operative cost of laparoscopic appendisectomy was greater (OA: LA Rs.4225.81: Rs.5560.92) compared to open appendisectomy which was highly significant (p-0.0001).

Late complications noted in the study were more with Open Appendisectomy group to Laparoscopic Appendisectomy group (7 to 2 patients). In Open Appendisectomy group, 3 patients had SSI, 2 had Sub acute intestinal obstruction, 1 patient had adhesions (noted on diagnostic laparoscopy for ovarian cyst), 1 had intra abdominal abscess. In Laparoscopic Appendisectomy group, 1 patient had SSI and 1 patient had umbilical sinus. In Laparoscopic Appendisectomy group, return to normal activities (13.86 days to 19.44 days) was earlier as compared to the Open Appendisectomy group which was highly significant (p- 0.0001). Histopathology revealed normal appendix in 5 patients in the Laparoscopic Appendisectomy group and 8 patients in the Open Appendisectomy group. For the other patients in both the groups histopathology was suggestive of acute appendicitis (Table 2).

**Table No 2: Comparative Results in the 2 groups.**

<table>
<thead>
<tr>
<th>N=200</th>
<th>LA group (n=100)</th>
<th>OA group (n=100)</th>
<th>P value(&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean duration of surgery in minutes</td>
<td>74.13</td>
<td>58.29</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Surgical site infection</td>
<td>0</td>
<td>11 (11%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Starting of oral feeds</td>
<td>15.14 hrs</td>
<td>24.48hrs</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Length of hospital stay</td>
<td>3.13 days</td>
<td>4.36 days</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Cost of surgery</td>
<td>Rs. 5560.92</td>
<td>Rs. 4225.81</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Return to normal activities</td>
<td>13.86 days</td>
<td>19.44 days</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
DISCUSSION

Acute appendicitis is the most common intra-abdominal condition requiring emergency surgery. The possibility of appendicitis must be considered in any patient presenting with an acute abdomen, and a certain preoperative diagnosis is still a challenge. Although more than 20 years have elapsed since the introduction of laparoscopic appendectomy (performed in 1983 by Semm, a gynaecologist), open appendectomy is still the conventional technique. Some authors consider emergency laparoscopy as a promising tool for the treatment of abdominal emergencies able to decrease costs and invasiveness and maximize outcomes and patients’ comfort. Several studies have shown that laparoscopic appendectomy is safe and results in a faster return to normal activities with fewer wound complications. These findings have been challenged by other authors who observed no significant difference in the outcome between the two procedures, and moreover noted higher costs with laparoscopic appendectomy.

Postoperative stay was significantly more in open appendectomy group when compared to laparoscopic appendectomy group (OA: 4.36 days, LA: 3.13 days; P-0.0001) in the present study. Sauerland and associates\(^{23}\) summarized the results of 28 randomized controlled trials and almost 3000 patients and reported a significant decrease in length of hospital stay in patients undergoing LA. Similar results were found by Golub and colleagues.\(^{24}\)

At a glance the mean operative cost of laparoscopic appendectomy seems to be greater compared to open appendectomy in the present study (LA: Rs 5560.92, OA: Rs 4225.81) which was highly significant (p-0.0001). But considering the total cost of the disease when cost of accommodation, operation and duration of time, daily cost of inpatient stay, hourly cost of operating room and the patients consumption is taken into account laparoscopic appendectomy provides a clinical comfort in all patients. Return to normal activities was more in open group as compared to in the laparoscopic group (OA: 19.44 days, OA: 13.86 days; p-0.0001HS) was shown in the present study. Pendersen AG et.al reported the median time to return to normal activity as 7 days in laparoscopic group to 10 days in open group. Others have also shown that laparoscopic group patients returned to normal work earlier. Because of the competition of laparoscopic and open appendectomy, open appendectomy has improved greatly.
CONCLUSIONS

Our results showed the advantages of the laparoscopic approach over open appendectomy including shorter hospital stay, decreased need for postoperative analgesia, early food tolerance, and earlier return to work, lower rate of wound infection, against only marginally higher operative time higher hospital costs. Furthermore we found a considerable preference (during the collection of consent) of patients and a high satisfaction after the surgery in the laparoscopic group. Laparoscopy could be considered safe and equally efficient compared to open technique and should be undertaken as the initial procedure of choice for most case of suspected appendicitis. However, since there is no consensus to the best approach, both procedures (open and laparoscopic appendectomy) are still being practiced actively deferring the choice to the preference of surgeon and patients. In the future, laparoscopic appendectomy could represent the standard treatment for patients with appendicitis and undiagnosed abdominal pain.

REFERENCES


