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## Laparoscopic versus open appendectomy: A comparative study

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### Abstract

The current study was done to compare the effectiveness, safety and clinical outcome between Laparoscopic and Open Appendectomy in terms of operating time, complications and length of hospital stay. Patients undergoing Appendectomy by Laparoscopic and Open technique from November 2016 to October 2017 were enrolled in the study after fulfilling eligibility criteria. According to surgical approach patients were randomly divided into two groups Laparoscopic Appendectomy Group (LA group) & Open Appendectomy Group (OA group) respectively. The following parameters were assessed primarily in terms of operating time, resumption of oral diet, length of hospital stay, no. of analgesic doses, conversion rate, post-operative pain, Intraoperative and post operative complications like wound infection, prolong ileus, intraabdominal abscess, diarrhea and urinary tract infection. **Results:** We found that operating time was comparable in both groups, resumption of oral diet was earlier in LA Group as compare to OA Group (with p value of <0.0001) which was statistically significant, No. of analgesic doses used, length of hospital stay, Postoperative pain, Intraoperative and postoperative complications was less in LA Group whereas 2 patients in LA group was converted to open Group but difference was statistically significant. **Conclusion:** we concluded that Laparoscopic Appendectomy is safe and effective than Open Appendectomy irrespective of the indication for conversion to open.

**Keywords:** appendectomy, laparoscopy, Mc burney

### 1. Introduction

Acute appendicitis is one of the most common cause of acute abdomen seen in surgical practice, requiring emergency surgery. The life time rate of appendectomy is 8.6% and 6.7% among male and female respectively <sup>[1]</sup>. According to the literature, approximately 7% of the population diagnosed with appendicitis in their life time with peak incidence between the age of 10 and 30 years, thus making appendectomy the most routinely performed abdominal surgery <sup>[2]</sup>. Appendectomy is the second most common surgical procedure performed in USA, after laparoscopic cholecystectomy and most common intraabdominal surgical emergency, with life time risk of 6%. The overall mortality is around 0.3% and morbidity around 11% <sup>[3]</sup>.

Open appendectomy performed through right lower quadrant incision was first described by Mc Burney in 1894 in New York. He pioneered early diagnosis and early surgical intervention and also popularized the muscle splitting incision named after him <sup>[4]</sup>. Although more than a century has elapsed since Mc Burney first performed open appendectomy, this procedure remained the standard treatment of choice for acute appendicitis and has remained unchanged for most surgeons due to its favorable safety and efficacy <sup>[5]</sup>.

Kurt Semm, a German gynaecologist performed the first laparoscopic appendectomy in 1981 <sup>[6]</sup>. Laparoscopic appendectomy reported to be a viable and safe procedure and has gained worldwide acceptance. The clinical advantages of laparoscopic appendectomy like lower incidence of wound infection reduced hospital stay, faster recovery, shorter post operative ileus, reduced postoperative pain and better post operative scar has been reported over the years by several studies <sup>[6]</sup>.

As the use of laparoscopy is increasing in appendectomy, data are needed to compare its safety and efficacy in patients suffering from acute appendicitis. Therefore it is purposed to take this study to compare therapeutic effects, safety and clinical outcome of laparoscopic versus open appendectomy.

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## 2. Aims and objective

1. To compare the effectiveness and safety of Laparoscopic versus Open appendectomy in treatment of Acute Appendicitis.
2. To compare the clinical outcome between Laparoscopic and Open Appendectomy in terms of operating time, complications and length of hospital stay.

## 3. Material and methods

This prospective study was conducted in the Post Graduate Department of Surgery; Government Medical College and Associated Hospital Jammu after obtaining approval from Institutional Ethical Committee. The study included patients undergoing Appendectomy by Laparoscopic and Open technique from November 2016 to October 2017. Patients admitted in department of surgery for acute appendicitis were enrolled in the study after fulfilling eligibility criteria. According to surgical approach patients were randomly divided into two groups.

Group A: - Laparoscopic Appendectomy Group (LA group)

Group B: - Open Appendectomy Group (OA group)

After explaining the study, a written informed consent was taken from every patient.

### 3.1 Criteria for inclusion

1. Age 10 years and above.
2. Clinical diagnosis of acute appendicitis (History of right lower quadrant pain or periumbilical pain migrating to the right lower quadrant with nausea and/or vomiting, fever of more than 38°C and/or leukocytosis >10000 cells per ml, right lower quadrant guarding, and tenderness on physical examination).

### 3.2 Criteria for exclusion

1. Diagnosis of acute appendicitis not clinically established as per inclusion criteria.
2. History of symptoms for more than 5 days.
3. Appendicular lump felt clinically or confirmed by ultrasonography.
4. Contraindication to General Anesthesia (Severe cardiac or pulmonary disease, cirrhosis, coagulation disorders).
5. Pregnancy.
6. Generalized peritonitis, shock on admission.

All patients who meet the inclusion criteria were enrolled in study groups were thoroughly examined and investigated. The surgeons experienced in open and laparoscopy technique performed the procedure. The patients which were enrolled in laparoscopy appendectomy (LA Group) were operated under general anaesthesia, whereas the patients in open appendectomy (OA Group) were operated under Spinal anaesthesia or General anaesthesia. The patients in both groups received appropriate antibiotic coverage from the time of diagnosis till 48 hrs after surgery. Urinary catheter was inserted in patients of LA Group preoperatively and was removed immediately post procedure in operating room. Injection Diclofenac sodium 75 mg intravenously (injection tramadol 50 mg intravenously where there will be any contraindication to NSAIDS) was administered every 8 hours postoperatively for first 24 hours and further on demand. Nasogastric tube was inserted in patients with significant postoperative ileus. Appendectomies were performed using standard open and laparoscopic techniques. Postoperatively patient were started on clear liquid diet once bowel sounds are audible and advanced to normal diet when the

liquid diet is tolerated. Patients were discharged when they were afebrile and tolerating normal diet.

### 3.3 Operative technique

In open appendectomy group (OA Group): Appendectomy was performed through Mc burney splitting incision in the right lower quadrant.

In laparoscopy appendectomy (LA group): Appendectomy was performed by standard 3 ports laparoscopic technique after creating pneumoperitoneum by continuous pressure of 10-12 mmHg of carbon dioxide. A 10mm trocar was placed in the periumbilical area and two additional trocars 5 or 10mm in the suprapubic area and 5mm trocar in the left lower abdominal quadrant was introduced under vision.

Following Parameters were recorded:

1. Operating time: was calculated from the time of incision to the placement of last stitch for wound closure.
2. Post operative hospital stay: was calculated and defined as period between time of shifting of patient to recovery ward up to discharge from the ward.
3. No. of analgesic doses: No. of doses of injectable analgesic given post operatively was recorded.
4. Time of resumption of oral fluid: was calculated from the time of completion of surgery.
5. Conversion rate.
6. Postoperative pain.
7. Postoperative complications like wound infection, intra abdominal abscess, prolonged ileus, diarrhea and urinary tract infection.

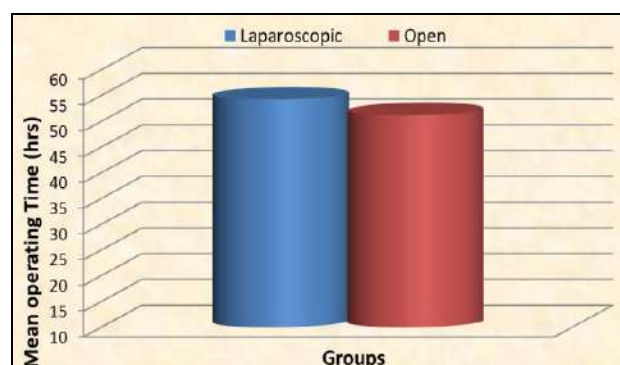
## 4. Results

Patients were randomly distributed into 2 groups each comprising of 40 patients. Group LA –Laparoscopic Appendectomy & Group OA –Open Appendectomy. A descriptive statistical analysis based on frequency tables of categorical values was performed, using a Chi-square test, to test the significance of the association between qualitative variables and the results were expressed as percentages. The data collected to age and sex distribution was comparable between two groups

**Table 1:** Group comparison for Operating Time (hrs)

Operating Time (hrs)	Mean ± SD	
	Laparoscopic	Open
	54.23 ± 8.10	51.18 ± 9.67
P- value	0.135 NS	

Mean operating time in LA group ranges from 54.23 ± 8.10 and OA group ranges from 51.18 ± 9.67.

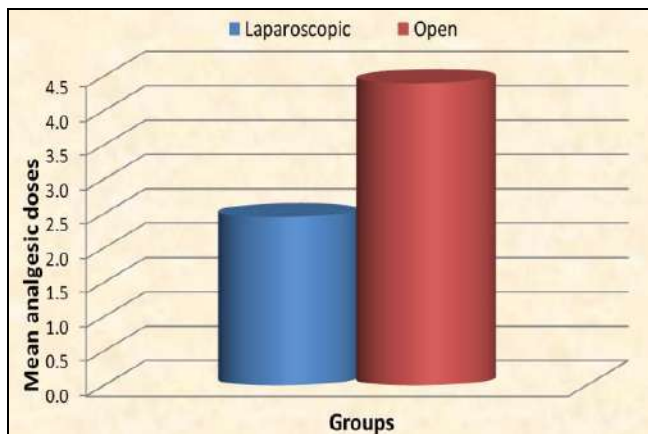


**Fig 1:** Graphical representation of mean Operating time (hrs.) in LA and OA Group

**Table 2:** Comparison for number of Analgesic doses

Analgesic doses	No. of patients (%)	
	Laparoscopic	Open
1	3 (7.50)	0 (0.00)
2	18 (45.00)	0 (0.00)
3	16 (40.00)	4 (10.00)
4	1 (2.50)	22 (55.00)
5	0(0.00)	10 (25.00)
6	2 (5.00)	2 (5.00)
7	0 (0.00)	2 (5.00)
Mean ± SD	2.58 ± 1.03	4.40 ± 0.93
P- value	<0.0001	S

85% of patients in LA group required 2-3 analgesic doses whereas 80% of patients in OA group required 4-5 analgesic doses. Maximum number of analgesic doses required in LA group was 4 in two patients and in OA group 7 in two patients.

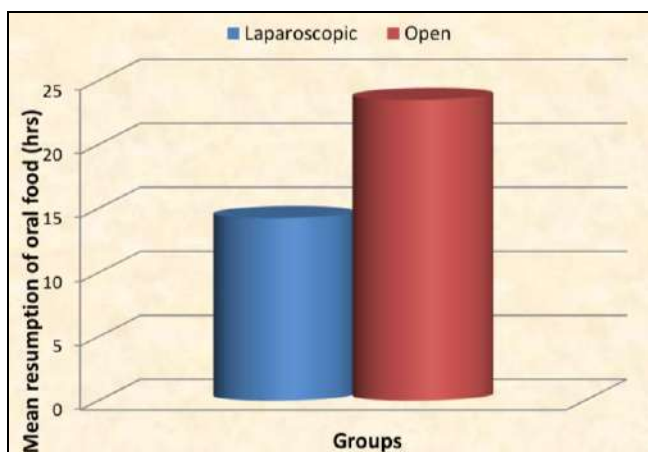


**Fig 2:** Graphical representation of mean Analgesic doses in LA and OA Group

**Table 3.** Comparison for resumption of oral food (hrs)

Resumption of oral food (hrs)	Mean ± SD	
	Laparoscopic	Open
	<b>14.25 ± 6.86</b>	<b>23.50 ± 12.34</b>
P- value	<0.0001	S

Mean time for resumption of oral food in LA group ranges from 14.25 ± 6.86 and 23.50 ± 12.34 in OA group p value <0.0001 which is statistically significant.

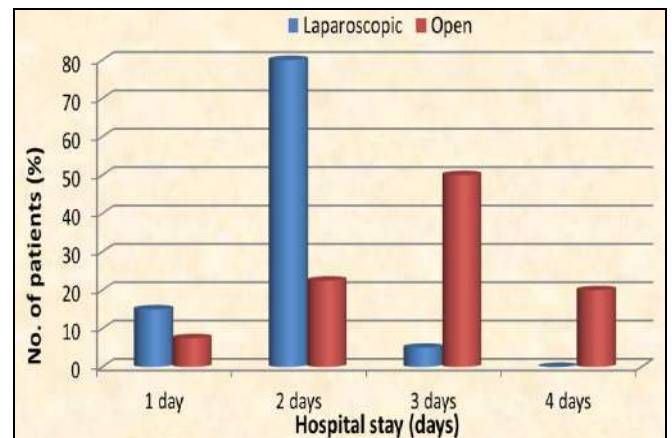


**Fig 3:** Graphical representation of mean Resumption of oral food (hrs.) in LA and OA Group

**Table 4:** Comparison for Length of Hospital stays (days)

Hospital stay (days)	No. of patients (%)	
	Laparoscopic	Open
1 day	6 (15.00)	3 (7.50)
2 days	32 (80.00)	9 (22.50)
3 days	2 (5.00)	20 (50.00)
4 days	0 (0.00)	8 (20.00)
Mean ± SD	1.90 ± 0.44	2.83 ± 0.84
P- value	<0.0001	S

Length of hospital stay in LA group ranged from 1.90 ± 0.44 and in OA group ranged from 2.83 ± 0.84 with p value <0.0001 which is statistically significant. In LA group 38(95%) of the patients discharged in 2 days whereas in OA group 12(30%) were discharged in 2 days and 32(80%) discharged in 3 days.

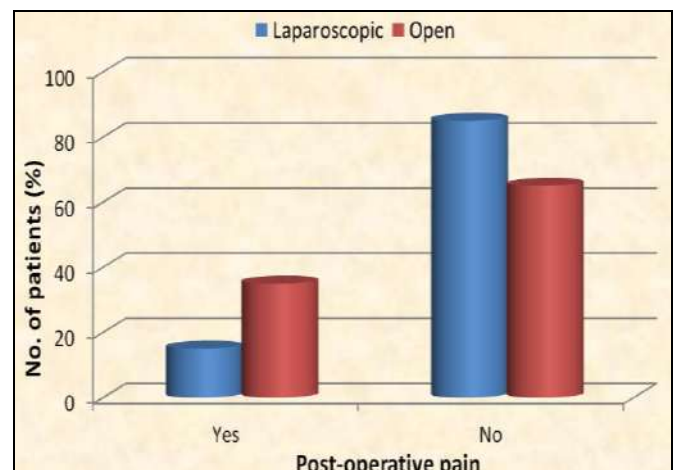


**Fig 4:** Graph representing Length of Hospital stay in days in LA and OA Group

**Table 5:** Comparison for Post-operative pain

Post-operative pain	No. of patients (%)	
	Laparoscopic	Open
Yes	6 (15.00)	14 (35.00)
No	34 (85.00)	26 (65.00)
P- value	<0.0001	

In LA group 6 (15%) patients complained of pain whereas in OA group 14 (35%) patients complained of pain with P value <0.0001 which is statistically significant

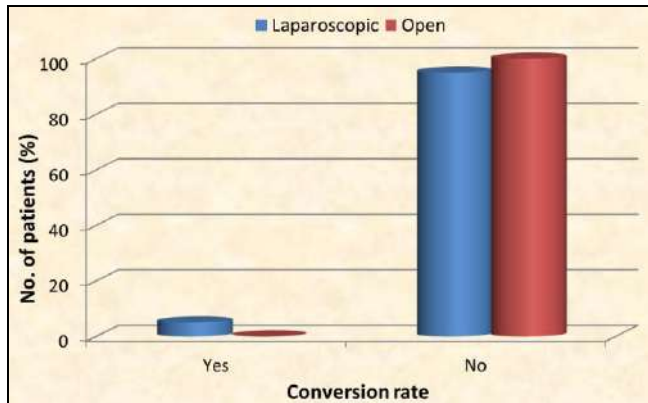


**Fig 5:** Graphical representation of number of patients with postoperative pain in LA and OA Group

**Table 6:** Group comparison for Conversion rate

Conversion rate	No. of patients (%)	
	Laparoscopic	Open
Yes	2 (5.00)	0 (0.00)
No	38 (95.00)	40 (100.00)
P- value	0.021	S

In LA group 2 (5%) patient were converted to open with P value 0.021 which is statistically significant.

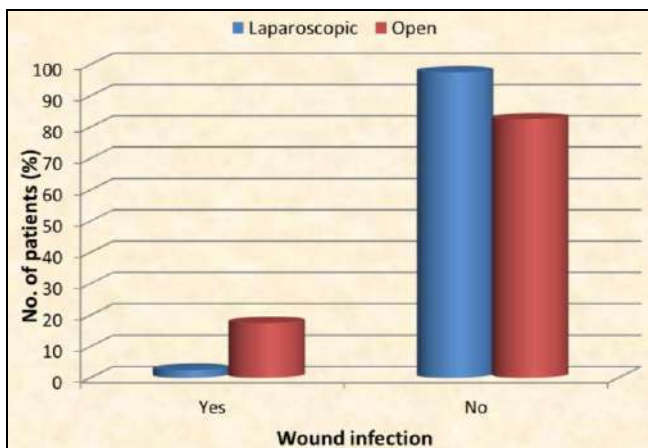


**Fig 6:** Graphical representation of conversion rate in LA and OA Group

**Table 7:** Comparison for Wound infection

Wound infection	No. of patients (%)	
	Laparoscopic	Open
Yes	1 (2.50)	7 (17.50)
No	38 (97.50)	33 (82.50)
P- value	<0.0001	S

In LA group 1(2.5%) patient had wound infection whereas in OA group 7(17.5%) patients had wound infection with P value 0.0001 which is statistically significant. OA group has higher wound infection rate compared to LA group.

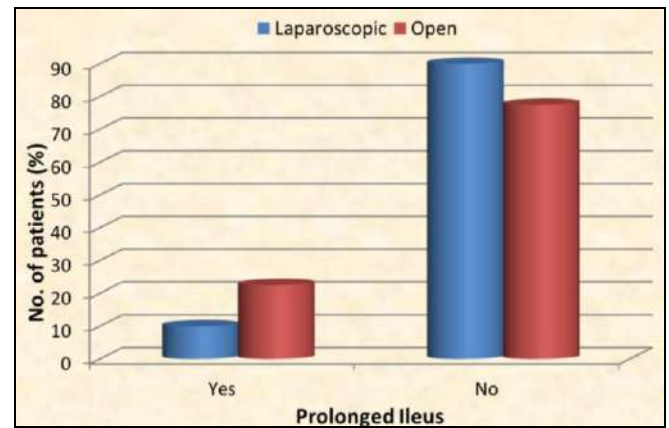


**Fig 7:** Graphical representation of Wound infection in patients in LA and OA Group

**Table 8:** Group comparison for Prolonged Ileus

Prolonged Ileus	No. of patients (%)	
	Laparoscopic	Open
Yes	4 (10.00)	9 (22.50)
No	36 (90.00)	31 (77.50)
P- value	0.022	

In LA group 4(10%) patient had prolonged ileus whereas in OA group 9(22.5%) patient had prolonged ileus with P value 0.022 which is statistically significant



**Fig 8:** Graphical representation of No. of patients (%) with Prolonged ileus

**5. Discussion**

Laparoscopy is a major surgical advance that has enabled the general surgeon to stretch his hands in the superspeciality area. The controversy that currently exists over the reported benefits of Laparoscopic Appendectomy motivated us to analyze our experience with this procedure. Open appendectomy has been the procedure of choice for treatment of acute appendicitis for more than a century. Although it is a safe procedure but postoperative complications occur in 10-20% of cases [8] and is also associated with post operative pain affecting the normal activity. Thus we conducted the study to compare the therapeutic effects, safety and clinical outcome of laparoscopic appendectomy versus open appendectomy.

Operating time: In our study mean operating time in LA group was 54.23 ± 8.10 and OA group was 51.18 ± 9.67 with a p value of 0.135 which was comparable and not statistically significant. We measured operating time from making of incision to application of last stitch. Our results are in accordance with results obtained by [7, 5, 9] observed that mean operating time was similar for these two procedures with a difference of 2-9 minutes in favor of OA group that was statistically not significant.

Our results are not in accordance with results obtained by [10] who reported laparoscopic approach takes 12.35 min longer than open surgery (p <0.0001) which is statistically significant. This finding is related to the experience of the surgeon who carried out the laparoscopic procedure mainly in case of complicated appendicitis in which laparoscopic dissection can be technically complex and therefore time consuming.

Number of analgesic doses: In our study analgesic dose requirement was more in OA group than in LA group. In LA group mean analgesic dose required was 2.45 ± 0.71 and in OA group analgesic dose required was 4.40 ± 0.93. Similar results were obtained by [2, 11, 12] they showed number of analgesic dose requirement was less in LA group than OA group, frequency of use of analgesia was less in laparoscopic appendectomy as compared to open appendectomy.

Small trocar incisions of laparoscopy also leads to minimum trauma to abdominal wall, less pain and faster recovery. Thus this could be the reason that number of analgesic use was less in LA group as compared to OA group.

Resumption of oral food (hrs.) So far as resumption of oral food is concerned, patients in LA group had early resumption of food (mean  $14.25 \pm 6.86$ ) as compared to OA group (mean  $23.50 \pm 12.30$ ). The difference was statistically significant ( $p < 0.0001$ ). Similar results obtained by [10, 12, 2] showed that laparoscopic approach leads to reduction of this period as compared to open approach and resumption of oral food (hrs) was earlier in LA group than OA group.

### 5.1 Length of hospital stay

In our study mean length of hospital stay was less in LA group ( $1.90 \pm 0.44$ ) as compared to OA group ( $2.83 \pm 0.84$ ). In LA group most of the patients were discharged on second day and the maximum length of stay was 3 days in 2 patients. In OA group most of the patients were discharged on third day and maximum length of stay was 4 days in 8 patients. The P value is  $< 0.0001$  which was statistically significant. This could be because the minimally invasive operation (LA) by definition allow for a quicker recovery as compared to open surgery.

Similar results were also obtained by [13, 14, 11] reported length of hospital stay was shortened by 1.1 day in laparoscopic approach and duration of hospital stay was significantly low for laparoscopic group ( $2.84 \pm 0.9$ ) as compared to open group ( $7.68 \pm 2.38$ ). It has been shown that shorter hospital stay in LA group as compared to OA group was attributed to minimal trauma to abdominal wall which is a significant factor in post-surgical discomfort and lead to better mobility and earlier ambulation.

### 5.2 Postoperative pain

Postoperative pain was assessed both subjectively and objectively by tabulation of analgesic use and postoperative complain of pain. In our study patients in LA group had less postoperative pain as compared to OA group. A total of 85% patients were pain free in LA group whereas 65% had pain in OA group. P value was  $< 0.0001$  which was statistically significant. Our results also match with those of [1, 15, 5] they observed pain score was  $3.14 \pm 0.63$  for open group as compared to  $2.4 \pm 0.90$  in lap group ( $p < 0.05$ ) which was statistically significant and reported less pain in first 48 hrs after lap appendectomy. Smaller incision and minimal tissue handling may be the reason for decreased postoperative pain perception in laparoscopic group.

### 5.3 Conversion rate

No patient in OA group was converted to laparotomy whereas 2 patients in LA group (5%) were converted to open appendectomy because of complicated appendicitis. The difference was statistically significant ( $p < 0.021$ ). Our results were in accordance with [3, 16], observed conversion was required in 6 patients in laparoscopy group (7.3%) as compared to open group because patients had complicated appendicitis (perforated or gangrenous).

### 5.4 Postoperative complications

Regarding postoperative complications in our study we found that OA group was associated with more complications like wound infection, postoperative ileus when compared with LA group. Whereas other complications like intraabdominal abscess, urinary tract infection and diarrhea were comparable. Wound infection was seen in 17.5% patients of OA group as compared to 2.5% in LA group; prolonged ileus was seen in 22% of patients in open appendectomy and 10% patients with laparoscopic appendectomy. Our results are in accordance with

results obtained by [1, 10, 17] reported wound infection was more common after open appendectomy (20%) than laparoscopic appendectomy (4%). Similar results were obtained by [18, 19] they concluded that LA was better than OA with respect to postoperative wound complications.

The reduced incidence of wound infection is a major advantage of LA. The extraction of specimen with a bag and through a trocar port rather than directly through surgical wound as done in open procedure can explain reduced incidence of infection. More over smaller size of lap incision as compared to open also reduces the probability of infection.

In our study prolonged ileus was seen in 22% of the patients in OA group and 10% of patients in LA group ( $p < 0.022$ ). Similar results were obtained by [17, 20] reported that laparoscopic appendectomy was associated with lesser postoperative ileus compared to open appendectomy Our results are also in accordance with [7] who reported total no. of complication was less in LA group as compared to OA group.

## 6. Summary

We aimed to compare the effectiveness, safety and the clinical outcome between Laparoscopic and Open Appendectomy in terms of operating time, complications and length of hospital stay of Laparoscopic versus Open appendectomy in treatment of Acute Appendicitis. All the patients were comparable with respect to age and sex. The following parameters were assessed primarily in terms of operating time, resumption of oral diet, length of hospital stay, no. of analgesic doses, conversion rate, post operative pain, Intraoperative and post operative complications like wound infection, prolong ileus, intraabdominal abscess, diarrhea and urinary tract infection

Operating time: We found that operating time was comparable in LA group and OA Group.

Resumption of oral diet: We found that resumption of oral diet was earlier in LA Group ( $14.256 \pm 86$ ) as compare to OA Group ( $23.501 \pm 2.34$ ) with p value of  $< 0.0001$  which was statistically significant.

No. of Analgesic doses: No of analgesic doses used was less in LA group than OA group.

Length of hospital stay: length of hospital stay was less in LA Group, maximum no. of patients discharged on 2<sup>nd</sup> day in LA group as compare to 3<sup>rd</sup> day in OA Group.

Conversion rate: 2 patients in LA group was converted to open Group.

Postoperative pain: was less in LA Group as compare to OA Group.

Intraoperative and postoperative complications: were seen to be less in LA group as compared to OA group.

## 7. Conclusion

On analyzing the data, we found a definite difference in the outcome between Open and Laparoscopic appendectomy in selected patients. We conclude that the laparoscopic method of appendectomy is better than the open method for acute appendicitis as LA is associated with less postoperative pain, reduced no. of analgesics used, earlier resumption of oral food and decreased length of hospital stay, fewer intraoperative and post operative complications although operating time is comparable and conversion rate is more in laparoscopic appendectomy. Laparoscopic Appendectomy is safe and effective than Open Appendectomy irrespective of the indication for conversion to open. Overall, Laparoscopic Appendectomy is better than Open Appendectomy in patients with acute appendicitis.

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