



A Comparative Study of Laparoscopic Appendicectomy and Open Appendicectomy

Authors

Dr B.S Ramesh¹, Dr Sharanappa Beragi²

¹Prof and HOD, Department of General Surgery, Dr.B.R.Ambedkar Medical College, Bengaluru, Karnataka

²Postgraduate, Department of General Surgery, Dr.B.R.Ambedkar Medical College, Bengaluru, Karnataka

Corresponding Author

Dr Sharanappa Beragi

Address: #5, GPK14-4-116, Radhakrishna Colony, Kuknoor, TQ; Yelburga Dist; Koppal, 583232

Email: drsharanberagi@gmail.com, Mobile no-9591440888

ABSTRACT

Aims and Objectives: Comparative study between laparoscopic appendicectomy and open appendicectomy in terms of safety and benefits with respect to duration of operation, post-operative pain, resumption of oral diet, duration of hospital stay, incidence of complications and cost.

Methods: Prospectively collected data from 120 consecutive patients between October 2014 and September 2016 with acute and recurrent appendicitis were studied. These comprised of 60 patients who underwent conventional appendicectomy and 60 patients treated laparoscopically. The two groups were compared with respect to duration of operation, post-operative pain, resumption of oral diet, duration of hospital stay, incidence of complications and cost.

Results: Most patients presented in second-third decade of life. Laparoscopic appendectomy was associated with a shorter hospital stay (3.22 Vs 5.87 days, $P=0.001$), longer operating time (70.83 ± 18.28 vs 52.00 min, $P < 0.001$), less Post operative pain scores (0.47 vs. 0.73; $P < 0.001$) at discharge, early resumption of normal diet. Post operative complications were equal in both groups. The total cost of hospital stay was not significantly higher in laparoscopic appendicectomy than open appendicectomy group (11944.78 ± 12170.85 Vs 11149.90 ± 1988.76 INR, $p < 0.619$) respectively. There was no mortality in either group.

Conclusion: Overall, laparoscopic appendicectomy is better than open appendicectomy in selected patients with acute or recurrent appendicitis.

Keywords: Laparoscopic appendicectomy, open appendicectomy, conventional appendicectomy, Acute appendicitis.

INTRODUCTION

Acute appendicitis continues to be the most common cause of an 'acute abdomen' in young adults and, as such, the associated symptoms and signs have become a paradigm for clinical teaching. Appendicitis is sufficiently common that appendicectomy is the most frequently performed

urgent abdominal operation and is often the first major procedure performed by a surgeon in training accounts for approximately 1% of all surgical operation.^{[1],[2]}

Even though modern diagnostic facilities, surgery skills, fluids and antibiotic therapy have brought down the mortality from 50% (before 1925) to

less than 1/1,00,000 persons, still the morbidity is more than 5-8%, mainly due to wound infection because of delayed diagnosis and treatment.^[3]

Although more than a century has elapsed since Mc Burney first performed open appendectomy^[1], this procedure remains the treatment of choice for acute appendicitis for most surgeons for nearly a century until 1983, when Curt Semn performed the first laparoscopic appendectomy.^[6] The introduction of laparoscopic surgery has dramatically changed the field of surgery. With improvements in the equipment and increasing clinical experience it is now possible to perform almost any kind of procedure under laparoscopic visualization. But even then, the efficiency and superiority of laparoscopic approach compared to the open technique has been the subject of much debate with different clinical trials with varied result.^[7]

The advantages of laparoscopic appendectomy over open appendectomy are thought to be less postoperative pain, shorter hospital stay and early return to usual activity.^{[4],[5]} While the incidence of postoperative wound infection is thought to be lower after the laparoscopic technique, the incidence of postoperative intra-abdominal sepsis may be higher in patients operated on for gangrenous or perforated appendicitis.^{[4],[5]}

Though multiple prospective randomized trials, meta-analyses^{[8]-[10]} and systematic reviews^{[11],[12]} have been conducted to assess the value of LA over OA, the heterogeneity of the measured variables and other weaknesses in methodology have not allowed to draw definitive conclusions and generalizations.^{[11],[12]} Hence the “gold standard” modality of treatment for clinically confirmed appendicitis is still not established.

In the present study, we aim to compare the laparoscopic approach and the conventional technique in the treatment of acute appendicitis, using prospectively collected data from patients subjected to appendectomy between between October 2014 and September 2016.

AIMS AND OBJECTIVES OF STUDY

Comparative study between laparoscopic appendectomy and open appendectomy in terms of safety and benefits with respect to

- 1) Duration of operation
- 2) Post operative pain
- 3) Resumption of oral diet
- 4) Duration of hospital stay
- 5) Incidence of complications
- 6) Cost.

METHODOLOGY

Source of data: A prospective observational study will be conducted on patients admitted to our hospital, with symptoms suggestive of acute or recurrent appendicitis during the period from October 2014 to September 2016.

Method of collection of data

Sample & Sampling Technique: Prospective study from October 2014 to September 2016 involved 120 cases that were consecutively selected, where the investigator was a part of the surgical team managing the patients, by using random sampling technique.

A sample of size 60 each laparoscopic and open appendectomy case will be selected using purposive sampling technique and compared in terms of

- 1) Duration of operation.
- 2) Post operative pain.
- 3) Resumption of oral diet.
- 4) Duration of hospital stay.
- 5) Incidence of complications (intraoperative & post-operative).
- 6) Cost.

Inclusion criteria:

1. Patients age >10 years of age
2. Both sexes
3. Patients seen at the surgical department of our hospital who were provisionally diagnosed of having Acute Appendicitis with clinical suspicion and investigatory support later confirmed by intraoperative findings.

Exclusion criteria:

1. Patients with any other significant illness which is likely to affect the outcome more than the disease in study.
2. Patients who are unfit for surgery.
3. Patients not willing for surgery.
4. Generalized peritonitis
5. Appendicular mass or abscess
6. Pregnancy

Open appendectomy was performed either under general anesthesia or spinal anesthesia, through a muscle splitting incision in the right iliac fossa. The base of the appendix was crushed and ligated and the stump of the appendix was not invaginated. Laparoscopic technique performed under general anesthesia using a standardized approach involving the open technique for the trocar insertion and by 3- port technique. The appendix was divided after double ligation of the base. Appendix extraction was performed using trocar sleeve to protect the wound from contamination during removal.

All cases were followed in the postoperative period till they were discharged and then later followed for a period of 4 weeks in the outpatient department.

The following parameters were observed during the follow up in comparison between the two procedures, the duration of surgery in minutes, resumption of oral diet in days, post operative pain using a verbal response pain scale from 0 to 5, 0 being no pain and 5 being the worst possible pain,. Duration of analgesic use in number of days, post operative complications like wound infection, intra-abdominal abscess and peritonitis.

Patients in both the study groups were discharged as soon as possible, when they were on a normal diet, afebrile for 24 hours, when fully mobilized without need for analgesics. Duration of stay after surgery in number of days, and the total cost of hospital stay was noted.

Wound infection was defined as discharge of pus that required surgical drainage. Peritonitis was defined as generalized inflammation of the peritoneum. Intra-abdominal abscess was defined as a fluid collection diagnosed at ultrasonography or computed tomography which contained pus at the time of drainage.

A proforma was used to collect the relevant information. The data collected will be analyzed statistically using descriptive statistics namely the Students t-test, Chi-square analysis, Proportion, Mean, Standard Deviation wherever applicable and P value of <0.05 was considered significant.

OBSERVATION AND ANALYSIS

A total of 120 patients with acute and recurrent appendicitis were admitted during the study period. 60 patients were subjected to open appendectomy and 60 patients to laparoscopic appendectomy. Most of the patients in our study were between 10-30 age group (Table 1, Figure-1). The age of presentation was comparable between either groups (p is not significant). The patient were most often symptomatic in the second and third decade of life (p is significant) in either group. The mean age of the patients in open and laparoscopic appendectomy was 22.9 and 25.8 years respectively (Table 1).

Table 1: Age distribution of patients studied

Age in years	Open Group	Laparoscopy Group	Total
10-20	46.7	33.3	40
21-30	35	40	37.5
31-40	11.7	18.3	15
41-50	6.7	3.3	5
>50	0	5	2.5
Total	100	100	100
Mean \pm SD	22.92 \pm 9.13	25.80 \pm 10.71	24.36 \pm 10.02

Samples are age matched with P=0.115

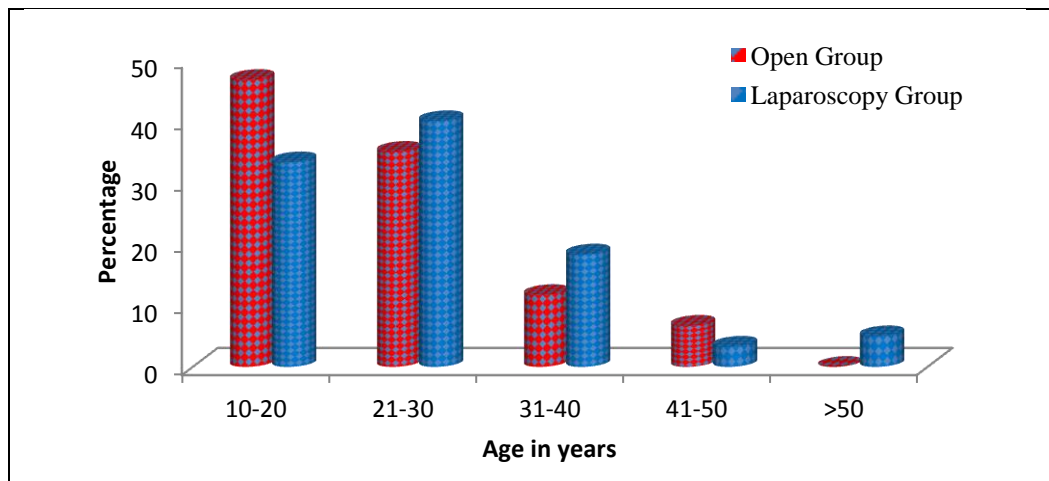


Figure-1: Age distribution.

In our present study 76.7% patients of open appendicectomy and 45% patients of laparoscopic appendicectomy were males. 23.3% patients of open and 55% of laparoscopic appendicectomy were females (Table 2). Most of the patients in either group complained of abdominal pain [56(93.3%) in open group and 55 (91.7%) in laparoscopic group]. History of vomiting was present in 35(58.4%) of open and 40 (67.3%) of laparoscopic group. The other complaint was fever in 26 (43.3%) of open and 24 (40.3%) of laparoscopic group (Table 3, Figure-2). Among 120 patients 33.3 % of open group and 15% of laparoscopic group had the history of episodes of abdominal pain in the past. Rest of the patients 66.7% and 85% of the patient of open and laparoscopic group respectively had the Acute episode (Table 4). Most of the patients in either group not associated with any diseases or any previous surgeries. All patients in either group

who underwent surgery were within ASA grade 3, most common being ASA grade 1. The TLC (WBC Count) was elevated beyond the higher limit of normal value of 11000 cu/mm in 80% patients who underwent open surgery as compared to 60% Patients who underwent laparoscopic surgery (Figure-3). The preoperative ultrasonography showed an inflamed appendix in 74.2 % of the patients. In laparoscopic group showed 68.3% and open appendicectomy were 80% of inflamed appendix (Table 5).

Table 2: Gender distribution of patients studied

Gender	Open Group	Laparoscopy Group	Total
Female	23.3	55	39.2
Male	76.7	45	60.8
Total	100	100	100

P<0.001**, Significant, Chi-Square test

Table 3: Presenting Complaints

Complaints	Open Group		Laparoscopy Group		Total
	N	%	N	%	
Fever	26	43.3	24	40.3	41.65
Pain	56	93.3	55	91.7	92.5
Vomiting	35	58.4	40	67.3	62.85

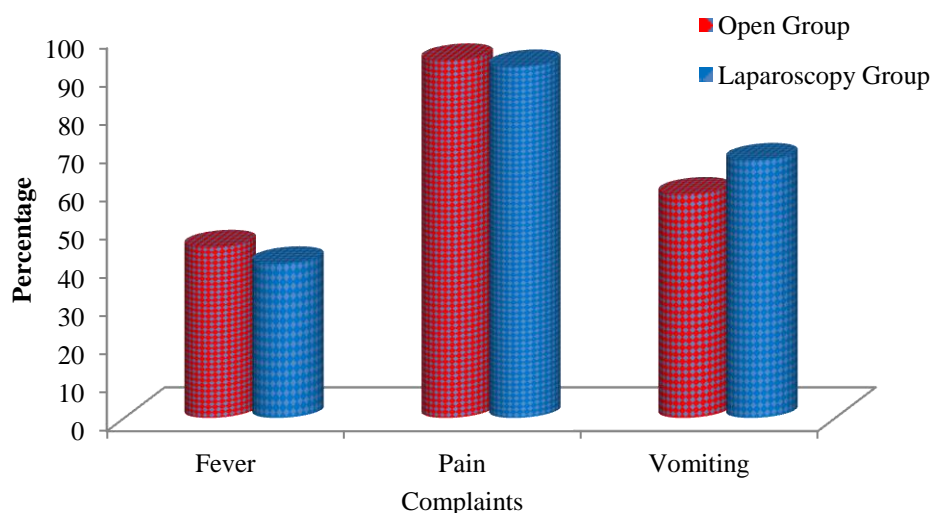


Figure-2: Presenting Complaints

Table 4: Severity of presentation

Severity of presentation	Open Group	Laparoscopy Group	Total
Acute	66.7	85	75.8
Recurrent attacks	33.3	15	24.2
Total	100	100	100

P=0.019*, Significant, Chi-Square test

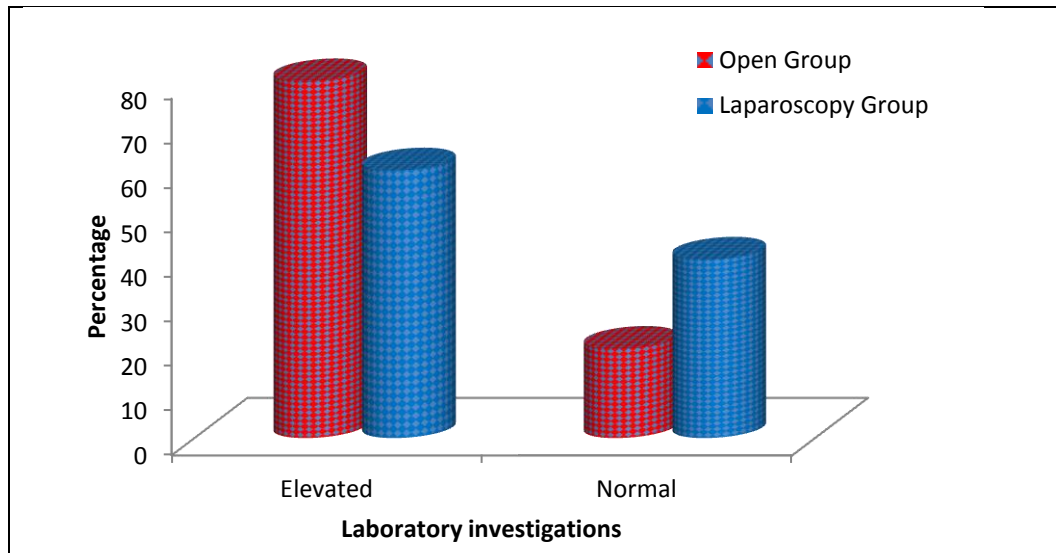


Figure-3: Laboratory Investigations

Table 5: Radiological Investigations on pre-op ultrasonography

Radiological investigations	Open Group	Laparoscopy Group	Total
Inflamed appendix	80	68.3	74.2
Normal	20	31.7	25.8
Total	100	100	100

P=0.144, Not Significant, Fisher Exact test

Using the criteria defined in the methodology the mean operative time was more in laparoscopic group(70.83 ± 18.28 min) as compared to open group(52.00 ± 22.25) (p is significant) (Table 6, Figure-4).. The operative field was adhesions free in most of cases taken up for laparoscopic appendicectomy as compared to those underwent open appendicectomy (p is significant) (Table 7).The discomfort experienced by the group who underwent laparoscopic surgery (n=60) was compared to the discomfort experienced for the group who underwent open surgery (n=60). Well accepted pain scoring system, the verbal response scale (VRS) were used to grade the pain. On the day of surgery most of the patients who underwent laparoscopic appendicectomy experienced grade II to III pain as compared to open group who experienced grade III to IV pain (p is significant) and 1 patient experienced grade V pain in open group. Prior to discharge the pain experienced by both groups had decreased, now most of laparoscopic group experienced grade 0 on VRS Scale as compared to open group who experienced grade I on the same scale (p is significant)(Table 8).. In all cases pain relief was

achieved by injectable NSAIDS administered by IM route. The duration of Post operative analgesia required in the Laparoscopic Group was significantly less than the Open Group (p is significant)) (Table 9).

Majority of patients in both laparoscopic (85%) and open group (63%) were able to tolerate oral fluids and diet on 1st post operative day(Table-10,Figure- 5). There were no major complications in either group. The most common complication in either group was wound infection, 16.7% in open group as compared to 6.7% in laparoscopic group (p is significant). There was no mortality in either group(Table-11). The average stay for patients undergoing laparoscopic appendicectomy was 3.22 days(range1-7 days). Patient who underwent open surgery mean duration of post operative stay was 5.87 days (range 1-14 days, p is significant) (Table-12, Figure- 6). The average cost of patients undergoing Laparoscopic appendicectomy was slightly higher as compared to the patients who underwent open appendicectomy (Table-13, Figure- 7, p is not significant).

Table 6: Operation time distribution in two groups of patients studied

Operation time	Open Group	Laparoscopy Group	Total
<50	56.7	8.3	32.5
50-110	41.7	90	65.8
>110	1.7	1.7	1.7
Total	100	100	100
Mean \pm SD	52.00 ± 22.25	70.83 ± 18.28	61.42 ± 22.37

P<0.001**, Significant, student t test

Table 7: Operative adhesions

Operative adhesions	Open Group	Laparoscopy Group	Total
Normal	71.7	63.3	67.5
Minimal Adhesions	21.7	35	28.3
Dense Adhesions	6.7	1.7	4.2
Total	100	100	100

P=0.148, Not Significant, Fisher Exact test

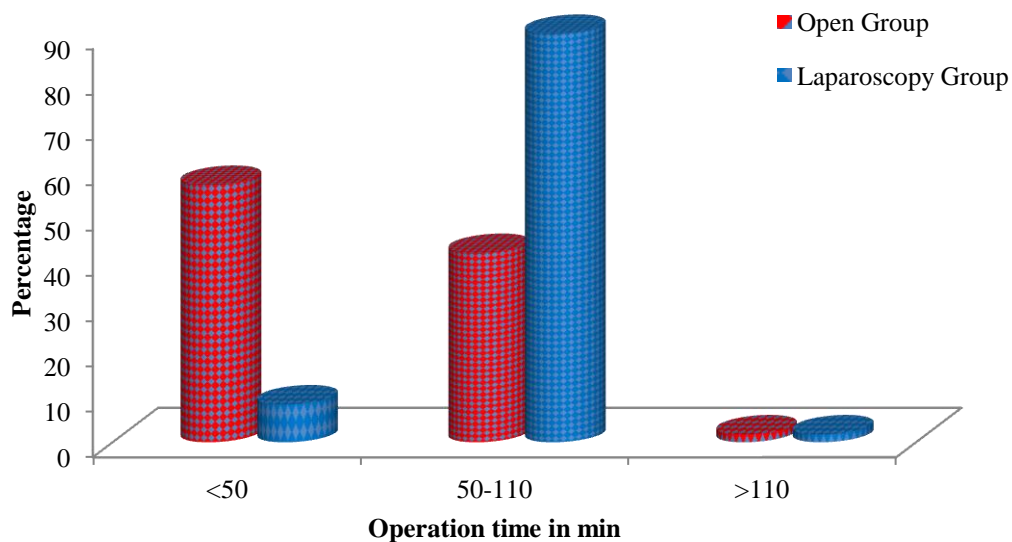


Figure- 4: Average Operating Time in Laparoscopic/Open group

Table 8: Pain distribution in two groups of patients studied

Pain score	Post op day 1	On discharge	% change
Open Group (n=60)			
□□	0	21.7	21.70%
□□	0	71.7	71.70%
□□	11.7	6.7	-5.00%
□□	51.7	0	-51.70%
□□	33.3	0	-33.30%
□□	3.3	0	-3.30%
Laparoscopy Group (n=60)			
□□	0	60	60.00%
□□	0	38.3	38.30%
□□	63.3	1.7	-61.60%
□□	36.7	0	-36.70%
□□	0	0	0.00%
□□	0	0	0.00%
P value	<0.001**	<0.001**	-

Chi-square test/Fisher Exact test

Table 9: Duration of IV analgesic required

Duration of IV analgesic required	Open Group	Laparoscopy Group	Total
1-2	10	86.7	48.3
3-6	90	13.3	51.7
Total	100	100	100

P<0.001**, Significant, Chi-Square test

Majority of patients in both laparoscopic (85%) and open group (63%) were able to tolerate oral fluids and diet on 1st post operative day (Table-10, Figure- 5). There were no major complications in either group. The most common complication in either group was wound infection, 16.7% in open group as compared to 6.7% in laparoscopic group (p is significant). There was no mortality in either group (Table-11). The average stay for

patients undergoing laparoscopic appendicectomy was 3.22 days (range 1-7 days). Patient who underwent open surgery mean duration of post operative stay was 5.87 days (range 1-14 days, p is significant) (Table-12, Figure- 6). The average cost of patients undergoing Laparoscopic appendicectomy was slightly higher as compared to the patients who underwent open appendicectomy (Table-13, Figure- 7, p is not significant).

Table 10: Initiation of oral feeds in two groups of patients studied

Initiation of oral feeds	Open Group	Laparoscopy Group	Total
1	63.3	85	74.2
2	31.7	13.3	22.5
3	5	1.7	3.3
Total	100	100	100

P=0.016*, Significant, Fisher Exact test

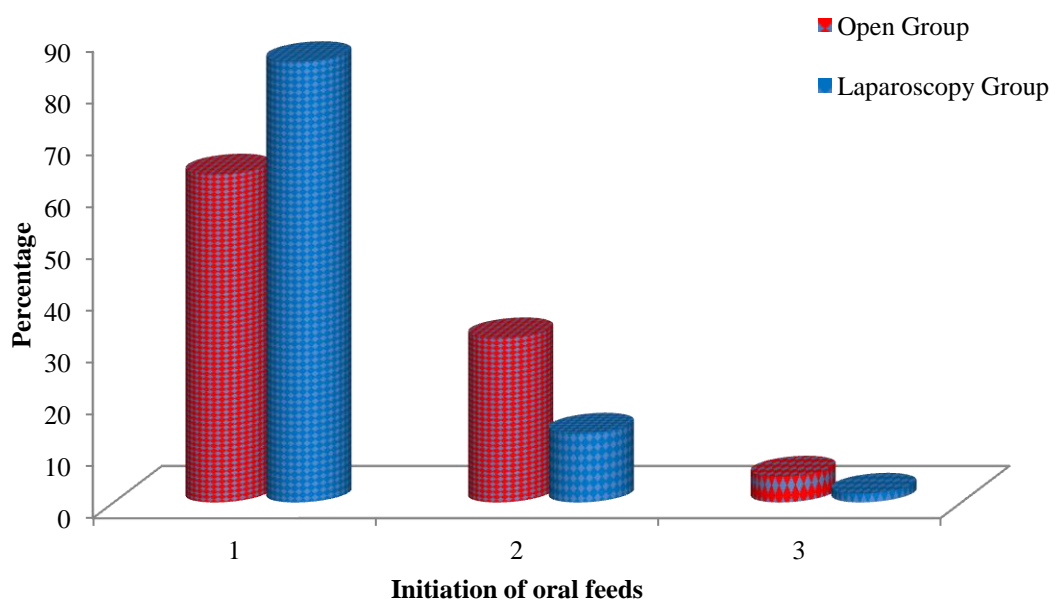


Figure- 5: Initiation of Oral Feeds in Post-Operative Period in Laparoscopic/Open Group.

Table 11: Post-Operative complications in two groups of patients studied

Post-Operative complications	Open Group	Laparoscopy Group	Total
Nil	83.3	88.3	85.8
Others	0	5	2.5
Wound infection	16.7	6.7	11.7
Total	100	100	100

P=0.070+, Significant, Fisher Exact test

Table 12: Hospital Stay in days in two groups of patients studied

Hospital Stay(days)	Open Group	Laparoscopy Group	Total
1-2	0	21.7	10.8
3-5	68.3	73.3	70.8
6-10	25	5	15
>10	6.7	0	3.3
Total	100	100	100
Mean ± SD	5.87±2.27	3.22±1.12	4.54±2.22

P<0.001**, significant, student t test

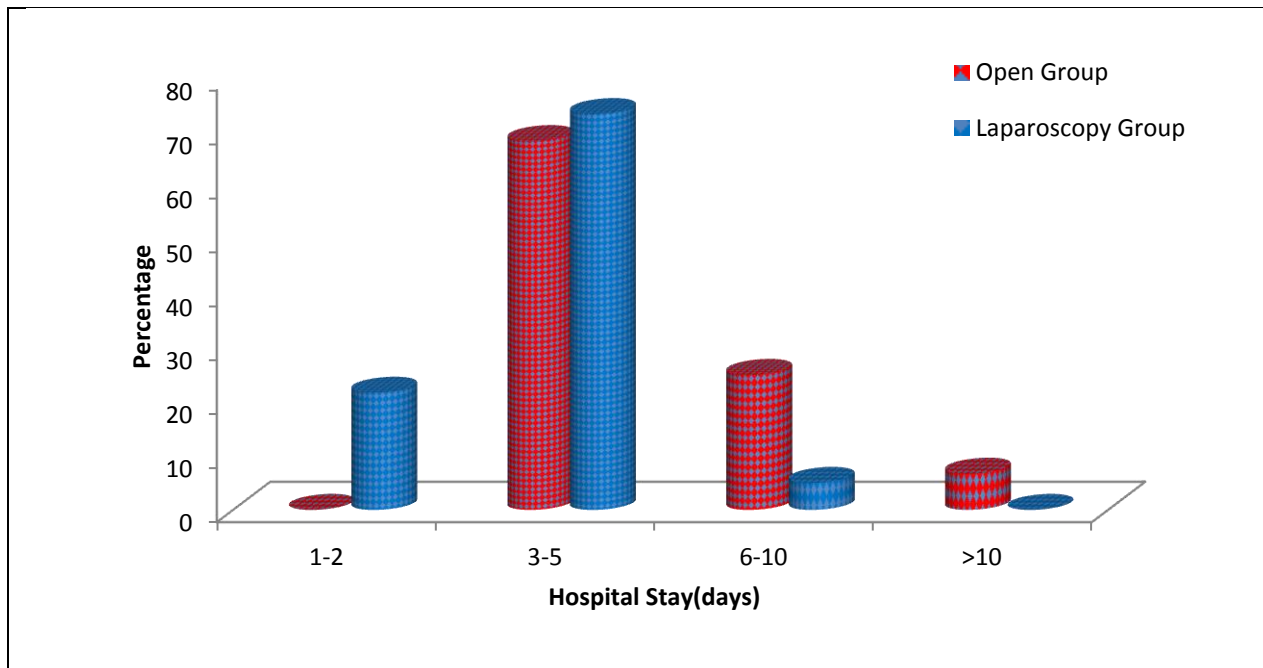


Figure-6: Mean Duration of Post-Operative stay in Laparoscopic/ Open Group

Table 13: Total Cost in two groups of patients studied

Total Cost	Open Group	Laparoscopy Group	Total
<10000	8.3	23.3	15.8
10000-13000	85	75	80
>13000	6.7	1.7	4.2
Total	100	100	100
Mean ± SD	11149.90±1988.76	11944.78±12170.85	11547.34±8692.68

P=0.619, Not significant, student t test

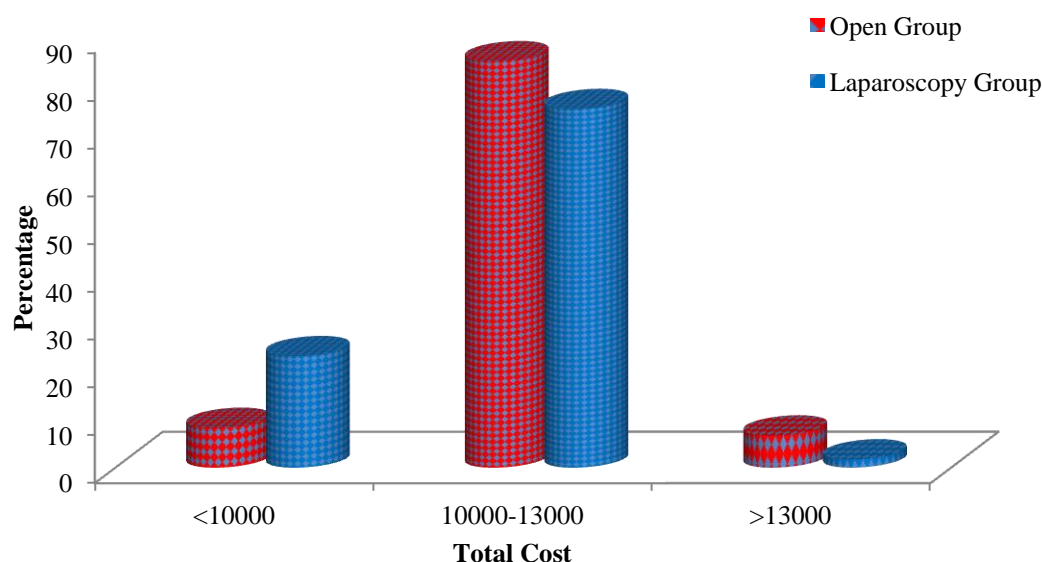


Figure-7: Total Cost of Hospital stay in Laparoscopic/Open group

DISCUSSION

Acute appendicitis is the most common intra-abdominal condition requiring emergency surgery.^[1] Although more than 20 years have elapsed since the introduction of laparoscopic appendectomy, there is no consensus on its advantages and disadvantages compared to the conventional technique. The controversy that currently exists over the potential benefits of laparoscopic appendectomy motivated us to analyze our experience with this procedure. The relative advantages and disadvantages of the laparoscopic and open appendectomy are measured primarily in terms of duration of operation, resumption of oral diet, post operative pain and analgesic use in days. Post operative complications like wound infection, peritonitis, intrabdominal abscess. Postoperative recovery in the form of postoperative duration of hospital stay and total cost during the hospital stay, and return to normal activity were assessed.

In this study the age groups (mean of 22.92 and 25.80 in the open and laparoscopy group) were comparable between the two groups. Most of the patients presented in second-third decade of life. Most common symptom of presentation in both groups was pain abdomen (92.5%), which is

significant ($p < 0.005$). Most of the patients in both the groups had acute presentation (75.8%), rest of them had intermittent presentation (24.2%) ($P = 0.019$). In the patients who underwent surgery (lap or open) most of the patients were in ASA Grade I (86.7%). Majority of the patients in open group, intraoperatively were adhesion free (71.7%) as compared to laparoscopic group (63.3%). This was statistically not significant ($p = 0.28$).

There was a significant increase in the time taken for the procedure during laparoscopic appendectomy compared to the open method (mean of 70.83 ± 18.28 versus 52.00 ± 22.25 respectively). This was statistically significant ($P < 0.001$). Similar results were observed in some of the studies.^{[16],[17]} There was a significant difference in the postoperative pain scores between open and laparoscopic appendectomy at 24 hours (3.09 vs. 2.45 respectively; $P < 0.001$) at discharge (0.47 vs. 0.73 respectively; $P < 0.001$), this difference could have been because of a longer incision, and stretch of the muscles. Similar observations have been reported by others.^{[16],[17],[20]} The duration of postoperative analgesia required was more in the open group than the laparoscopy group (3.2 ± 1.04 versus 1.6 ± 0.75 days

respectively; $p < 0.001$). Similar results have also been reported.^{[13],[15],[16]}

The overall incidences of postoperative Complications were comparable in both the groups. There was a reduction in the post operative wound infection in the laparoscopy group (6.7%) as compared to the open group (16.7%). Similar results have been seen in other studies.^{[13],[14],[18],[20]} There was no mortality in either group.

Time to resume normal diet was earlier in the laparoscopy group with a mean of 1.14days \pm 0.433 and mean of 1.94 days \pm 0.670 in the open group, this difference was statistically significant ($p = 0.016$). Similar studies have shown that the duration of ileus is shorter in the laparoscopy group with an early return to normal bowel function.^{[13],[20]}

Duration of hospital stay was significantly lower for the laparoscopy group (mean of 3.22 \pm 1.12days) as compared to the open group (mean of 5.87 \pm 2.27days) ($P=0.001$). A longer hospital stay in the open group has been reported by others.^{[13],[16],[18],[19],[20]} A similar study reported the median hospital stay for patients in laparoscopy group and open group were 3 days and 4 days, which were comparable.^[21]

The total cost of hospital stay was slightly higher in laparoscopy group ((mean of 11944.78 rupees \pm 12170.85) as compared to open group (mean of 11149.90 rupees \pm 1988.76), which is not significant ($p < 0.619$). Similar results have been seen in other studies.^[21]

CONCLUSION

The present comparative study of laparoscopic appendicectomy versus open appendicectomy it concludes that Appendicectomy in uncomplicated acute appendicitis is a safe procedure, regardless of the technique performed. Epidemiologically there was no significant difference in selection of procedure between different age. laparoscopic appendicectomy is associated with less post-operative pain and reduced analgesic requirement as compared to

open appendicectomy group. laparoscopic appendicectomy is associated with faster recovery and early restart of oral intake than open appendicectomy. Significantly low wound related complications and infections are reported in laparoscopic appendicectomy than open appendicectomy. laparoscopic appendicectomy patients showed better post-operative comfort, convalescence and less morbidity when compared to open appendicectomy, although a longer duration of surgery with a slightly higher cost of hospital stay was involved.

Overall, laparoscopic appendicectomy is better than open appendicectomy in selected patients with acute or recurrent appendicitis.

REFERENCES

1. Bailey & Love's Short Practice of Surgery 26th Edition.,1199-1200.
2. Telfor G, Wallace J, "Appendix" chapter 13 in Oxford text book of surgery, Morris PJ., Wood WC., Eds. Vol.2, 2nd Edn, Oxford Medical Publications, 2000; 180-189.
3. Palanivelu C, Laparoscopic Appendectomy, Chapter 58 in Art of Laparoscopic surgery, textbook and atlas vol.1,Jaypee Publications, 2007;943-970 .
4. Michael JZ, Stanley WA, Douglas SS, David IS. Appendix and appendectomy. Maingot's abdominal operations. 11th edition. 2007;21:589-608.
5. Frazee RC, Roberts JW, Symmonds RE. A prospective randomized trial comparing open versus laparoscopic appendectomy. Ann Surg. 1994;219:725-8.
6. Semm K. Endoscopic appendectomy. Endoscopy 1983;15:59-64.
7. Schreiber JH. Early experience with laparoscopic appendectomy in women. SurgEndosc 1987;1:211-6.
8. Chung RS, Rowland DY, Li P. A meta-analysis of randomized controlled trials of laparoscopic versus conventional appendectomy. Am J Surg. 1999;177:250-6.

9. Garbutt JM, Soper NJ, Shannon WD. Meta-analysis of randomized controlled trials comparing laparoscopic and open appendectomy. *SurgLaparoscEndosc*. 1999;9:17-26.
10. Golub R, Siddiqui F, Pohl D. Laparoscopic versus open appendectomy: a meta-analysis. *J Am Coll Surg*. 1998;186:545-3.
11. Sauerland S, Lefering R, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. *Cochrane Database Syst Rev*. 2002;(1):CD001546.
12. Slim K, Pezet D, Chipponi J. Laparoscopic or open appendectomy ?critical review of randomized, controlled trials. *Dis Colon Rectum*. 1998;41:398-403.
13. Tate JJT, Chung SCS, Dawson J, Leong HT, Chan A, Lau WY, et al. "Conventional versus laparoscopic surgery for acute appendicitis" *Br J Surg*. June 1993;80:761-762.
14. Bennett J, Boddy A, Rhodes M, Choice of approach for appendectomy: A metaanalysis of open versus laparoscopic appendectomy. *Surg Laparosc Endosc Percutan Tech* 2007;17:245-255.
15. Frazee RC, Robert JW, Symmonds RE, Snyder K, Hendricks JC, Smith RW, et al. "A prospective randomized trial comparing open versus laparoscopic appendectomy." *Ann Surg*. 1994; 219:725-731.
16. Ortega AE, Hunter JG, Peters JH, Swantrom LL, Schirmer B, "A prospective randomized comparison of laparoscopic appendectomy with open appendectomy." *Am J Surg*. 1995;169:208-273.
17. Chung RS, Rowland Dy, Paul Li, Diaz J, Clevelan, Ohio, "A meta analysis of Randomized controlled trials of laparoscopic versus conventional appendectomy," *Am J Surg*,1999;177:250-256.
18. Pedersen AG, Petersen OB, Wara P, Ronnjng H, Qvist N and Laurberg S, "Randomized clinical trial of laparoscopic versus open appendectomy" *Br J Surg*.2001;88:200-205.
19. Josloff RK, Zucker KA. Laparoscopic appendectomy, Chapter 19, in *SurgicalLaparoscopy*, Zucker KA, Eds., 2nd Edn, Lippincott Williams and Wilkinspublications 2001; 229-235.
20. Seeney KJ, Keane FBV, "Moving from open to laparoscopic appendectomy" *Br J Surg*.2003;90:257-258.
21. Nguyen N, Zainabadi K, Mavandadi S. Paya M, Stevens CM, Root J, et al. Trends inutilization and outcomes of laparoscopic versus open appendectomy. *Am J Surg*2004; 188(6): 813-820.