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A comparative study of laparoscopic appendicectomy and open appendicectomy

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Abstract
Laparoscopic appendicectomy combines the advantages of diagnosis & treatment in single procedure with least morbidity. In addition, whole abdomen can be visualized to rule out other coexisting pathology. Patients are likely to have less postoperative pain and be discharged from hospital and return to activities and routine work sooner than those who have undergone open appendicectomy. Other advantages include decreased incidence of wound infection, better cosmesis, feasibility to explore the entire peritoneal cavity for diagnosis of other conditions and effective peritoneal toileting without the need for extending the incision. Laparoscopic appendicectomy is increasingly employed, particularly in young women of child bearing age in whom the differential diagnosis of right lower quadrant pain includes gynecological pathology as well. Most of criticism has focused on the increased technical difficulty and higher hospital cost, which have not yielded any significant improvement in the length of hospital stay or patient recovery. Further research is needed to determine the safety, efficacy and long-term effects of laparoscopic appendicectomy in comparison with the traditional open appendicectomy.

Keywords: laparoscopic appendicectomy, open appendicectomy, complications.

Introduction

Appendicitis is the most common intra-abdominal condition requiring emergency surgery [1]. Appendicectomy continues to be one of the commonest surgical procedures and accounts for approximately 1% of all surgical operation [2]. Even though modern diagnostic facilities, improved surgery skills & modern antibiotic therapy have brought down the mortality from 50% (before 1925) to less than 1/1,00,000 person, but still the morbidity is as high as 5-8% mainly due to wound infection, attributable to delayed diagnosis and delayed treatment [3].

Although open appendicectomy has been the gold standard treatment of appendicitis, recent introduction of laparoscopic appendicectomy has gained acceptance both by surgeons and the patients. Extensive research and experience of open appendicectomy is available. Open surgery has its inherent problems and associated morbidity and adverse cosmesis. Hence, laparoscopic appendicectomy has attracted surgeons and has created improved acceptability of laparoscopic appendicectomy among patients.

Laparoscopic appendicectomy was first performed by a gynecologist *Kurt Semm* in 1982 who conducted the procedure on a normal appendix [4]. *Pier* and co-workers published the first large series of laparoscopic appendicectomy for acute appendicitis in 1990 [5]. Laparoscopic appendicectomy combines the advantages of diagnosis & treatment in single procedure with least morbidity. In addition, whole abdomen can be visualized to rule out other coexisting pathology. Patients are likely to have less postoperative pain and be discharged from hospital and return to activities and routine work sooner than those who have undergone open appendicectomy. Other advantages include decreased incidence of wound infection, better cosmesis, feasibility to explore the entire peritoneal cavity for diagnosis of other conditions and effective peritoneal toileting without the need for extending the incision. Laparoscopic appendicectomy is increasingly employed, particularly in young women of child bearing age in whom the differential diagnosis of right lower quadrant pain includes gynecological pathology as well. Most of criticism has focused on the increased technical difficulty and higher hospital cost, which have not yielded any significant improvement in the length of hospital stay or patient recovery. Further research is needed to determine the safety, efficacy and long-term effects of laparoscopic appendicectomy in comparison with the traditional open appendicectomy.

Aim & Objectives

Aim

To compare the outcome between laparoscopic appendicectomy versus open appendicectomy in patients with acute appendicitis.

Objective

To evaluate and compare the following parameters

1. Duration of surgery
2. Post-operative pain and requirement of analgesics
3. Post-operative period of hospital stay.
4. Time until resumption of diet.
5. Time taken to return to routine work
6. Post-operative complications (e.g vomiting, Ileus, surgical site infection and hypertrophic scar)

Material and Methods

Study design: A single centre, prospective, randomized, comparative study

Study period: April 2014 to October 2015.

Study centre: Department of Surgery
Patna Medical College and Hospital, Patna

Sample size: 60 (30 in each group)

Target group: Patients with acute appendicitis admitted through Emergency/OPD

Inclusion criteria
All patients with clinical diagnosis of acute appendicitis between age 10 to 50 years with ASA grade 1e or 2e

Exclusion criteria
1. History of symptoms for more than 5 days
2. A palpable mass in the right lower quadrant
3. Cirrhotic patients or patients with coagulation disorders
4. Generalized peritonitis
5. Shock at time of admission
6. Patients converted to open procedure due to instrument error
7. Patients with large ventral hernia, history of laparotomy or any contraindication to laparoscopic surgery.
8. Inability to give informed consent
9. Pregnancy

Ethical clearance
Ethical clearance was taken from the institute ethical review board.

Methodology
All the patients presenting in the emergency/OPD with acute onset right lower quadrant pain abdomen were assessed clinically and investigated.
The diagnosis of appendicitis was made based on the following criteria:-
1. History of right lower quadrant pain or periumbilical pain migrating to the right lower quadrant
2. Anorexia, nausea and/or vomiting
3. Fever of more than 37.5degree
4. Right lower quadrant tenderness and guarding on physical examination
5. Leucocytosis > 10,000 cells per ml and presence of immature white cell lineage in peripheral smear
6. Ultrasonography finding of acute appendicitis

A complete pre-operative routine hematological, biochemical, serological and biophysical investigation was done which included: CBC, Serum Urea and creatinine, Serum electrolytes, Random blood sugar, Routine and microscopic urine analysis, Viral profile (HIV I & II, HBsAg and anti HCV), ECG and Chest X ray.
Patients were informed about the surgical technique, need of surgery, measurement of pain using visual analog pain scale (Wong Baker Pain Scale).

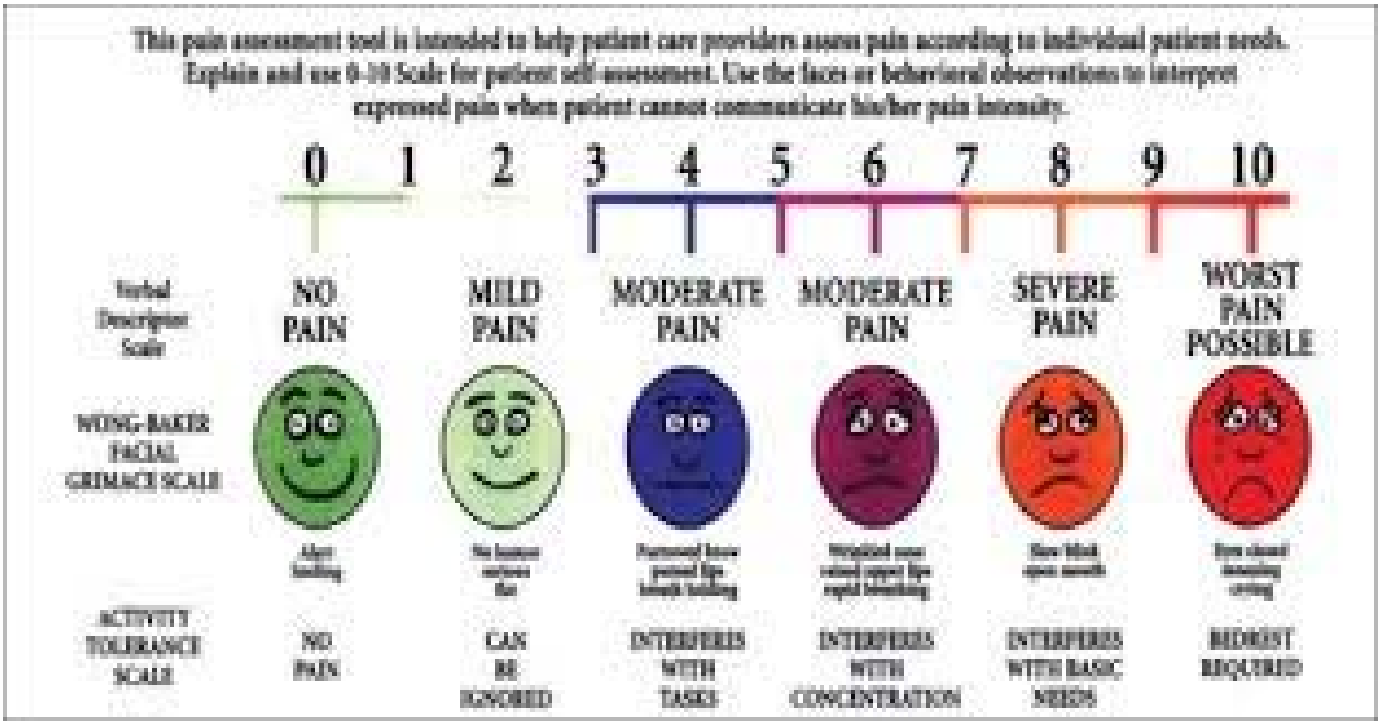


Fig 1: Wong Baker Pain Scale (VAS)

The qualifying patients were informed of the risk and benefits of each type of operative procedure and asked to sign a detailed informed consent in their respective language.
Postoperative pain was assessed at 6, 12, 18 & 24 hrs on post op day (POD0) and 12 hourly on POD1& POD2. Patient were administered inj. diclofenac in the dose of 1mg/kg I.M every 12 hourly. Rescue analgesia was administered in the form of I.V. tramadol in the dose of 1mg /kg, if VAS score (Pain scoring system) was more than 3 or when patient was in distress due to pain.
After the patients were discharged, the patients were followed up in OPD after 7days and checked for complications like wound infection and intra-abdominal abscess and followed up after 3 months for hypertrophic scar and other complications.

All the data were recorded in the standard proforma and later tabulated using SPSS software version 24. Comparison of quantitative variables was done using Student's T-test and chi square test was used for qualitative variable or attributes.
For the level of significance P value <0.05 was considered statistically significant.

Result

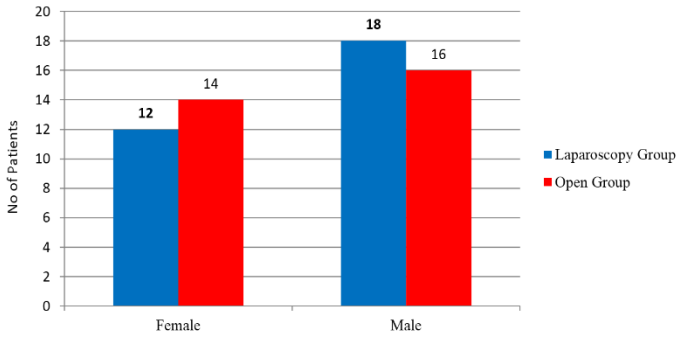
Total 60 patients were included in the study as per sample size and inclusion criteria and 30 patients each were randomized in two study group of laparoscopic appendectomy and open appendectomy.

Sex distribution

There were 12 female and 18 male in laparoscopic group compared to 14 female and 16 male in open group. The male to female ratio (M:F) was 1.5:1 and 1.14:1 respectively. There was no significant difference between the two groups. (P value > 0.05)

Table 1: Sex Distribution

Gender	Laparoscopy group	Open group	P value	Chi Square
Female	12 (40%)	14 (46.7%)	P>0.05	0.27
Male	18 (60%)	16 (53.3%)		
Total	30	30		
M:F	1.5:1	1.14:1		



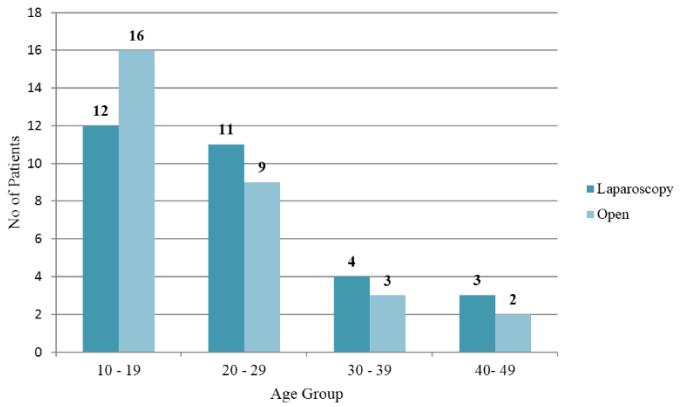
Graph 1: Sex Distribution

Age Distribution

Of the 60 patients admitted for open and laparoscopic appendectomy between age group 10 to 50 years a majority of patients were between the age of 10 to 30 years.

Table 2: Age Distribution

Age group	Laparoscopy group	Open group	t-value	P value
10-19	12	16	0.89	>0.05
20-29	11	9		
30-39	4	3		
40-49	3	2		
Total	30	30		
Mean±SD	22.53±9.41	20.47±8.64		



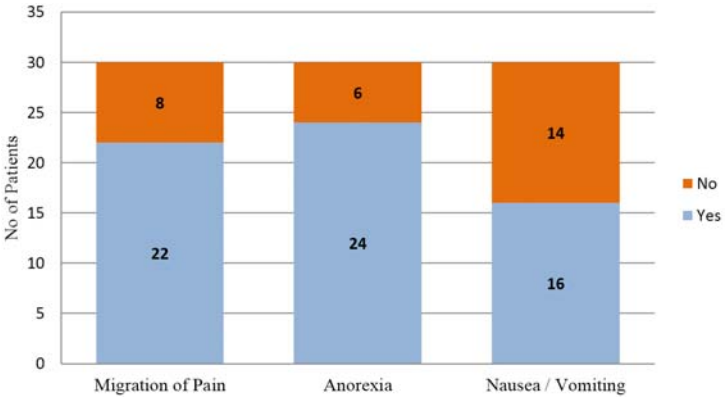
Graph 2: Age Distribution

Clinical Symptoms

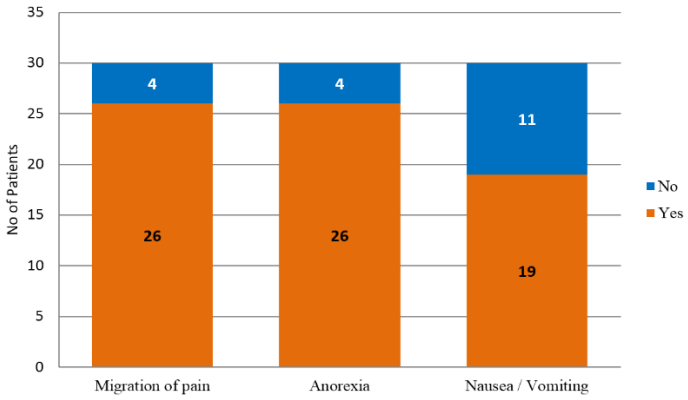
The patients included in the study group at the time of admission presented with varied symptoms and signs. The patients were assessed using Alvarado's Score based on symptom of migration of pain, anorexia, nausea and vomiting and clinical sign of tenderness, rebound tenderness and elevated temperature. A statistical analysis of patients symptoms and signs in the two group revealed P-value >0.05 which is statistically non-significant and hence patients in two groups were comparable with identical symptoms and signs.

Table 3: Comparison of Symptom of Patients in Two Groups

Symptom		Laparoscopy group	Open group
Migration of pain	Yes	22 (77.3%)	26 (86.7%)
	No	8 (22.7%)	4 (13.3%)
Anorexia	Yes	24 (80%)	26 (86.7%)
	No	6 (20%)	4 (13.3%)
Nausea/Vomiting	Yes	16 (53.3%)	19 (63.3%)
	No	14 (46.7%)	11 (36.7%)



Graph 3: Clinical symptoms (Laparoscopy group)



Graph 4: Clinical symptoms (Open group)

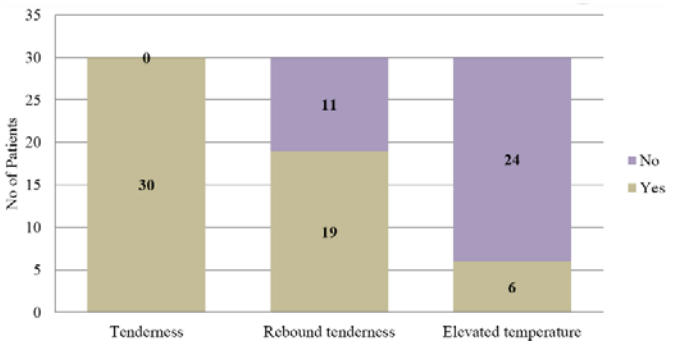
Clinical signs

The patients were clinically evaluated for pain lower abdomen and as per criteria of Alvarado Score for diagnosis of acute appendicitis different sign elicited were recorded besides a complete general examination of the patient. The sign elicited were comparable for the two group of patients.

Table 4: Comparison of Clinical Sign present in Patients in Two Group

Sign		Laparoscopy group	Open group
Tenderness	Yes	30 (100%)	30 (100%)
	No	0	0
Rebound Tenderness	Yes	13 (43.3%)	19 (63.3%)
	No	17 (56.7%)	11 (36.7%)
Elevated Temperature	Yes	6 (20%)	6 (20%)
	No	24 (80%)	24 (80%)

Graph 5: Clinical Sign (Laparoscopy Group)



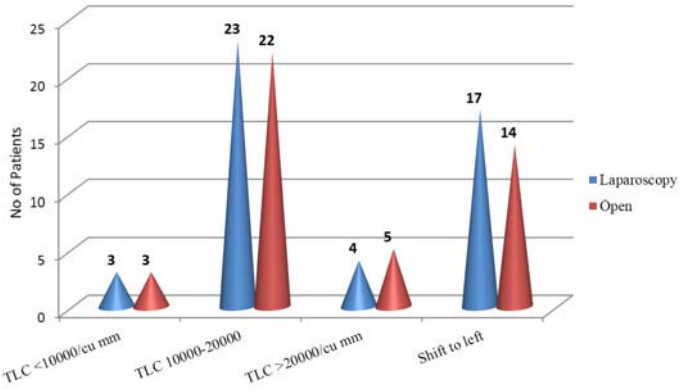
Graph 6: Clinical Sign (Open Group)

Investigation

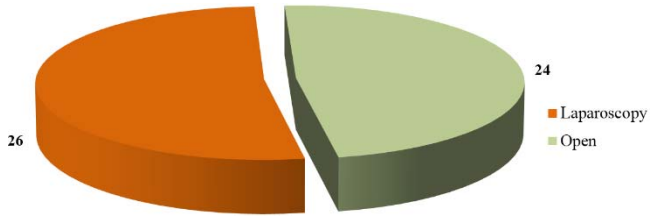
Apart from routine investigations done, the investigatory findings incorporated in Alvarado Score i.e. increased leucocytes count and shift to left were compared for the two group of patients and the difference was statistically non-significant (P value >0.05) and hence the patients were identical based on investigatory findings.

Table 5: Comparison of investigatory findings of the patients of the two groups

Parameters		Laparoscopy group	Open group
Leucocyte count	<10,000/mm^3	3 (10%)	3 (10%)
	10,000-20,000/mm^3	23 (76.7%)	22 (73.3%)
	>20,000/mm^3	4 (13.3%)	5 (16.7%)
Shift to left	Yes	17 (56.7%)	14 (46.7%)
	No	13 (43.3%)	16 (53.3%)
USG finding s/o acute appendicitis	Yes	26(86.6%)	24(80%)
	No	4(13.4%)	6(20%)



Graph 7: Comparison of Total Leucocyte Count and Shift to Left



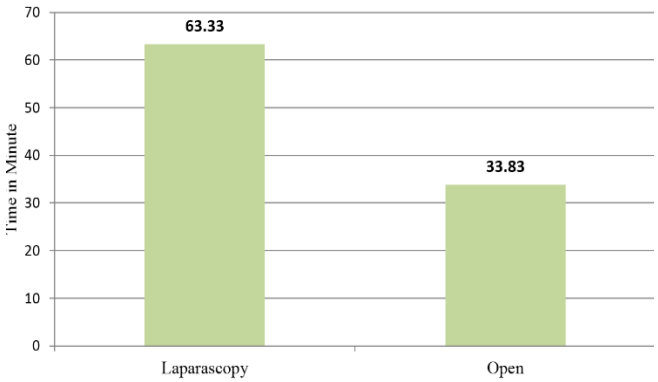
Graph 8: Comparison of USG finding suggestive of acute appendicitis in the two group

Duration of Surgery

Statistically significant difference in operating time was observed with laparoscopic group of patients requiring longer duration for surgery as compared to the open group. The Mean±SD operating time required for laparoscopic surgery was 63.33±14.10 minute versus 33.83±7.51 minute required for open surgery.

Table 6: Comparison of operating time between two groups

	Laparoscopic group	Open group	t-Value	P-value
Total time(min)	Mean±SD 63.33±14.10	Mean±SD 33.83±7.51	10.11	<0.001



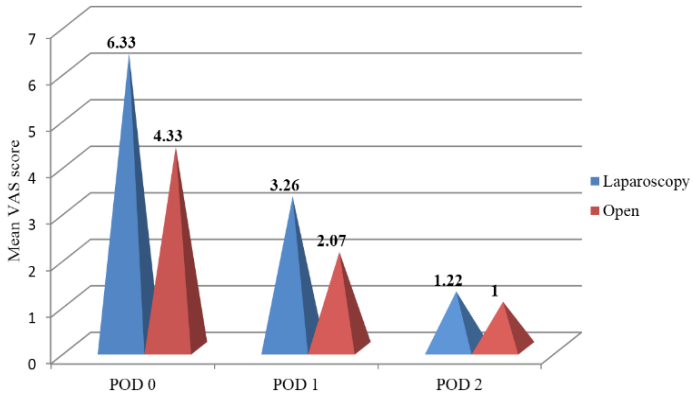
Graph 9: Comparison of mean operating time (in minute) of the two groups

Visual Analogue Pain Score

Statistically the pain score of laparoscopic appendicectomy patients and open appendicectomy patients were compared on post-operative day 0, 1 and 2. It was observed that patients undergoing laparoscopic appendicectomy had higher visual analogue pain score on post-operative day and 1st post-operative post-operative day and the difference was statistically significant.

Table 7: Comparison of Visual Analogue Pain Score on Post-Operative Day 0, 1 & 2

Post-Operative Day	Group	Mean VAS	SD	SEM	t-value	P value
POD 0	LA	6.33	1.15	0.21	6.89	<0.001
	OA	4.33	1.09	0.20		
POD 1	LA	3.26	0.69	0.13	6.28	<0.001
	OA	2.07	0.78	0.14		
POD 2	LA	1.22	0.42	0.42	1.62	>0.05
	OA	1.00	0	0		



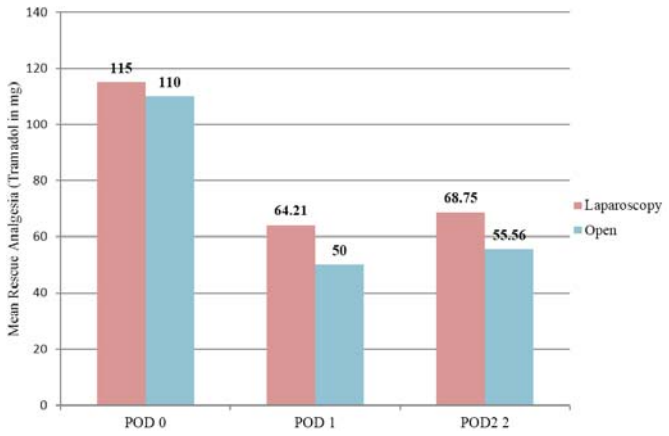
Graph 10: Comparison of VAS Score on POD 0, 1 & 2 between two groups

Rescue Analgesia Requirement

Administered dose of rescue analgesia on post-operative day 0, 1 and 2 in the form of intravenous Inj Tramadol was compared for the two groups and the difference of which was found to be statistically non-significant with P value > 0.05.

Table 8: Comparison of Rescue Analgesia Required on Post-Operative Day 0, 1 and 2

Post-Operative Day	Group	Mean dose of Rescue Analgesia	SD	SEM	t-value	P value
POD 0	LA	115.00	35.11	6.41	0.61	>0.05
	OA	110.00	27.54	5.03		
POD 1	LA	64.21	23.00	4.35	0.81	>0.05
	OA	50.00	50.00	0.00		
POD 2	LA	68.75	37.20	13.15	0.96	>0.05
	OA	55.56	16.67	5.56		



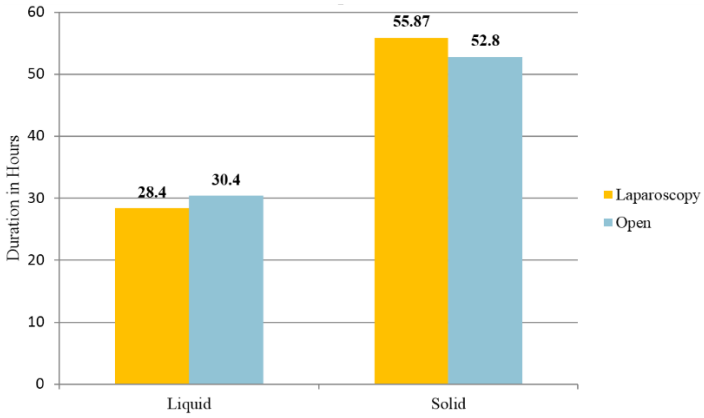
Graph 11: Comparison of Mean Rescue Analgesia Requirement on POD 0, 1 & 2 between the two groups

Initiation of oral liquid and solid diet

Statistically non-significant difference was observed while comparing the time interval of initiation of liquid and solid diet in the patients of two groups post operatively.

Table 9: Comparison of average time to initiation of liquid and solid diet

Diet	Laparoscopic group Mean±SD	Open group Mean±SD	t-value	P value
Liquid	28.40±6.67 hrs	30.40±14.4 hrs	0.68	>0.05
Solid	55.87±12.71 hrs	52.80±15.94 hrs	0.82	>0.05



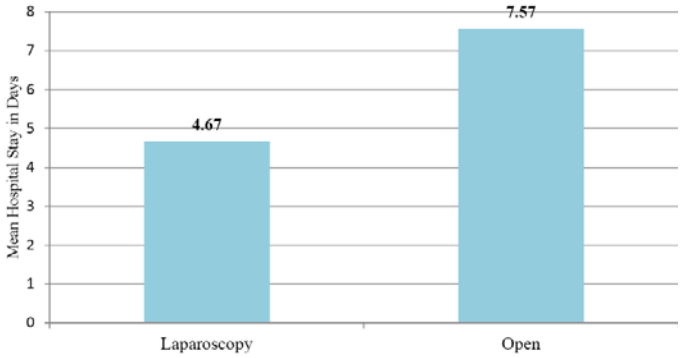
Graph 12: Comparison of initiation of liquids & solids orally in two groups

Length of hospital stay

A comparison of total length of hospital stay for the two group revealed statistically significant difference in mean hospital stay with laparoscopic group patients having shorter duration of hospital stay (Mean±SD of 4.67±2.93 days) compared to open group (Mean±SD of 7.57±1.10 days)

Table 10: Comparison of average hospital stay between the two groups

	Laparoscopic group	Open group	t-Value	P-value
Hospital Stay (in days)	Mean±SD 4.67±2.93	Mean±SD 7.57±1.10	5.08	<0.001



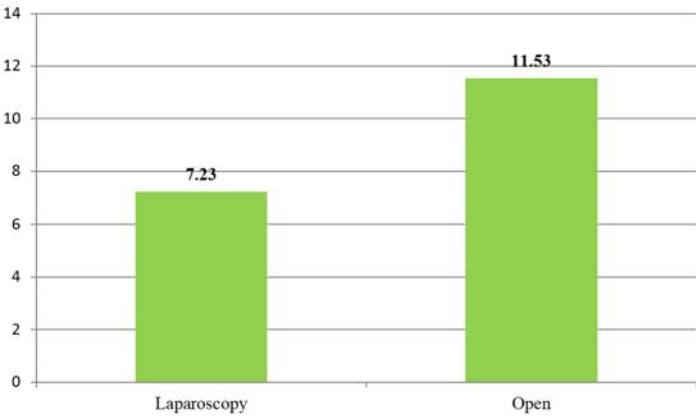
Graph 13: Comparison of average hospital stay (in days) between the two groups

Return to routine work

Early return to routine work was observed in patients undergoing laparoscopic appendicectomy (Mean±SD of 7.23±1.52 days) compared to open appendicectomy (Mean±SD of 11.53±1.68 days). The difference was statistically significant.

Table 11: Comparison of return to routine work

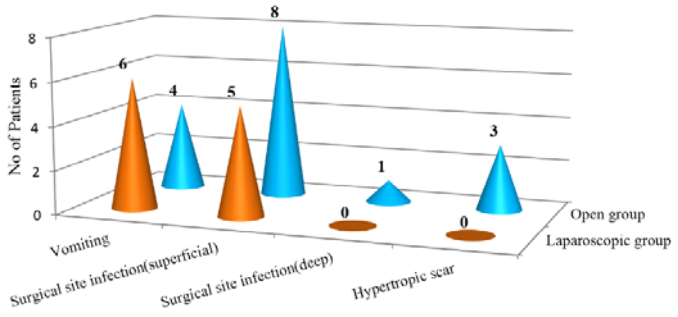
Laparoscopic group (In days)	Open group (In days)	t-value	P value
Mean±SD 7.23±1.52	Mean±SD 11.53±1.68	10.40	<0.001



Graph 14: Comparison of return to routine work (in days) for the two groups

Complications

The incidence of post-operative complication was compared between the two groups and the difference was found to be statistically non-significant.



Graph 15: Incidence of complication in the two groups

Discussion

Acute appendicitis is the most common intra-abdominal condition requiring emergency surgery [1]. Left untreated, appendicitis has the potential for severe complications, including perforation or sepsis, and may even cause death. [6] Though more than 25 years has elapsed since the introduction of laparoscopic appendectomy, there is no consensus on its advantages and disadvantages compared to the conventional technique.

It is a known fact that appendicitis is the disease of younger age, our study also supports this view but no age is immune to appendicitis. In our study we excluded the patient aged less than 10 years and more than 50 years of age. Majority of patients in our study were between 10-30 years of age. Different literatures suggest that peak incidence of acute appendicitis occurs between the ages 10 and 30 years [7]. In comparative international studies commonest age group was between 10-30 years (90%) [8]. The mean age of the patient included in our study was 22.53±9.41 years in laparoscopic group and 20.47±8.64 years in open group. In the study done by Peiser *et al* [9], the mean age was 32.8 years in open group and 31.2 years in laparoscopic group. Similarly in a study done by Kahagias I *et al* the mean age was 33.4±18years in open group and 33.8±17.8years in laparoscopic group.

In our study there were 60% male and 40% female in laparoscopic group and 53.3% male versus 46.7% females in open group. In the study done by Kehagias I *et al* there were 55.1% males and 44.9% females in open group and 44.5% males and 55.5% females in laparoscopic group.

Pain was the most important presenting symptoms and was present in majority of the patients in both the groups of our study. This is similar to study of Adesunkanmi AR [10], who reported abdominal pain in all cases of appendicitis.

In both groups there was non-significant difference in patient's characteristics with respect to age, sex, symptom and sign.

Recent studies have shown significant advantages of laparoscopic appendectomy with respect to the length of hospital stay, postoperative pain and infectious complication [11, 12, 13] 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 [14].

Keeping in mind that laparoscopic appendicectomy, 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.

Operative time remains a topic of much debate among experts. Preliminary studies has shown significantly longer operative

times for laparoscopic appendicectomy [12]. The lack of expertise of the surgeons with the new technique may contribute to the longer duration of the operation in the early studies. However, recent studies have supported the recent finding. In our study, mean duration of surgery was 63.33±14.10 minute in laparoscopic group and 33.83±7.51 minute in open group. In our study, duration of surgery in both laparoscopic and open group excluded the time required for anaesthetizing the patient, a parameter which would have more significantly increased the total operating room time for the patients undergoing laparoscopic procedure compared to open procedure, since the laparoscopic procedures were carried out under general anaesthesia whereas open procedure was done under sub arachnoid block.

Previous studies have given conflicting results with respect to the length of hospital stay after laparoscopic appendicectomy. Guller *et al* in a population based analysis using a national administrative data base showed that laparoscopic appendicectomy is associated with significantly shorter hospital stay. These findings were supported by the Cochrane collaboration large scale meta-analysis [10]. In our study, mean hospital stay 4.67±2.93 (days) in laparoscopic group and 7.57±1.10 (days) in open group. Our studies were support this view.

In the present study bowel movements were regularly observed in the two groups. There is no significant result observed in two groups for intake of liquid and solid diet. A study conducted by Kehagias I *et al* [9] bowel movements in the first post-operative day were observed in 92% patients subjected to laparoscopic group and 67% in the open group (p value <0.001). As a result, 78% patients in the laparoscopic group and 51% in the open group were able to tolerate a liquid diet within the first 24 postoperative hours.

In the present study, pain was assessed both subjectively via a visual analogue scale score and objectively by the medication used in the form of rescue analgesia. In this study, laparoscopic group show slightly more pain on operative and first post-operative day in comparison to open group. Although some studies have reported less pain in the first 48 hours after laparoscopic appendicectomy.

There was no mortality in our study. This is consistent with the majority of previous publications. It has been reported that the mortality rate is 0.05% and 0.3% in laparoscopic and open appendectomy respectively.

According to the Cochrane systemic review of the literature, [15] wound infection is about half, while intra-abdominal abscess formation is 3 times higher after laparoscopic appendicectomy compared to open appendicectomy. In present study, the rate of wound infection in patients with open group was higher (26.6%) in comparison to laparoscopic group (16.6%). Postoperative vomiting complication was slightly higher in laparoscopic group (20%) in comparison to open group (13.3%) due to high dose of medication used as rescue analgesia. There was no intra-abdominal abscess formation in laparoscopic group in comparison to only one cases of intra-abdominal abscess in open group. Postoperative hypertrophic scar formation in patients with open group was reported in three cases (10%). There was reported hypertrophic scar formation in laparoscopic group.

Provided that surgical experience and equipment are available, laparoscopic appendectomy is safe and equally efficient compared to the conventional technique. However, as long as there is no consensus to the best approach for appendicitis, the choice of the procedure should be based on the preference of the surgeons and patients.

Summary

This study "A Comparative Study of Laparoscopic Appendicectomy and Open Appendicectomy" was conducted in the Department of Surgery, Patna Medical College & Hospital, Patna to compare the outcomes of laparoscopic with open appendicectomy in patients with acute appendicitis. The study excluded patients with age less than 10 years and more than 50 years, appendicular lump or abscess, generalized peritonitis, coagulation disorders, pregnancy and in those where general anesthesia and laparoscopic surgery is contraindicated. The study included total of sixty patients who were equally divided in two group of laparoscopic and open group.

- There was no significant difference in two groups in following parameters i.e age, sex, presenting clinical symptoms and signs, investigation and USG finding.
- The mean duration of surgery 63.33±14.10 (min) in laparoscopic group in comparison to 33.83±7.51 (min) in open group.
- The mean time for oral intake of liquid diet 28.40±6.67 (hrs) and solid diet 55.87±12.71 (hrs) in laparoscopic group in comparison to liquid diet 30.40±14.69 (hrs) and solid diet 52.80±15.94 (hrs) in open group.
- The mean length of hospital stay 4.67±2.93 (days) in laparoscopic group in comparison to 7.57±1.10 (days) in open group.
- The mean time to return to routine work 7.23±1.52 (days) in laparoscopic group in comparison to 11.53±1.68 (days) in open group.
- Postoperative complication, surgical site infection superficial/deep, slightly more in open group in comparison to laparoscopic group. No case of intra-abdominal abscess formation was reported in laparoscopic group. There was 10% incidence of hypertrophic scar formation in open group.
- There was no mortality in our study.

Conclusion

Modern surgical era is era of minimal access surgery. If a newer surgical technique gives comparable or improved results, it should not only be accepted but should be promoted also. Laparoscopic Appendicectomy qualifies for these criteria. Hence, whenever feasible it should be the method of choice in surgical management of appendicitis.

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