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A Study of Open Versus Laparoscopic Appendicectomy

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Abstract
Background:*Appendicectomy has been the treatment of choice for acute appendicitis. Since advent Laparoscopic appendicectomy (LA) has struggled to prove its superiority over the open technique. This is in contrast to laparoscopic cholecystectomy, which has promptly become the gold standard for gallstone disease. Open appendicectomy (OA) has withstood the test of time for more than a century. The procedure is standardized among surgeons and unlike cholecystectomy, OA is typically completed using a small right lower quadrant incision and postoperative recovery is usually uneventful. Hence there a need to compare both in terms of efficacy and other issues.*
Methodology: *The primary objective of this study is to compare the results of LA with that of OA in terms of operating time, post-operative pain, wound infection, duration of hospital stay and time to return to usual activities. The secondary objective is to study the intra-operative factors causing conversion of LA to OA. Observational comparative study between two groups ie Open appendicectomy group and Laparoscopic appendicectomy group during period of Jan 2014 to Dec 2016 in a tertiary care teaching hospital results were analysed and conclusions were made with respect to post operative pain, stay, conversions etc*
Results and conclusion: *A Total of 192 cases included in the study of which 100 manged by open appendicectomy and 85 by laparoscopic appendicectomy 7 were excluded from the study as lap converted to open so primary analysis cannot be interpreted. Most of the cases were males most common cause of conversion is difficulty in identification of appendix due to anatomy or technique of approach. There is no much of differences between outcomes and laparoscopic is little advantageous in view of less post operative pain and early recovery and post op wound infections requiring interventions are relatively low however Cost factor and of-course in cases with peritonitis open appendicectomy is preferred.*
Keywords : *Appendicectomy, Conversion, Laparoscopic, Open Appendicectomy.*

I. Introduction

In the last decade laparoscopy has significantly affected general surgical procedures for a variety of pathological indications. With accumulation of experience and progress in armamentarium technology the number and types of procedures routinely performed with minimally invasive technique has grown. Laparoscopy is more often applied not only in elective surgery, but also in emergency surgeries. Suspected appendicitis is undoubtedly the most common indication for emergency surgical intervention, with a lifetime risk of 6[(1,2)]

Since its introduction by McBurney in 1894, appendicectomy has been the treatment of choice for acute appendicitis[3]. Since its initial description by Semm in 1983[4], Laparoscopic appendicectomy (LA) has struggled to prove its superiority over the open technique. This is in contrast to laparoscopic cholecystectomy, which has promptly become the gold standard for gallstone disease[5]. Open appendicectomy (OA) has withstood the test of time for more than a century. The procedure is standardized among surgeons and unlike cholecystectomy, OA is typically completed using a small right lower quadrant incision and postoperative recovery is usually uneventful.

The advantages of LA over OA are thought to be less postoperative pain, shorter hospital stay and early return to usual activity[6,7] . 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 [6,7] . There are however notions showing only minimal benefit from laparoscopic appendicectomy, with higher cost of this method.

However conversion to open surgery is inevitable in some cases. The conversion causes prolongation of hospital stay, increased total cost and dissatisfaction of the patients. The most valuable aspect of laparoscopy in the management of suspected appendicitis is as a diagnostic tool, particularly in women of child-bearing age [8] .Though multiple prospective randomized trials, meta-analyses [9-12] and systematic reviews [13-16] have been conducted to assess the value of LA over OA, the eterogeneity of the measured variables and other weaknesses

in methodology have not allowed to draw definitive conclusions and generalizations [15,16] . Hence, the 'gold standard' modality of treatment for clinically confirmed appendicitis is still not established.

Unfortunately, there are not many authoritative studies comparing the results of LA with OA in our locality.Hence the need for this study. This study also aims to study the intra-operative factors causing conversion of LA to OA.

The term 'appendectomy' has been used instead of 'appendicectomy' in some reference books, articles and journals. We have used the term 'appendicectomy' as in 'Bailey and Love 's short practice of surgery: 26th edition.'

Aim And Objectives

Aim:

- The aim of this study is to assess the merits and demerits of LA over OA in the treatment of clinically confirmed cases of appendicitis.

Objectives:

- The primary objective of this study is to compare the results of LA with that of OA in terms of operating time, post-operative pain, wound infection, duration of hospital stay and time to return to usual activities.
- The secondary objective is to study the intra-operative factors causing conversion of LA to OA.

II. Materials And Methods

Study Design

- This was an observational study where two groups were compared.
- All patients admitted in the Department of General surgery in a Tertiary Care Teaching Hospital, diagnosed with appendicitis and underwent surgery were studied
- They were studied during their stay in the hospital, during review for suture removal and were followed up until they returned to usual activities.

Setting

All cases of appendicitis operated from January 2014 to December 2016 in the Department of Surgery in Tertiary Care Teaching Hospital.

Case Definition

Clinically confirmed case of appendicitis means an Alvarado score of 7 or more (clinically strongly predictive of appendicitis) or an equivocal score (5-6) with sonological evidence (abdominal ultrasound or contrast-enhanced CT suggestive of appendicitis).Both emergency and elective cases were included in the study

Inclusion Criteria

- All cases of clinically confirmed appendicitis, of any age group, operated in the department of surgery in Tertiary Care Teaching Hospital from January 2014 to December 2016.
- Emergency as well as elective cases were included.

Exclusion Criteria

- Diagnosis could not be confirmed clinically or sonologically. (Alvarado score< 5 or 5-6 with no ultrasound evidence) [18]
- Cases of open appendicectomy done through any incision other than a right lower quadrant incision.
- All cases of LA converted to OA were excluded from comparison with OA. The converted group (LCO) was independently analyzed for conversion factors.
- Histopathology showing alternate diagnoses.

Sample Size And Duration Of Study

Being an observational study sample size was not calculated. All the cases of LA and OA done during the period from January 2014 to December 2016 were studied. The duration of study was 24 months.

Ethical Considerations

The study protocol was presented to the Institutional Ethical Committee prior to the commencement of study and was approved. Diagnosis was solely based on clinical findings, basic blood investigation and an ultrasound examination which is routinely done in all cases of suspected appendicitis. The choice of laparoscopic or open surgery was based on patient preference.

Study Procedure

All cases of suspected appendicitis were clinically examined and basic blood tests done. They were given scoring according to Alvarado score.

An ultrasound scanning was done as supportive evidence in all patients.

All cases with an Alvarado score of 7 or more (group A), and those cases with an equivocal score of 5-6 (group B) with Ultrasound positivity (P) were also considered diagnostic.

These patients underwent all the preoperative investigations which included a complete blood count with ESR, blood grouping and Rh typing, random blood sugar, blood urea, serum creatinine, coagulation profile, serology for HIV and Hepatitis B, chest X ray and Electrocardiogram.

They underwent a pre anaesthetic evaluation and were posted for surgery.

Then the 2 surgical options (LA and OA) are given to the patient and the relatives, and are operated depending on patient's preference.

All patients received preoperative IV doses of a 3rd generation cephalosporin every 2 hours from the time of diagnosis until surgery.

Surgery

OA was done through a Gridiron (McArthur-McBurney) or Lanz skin crease incision. A double ligation of the stump was performed with an absorbable suture. If the appendix looked normal, it was removed. Distal ileum was inspected in all cases to rule out Meckel's diverticulum, If appendix was found perforated, abdomen and pelvis were irrigated with warm saline solution.

Abdomen was closed in layers with absorbable suture (polyglactin) and skin stapled.

LA was performed using 3 ports, with laparoscope at umbilicus. The abdominal cavity was explored to locate the appendix and to rule out alternative diagnoses. The mesoappendix was divided with diathermy and base of appendix endolooped with catgut and divided. In case of perforation, saline irrigation and suction was done. The fascial defect in the umbilical port was closed with polyglactin sutures and skin stapled.

Non-suction drainage was left in situ in cases of abscess and generalized peritonitis in both OA and LA.

Postoperative Course

Intravenous 3rd generation cephalosporin was continued postoperatively until patient starts oral intake. Then it is changed to a 3rd generation oral cephalosporin and continued for a total of 5 days. Patients found to have a complication (gangrenous or perforated appendix) during surgery were treated with a triple antibiotic coverage: cephalosporin, gentamycin or amikacin and metronidazole until the WBC count was within normal limits and the temperature under 99 degree F for 24 hours. Postoperatively all patients received hourly Tramadol injection, dose according to body weight, for pain.

Once bowel sounds appeared, a clear liquid was started, and advanced to regular diet step by step when tolerated and flatus passed.

Patients were discharged when they tolerated a regular diet, and were afebrile for 24 hours.

They were asked to review after 1 week for staple removal, or earlier if any adverse symptoms were observed.

Outcome Parameters

The following parameters were recorded:

- Operating time (skin to skin)- in minutes.
- Postoperative pain in Visual Analogue Scale on postoperative day 1&2.
- Duration of hospital stay.
- Infective complications: superficial and deep wound infections.
- Time to return to usual activities.
- Indications for conversion from LA to OA.
- Pathological report.

Outcome Analysis

The results of laparoscopic appendicectomy were compared with that of open appendicectomy in terms of operating time, post operative pain, hospital stay, wound infection (surgical site infection) and time to return to usual activities.

Operating time was calculated from skin incision to completion of skin closure in both techniques.

Post operative pain on post operative day 1 and 2 were analyzed using visual analogue scale [14]. In this scale a score of 0 is allocated for 'no pain' and a score for 'worst imaginable pain and patient is asked to rate their pain.

Hospital stay was calculated from day of to the day of discharge. Infective complications, if occurred during the period of hospitalization, were recorded.

In 1992 the Surgical Wound Infection Task Force published a new set of definitions for wound infections that included changing the term to Surgical Site Infection (SSI). SSI are divided into incisional superficial, incisional deep and organ / space related (anatomic location of the procedure itself) [18]. Our study analyzed the first group; i.e. incisional infection only.

There are scoring systems for the severity of wound infection which are particularly useful in research. We have used the Southampton scoring system [19]

Grade	Appearence
0	Normal healing
I	Normal healing with mild bruising or erythema
Ia	Some bruising
Ib	Considerable bruising
Ic	Mild erythema
II	Erythema plus other signs of inflammation
IIa	At one point
IIb	Around sutures
IIc	Along wound
IId	Around wound
III	Clear or haemo-serous discharge
IIIa	At one point only(</= 2cm)
IIIb	Along wound (> 2cm)
IIIc	Large volume
IIId	Prolonged (> 3 days)
Major Infection	
IV	Pus
IVa	At one point only(</= 2cm)
IVb	Along wound (> 2cm)
V	Deep or severe wound infection with or without tissue breakdown; haematoma requiring aspiration

The patients were again studied during review for suture or Staple removal and enquired regarding return to usual activities. If not, the patient was followed up until he/she resumed usual activities. As the usual activities depends on the age, sex and occupation and many other social factors and are highly variable in the study population, 'Activities of Daily Living (ADL)' scale by Katz was applied to analyse the time to return to usual activities.

Katz Activities Of Daily Living Scale

Many surgical outcome studies focus on patient disability, a component of general health status. The most widely used scale being ADL scale developed by Katz. It summarizes the degree of independence in bathing, dressing, using the toilet, transferring, continence and eating. Patients are scored yes (1) or no (0) for independence in each of the six functions. A score of 6 indicates full function, 4 indicates moderate impairment, and 2 or less indicates severe functional impairment. I have taken, full independence (score 6) as return to usual activities.

If an LA was converted to OA, the per-operative factor for conversion was recorded and studied.

Table. Katz Activities Of Daily Living Scale

ACTIVITIES	Fully Independent (l point)	Dependent (0 point)
BATHING	Receives either no assistance or assistance in bathing only one part of body.	Dependent
DRESSING	Gets clothes and dresses without any assistance except for	Dependent

	tying shoes.	
TOILETING	Goes to toilet room, uses toilet, arranges clothes, and returns without any assistance.	Dependent
TRANSFERRING	Moves in and out of bed and chair without assistance (mechanical walking aids acceptable).	Dependent
CONTINENCE	Controls bowel and bladder completely by self (without occasional "accidents").	Dependent
EATING	Feeds self without assistance (except for help with cutting meat or buttering bread).	Dependent

Study Limitations

Our study has some limitations

- It's not a randomized and blinded study.
- Cost analysis was not included
- Follow up was limited to first few days postoperatively. Our study focused only on early postoperative complications, and no long term follow up was done.
- Surgery was performed by many different surgeons and the level of expertise in the performance of LA technique was not strictly standardized.

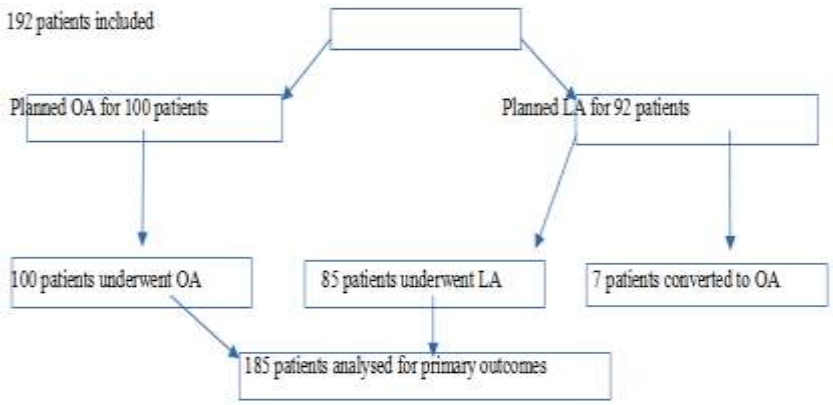
III. Statistical Analysis

Being an observational study, all cases of appendicitis operated in the Department of General surgery during the study period were analyzed. The collected data were analysed using the SPSS version 16.0.Independent t-test was used to assess the significance of difference between the two groups, in terms of 'operating time' and 'time to return to usual activities'. Chi-square test was used to assess the 'wound infection' rates between the two study groups. As the continuous variables 'post operative pain' and 'hospital stay' were not following the assumption of homogeneity of variences according to the Levine's test, independent t-test could not applied to study these parameters. Hence, Mann Whitney U non-parametric test was used.

IV. Results

A totaI of 192 patients were included in the study during this period, according to the inclusion criteria. Of this 100 patients underwent an open appendicectomy, 85 underwent a laparoscopic appendicectomy, and 7 patients were converted from an LA to OA. These 7 patients were excluded from analyzing the primary outcome measures. i.e. the operating time, post operative
pain, hospital stay, wound infection, and time to usual activities.

Figure. Patient allocation



Demographic Characteristics

Of the total 192 patients, there were 104 males and 88 females. The mean age of the study population was 25.46 years (Range: 7-72 years). There was no significant difference between the mean ages of the two groups. But there was some difference in the sex predilection between the two groups (OA & LA). When two-thirds of patients (66%) in the OA group were males, 61.2% of patients in LA group were females, probably due to cosmetic concerns.

Table 1. Demographic characteristics of study subjects

Demographic Characteristics	**Whole Population**	**OA**	**LA**
	Mean (Range)		
AGE	25.46 (7-72) Years	26.71 (8-72) Years	24.19 (7-66) Years
	Frequency (Percentage)		
MALES	104 (54.2%)	66(66%)	33(38.8%)
FEMALES	88 (45.8%)	34(34%)	52(61.2%)

Figure -Age distribution of Study Subjects

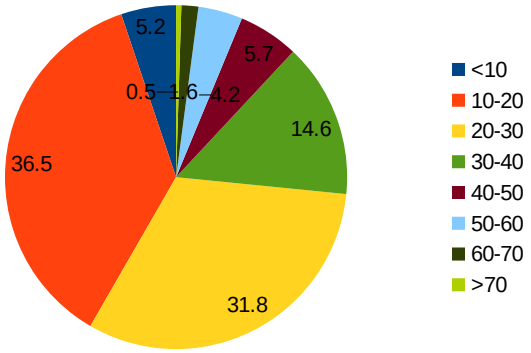


Figure-Sex distribution of study subjects

Fig. OA

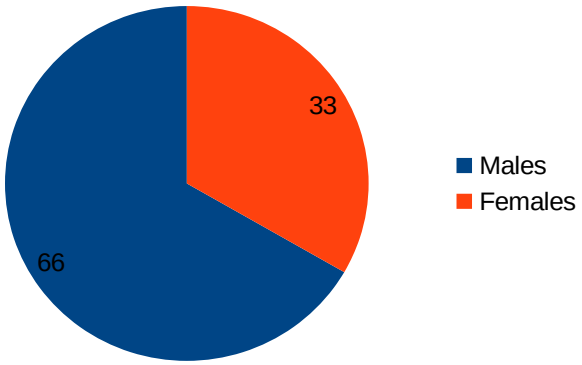


Fig. LA

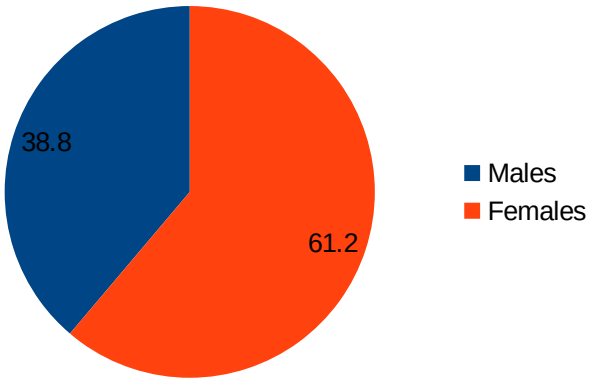


Figure -Sex distribution of Study subjects

Fig. Males

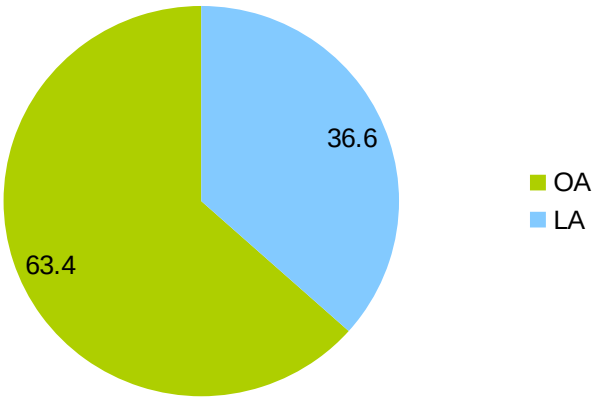
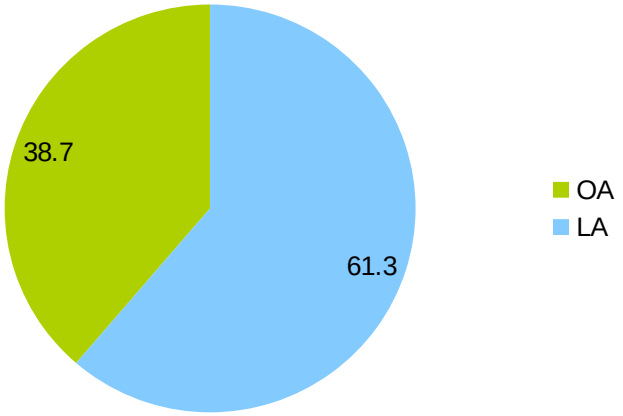


Fig. Females



Disease Characteristics And Co-Morbidities

The duration of symptoms was 2.22 days (Range 1-6 days) in the study subjects. There were no prior Similar episodes in most Of the patients (65.6%) where as there were 1, 2 & 3 similar episodes in 42, 21 & 3 patients respectively. There was at least one co-morbid medical condition in 30(15.6%) patients only, where as there was no history of any co-morbidity in the rest 162 (84.4%) patients. The co-morbid conditions mainly included diabetes, hypertension, and bronchial asthma, and rarely some other illnesses like COPD, heart diseases, musculoskeletal disorders, and autoimmune disorders. The disease characteristics like duration of symptoms, number of prior similar episodes and presence of co-morbidities were similar between the two groups.

Table. Disease characteristics of study subjects

Disease characteristics	Whole population	OA	LA
Duration of symptoms: mean +/- S.D.	2.22+/-0.92 days	2.24+/-0.976 days	2.16+/-0.829 days
Number of prior similar episodes:	Frequency (%)		
0	126 (65-6%)	71 (71%)	50 (58.8%)
1	42 (21.9%)	12 (12%)	29 (34.1%)
2	21 (10.9%)	14 (14%)	6 (7.1%)
3	3 (1.6%)	3 (3%)	0 (0%)
Co morbidities	30 (15.6%)	18 (18%)	12 (14.1%)

Figure -Duration of symptoms (in days) at presentation

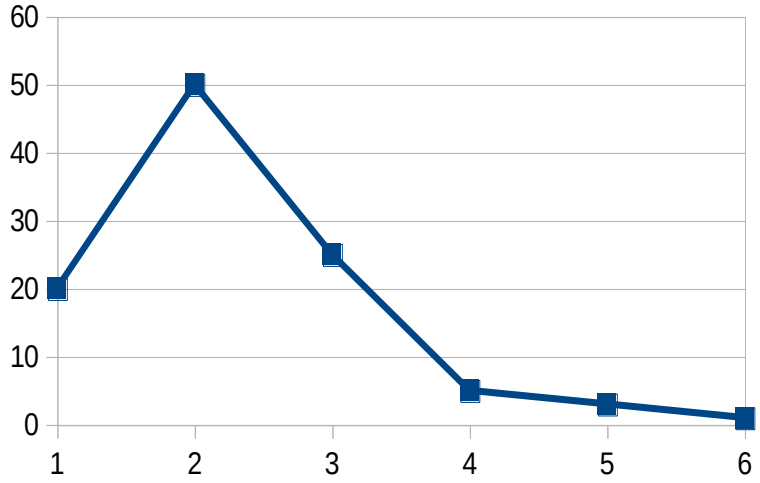


Figure-No. of prior similar episodes

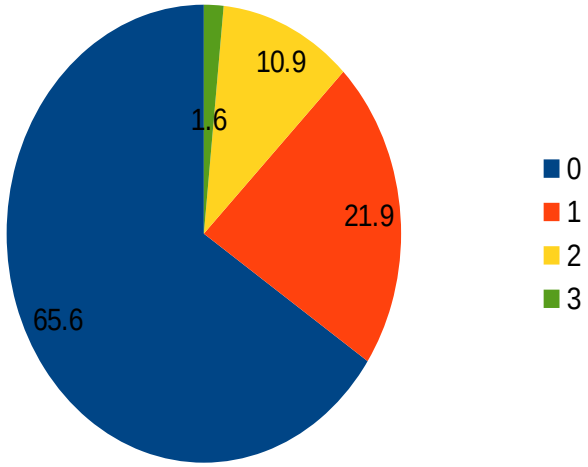
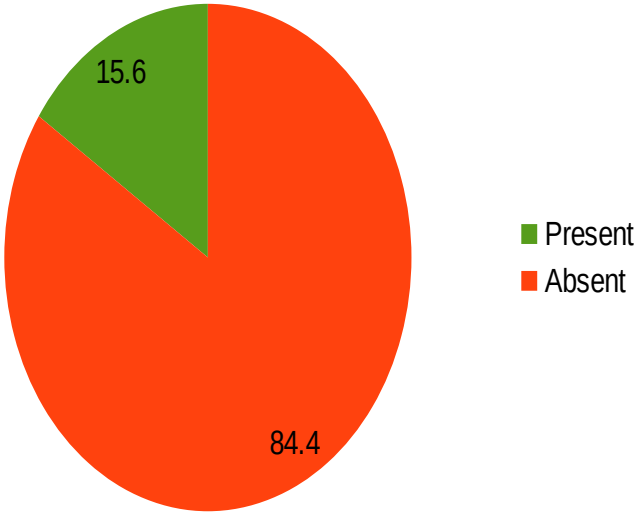


Figure-Co morbidities in study subjects



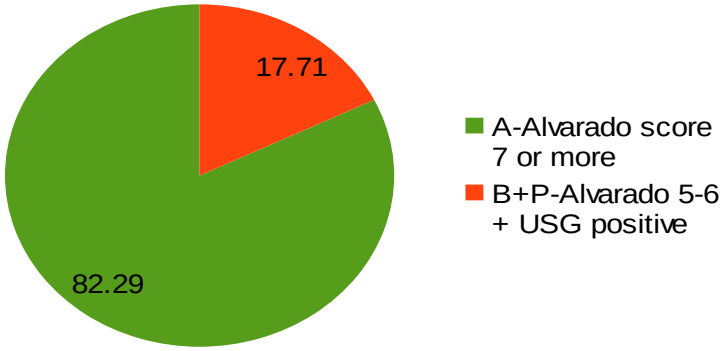
Diagnostic Criteria

Most of the patients could be diagnosed clinically. 158 patients (82.3%) had an AIvarado score of 7 or more. Only 34 patients (17.7%) had a score of 5-6 and ultrasound scanning was used in confirming the diagnosis, though ultrasound scanning was done for all patients. i.e. 82.3% of cases could be diagnosed by clinical examination alone. So, clinical examination still remains the cornerstone for diagnosing acute appendicitis.

Table. Diagnostic criteria

Alvarado score	Frequency (percentage)
7 or more (A)	158 (82.29)
5-6 (B)	34 (17.71)

Figure -Diagnostic criteria satisfied by the study subjects

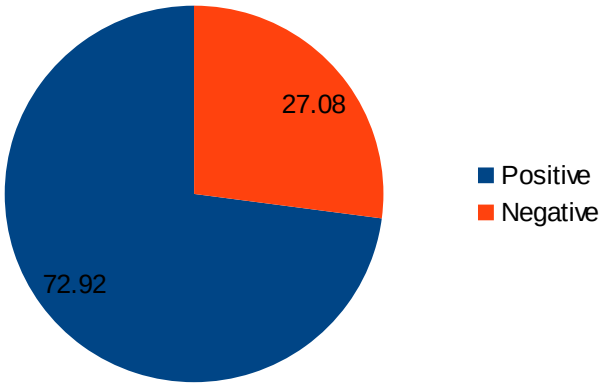


Among the 192 patients, 140 (72.9%) were ultrasound positive, while 52 (27.1%) were ultrasound negative. i.e. the sensitivity of USG in acute appendicitis is not very good, and is highly operator dependent.

Table. USG diagnosis

USG	Frequency (percentage)
Positive (P)	140 (72.92)
Negative (N)	52 (27.08)

Figure-USG diagnosis of study subjects



Surgery Undergone

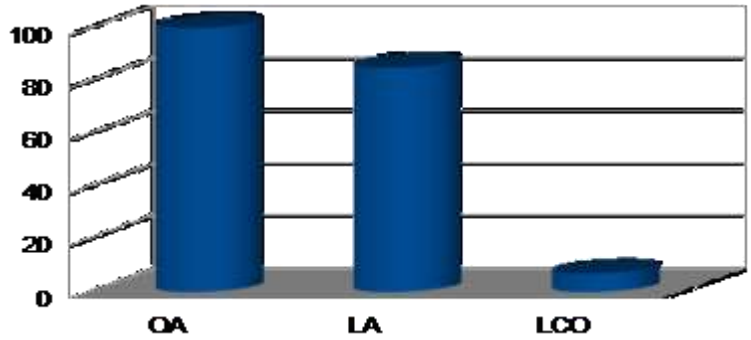
100 patients chose for an OA, while 92 patients chose an LA. Of this, 7 patients were converted from an LA to OA due to various reasons. These 7 patients were excluded from analysis, and the rest 85 patients were analyzed in LA group.

Table. Type of surgery undergone.

Type of surgery	Frequency (percentage)
OA	100 (52.1)
LA	85 (44.3)

LCO	7 (3.6)

Figure -Type of surgery undergone



Primary Outcome Measures

Operating time:

The mean operating time in the whole population was 46.36 minutes, which is similar to previous studies. There was no significant difference (P=0.647) between the two groups in terms of operating time. The mean operating time for OA was 44.4 min and for LA was 45.75 min. But, the operating time was found to be highly variable (range: 18.135 min) in the LA group, depending on the surgeon's experience in laparoscopic surgeries. This could be attributed to the learning curve, associated with any laparoscopic procedures. But the operating time was more or less similar between the operating surgeons in the OA group. Obviously, the mean operating time was found to be longer in LCO group (81.86 min).

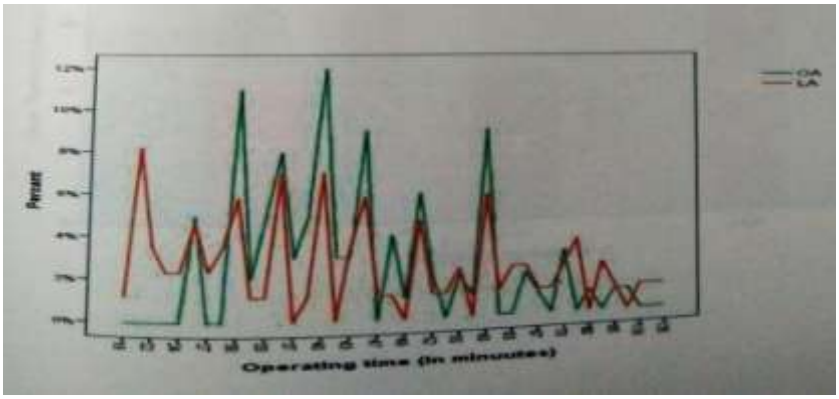


Table -Mean Operating time

Mean Operating time in minutes (Range)	
OA	44.40 (25-100)
LA	45.75 (18-135)

P=0.647 t-test value=0.473

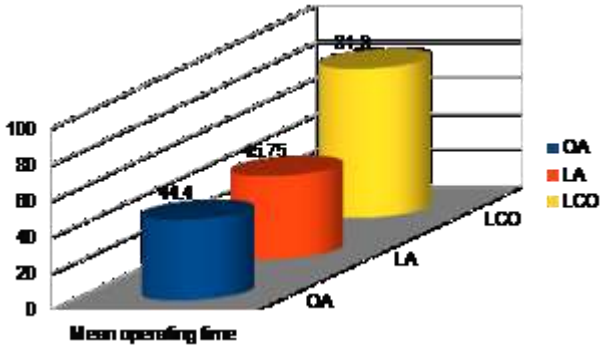
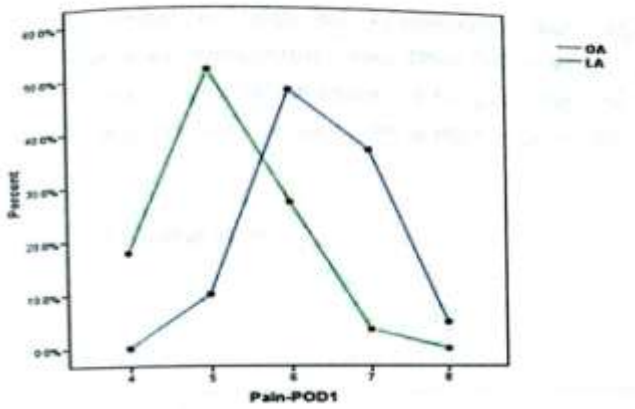


Figure 15. VAS scores on POD1:



Post operative pain

Post operative pain was significantly less in the LA group compared to the OA group on post operative day 1 as well as on day 2.

On the first post operative day, the mean VAS was 6.37 for OA and 5.16 for LA, and the difference is statistically significant (p=0.0001)

On the 2nd post operative day also, pain was significantly less (p=0.0004) in the LA (mean VAS-2.73) group compared to OA (mean VAS-3.71).

Table . Postoperative pain on POD1:

Mean VAS score on PODI +/- S.D		
OA	6.37 +/- 0.734	P=0.0001
LA	5.16 +/- 0.750	

Table . Postoperative pain on POD2:

Mean VAS score on POD2 +/- S.D.		
OA	3.71 +/- 0.902	P=0.0004
LA	2.73 +/- 0.746	

Figure -Post operative pain on POD1 and POD2

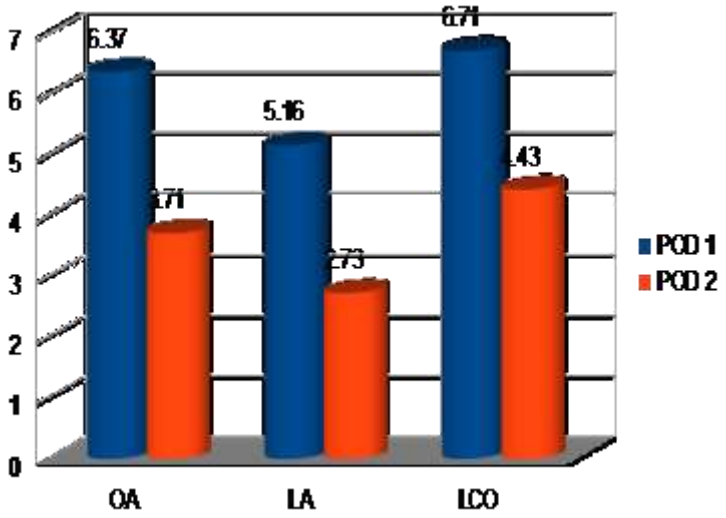
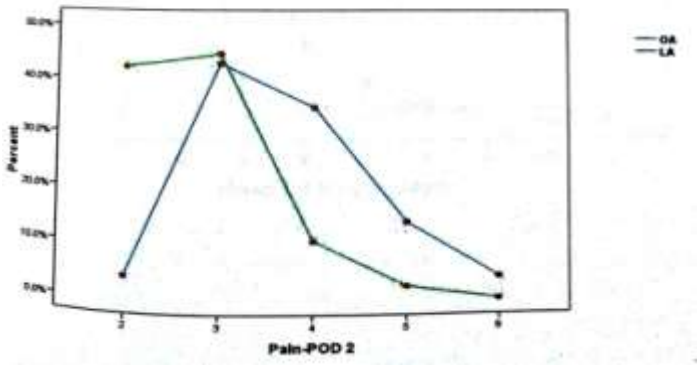


Figure 16. VAS scores on POD2:



Hospital Stay

The mean duration of hospital stay in the whole population was 4.73 days. The mean hospital stay was also significantly less (P=00001) in the LA group compared to the OA group. The mean duration of hospital stay was 5.29 days (range 3-12) in the OA and 3.92 days (range 2-9) in the LA group respectively.

Figure -Hospital stay

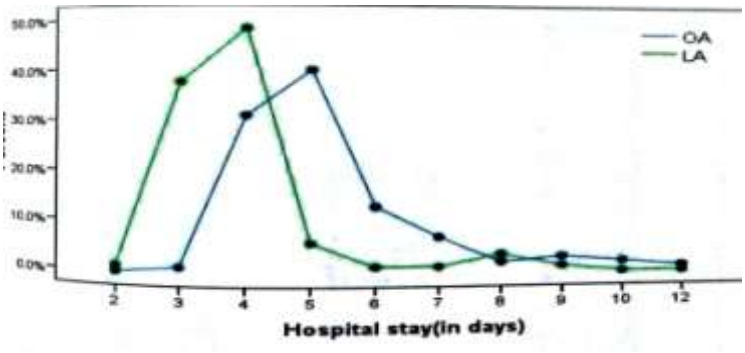
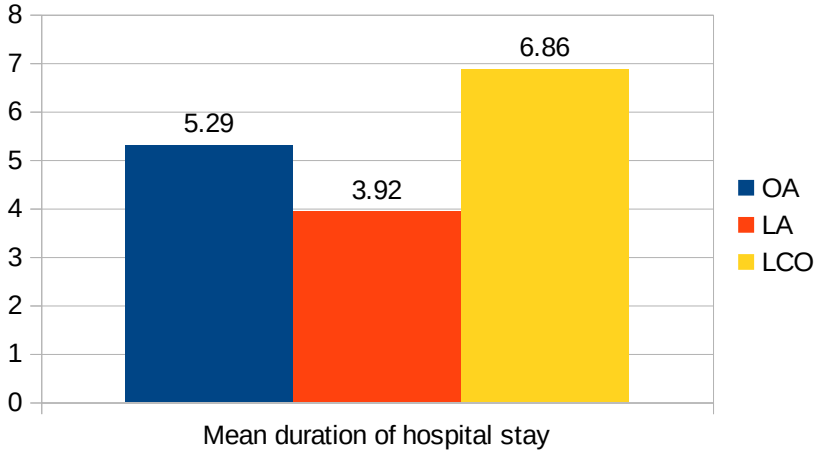


Table – Duration of hospital stay

Mean duration of hospital stay +/- S.D		
OA	5.29 +/- 1.533	P=0.0001
LA	3.92 +/- 1.227	

Figure – Mean duration of hospital stay



Wound infection

The wound infection rate in the whole study population was 12%, out of which 8.8% were minor infection and 3.12% were major infection, as per the southampton grading system. The total wound infection rates were 16 % in OA and 7.1 % in LA group, but the difference was not statistically significant (P=0.06) But all the cases in the LA group were only minor infections according to the southampton grade. And all cases of major wound infection were found in the OA group. So there appeared to be a significant difference between the two groups in major wound infection rate.

Figure. Rates of Major and Minor Wound Infection in the study groups

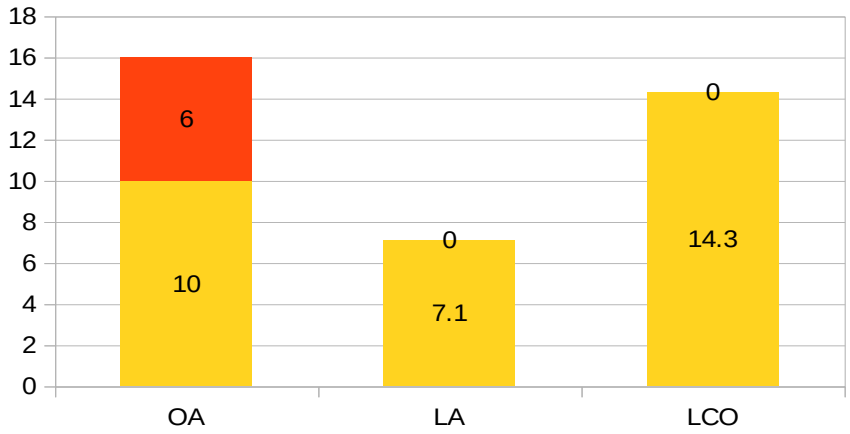


Table. Wound infection in study groups:

	OA-frequency(%)	LA-frequency (%)	
YES	16 (16)	6 (7.1)	P=0.06 Chi square value- 3.51
NO	84 (84)	79 (92.9)	

Time to usual activities

The mean time to usual activities in the population was 9.03 days. The patients in the OA group took more time to return to usual activities (mean 10.06 days) compared to the LA group (mean 7.54 days). There was a statistically significant difference (P=0.0003) between the two groups.

Table. Time to usual activities:

Time to usual activities +/- S.D.(days)		
OA	10.06 +/- 2.313	P=0.0003 t-test value-8.918
LA	7.54 +/- 1.296	

Figure. Time to usual activities in study subjects:

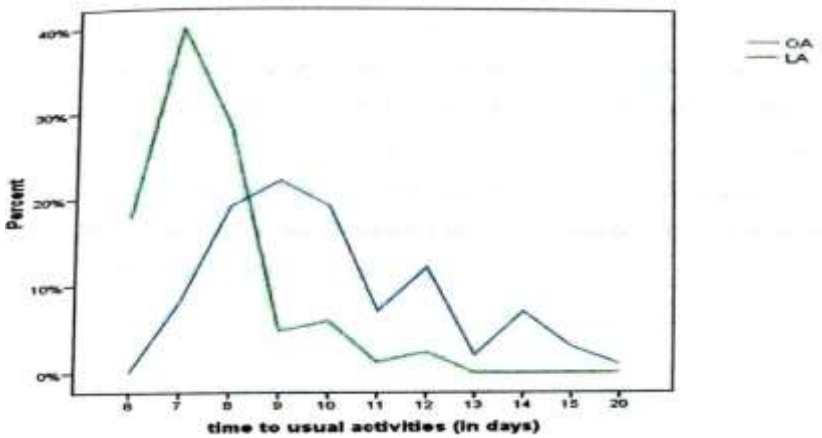
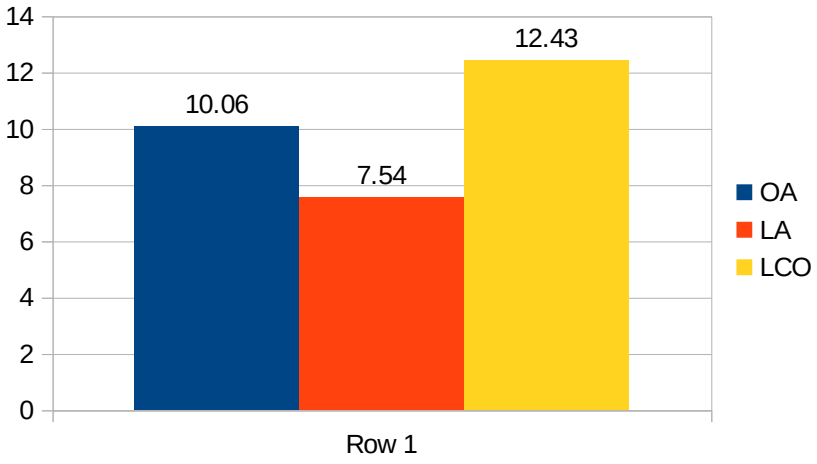


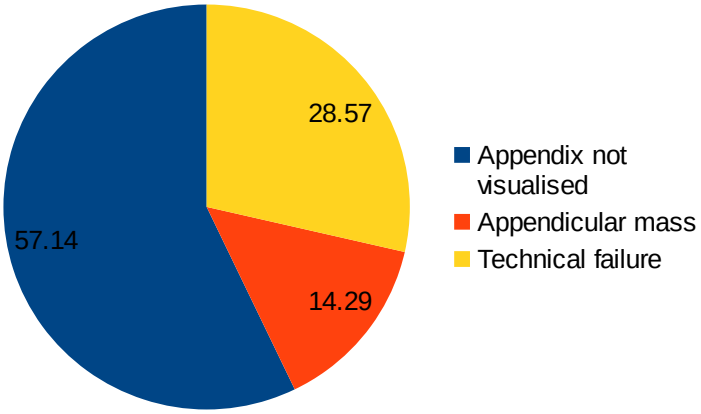
Figure. Mean time to usual activities in study groups:



Secondary Outcome: Cause Of Conversion

There were total 7 cases of conversion from LA to OA (conversion rate-7.6%). Out of this 4 cases were converted due to inability to identify the appendix because of difficult / distorted anatomy, I case due to appendicular mass formation and 2 cases due to technical failure. Difficult anatomy included those due to severe inflammation and abscess formation, retrocaecal position, and adhesions due to previous abdominal surgery.

Figure. Causes of conversion



V. Discussion

Results Of Previous Studies

The overall mortality of OA is around 0.3%; and morbidity around 11% [17]. Given the large number of procedures done annually, the validation of a minimally invasive technique that would improve outcomes may have a direct impact on patient management and possibly an indirect effect on the economics of health care.[25] Numerous prospective randomized trials [22-24], meta-analyses [9-12] and systematic critical reviews [13-16] have been conducted to assess the value of LA over OA, but there is some variability in the results of these studies. As suggested by all meta- analyses and systematic reviews, the methodological quality of most studies was "poor to moderate". Only 7 PRS had a sample size of 200 patients or more. The majority of non randomized studies favored laparoscopy. These should be analyzed with caution because of their inherent bias. In an article published in Ann Surg 2005, Katkhouda et al performed an extensive search of literature comparing LA to OA in adults using the review of Cochrane Central Registry of controlled trials, MEDLINE, and SciSearch. 45 prospective randomized studies, 4 meta analyses, 4 systematic reviews (including 1 cochrane database) and 4 large non randomized comparative trials were included in the review.[25]

In 1993, Tate et al from Hong Kong published data collected on the initial 55 patients 6 months after the introduction of LA in their hospital, that were compared to 100 OA.[26] They found significant benefits in favor of LA. These same authors in a follow up PRS conducted in the same institution concluded that their study could "no longer support the widespread adoption of a laparoscopic alternative to a traditional operation based

on initial uncontrolled studies. Two studies from Sweden and Denmark that included 500 and 583 patients, respectively followed sound scientific principles [27,21], but the lack of appropriate blinding and inclusion of multiple centres weakened the results.

VI. Review Of Outcomes

Infectious complications like wound infection and intra abdominal abscesses are two variables by which the techniques have been traditionally compared. However most studies demonstrated reduced wound infection rate for LA. On the other hand, Klingler et al [28] and Katkhouda et al [25] found that infectious complications were similar in both groups. The incidence of intra abdominal abscess formation was slightly higher in the laparoscopic group [14-16]. It is possible to reduce this if the sigmoid colon is retracted, the patient is placed in trendelenburg, and the pelvis is completely irrigated and aspirated under direct vision [29].

The overall reported mortality of appendectomy is very low and was estimated in a review of large administrative database at 0.05% for LA and 0.3% for OA [17] , reinforcing the fact that appendicectomy in the absence of peritonitis is a safe procedure, regardless of the technique.Overall complication rates were similar in both groups in most of the studies. The most serious early complication in the LA group, that required a reoperation is injury of the epigastric vessels due to an inadequate trocar placement, and is avoidable with the placement of trocars under direct vision lateral to the epigastric arteries [25]. The removal of all cannulas should also be done under direct vision prior to releasing of the pneumoperitoneum to detect any subtle bleeding from the abdominal wall.The operating room time, in most of the previous studies was longer for the LA group, despite the subjective perception that it can be an easier operation [13-15], this may be due to the inclusion of additional steps for set up, insufflation, trocar entry under direct vision, and diagnostic laparoscopy.

Pain assessment can be done in two ways : subjectively by the visual analogue scale and objectively by the tabulation of pain medications. The literature is divided on this subject. Some studies show less pain in the first two days after LA 9-12. All but one of these studies were non-blinded, thus reducing the validity of the results . The question of whether LA decreases the length of hospitalization has been a matter of debate over the past decade [17,30]. The literature provides contradictory results. Although some recent retrospective cohort studies of chart reviews found LA associated with significantly shorter hospital stay [31-34], other retrospective investigations reported non-significant differences [35,36]. Similarly some RCT assosciated LA with decreased hospital stay; however others report no significant differences. Even meta-analyses report controversial findings Saderland and associates summarized the results of 28 RCT and almost 3000 patients and reported a significant decrease in length of hospital stay in LA group [12]. Similar results were found by Golub and colleagues [11], whereas another meta-analysis failed to show a statistically significant difference [10]. The current literature describes that the difference may be affected by hospital factors or social habits. Moreover further discrepancies may arise from diverse health care policies and insurance systems in different countries.

The return to normal activity following appendicectomy is also a subject of debate. A minimally invasive operation by definition should allow for a quicker recovery, shorter convalescence at home, and quicker return to work. Several studies found LA to be assosciated with significantly earlier return to normal activities compared to OA. The results of a prospective RCT by Katkhouda and colleagues, based on the use of an objective instrument to measure the activity showed no difference in scores post operatively and at 2 weeks [25]. Others found improved postoperative activity in the LA group. But the comparison among the studies is difficult because of the variable definitions of activity. Results in 4 meta-analyses were statistically "highly heterogenous" [9-12]. In contrast, Ignacio et al [20] carried out a blinded prospective study in a tertiary care military based hospital on healthy active-duty men. This specific cohort was selected because the mandatory documentation required for convalescence in the the military, made for accurate assessment of lost days. In this study there was no difference in Pain on days 1 and 7 postoperatively or in the time to return to work. It has been previously reported that the presence of appendiceal perforation or abscess is assosciated with poorer outcome [32]. Most studies, however, didn't stratify the findings by the presence of abscess or perforation. In a large retrospective study, stratified analyses were performed for patients with or without perforation [32.] The average length of hospital stay was significantly shorter for LA patients with or without perforation. Similar results were reported by Hebebrand et a1 [37] from Germany. In an administrative database conducted by Ulrich and associates, median length of hospital stay was shorter regardless of whether abscess or perforation was present but, In- hospital infections were significantly lower in the subset of LA patients without abscess or perforation. The assessment of quality of life using the SF-36, by Katkhouda et al [25] showed improved scores in the LA group for 3 of the 8 parameters, namely physical functioning, general health, physical health, and in the general score.

The conversion rate from LA to OA in most of the previous studies was low (4-5%). In an RCT published by Sakpal and colleagues [38] in New Jersey, USA in 2012, the conversion rate was 4.16%, and the most common reason was severe acute inflammation (38.7%) followed by adhesions due to prior Surgery(25.81). Females and elderly (>65 years) had higher likelihood of conversion. Hellberg et al (Sweden) [39]

and Marcin et a1 [40] in two different studies found the most common cause of conversion to be a difficult anatomy (retrocaecal localization) of the appendix, followed by a significant inflammatory infiltrate or abscess which prevented a safe laparoscopic procedure. Infrequent conversions in most of the recent studies result from substantial operative team experience. Obese patients and women of child bearing age are two groups of patients who are found to benefit from laparoscopy in many previous studies.

Obese patients who underwent LA are seen to have an improved postoperative course and reduced complication rate, especially from the wound site, which is a serious problem in this group of patients. LA also gives a much better access in obese patients. Gynaecological diseases are common causes of acute abdominal symptoms, in childbearing women. Laparoscopy makes definite determination of intra abdominal pathology possible and allows for avoidance of unnecessary laparotomy and risk of adhesions, which can be a cause of intestinal obstruction or infertility in long term observation. But diagnostic laparoscopy was not included in my study.

VII. Results Of Present Study

In my observational study conducted at Amala Institute of Medical Science, Thrissur, during the period from January 2014 to June 2016, 192 patients underwent appendicectomy, of which 92 patients chose for laparoscopic surgery. As seven out of this had to be converted to open surgery, finally 85 cases of LA were compared with 100 cases of OA. There was no mortality in
either group.

The mean age of the patient population was 25.4 years. The sex ratio of the population was 1.1 : 1 (male : female). These are in concordance with most of the previous studies.

Majority of females chose an LA (61.3%), while majority of males (63.4%) for an OA. This is probably due to the cosmetic advantage of LA over OA. Other than sex, factors which were found to influence the mode of surgery were age, marital status, comorbid conditions and economic status of the patients. Younger people, unmarried and economically sound people preferred the minimally invasive technique. Certain medical conditions like bronchial asthma, COPD, and cardiac diseases where general anaesthesia is considered risky, also influenced the decision making. The direct cost involved in an LA was definitely higher than that in OA, and hence some economically backward class of patients could not afford an LA. Most of the patients underwent surgery at their first (65.6%) or second (21.9%) episode of symptoms. Complicated appendicitis was relatively low in incidence. This may be attributed to the increased awareness among public regarding the disease and its complications (perforation and peritonitis). Prevalence of comorbidities in the study subjects was low (15.6%) and is probably due to the younger age group affected by the disease.

The role of clinical examination in diagnosis of acute appendicitis was ascertained by the results of the study. Alvarado score alone (7 or more) could diagnose 82.3% of cases of appendicitis. And in those with a score of 5 or 6, could be diagnosed with the help of an ultrasound. On the other hand, USG positivity was seen in only 72.9% of cases. Those with an inconclusive USG finding, also were operated if had an Alvarado score 7 or more, and diagnosis was peroperatively confirmed. To conclude, clinical examination and Alvarado scoring system is still the cornerstone of diagnosis in appendicitis. The sensitivity of USG in previous studies was around and is highly operator dependent.

There was no significant difference in operating time between the two groups, despite the subjective perception that LA can be an easier operation. But, this is again supporting the results of previous studies. This may be due to the inclusion of additional steps for setup, insufflation and trocar entry under direct vision and/or due to the lack of experienced assistants, nursing staff and technicians to detect and trouble shoot technical issues during the procedure. Another finding was that the operating time was more or less consistent in the OA group whereas was highly variable in the LA group. This was probably due to difference in technical expertise among different surgeons in the relatively newer technique, LA. Post operative pain was significantly less in the LA group, both on postoperative day 1 & 2. The pain on day 2 was much less in LA, and the need for rescue medications was almost nil on day 2. This is consistent with most of the previous trials and is a definite advantage of the less invasive technique. Wound infection rate in this study was 12 %, but consisted mainly of minor infection (8.85%), most of which settled without any intervention. Though there was no significant difference between the two groups in terms of wound infection, there was no major infection in the LA group. All the 6 cases of major infection were in the OA group, which required minor surgical interventions and modification or prolongation of antibiotics. So the incidence of major wound infection is definitely less in the LA group, which is consistent with some previous studies. The incidence intra-abdominal abscess is thought to be more in the LA group as per the previous studies, but not analysed in any study.

Duration of hospital stay was significantly longer in the OA group, and there are contradictory reports in different studies, with similar as well as opposite results. The cause of shorter stay in my study may be due to the lesser pain, early institution of oral feeds, and early mobilization associated with the laparoscopic technique.

The time to return to usual activities was also much lesser in the LA group, and may be due to the same factors as for hospital stay, added with the increased confidence among patients associated with the smaller wound and lesser stitches. The rate of conversion was 7.6%, against a conversion rate of 4-5% in previous studies. The most common cause, as in previous studies, was difficulty in identifying the appendix (57.14%) due to difficult anatomy or severe inflammatory changes. The next common cause was technical failure (28.57%), which was indirectly related with the experience of the surgeon in the LA technique. One case was converted due to mass formation. Conversion was also related to the learning curve of LA, as most of the cases of conversion were done by surgeons less experienced in the laparoscopic technique.

Conclusion

- Appendicectomy in the absence of generalized peritonitis, is a safe procedure, regardless of the technique performed.
- OA is a time-tested procedure, with a small incision and minimal morbidity.
- Laparoscopic appendicectomy has advantages over its open counterpart, in terms of postoperative pain, duration of hospital stay, and time to return to usual activities.
- There is no significant difference in operating time between the two techniques. Rather, LA may take much longer in the learning curve.
- Though there is no significant difference in wound infection as a whole, major infection that requires intervention is much less in LA.
- The commonest cause of conversion is difficulty in identifying appendix (difficult anatomy/ severe inflammation), followed by technical failure.
- In diagnosed cases of acute appendicitis laparoscopic appendicectomy has got some advantages compared to open appendicectomy in experienced hands.

References

[1]. Samelson SL, Reyes Management of perforated appendicitis in children-revisited. Arch
[2]. surg. 1987; 122: 691-696.
[3]. Editorial. A sound approach to the diagnosis of acute appendicitis. Lancet. 1987; i: 198-200.
[4]. McBurney C. The incision made in the abdominal wall in cases of appendicitis, with a description ofa new method of operating. Ann Surg 1894; 15: 20-38.
[5]. Semm K. Endoscopic appendectomy. Endoscopy. 1983;15:59—64.
[6]. Majeed A W, Troy G, Nicholl JP, et al. Randomized, prospective, single-blind comparison of laparoscopic versus small-incision cholecystectomy. Lancet. 1996;347:989—994.
[7]. Michael JZ, Stanley WA, Douglas SS, David IS. Appendix and appendectomy. Maingot 's abdominal operations. 11th edition. 2007;21 :589-608.
[8]. Frazee RC, Roberts J W, Symmonds RE, et al. A prospective randomized trial comparing open versus laparoscopic appendectomy. Ann surg 1994; 219: 725-728.
[9]. Josef E. Fischer, Kirby I. Bland. Mastery of surgery. edition. 2007; volume 2: 1430-1438.
[10]. Chung RS, Rowland D Y, Li P, et al. A meta-analysis of randomized controlled trials of laparoscopic versus conventional appendectomy. Am JSurg. 1999; 177: 250-256.
[11]. Garbutt JM, Soper NJ, Shannon WD, et al. Meta-analysis of randomized controlled trials comparing laparoscopic and open appendectomy. Surg Laparosc Endosc. 1999; 9: 17-26.
[12]. Golub R, Siddiqui F, Pohl D. Laparoscopic versus open appendectomy: a meta-analysis. J Am Coll Surg. 1998; 186: 545-553.
[13]. SauerIand S, Lefering R, Holthausen U, et al. Laparoscopic vs conventional appendectomy: a meta-analysis of randomised controlled trials. Arch Surg. 1998;383:289 —295.
[14]. Fingerhut A, Millat B, Borrie F. Laparoscopic versus open appendectomy: time to decide. World J Surg. 1999;23:835— 845.
[15]. McCall JL, Sharples K, Jadallah F. Systematic review of randomized controlled trials comparing laparoscopic with open appendicectomy. BrJSurg. 1997;84:1045—1050.
[16]. Sauerland S, Lefering R, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. Cochrane Database Syst Rev. 2002; (1): CD001546.
[17]. Slim K, Pezet D, Chipponi J. Laparoscopic or open appendectomy? critical review of randomized, controlled trials. Dis Colon Rectum, 1998; 41: 398-403.
[18]. Guller U, Hervey S, Purves H , et al. Laparoscopic versus open appendectomy: outcomes comparison based on a large administrative database. Ann Surg. 2004;239(1):43—52.
[19]. Courtney M. Townsend, R. Daniel Beauchamp, B. Mark Evers, Kenneth L. Mattox. Sabiston Textbook of Surgery The biological basis of modern surgical practice. 19th edition. 2012; volume 2: chapter 51: 1279-1293.
[20]. Norman S. Williams, Cristopher J. K. Bulstrode, P. Ronan O' Connell, The Vermiform Appendix. Bailey and Love 's short practice of Surgery: 20edition 2013; chapter 71: 1199-1214.
[21]. Ignacio RC, Burke R, Spencer D, et al. Laparoscopic versus open appendectomy: what is the real difference? results of a prospective randomized double-blinded trial. SurgEndosc . 2004; 18(2):334—337.
[22]. Pedersen AG, Petersen 0B, Wara P, et al. Randomized clinical trial of laparoscopic versus open appendicectomy. BrJSurg. 2001; 88: 200-205.
[23]. Tate JJ, Dawson J W, Chung SC, et al. Laparoscopic versus open appendicectomy: prospective randomised trial. Lancet. 1993; 342: 633-637.
[24]. Ortega AE, Hunter JG, Peters JH, et al. A prospective, randomized comparison of laparoscopic appendectomy with open appendectomy. Am JSurg. 1995; 169: 208-212.

[25]. Minne L, Varner D, Burnell A, et al. Laparoscopic vs. open appendectomy: prospective randomized study of outcomes. Arch surg. 1997; 132: 708-711.
[26]. Katkhouda N, Rodney JM, Shirin T, et al. Laparoscopic versus open appendectomy: A prospective randomized double-blind study. Ann surg 2005; 242: 439-450.
[27]. Tate JJ, Chung SC, Dawson J, et al. Conventional versus laparoscopic surgery for acute appendicitis. BrJSurg. 1993;80:761—764.
[28]. Heikkinen T J, Haukipuro K, Hulkko A. Cost-effective appendectomy. Open or laparoscopic? A prospective randomized study. Surg Endosc. 1998; 12(10): 1204-1208.
[29]. Klingler A, Henle K P, Beller S, et al. Laparoscopic appendectomy does not change the incidence ofpostoperative infectious complications. Am J Surg. 1998; 175: 232-235.
[30]. Katkhouda N, Friedlander MH, Grant SW, et al. Intraabdominal abscess rate after laparoscopic appendectomy. Am J Surg 2000; 180: 456-459.
[31]. Temple LK, Litwin DE, McLeod RS. A meta-analysis of laparoscopic versus open appendectomy in patients suspected of having acute appendicitis. Can J Surg. 1999; 42: 377-383.
[32]. Vallina VL, Velasco JM, McCulloch CS. Laparoscopic versus conventional appendectomy. Ann Surg. 1993; 218: 685-692.
[33]. Richards KF, Fisher KS, Flores JH, et al. Laparoscopic appendectomy: comparison with open appendectomy in 720 patients. Surg Laparosc Endosc- 1996;6:205-209.
[34]. Heinzelmann M, Simmen HP, Cummins AS, et al. Is laparoscopic appendectomy the new 'gold standard'? Arch Surg. 1995; 130:752-785.
[35]. Kurtz RJ, Heimann TM. Comparison of open and laparoscopic treatment of acute appendicitis. Am J Surg 2001; 182: 211-214.
[36]. Moberg AC, Montgomery A. Appendicitis: laparoscopic versus conventional operation: a study and review of literature. Surg Laparosc Endosc. 1997;7:459-463.
[37]. Fallahzadeh H. Should a laparoscopic appendectomy be done? Am surg 1998; 64: 231-233.
[38]. Hebebrand D, Troidl H, Spangenberger W, et al. Laparoscopic or classical appendectomy? A prospective randomized study. Chirurg. 1994; 65: 112-120.
[39]. Sakpal S V, Bindra SS, Chamberlain RS. Laparoscopic appendectomy conversion rates two decades later: an analysis of surgeon and patient specific factors resulting in open conversion. J Surg Res. 2012 jul; 176: 42-49.
[40]. Hellberg A, Rudberg C, Enochson L et al. Conversion from laparoscopic to open appendectomy: a possible drawback of the laparoscopic technique? Eur J Surg. 2001 Mar; 167(3): 209-213.
[41]. Marcin S, Andrzej B, Anna G. Open or laparoscopic appendectomy'? Videosurgery and other miniinvasive techniques. 2009;4(3): 1 10-114.
[42]. Corneille MG, Steigelman MB, Myers JG, et al. Laparoscopic appendectomy is superior to open appendectomy in obese patients. Am J surg. 2007; 194•.877-880.
[43]. Zaninotto G, Rossi M, Anselmino M, et al. Laparoscopic versus conventional surgery for suspected appendicitis in women. Surg Endosc 1995; 9: 337-340.