Laprascopic Versus Open Appendicectomy: An Analysis of the Surgical Outcomes and Cost Efficacy in a Tertiary Care Medical College Hospital

Akshatha Manjunath[1], Aparajita Mookherjee[2]

ABSTRACT

Introduction: This study aimed to compare the surgical outcomes and cost efficiency of laparoscopic versus open appendectomy.

Material and Methods: A retrospective analysis of 100 patients who underwent appendicectomy in a Medical College Hospital from January 2011 to June 2015 was undertaken. Patients were divided into two groups of 50 each, and variables were analyzed including patient demographic data, operative time, duration of post operative pain and hospital stay, post operative complications and total costs. The results were analyzed by using statistical package for social services (SPSS, version 11.0, Chicago IL), Students t test, Chi square or Fischer's exact test as appropriate.

Results: Laparoscopic and open appendicectomy were performed in 50 patients each. There was no statistical significance (p=0.8293) in the mean operative time (LA=73.36 mins, OA = 63.67 mins). Mean duration of postoperative pain was much less for the laparoscopic group (1.81 days) and statistically significant (p=0.0014). The incidence of complications was much lower after laparoscopic surgery (4%) in comparison to open surgery (12%). Length of hospital stay was significantly lesser (p=0.0010) while mean total cost was significantly higher (p=0.0001) in the LA group.

Conclusion: As laparoscopic appendectomy is associated with fewer complications, shorter hospital stay, almost similar operative time, lower rate of intraabdominal abscess and marginally higher cost of treatment when compared to open appendicectomy, it can be recommended as the preferred approach of treatment for acute appendicitis.

Keywords: Laparoscopic appendicectomy (LA), open appendectomy (OA), complications, hospital stay, operative time, overall costs

INTRODUCTION

Appendicitis is the most common cause of surgical abdomen in all age groups[1] with a lifetime risk of 6%.[2] Open appendicectomy (OA), first described in 1894 by McBurney, performed through the right lower quadrant muscle splitting incision has for long been applied as the Gold standard procedure.[3] This procedure has mainly remained unchanged for about 100 years due to its favorable efficacy and safety.

In 1983, Kurt Semm, a German gynaecologist, introduced the use of laparoscopic techniques with the first large study of laparoscopic appendicectomy (LA) reported by Pier et al in 1991.[4,5] Although initially a controversial procedure, accumulating evidence supports the use of laparoscopic appendicectomy for the treatment of appendicitis.[2,6] The putative advantages of laparoscopic approach are quicker and less painful recovery, early oral intake, fewer postoperative complications and better cosmesis.[4] It also allows better assessment of other intra abdominal pathologies.

But nevertheless, its superiority over OA is still being debated as most of the advantages are of limited clinical relevance due to the small sample sizes and the high risk of type II errors (failing to observe a difference when in truth there is one).[7]

Intra-abdominal abscesses are a concern when performing laparoscopic appendectomies in case of complicated appendicitis. A meta analysis conducted on children with appendicitis revealed that intra abdominal abscess formation was more common following LA, although this was not statistically significant.[8] In adults, LA has been associated with a higher rate of intra abdominal abscesses with a consequent higher rate of readmission and interventions.[9] However one study using a nationwide inpatient sample database in the US revealed that laparoscopic appendectomies were associated with lower morbidity, lower mortality, shorter hospital stay and a reduction in hospital charges.[10]

This retrospective study was aimed at comparing the treatment outcomes between LA and OA, and to determine the feasibility of LA especially in terms of safety, duration of hospital stay and cost effectiveness in the setup of a Medical College Hospital where most of the patients belong to the lower socioeconomic strata.

MATERIALS AND METHODS

This retrospective study was conducted in a tertiary care medical college hospital between January 2014 and June 2015 with a follow up period of 6 months. Ethical clearance was obtained by the Ethics Committee of the institute before commencement of the study. 100 patients reporting to the surgical OPD with features of acute appendicitis were included in our study, excluding patients below 12 years, pregnant women, patients unfit for GA/laparoscopy and those having generalized peritonitis. After obtaining an informed consent, all patients were subjected to a preoperative work up including routine investigations, USG abdomen, erect X ray abdomen, renal and liver function tests as well as any other tests required by the anesthesiologists. The subjects were then randomised into the open appendicectomy and laparoscopic appendicectomy groups, comprising of 50 patients each. All patients received one preoperative course of

[1]Assistant Professor, [2]Professor, Department of General Surgery, Vydehi Institute of Medical Sciences and Research Centre, Bangalore, India

Corresponding author: Dr Akshatha Manjunath, Department of General Surgery, Vydehi Institute of Medical Sciences and Research Centre, Nallurhalli, Whitefield – 560066, Bangalore, Karnataka, India

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antibiotics (3rd generation cephalosporin or fluoroquinolone with Metronidazole) and were taken up for surgery under GA only.

Surgical techniques for open/ conventional appendicectomy
Surgery was done either through McBurney's muscle splitting or Lanz's skin crease incision. Appendix was identified, mobilised, mesoappendix ligated, appendix removed and base was transfixed.

Surgical techniques for laparoscopic appendicectomy
Surgery was done using three ports - one 10 mm at the umbilicus and two 5 mm ports in the suprapubic and left iliac regions. After identification of appendix, base was clamped using 2 endoclips and appendix divided.

All specimens were sent for histopathological examination. All patients were observed in the postoperative ward for 24 hours, and then shifted. Oral feeding was commenced on appearance of bowel sounds. Wounds were dressed on second postoperative day and sutures removed on the 7th postoperative day (in uninfected wounds). Discharge, in case of uncomplicated patients of open surgery was done as per patient's preference but at least after completing one bowel movement. All patients underwent minimum of 2 follow-ups - first after 1 week and 6 months later.

Comparable data was tabulated and analyzed statistically to reach a conclusion regarding the surgical outcomes of both procedures.

STATISTICAL ANALYSIS

The data was analyzed using Statistical package for social services (SPSS, version 11.0; Chicago IL, USA). Continuous variables like age, hospital stay and operative duration were presented as Mean + SD, while categorical variables such as gender and postoperative complications were expressed as frequency and percentages using 95% confidence interval. Student's t test was used to compare the means of continuous variables while categorical variables were compared using Chi-square or Fischer's exact test, as appropriate. Probability equal to or less than 0.05 ($p<0.05$) was considered significant.

RESULTS

Of the 100 patients included in the study, 50 (50%) patients underwent open surgery and 50 (50%) patients underwent laparoscopic surgery. There was one conversion to OA (2%) because of dense adhesions. One case of OA (2%) was converted to midline incision, as appendix could not be identified through Gridiron incision.

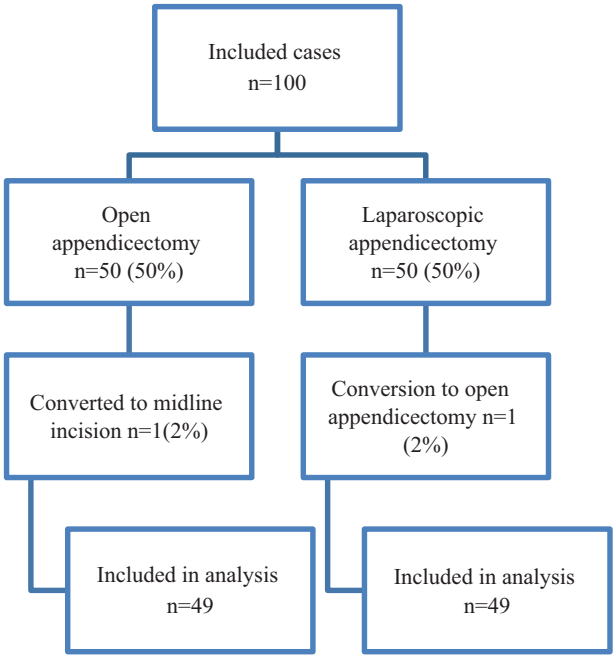

Figure-1: Study profile

	LA Group (n=50)	OA Group (n=50)	p value
Mean age (in years)	25 (18-46)	24 (18-50)	1.000
Gender			
Male	25 (50%)	27(54%)	1.000
Female	25(50%)	23(46%)	1.000
Total count (in cells/cumm)			
Uncomplicated cases	12.3(4.8-25.5)	13.2(4.9-22.6)	0.812
Complicated cases	20.2 (4.8-25.5)	20.5(4.9-22.6)	0.826
Intraoperative findings			
Inflammed appendix	49 (98%)	44(88%)	0.827
Gangrenous appendix	1 (2%)	3(6%)	
Perforated appendix	0	1(2%)	
Meckel's diverticulum	0	1(2%)	
Intestinal worms	0	1 (2%)	

Table-1: Patient demographics and presentation

	LA Group	OA Group	Difference	P value
Mean operation time (in minutes)	73.36	63.67	9.69	0.8293
Mean duration of postoperative pain (in days)	1.81	4.79	-2.98	0.0014*
Post operative complications rate	4%	12%	-8%	1.000
Mean hospital stay (days)	3.65 (2-7)	6.87(3-12)	-3.22	P=0.0010 *
Mean total cost (Rs)	17079	11766	5313	0.0001**
*Statistically significant; ** Highly significant				

Table-2: Clinical outcomes

Demographic Profile

Patients from both the groups were found comparable in terms of age, gender, clinical presentation and investigative findings. Of the total operated patients, 52 were males (52%) and 48 were females (48%). The age ranged between 18 and 50 years in the OA group (mean- 24 years) while similarly the laparoscopic patients were between 18 and 46 years (mean- 25 years).

All patients presented with right iliac fossa pain with 23 % having fever and 28% having vomiting. All three cardinal symptoms of pain, fever and vomiting were seen in only 10 %. 60 % of the patients had a total leucocyte count above 11000 cells/cu mm. (normal reference range: 4000-11000 cells/cu mm). While in the other 38% patients, although the total count was within normal range, diagnosis of acute appendicitis was based on clinical suspicion and USG confirmation. Hence in this study, a raised total count had a sensitivity of 61.22% (CI: 0.50-0.70). However, all patients who subsequently had a gangrenous or perforated appendicitis had a significantly higher total count (> 16000 cells/cumm). Hence total count, though a useful marker, can provide only a clue to the diagnosis and a normal count can by no means preclude the diagnosis of acute appendicitis.

On USG abdomen, the typical finding of "an aperistaltic blind ending noncompressible tubular structure" was present in 62 % patients while only probe tenderness was detected in 6% patients and appendix was not visualized in 29% patients. Even in inconclusive patients, surgery was performed based on elevated total count and clinical diagnosis. Hence USG alone as a means of diagnosis had a low sensitivity in this study.

Intraoperatively, 44 patients in the open group (88%) and 49 patients (98%) in the laparoscopic group showed inflammed appendix, while a total of 4 patients (4%) had gangrenous and one patient (1%) had perforated appendicitis. 2 patients of the open group (4%) had a concomitant pathology of Meckel's Diverticulum and intestinal worms, with diverticulectomy and evacuation of worms done respectively (Table-1).

Surgical Outcomes

The mean operative time was 63.67 minutes (range: 50-150 minutes) for the OA group and 73.36 mins (range 60-180 mins) for the LA group, with no statistically significant difference (p=0.8293). The longest duration of time in LA group was in the single case of conversion (2%) due to dense adhesions between appendix and caecum and in the OA group (2%), which was converted to midline incision due to non-identification of appendix through the McBurney's incision. The patients of the LA group had significantly lower duration of postoperative pain (mean - 1.81 days) compared to a mean of 4.79 days in the OA group. This finding was statistically significant (p=0.0014).

There was no mortality during this study but we had a total postoperative morbidity of 8 % (8 cases). 5 patients (10%) had wound infection and one (2%) patient with intra abdominal abscess (all in the OA group), were all managed conservatively. The only complications seen in the LA group were 2 (4%) patients with paralytic ileus. All values were not statistically significant (p=1.0000).

Mean hospital stay was found to be statistically shorter (p=0.0010) for the LA group (Mean 3.65 days) in relation to the OA group (Mean 6.87 days). 97 % of patients resumed normal lifestyle after removal of sutures. The mean expenditure at the time of discharge of the OA group was Rs 11, 766 (SD-Rs 403.25) whereas for the patients of the LA group, the mean expenditure was Rs 17079 (SD-Rs 463.41). With the p value <0.0001, it was found to be statistically highly significant. 3 patients (6%) of the OA group had to be readmitted after discharge of which 2 patients (4%) had purulent discharge from scar (treated conservatively for 7 days with daily dressing and iv antibiotics) and one patient (2%) reported 18 months after surgery with features of intestinal obstruction. This patient underwent laparoscopic adhesiolysis and was discharged after 7 days.

DISCUSSION

Excellent results following laparoscopic appendectomy and easier availability of instruments for laparoscopic surgery in recent years has made laparoscopic appendicectomy a popular choice of surgery amongst many patients for both simple and complicated cases of acute appendicitis. The rate of LA between 1998 and 2008 increased from 20.6% to 70.8%, becoming the prevalent approach to treat acute appendicitis since 2005.[11]

In addition to the clinical benefits described in several studies, the laparoscopic approach allows a full exploration of the peritoneal cavity,[12] thus representing an important diagnostic tool in case there is only suspicion of acute appendicitis. Several diseases like PID, endometriosis, ovarian cysts, ectopic pregnancy, cholecystitis, colonic perforation may mimic appendicitis.[13] A definitive diagnosis is obtained in 96% of patients undergoing LA compared with 72% of those undergoing open procedures.[14] LA has been proposed as a preferred technique in obese patients and in elderly patients.[15] In these patients, the laparoscopic approach is associated with reduced hospital stay, less post op morbidity and lower cost compared to open approach.

Despite the obvious advantages described, the advantage of LA still remains a matter of debate because of concerns about possible longer operative time, higher rate of post op intra abdominal abscesses and higher costs compared to OA. Because of all of the above, the open approach appears to be still widely used in clinical practice.

In the present study, the duration of both LA and OA were comparable (difference of 9.69 minutes) which was not found to be statistically insignificant. This can be attributed to the fact that being a teaching hospital all open surgeries were performed by surgical residents under supervision and all LA were done by experienced specialists. The longer duration of laparoscopic surgery can be explained by the fact that LA involves additional steps of gas insufflation, trocar entry and diagnostic confirmation and technically more complex dissection in case of complicated appendicitis. A world wide spread of training in lap technique lead to a significant reduction in difference of operative time compared to open procedures after 2000, as evidenced by several meta analyses.[16,17]

In the present study, pain was assessed both subjectively and objectively by the tabulation of analgesic use. Several studies have reported less pain in the first 48 hours after lap appendectomy.[18,19] and in our series too, the same observation was made throughout the hospital stay. Smaller incision and minimal tissue handling maybe the reason for decreased post operative pain perception in LA. Another interesting observation has been the patient's perception of pain after appendectomy.

In one study done by Ortega et al,[20] linear analogue pain scores were recorded in 135 patients blinded to the procedure of operation by special dressing and pain score was very less in lap group compared to open. Those who underwent lap appendicectomy were more vocal of pain although it was of a lower intensity. This could have risen from the explanation that laparoscopic procedures are painless or a lower level of endorphins is released or due to lower peritoneal injury from pneumoperitoneum.

Our results showed an overall 3.49-day reduction in recovery time for LA compared to OA (p= 0.0022). Early return to full activity is accepted as an obvious advantage of LA, which was supported by a large-scale Meta analyses conducted by the Cochrane colorectal Cancer group review.[7] The trocar incisions of LA contribute to minimum trauma to the abdominal wall and less pain, allowing faster recovery. A trend towards less difference in return to normal activity was noted in studies done before and after 2000.[21]

The present study confirmed a significant lower incidence of post operative complications in the patients treated by lap approach (4.08% versus 12.24% for OA cases). These results are in agreement with previous reports, which vary from 5.7% to 25.8% for OA and 3% to 19% for LA.[7,18,22]

Although the infection of surgical wound is not per se a life threatening condition, it worsens the quality of life in the early postoperative period and prolongs the convalescence and recovery time. In our study, there was not a single case of wound infection after LA and most of the literature supports this view.[17] The extraction of specimen with a bag through a trocar port rather than directly through the surgical wound as in OA can explain this reduction in incidence. Moreover the smaller size of the laparoscopic incisions reduces the probability of infection especially in obese patients

The occurrence of intra abdominal abscess after LA represents a potentially life threatening event. Several meta analyses of randomized controlled trials published in recent years.[7,16,17] have shown an increased risk of intraabdominal abscess after LA. This may be attributed to improper laparoscopic techniques; CO 2 insufflation may promote mechanical spread of bacteria in peritoneum, aggressive handling of infected appendix, use of irrigation fluids leading to contamination of peritoneal cavity. In this study, however, no patient in LA group and one patient in OA group developed intra abdominal abscess, the difference being statistically insignificant. Three possible causes of our results in this aspect maybe because of the small sample size, only one case of perforated appendix and higher laparoscopic skills of experienced surgeons.

In this study 4% of patients in the LA group and no patients in the OA group developed paralytic ileus, which did not reach statistical significance. This finding is mirrored in other studies. But some studies have reported statistically significant post operative ileus in the LA group due to reduced manipulation of the ileum and the caecum in the hand of a skilled surgeon, minor abdominal trauma and less pain due to the small incisions of the trocars.[17,23]

Post operative ileus along with pain and wound infection may hamper the mobility of the patient, in turn prolonging the hospital stay and increasing the cost of the treatment. The study shows that the length of hospital stay was 3.49 days for LAP patients (P=0.0022), which was statistically significant. The result is comparable to the results of Wei et al and other recent cohort studies.[24-26]

This reduction of length of hospital stay has a direct impact on costs. Although the cost of LA is higher that OA, the difference in total cost between the two procedures is decreased by shorter length of stay and earlier return to work life.[27]

The debate about cost comparison between the two groups still exists, and our study too found that LA cost the patients approximately Rs 5313 higher than OA (which was statistically highly significant, p=0.0001). Heikkenen TJ et al[28] reported a randomized study for cost effectiveness of LA while Wei et al[23] in their meta analysis including 8 RCTs performed an analysis of the costs across different countries and age groups using the hospital cost ratio to compare. The total hospital costs for LA were 11% higher (for both simple and complex cases) than OA but the difference was not found to be statistically significant. Though the overall costs were higher, significant cost savings were seen due to rapid convalescence and because of no hidden costs as seen in the OA group due to longer hospital stay, cost of treatment of complications and readmission, delayed return to livelihood and loss of earnings.

In our study, there were 3 cases (all from OA group) of readmission in the follow up period during the course of the study. Two were cases of wound infection discharged after antibiotics and dressings, and the third was a case of small bowel obstruction (needed laparoscopic adhesiolysis). Reports show that incidence of small bowel obstruction is as high as 2.8%[28] as opposed to 1 % in our study, and equal in both groups. Our lower incidence may be due to insufficient follow up period (onset is described commonly in first 4 years after surgery).

The limitation of our study is its retrospective nature. The follow up period was limited to only 6 months postoperatively. Hence we could only focus on immediate and primary outcomes, and could not take into account the long-term complications (like obstruction and incisional hernias), and their effect on health care costs. Due to restriction of time, the sample size was small compared to other studies. Our hospital caters mostly to patients belonging to low socio-economic strata; hence bias on the choice of treatment could have affected some of the results. Surgical residents performed most of the surgeries in OA group in comparison to senior surgeons operating in the LA group. So some of the outcomes of the OA group could have been affected due to the learning curve.

CONCLUSION

In our study, we compared the outcomes between laprascopic and open appendicectomy for treatment of acute appendicitis in a Medical College Hospital. Laparscopic surgery was found to be superior in terms of lesser post-operative pain, shorter hospital stay, fewer wound infection and cases of intra-abdominal abscess. The length of both procedures was not significantly different and fewer readmissions were seen in the LA group.

The only disadvantage of LA was the marginally higher cost to OA group, but the hidden costs increases the total cost of treatment in OA group both in terms of expenditure and delayed return to work.

Our study has proved that provided surgical experience and

equipments are available, laparoscopic appendicectomy is safe and equally efficient compared to the conventional technique and can be recommended as the preferred approach for the treatment of acute appendicitis.

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