Original Article

Laparoscopic Versus Open Appendectomy: A Comparison of Primary Outcome Measures

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ABSTRACT

Background/Aim: The aim of the study was to compare laparoscopic and open appendectomy (OA) in terms of primary outcome measures. Study design: A randomized controlled trial. Place and duration of the study: Khyber Teaching Hospital, Peshawar, Pakistan, February 2008 to December 2009. **Patients and Methods:** A total of 160 patients were divided into two groups, A and B. Group A patients were subjected to laparoscopic appendectomy (LA), whereas Group B patients were subjected to OA. Data regarding age, gender, and primary outcome measures, such as hospital stay, operative duration, and postoperative complication, were recorded and analyzed. Percentages were calculated for categorical data, whereas numerical data were represented as mean ± SD. Chi-square test and *t* test were used to compare categorical and numerical variables, respectively. Probability ≤ 0.05 ($P \leq 0.05$) was considered significant. **Results:** After randomization, 72 patients in group A and 75 patients in group B were analyzed. The mean age of patients in groups A and B was 23.09 ± 8.51 and 23.12 ± 10.42 years, respectively, ($P = 0.981$). The mean hospital stay was 1.52 ± 0.76 days in group A and 1.70 ± 1.06 days in group B ($P = 0.294$). The mean operative duration in group A and B were 47.54 ± 12.82 min and 31.36 ± 11.43 min, respectively ($P < 0.001$). Pain (overall level) was significantly less in group A compared with group B ($P = 0.004$). The two groups were comparable in terms of other postoperative complications, such as hematoma ($P = 0.87$), paralytic ileus ($P = 0.086$), urinary retention ($P = 0.504$), and wound infection ($P = 0.134$). **Conclusion:** LA is an equivalent procedure and not superior to OA in terms of primary outcome measures.

Key Words: Acute appendicitis, laparoscopic appendectomy, open appendectomy

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Appendicitis is the most common cause of surgical abdomen in all age groups.[1,2] Approximately 7%–10% of the general population develops acute appendicitis with the maximal incidence being in the second and third decades of life.[3,4] Since 1894, the first description of open appendectomy (OA) by McBurney, it was the gold standard for treating patients with acute appendicitis for more than a century.[5] In contrast, the first laparoscopic appendectomy (LA) was performed in 1983 by Semm, a German gynecologist.[6]

LA, unlike laparoscopic cholecystectomy, has not gained much popularity since its introduction.[7] Despite numerous randomized controlled trials published so far, comparing OA and LA, the relative advantages of the two procedures are still to be established.[8-11] Furthermore, it is argued that the advantages of LA over OA, such as short hospital stay, less analgesia requirement, rapid postoperative recovery, and better cosmetic outcome, are not significant.[12] In the developing countries only a few studies have been conducted comparing the two modalities in the treatment of acute appendicitis.[13]

There is thus a need to carry out further trials. Our hospital is a government hospital and majority of the patients attending it belong to lower socioeconomic group. LA is frequently practiced in our department. With not much regional studies comparing the two procedures, we endeavored to analyze and compare the LA and OA in terms of operative and postoperative outcomes.

PATIENTS AND METHODS

This study was conducted at Khyber Teaching Hospital,

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Peshawar, from February 2008 to December 2009, as part of a single-center randomized clinical trial. The objective of the study was to compare LA and OA in terms of primary outcome measures, such as operative duration, length of hospital stay, and postoperative complications, as these are the ultimate determining factors in deciding between LA and OA. All other outcome measures, such as cost of the treatment of the two techniques, are regarded as secondary, and were not considered. Approval for the study was obtained from the Ethics Committee of the hospital.

In this study, 160 patients, presenting to outpatients department (OPD) with clinical diagnosis of acute appendicitis were included. The diagnosis was made clinically with history (right iliac fossa [RIF] or periumbilical pain shifting to RIF, nausea/vomiting), physical examination (tenderness or guarding in RIF), and TLC (white blood cell (WBC) count > 10,000/dL). The clinical and laboratory data were used to calculate the Alvarado score of patients with MANTRELS (migratory pain, anorexia, nausea/vomiting, tenderness in RIF, rebound tenderness, elevated temperature, leukocytosis, and shift of WBCs). Any patient with a score of 7 or more was operated on as having acute appendicitis. Appendicitis was confirmed on histopathology, which also showed different grades of inflammation. The patients were selected through consecutive nonprobability sampling and were randomly allocated to two groups, A and B, using lottery method. Group A patients were subjected to LA and group B patients to OA.

The inclusion criteria were patients with clinical diagnosis of acute appendicitis, age 12–60 years, American Society of Anesthesiologists Class I, informed consent, and willing to abide by the follow-up protocol. Patients with previous abdominal surgery, large ventral hernias, mass RIF, and history of symptoms for more than 5 days were excluded from the study. Patients with converted LA were included in the LA group (intention to treat principle). All the patients included in the study were admitted a day before surgery, as part of the routine protocol of our unit. History, physical examination and investigations, such as full blood count, urine routine examination, ultrasonography (US) of abdomen and pelvis, were performed for diagnosis. Once a diagnosis of acute appendicitis was made, investigations for anesthesia fitness, such as blood urea and sugar, serum electrolytes, chest radiography, Hepatitis B and C screening, and electrocardiography, were also performed. The patients were explained the risks and benefits of the two procedures and an informed consent was obtained.

The patients were operated by a single consultant surgeon, under general anesthesia, with sufficient capability of performing the two procedures (LA and OA). The patients were given, in both the groups, a prophylactic dose of third-generation cephalosporin and metronidazole at induction as part of the protocol, whereas two doses of the same were repeated postoperatively at 8 and 16 h.

LA was performed through a 3-port technique with carbon dioxide used for the creation of pneumoperitoneum through a 5-mm infraumbilical port up to a pressure of 12 mmHg. The other two ports were placed in the lower abdomen according to the individual surgeon's choice. After identification of the appendix, the mesoappendix was ligated, with Vicryl 1 after creation of a window in its base, and cut. The base of the appendix was crushed and ligated using Vicryl 1 endoloop. The appendiceal specimen was retrieved through a 10-mm infraumbilical port. Endodiathermy was used for hemostasis. OA was performed through standard Lanz incision. After the incision, peritoneum was accessed and opened to deliver the appendix, which was removed in the usual manner. Skin incision in both the procedures was closed with subcuticular prolene 2/0 suture.

The patients were not given oral feed until they were fully recovered from anesthesia and had their bowel sounds returned when clear fluids were started. Soft diet followed by regular diet was introduced when the patients tolerated the liquid diet and had passed flatus. Patients were discharged once they were able to take regular diet, afebrile, and had good pain control. A standardized questionnaire was used to record the data.

All the operative details were recorded. The operative time (minutes) for both the procedures was counted from the skin incision to the last skin stitch applied. Pain was measured qualitatively (subjectively) using visual analog scale. The length of hospital stay was determined as the number of nights spent at the hospital postoperatively. Postoperative complications were recorded in the proforma during the hospital stay and till 1 month (follow-up visit fortnightly in OPD). Wound infection was defined as redness or purulent or seropurulent discharge from the incision site observed within 30 days postoperatively. Seroma was defined as localized swelling without redness with ooze of clear fluid. Paralytic ileus was defined as failure of bowel sounds to return within 12 h postoperatively. Confounding variables were controlled through strictly following the exclusion criteria.

Statistical analysis

The data were analyzed using statistical package for social sciences (SPSS, version 11.0; Chicago, IL, USA). Continuous variables, such as age, hospital stay, and operative duration, were presented as mean ± SD, while categorical variables, such as gender and postoperative complication, were expressed with 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 Fisher's exact test, as appropriate. Probability equal to or less than 0.05 ($P \leq 0.05$) was considered significant.

RESULTS

A total of 160 patients were included in the study, 80 each in LA and OA groups, respectively. Eight patients from group A and 5 patients from group B were lost to follow-up because they did not abide by the protocol. Therefore, a total of 72 patients in group A and 75 patients in group B were analyzed, as shown in Figure 1. The mean age of the patients was 23.09 ± 8.51 years in group A and 23.12 ± 10.42 years in group B. In group A there were 40 males and 32 females with male to female ratio (1.2:1), whereas in group B there were 44 males and 31 females (male to female ratio 1.4:1) as shown in Table 1. The two groups were comparable in terms of body mass index (BMI) and WBC count, as depicted in Table 1.

Negative appendectomy rate, as confirmed on histopathology, was 4 (5.3%) and 2 (2.6%) in LA and OA group, respectively. The final diagnosis in these patients being, Meckel's diverticulitis (n=1), ureteric colic (n=2), and ruptured ovarian cyst (n=1) in the LA group, and ureteric colic (n=2) in the OA group. Peroperatively, appendix in LA was phlegmonous 6.6% (n=5), perforated 9.3% (n=7), gangrenous 1.3% (n=1), and acutely inflamed in 77.3% (n=58) patients. The corresponding figures in the OA group were 2.6% (n=2), 10.6% (n=8), 0% (n=0), and 84% (n=63), respectively. One patient in the LA group was converted to OA due to mass formation.

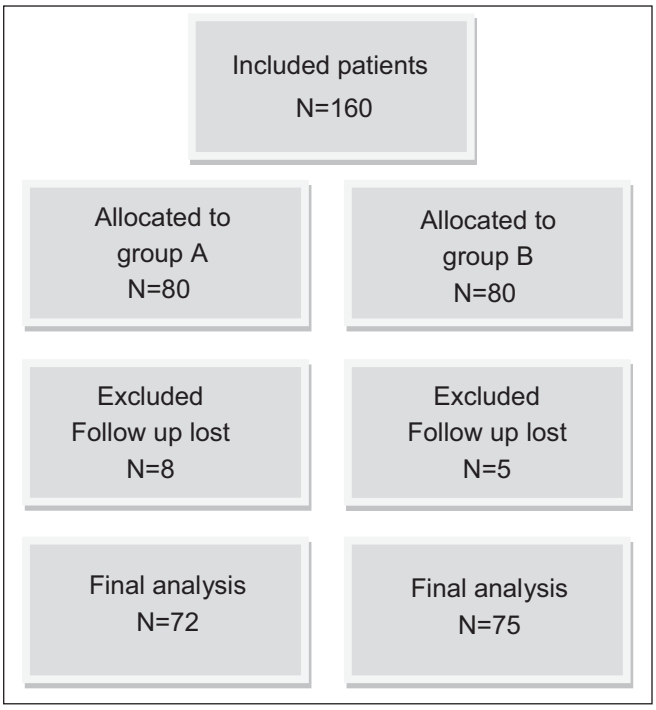

Figure 1: Patient allocation

As shown in Table 2, the mean postoperative hospital stay was 1.52 ± 0.76 days in LA compared with 1.70 ± 1.06 days in OA, which was statistically not significant ($P = 0.287$). The mean operative duration was 48.26 ± 12.82 min in LA and 31.36 ± 11.43 min in OA ($P < 0.001$).

Postoperative complications were compared and they did not reveal any statistically significant difference between the two modalities as shown in Table 2. There was, however, an increased proportion of patients experiencing some degree of pain in OA vs LA group, 90.6% and 72.2%, respectively ($P = 0.004$). Pain was qualitatively stratified into mild, moderate, and severe, according to visual analog scale, with decreased incidence of severe pain in the OA group compared with the LA group, 24% vs 38% patients, respectively, which proved statistically significant ($P = 0.023$), as shown in Table 2.

DISCUSSION

In recent years, a great majority of surgeons have embarked on LA, which is mainly attributable to excellent results gained in laparoscopic cholecystectomy. However, OA is not lagging much behind LA and has flourished as a minimally

Table 1: Demographic features (n=147)

	LA n=72	OA n=75	*P* value
Age (years)	23.09 ± 8.51	23.12 ± 10.42	0.981
Gender	40 ± 32	44 ± 31	0.588
BMI	25.02 ± 3.12	24.68 ± 2.64	0.475
WBC count (/mm^3)	11,111 ± 2171	10,910 ± 2186	0.574

LA: Laparoscopic appendectomy; BMI, Body mass index; OA: Open appendectomy; WBC: White blood cell; Data expressed as mean ± standard deviation or n (%) as appropriate

Table 2: Comparison of primary outcome measures

Outcome measures	LA (n =72) (%)	OA (n=75) (%)	*P* value
Hospital stay (days)	1.52 ± 0.76	1.70 ± 1.06	0.294
Operative duration	47.54 ± 12.82	31.36 ± 11.43	< 0.001
Postoperative complications			
Hematoma	1 (1.3)	4 (5.3)	0.187
Paralytic ileus	5 (6.9)	1 (1.3)	0.086
Urinary retention	3 (4.1)	5 (6.6)	0.504
Wound infection	3 (4.1)	8 (10.6)	0.134
Pain	55 (72.2)	68 (90.6)	0.004
Mild	22 (40)	19 (28)	0.480
Moderate	20 (36)	23 (34)	0.700
Severe	13 (24)	26 (38)	0.023

invasive procedure due to the shorter and cosmetically acceptable incision. The advantages of LA over OA are thus, if any, only marginal and difficult to confirm.[14]

The clinical presentation of acute appendicitis can overlap significantly with other clinical conditions with only 50%–60% of patients having the classical presentation.[15] In our study, a majority of the patients with negative appendectomies, in both the groups, were females, which is corroborated by another study.[15] The higher rate of misdiagnosis in females may be due to the gynecologic pelvic diseases and female functional abnormalities.[4] Therefore, in patients with atypical presentation, diagnostic laparoscopy instead of US, computed tomography, or serial WBC counts, should be considered early due to its easy availability, nil mortality, excellent diagnostic yield, and low morbidity.[16] This is one aspect where laparoscopic approach outshines the open approach.

This study shows that there was not a significant difference in the hospital stay between the two modalities of treatments. This is in corroboration with other studies.[12,14] Studies published in the early 1990s showed significantly shorter hospital stay in favor of LA.[17] Similarly, a local study also demonstrated a significantly shorter hospital stay in the LA group.[18] Milewczyk *et al*. demonstrated a longer hospital stay in LA vs OA group.[19] The question whether LA is associated with a shorter hospital stay has been a matter of controversy and the current literature yields conflicting data.[20] The difference in the hospital stay between the two procedures may be due to the difference in the health care system rather than the difference in the two procedures.[21] This appears to be one area where OA has fast caught up with LA.

Operative duration remains a much talked about aspect among experts whenever LA and OA are compared.[21] This study shows that the operative duration was significantly longer in LA compared with OA, which is consistent with other studies.[3,8,12,18,22] Peiser *et al*. reported no significant difference in the operative duration comparing the two procedures.[14] All the procedures in our study were performed by a consultant surgeon with sufficient minimal invasive surgery load and the difference can be explained by the fact that LA involves the additional steps of gas insufflation, trocar entry, and diagnostic laparoscopy.

According to Johnson, a new procedure must have, in addition to other benefits, such as less operative time and ease in performance, the advantage of safety (less complications and morbidity).[23] In our study, the overall complication rate was significantly lower in LA compared with OA. This is in agreement with other studies.[24] Guller *et al*. did not find any statistically significant difference in the overall morbidity between the two procedures.[20]

Wound infections may not be a serious complication as such but can cause inconvenience to the patient, impacting convalescence and quality of life.[8] In this study, fewer patients developed wound infection in the LA group, but the difference was not statistically significant. Similar observations are reported from other national and international studies.[3,8,12,14] In contrast to our results, a prospective study showed that a significant proportion of patients, undergoing OA, developed wound infection as opposed to LA.[24] In OA, direct delivery of the appendix through the wound may risk contamination, whereas utilization of laparoscopic port or bag for appendix retrieval may favor reduced frequency of wound infection in LA.[25] In contrast, intraabdominal abscess formation is almost 3 times more common in LA compared with the open counterpart.[12] This can be attributed to the fact that CO_2 insufflation in LA may facilitate spreading of microorganisms in the peritoneal cavity, especially in perforated appendicitis.[24] In the present study, however, no patient developed intraabdominal abscess.

In this study, 6.9% patients in the LA group and 1.3% patients in the OA group developed paralytic ileus, which did not reach statistical significance. This finding is mirrored in other studies.[24,26] Some studies have reported statistically significant postoperative ileus in LA arm compared with OA.[3,25] Postoperative 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 treatment.

Reduced postoperative ileus and wound infection can be beneficial in so many ways: less pain, early oral intake, early mobilization, all resulting ultimately in reduced hospital stay.[25] In our study, we found that pain (overall level as measured on visual analog scale) was significantly less in LA, which is in accordance with other studies.[12,21] In contradistinction with our results, other studies failed to show significant difference in pain perception between the two treatment options.[3,8] Smaller incisions and minimal tissue handling may be the reason for decreased postoperative pain perception in LA.

It would be befitting to acknowledge the limitations of our study. First, we did not include residents as surgeons in the study, although appendectomy is commonly performed by residents in our setup. Second, our follow-up was limited to 1 month postoperatively. Our aim was to look for early postoperative complications postdischarge. Third, this study was not blinded (treatment allocation and clinical outcome assessment not being blinded).

CONCLUSION

In our study, postoperative pain was significantly less in the LA group. In contrast, operative duration was longer

in LA, which touched statistical significance. There was, however, no difference in other primary outcome measures. In conclusion, LA is an equivalent procedure and not superior to OA in terms of primary outcome measures, as the benefit gained through reduced postoperative pain was balanced by significantly longer operative duration.

Based on the results of this study, firstly, we would like to recommend further trials comparing LA and OA not only for primary outcome measures assessment, but also for secondary outcome measures. Secondly, where the facilities and expertise are available for LA, the choice for treating acute appendicitis with any of the two modalities should finally be decided by the patient or the operating surgeon.

REFERENCES

1. Zhang Y, Zhao YY, Qiao J, Ye RH. Diagnosis of appendicitis during pregnancy and perinatal outcome in the late pregnancy. Chin Med J 2009;122:521-4.
2. Ozguner IF, Buyukayavuz BI, Savas MC. The influence of delay on perforation in childhood appendicitis. A retrospective analysis of 58 cases. Saudi Med J 2004;25:1232-6.
3. Kumar B, Samad A, Khanzada TA, Laghari MH, Shaikh AR. Superiority of laparoscopic appendectomy over open appendectomy: The Hyderabad experience. Rawal Med J 2008;33:165-8.
4. Fahim F, Shirjeel S. A comparison between presentation time and delay in surgery in simple and advanced appendicitis. J Ayub Med Coll Abbottabad 2005;17:37-9.
5. McBurney C. The incision made in the abdominal wall in case of appendicitis with a description of a new method of operating. Ann Surg 1894;20:38-43.
6. Semm K. Endoscopic appendectomy. Endoscopy 1983;15:59-64.
7. Kamal M, Qureshi KH. Laparoscopic versus open appendectomy. Pak J Med Res 2003;42:23-6.
8. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. Ann Surg 2005;242:439-48.
9. Olmi S, Magnone S, Bertolini A, Croce E. Laparoscopic versus open appendectomy in acute appendicitis: A randomized prospective study. Surg Endosc 2005;19:1193-5.
10. Sauerland S, Lefering R, Holthausen U, Neugebauer EA. Laparoscopic vs conventional appendectomy. A meta-analysis of randomized controlled trials. Langenbecks Arch Surg 1998;383:289-95.
11. Pirro N, Berdah SV. Appendicitis: Yes or no to laparoscopic approach? J Chir 2006;143:155-9.
12. Ali R, Khan MR, Pishori T, Tayeb M. Laparoscopic appendectomy for acute appendicitis: Is this a feasible option for developing countries? Saudi J Gastroenterol 2010;16:25-9.
13. Sheikh AR, Sangrasi AK, Shaikh GA. Clinical outcomes of laparoscopic versus open appendectomy. JSLS 2009;13:574-80.
14. Peiser HG, Greenberg D. Laparoscopic versus open appendectomy: results of a retrospective comparison in an Israeli hospital. Isr Med Assoc J 2002;4:91-4.
15. Chung CH, Ng CP, Lai KK. Delays by patients, emergency physicians, and surgeons in the management of acute appendicitis: retrospective study. Hong Kong Med J 2000;6:254-9.
16. Lee SL, Walsh AJ, Ho HS. Computed tomography and ultrasonography do not improve and may delay the diagnosis and treatment of acute appendicitis. Arch Surg 2001;136:556-62.
17. Frazee RC, Roberts JW, Symmonds RE, Synder SK, Hendricks JC, Smith RW, *et al*. A prospective randomized trial comparing open versus laparoscopic appendectomy. Ann Surg 1994;219:725-8.
18. Malik AM, Talpur AH, Laghari AA. Video assisted laparoscopic extracorporeal appendectomy versus open appendectomy. J Laparoendosc Adv Surg Tech A 2009;19:355-9.
19. Milewczyk M, Michalik M, Ciesielski M. A prospective, randomized, unicenter study comparing laparoscopic and open treatments of acute appendicitis. Surg Endosc 2003;17:1023-8.
20. Guller U, Hervey S, Purves H, Muhlbaier LH, Eric D. Peterson ED, *et al*. Laparoscopic versus open appendectomy outcomes comparison based on a large administrative database. Ann Surg 2004;239:43-52.
21. Peiser JG, Greenberg D. Laparoscopic versus open appendectomy: Results of a retrospective comparison in an Israeli Hospital. Isr Med Assoc J 2002;4:91-4.
22. Bresciani C, Perez RO, Habr-Gama A, Jacob CE, Ozaki A, Batagello C, *et al*. Laparoscopic versus standard appendectomy outcomes and cost comparisons in the private sector. J Gastrointest Surg 2005;9:1174-80.
23. Johnson A. Laparoscopic surgery. Lancet 1997;349:631-5.
24. Kehagias I, Karamanakos SN, Panagiotopoulos S, Panagopoulos K, Kalfarentzos F. Laparoscopic versus open appendectomy: Which way to go? World J Gastroenterol 2008;14:4909-14.
25. Aziz O, Athanasiou T, Tekkis PP, Purkayastha S, Haddow J, Malinovski V, *et al*. Laparoscopic versus open appendectomy in children: a meta-analysis. Ann Surg 2006;243:17-27.
26. McKinlay R, Neeleman S, Klein R, Stevens K, Greenfield J, Ghory M, *et al*. Intraabdominal abscess following open and laparoscopic appendectomy in the pediatric population. Surg Endosc 2003;17:730-3.

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