OUTCOME OF LAPAROSCOPIC VS OPEN APPENDECTOMY IN THE MANAGEMENT OF ACUTE APPENDICITIS

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ABSTRACT

The worldwide trend of appendectomy is shifting from conventional open to the laparoscopic technique. The study's objective was to compare laparoscopic and open appendectomy in terms of various operative and postoperative parameters to find the best operative technique. A prospective comparative study was conducted on 142 patients undergoing laparoscopic (n=43) or open appendectomy (n=99) from 1st February 2022 to 30th January 2023 under the Department of Surgery of Kathmandu Medical College Teaching Hospital (KMCTH). In five patients, laparoscopic appendectomy was later converted to open and excluded from the study. The mean operating time for the open appendectomy group was 44.1±13.1 minutes while for the laparoscopic appendectomy group, it was 48.4±14.0 minutes (p=0.047). Visual analogue score taken on 1st, 7th and 30th post-operative day for open and laparoscopic appendectomy were 4.0±2.2 vs 3.6±1.9 (p=0.160); 1.4±1.3 vs 0.6±0.9 (p<0.001) and 0.2±0.5 vs 0.02±0.15 (p=0.107) respectively. The total days of postoperative hospital stay were 1.57±0.96 for open appendectomy and 1.58±1.07 for laparoscopic appendectomy (p=0.843). However, laparoscopic appendectomy group had an earlier return to normal activity (7.30±1.15 days) when compared to the open appendectomy group (8.05±2.42 days) (p=0.023). The laparoscopic appendectomy group also had fewer postoperative complications than the open appendectomy group (18.6% vs 24.2%) (p=0.411). Thus, laparoscopy is a safe and effective method of removal of appendix for acute appendicitis.

KEYWORDS

Appendicitis, open appendectomy, laparoscopic appendectomy, visual analogue score

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INTRODUCTION

Acute appendicitis is the most common cause of acute abdomen.[1] The lifetime incidence ranges from 6 to 16%.[2,3] In 1981, a German gynecologist named Kurt Semm performed the first laparoscopic appendectomy. Since then, LA has been performed with increasing frequency for treating acute appendicitis due to its advantages of decreased postoperative pain, shorter hospital stay, and early postoperative recovery[4,5] and due to the availability of equipment and expertise for minimal access surgery.[6]

It is noteworthy that traditional open appendectomy continues to be utilized in 50% of cases which is likely attributable to the fact that there exists a paucity of evidence to suggest that it is an inferior technique when compared to laparoscopic appendectomy.[7] Open appendectomy is currently considered the preferred method for managing complex cases of appendicitis owing to its demonstrated efficacy in reducing the incidence of postoperative intra-abdominal infections. Additionally, it is often employed as a contingency plan in cases where laparoscopic intervention proves difficult due to extensive inflammation or adhesion formation within the appendix.[8] The controversy about the appropriate method of appendectomy remains unclear.[9]

MATERIALS AND METHODS

Data of patients who underwent open and laparoscopic appendectomy between February 2022 to January 2023 at Department of Surgery of Kathmandu Medical College (KMC) Teaching Hospital were collected prospectively. The study was approved by KMC Institutional Review Committee (Ref: 2312202105). Patients above the age of 18 years with ASA I or II who were admitted with the provisional diagnosis of acute appendicitis and underwent either laparoscopic or open appendectomy were included in the study. The decision of laparoscopic or open appendectomy was based on the patient's choice.

A total of 147 patients were included in this study, out of which 99 underwent open appendectomy and 43 underwent laparoscopic appendectomy. Five patients who started with laparoscopic appendectomy were later converted to open and were excluded from the study. Written informed consent was taken from all the participants and those who did not consent were excluded from the study.

Exclusion criteria

1. Patients on whom the laparoscopic procedure was converted to open
2. Perforated appendix needing exploratory laparotomy
3. Patients who were under steroid therapy
4. Patients who underwent interval appendectomy
5. Patients who underwent additional surgical procedures other than appendectomy
6. Patients who did not consent

A single dose of a second-generation cephalosporin (cefuroxime) was given as prophylaxis before the patient received anesthesia. For patients undergoing open appendectomies, after patients received spinal anesthesia, abdomen was opened in layers until the peritoneal cavity was reached. After identifying the inflamed appendix, the mesoappendix was divided between silk ligatures. The appendix was transfixed and divided 3mm above its base. The abdomen was closed in layers using absorbable sutures, and the skin stapled. For laparoscopic appendectomy, patients received general anesthesia using intravenous propofol for induction and inhaled anesthetic agent. Pneumoperitoneum was established using 'Hassan's open technique from a 10 mm supraumbilical port. A 0-degree laparoscope was introduced into the peritoneum. Two additional 5 mm trocars were placed at the right subcostal region and the supra pubic region under direct vision. After identifying the appendix, the mesoappendix was divided using a harmonic scalpel, and the appendix tied at 3mm above the base using two preformed extra-corporeal knots made up of catgut (endoloop). The appendix was extracted, and the 10 mm port sites were closed. All specimens were sent for histopathological examination. All operations were performed by the same team of surgeons (residents or consultants).

The age, sex, intraoperative findings, duration of surgery (from skin incision to closure), and postoperative complication were recorded in all patients. Both groups of patients received injection Acetaminophen 1 gm 6 hourly and Ketorolac 30 mg 8 hourly in the initial 24 hours postoperatively followed by a combination of Acetaminophen 500mg and Ibuprofen 400 mg (Paraflam©) tablet 8 hourly after 24 hours of operation. All patients were kept under iv fluids for 24 hours and nil per oral for 6 hours following the operation. Feeding in the form of sips was started once the bowel sound was appreciated, and as the patient tolerated, a liquid diet within 24 hours followed by a soft to regular diet was given 24 hours post-

surgery. A visual analogue scale (VAS) was used to assess pain intensity on 1st, 7th, and 30th postoperative day. Patients were discharged after normalization of vitals and adequate pain control. The length of hospital stay (duration between date of surgery and date of discharge) was recorded. Patients were followed up in OPD after discharge on 7th post-operative day when staples were removed. Telephone follow up was done on 30th post-operative day.

Statistical analyses were performed with SPSS-16. For continuous variables, Kolmogorov–Smirnov test was applied to test normal distribution. The two groups were compared using the independent samples t-test for normally distributed continuous variables and the Mann–Whitney U test for non-normally distributed continuous variables. The chi-square test was used for the comparison of categorical variables. For continuous variables, numeric values were expressed as mean ± SD. The VAS score of patients was compared with the two-way analysis of variance method according to the peritoneal closure method. A p-value less than 0.05 was considered statistically significant.

RESULTS

From February 2022 to January 2023, 147 patients underwent either open (n=99) or laparoscopic appendectomy (n=43). Five patients started with laparoscopic appendectomy but later turned open for inability to proceed and were excluded from the study. There were 49 females (34.5%) and 93 males (65.5%) involved in the study, out of which 20 females (40.8%) opted for LA, which was statistically significant. The mean age of the patient in the OA group was 34.5 years, and LA was 28.9 years. A total of 127 (89.4%) patients had American Society of Anesthesiology Score of 1 while the remaining 15 (10.6%) patients had ASA Score of 2 which was statistically insignificant. Patient demographics are demonstrated in Table 1.

Table 1: Patients' demographics

	OA (n = 99)	LA (n = 43)	p value
Age (years)¥ (median, range)	34.5 ± 14.8 (30, 18-60)	28.9 ± 10.2 (25, 19-80)	0.029α
Sex (F/M)	29/70	20/23	0.047β
ASA Score ½	86/13	41/2	0.232 β

¥: mean ± SD; α: Mann-Whitney test; β: chi-square test; ASA: American Society of Anesthesiology

Table 2: Operative data

	OA (n = 99)	LA (n = 43)	p value
Operative time (min) ¥	44.1 ± 13.1	48.4 ± 14.0	0.047α

¥: mean ± SD; α: Mann-Whitney test

Operative data is shown in Table 2. The mean operating time for the open appendectomy group was 44.1±13.1 minutes while for the laparoscopic appendectomy group it was 48.4±14.0 minutes. The mean difference in operative duration between laparoscopic and open appendectomy was 4 minutes which was statistically significant.

The VAS in the LA group was always less than OA group. The difference in VAS scoring was statistically significant only in the 7th post-operative day and not significant on 1st and 30th post-operative day. The length of hospital stay was similar in both groups. However, patients undergoing LA returned to normal activity 1 day earlier than patients undergoing OA, which was statistically significant (7.30 days in LA vs 8.05 days in OA) (Table 3).

Open appendectomy was associated with more complications than laparoscopic appendectomy (24.2% vs 18.6%) but the difference was not statistically significant (p =0.411). Five patients in OA group and one patient in LA group had Clavien Dindo 1 complications like sinus tachy/brady arrhythmia for which no change in management was required. Sixteen patients in OA group and seven patients in LA had Clavien Dindo grade II complications. Analgesics for post-operative pain was the primary cause of additional pharmacologic intervention required in both groups. Antiemetic for post-operative nausea and vomiting was required in one patient undergoing LA. One patient in OA group required prokinetic drug for post-operative ileus and additional antihypertensive medication for hypertension was required in further one patient. Two patients in OA and one patient in LA had to be catheterized for urinary retention. The catheter was removed in 1st POD in all three patients. Three patients in OA group had Clavien Dindo IV complications who required ICU for further management. Among the patients who required ICU treatment, two patients developed septic shock requiring inotropes and one patient developed atrial fibrillation in the immediate post-operative period requiring IV antiarrhythmic drugs. There were no perioperative readmission or mortality in either of the groups.

DISCUSSION

In this prospective study, laparoscopic appendectomy had a favorable post-operative

Table 3: Outcomes of OA vs LA				
		OA (n = 99)	LA (n = 43)	p value
VAS score¥	1st POD	4.0 ± 2.2	3.6 ± 1.9	0.160α
	7th POD	1.4 ± 1.3	0.6 ± 0.9	<0.001α
	30th POD	0.2 ± 0.5	0.02 ± 0.15	0.107α
Hospital stay (days)		1.57 ± 0.96	1.58 ± 1.07	0.843 α
Return to normal activities (days)¥		8.05 ± 2.42	7.30 ± 1.15	0.023 α
Complications	None	75 (75.8%)	35 (81.4%)	0.411μ
	CD – I	5 (5.1%)	1 (2.3%)	
	CD – II	16 (16.2%)	7 (16.3%)	
	CD – III	0	0	
	CD – IV	3 (3.0%)	0	

¥: mean ± SD; α: Mann-Whitney test; μ: likelihood ratio test; CD: Clavien-Dindo classification

outcome in terms of pain control compared to open appendectomy. Although the 1st POD Visual Analogue Score (VAS) was comparable between the LA and OA group, the 7th POD VAS was significantly better in the LA group. This finding may be attributed to the intravenous analgesics received by all patients in the first 24 hours of the surgery, masking the pain in all patients. However, once the patient is discharged, the pain in the smaller incisions in LA patients were presumably better controlled by oral analgesics.

Our study showed a greater proportion of female patients undergoing LA. Gynaecological pathologies often mimic acute appendicitis leading to higher rates of negative laparotomies in females. In addition to affording preoperative diagnostic assessment, laparoscopy presents a more appealing option for young, fertile women owing to its superior postoperative cosmetic outcomes when compared to conventional open appendectomy.[13] This might have been the reason for more females opting for laparoscopic over open appendectomy in this study.

The results of our study show that LA took 4 minutes longer than OA which was statistically significant. Such finding has also been demonstrated in various other studies where statistically significant longer operative duration was required for LA in comparison to OA ranging from 4 to 12 minutes more in LA group.[5,14,15] The majority of appendectomies in our study were carried out by PGY1 or PGY2 residents who are still getting accustomed to the ergonomic demands of laparoscopic surgery. This lack of experience may account for the extended duration of LA observed in the study. As surgical proficiency improves, the operative duration for both groups tends to converge.[14] According to a meta-analysis conducted by Bennet *et al*,[16] an increase in laparoscopic surgical experience resulted in a notable decrease in the duration discrepancy between laparoscopic and open appendectomies.

The proposed advantages of LA is early recovery as reported in a meta-analyses[5,14] which show that patients undergoing LA have lesser hospital stay and early return to normal activity as compared to the OA group. These results collaborated with the findings in our study.

Many studies show that LA is associated with less post-operative pain and requires fewer analgesics than OA.[4,5,8,14] VAS, which is a qualitative tool to measure postoperative pain, is seen to be significantly lower than open appendectomy especially in the first 24 hours.[17,18] In this study, though the VAS was lower for LA at 1st post-operative day, it was not statistically significant (p=0.160). The VAS on follow up of patient in OPD during 7th post-operative day was however significantly lower for LA group when compared to OA group (p<0.001). Milewczyk *et al*,[11] in their study of 200 patients in Poland, found that VAS taken on 2nd and 7th POD were significantly lesser for LA when compared to OA (p<0.001). The mean VAS on 30th POD though was lower for LA group in this study, the difference was not statistically significant (p=0.107). Hart *et al*,[19] in their prospective randomized study of 81 patients undergoing LA or OA, were also unable to find a statistically significant difference between the VAS taken at 30th POD.

Guller *et al*[20] reported that the overall mortality rate for patients undergoing appendectomy was 0.24% with a significantly lower percentage of death in LA group in comparison to OA group. However, no mortality occurred in our study. There were lesser complications in the LA when compared to OA group, though it was statistically insignificant. Life threatening complications like septic shock and organ failure requiring inotrope and ICU stay were

seen only in the OA group. Intra-abdominal abscess formation, which is one of the frequently reported complications reported in LA, was not observed in our study.[21] This is likely due to the meticulous peri appendiceal intraperitoneal lavage that we routinely perform after the completion of LA.

There are certain limitations to this study. Firstly, it was conducted at a single institution, which may limit the generalizability of the findings. Secondly, the choice of operation was based on individual patient factors and not randomized, therefore introducing potential biases. Thirdly, blinding was not feasible, which may have influenced the results. Lastly, the follow-up period was only 1 month, hence long-term complications could not be assessed.

In conclusion, compared to open appendectomy, laparoscopic appendectomy has several benefits including reduced post-operative pain, shorter hospital stays, faster recovery to normal activities, and fewer complications. However, it should be noted that laparoscopic appendectomy has a slightly longer operative duration. Despite this, laparoscopic appendectomy should be considered the preferred option over open appendectomy whenever it is feasible.

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REFERENCES

1. Ceresoli M, Zucchi A, Allievi N *et al*. Acute appendicitis: Epidemiology, treatment and outcomes- analysis of 16544 consecutive cases. *World J Gastrointest Surg* 2016; 8: 693.
2. Lee JH, Park YS, Choi JS. The epidemiology of appendicitis and appendectomy in South Korea: National registry data. *J Epidemiol* 2010; 20: 97–105.
3. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. *Am J Epidemiol* 1990; 132: 910-25.
4. Ohtani H, Tamamori Y, Arimoto Y, Nishiguchi Y, Maeda K, Hirakawa K. Meta-analysis of the results of randomized controlled trials that compared laparoscopic and open surgery for acute appendicitis. *J Gastrointestinal Surg* 2012; 16: 1929–39.
5. Wei B, Qi CL, Chen TF *et al*. Laparoscopic versus open appendectomy for acute appendicitis: A metaanalysis. *Surg Endosc* 2011; 25: 1199–208.
6. Kumar S, Jalan A, Patowary BN, Shrestha S. Laparoscopic appendectomy versus open appendectomy for acute appendicitis: a prospective comparative study. *Kathmandu Univ Med J* 2016; 14: 244-8.
7. Reißfelder C, Cafferty BM, von Frankenberg M. Offene appendektomie: wann wird sie noch gebraucht? *Chirurg* 2009; 80: 602–7.
8. Switzer NJ, Gill RS, Karmali S. The evolution of the appendectomy: from open to laparoscopic to single incision. *Scientifica (Cairo)* 2012; 2012: 1–5.
9. Casarotto A, Zarantonello FR, Rebonato M. Appendectomy in women: is the laparoscopic approach always better than the "open" approach in uncomplicated appendicitis? *Surg Laparosc Endosc Percutan Tech* 2014; 24: 406–9.
10. Werkgartner G, Cerwenka H, El Shabrawi A *et al*. Laparoscopic versus open appendectomy for complicated appendicitis in high risk patients. *Int J Colorectal Dis* 2015; 30: 397–401.
11. Milewczyk M, Michalik M, Ciesielski M. A prospective, randomized, unicenter study comparing laparoscopic and open treatments of acute appendicitis. *Surg Endoscopy Other Interven Tech* 2003; 17: 1023–8.
12. Apelgren KN, Molnar RG, Kisala JM. Laparoscopic is not better than open appendectomy. *Am Surg* 1995; 61: 240–3.
13. Tzovaras G, Liakou P, Baloyiannis I *et al*. Laparoscopic appendectomy: differences between male and female patients with suspected acute appendicitis. *World J Surg* 2007; 31: 409–13.
14. Li X, Zhang J, Sang L *et al*. Laparoscopic versus conventional appendectomy - a meta-analysis of randomized controlled trials. *BMC Gastroenterol* 2010; 10. DOI: 10.1186/1471-230X-10-129.
15. Ingraham AM, Cohen ME, Bilimoria KY, Pritts TA, Ko CY, Esposito TJ. Comparison of outcomes after laparoscopic versus open appendectomy for acute appendicitis at 222 ACS NSQIP hospitals. *Surg* 2010; 148: 625–37.
16. Bennett J, Boddy A, Rhodes M. Choice of approach for appendicectomy: a meta-analysis of open versus laparoscopic appendicectomy. *Surg Laparosc Endosc Percutan Tech* 2007; 17: 244-55.
17. Shirazi B, Shahid Shamim M, Ali N. Laparoscopic versus open appendectomy: A comparative study. *J Pak Med Assoc* 2010; 60: 901-4.
18. Usmani A, Shoro AA, Memon Z, Hussain M, Rehman R. Diagnostic, prognostic and predictive value of Micro RNA-21 in breast cancer patients, their daughters and healthy individuals view project portfolio project view project laparoscopic versus open appendectomy: a comparative study. *Am J Cancer Res* 2016; 5: 2484-90.
19. Pradhan S, Ratna Shakya Y, Batajoo H *et al*. Laparoscopic versus open appendectomy: a prospective comparative study. *J Soc Surg Nepal* 2016; 18: 29. DOI: 10.3126/jssn.v18i2.18572.
20. Hart R, Rajgopal C, Plewes A *et al*. Laparoscipic versus open appendectomy: a prospective randomized trial of 81 patients. *Can J Surg* 1996; 39: 457-62.
21. Guller U, Hervey S, Purves H *et al*. Laparoscopic versus open appendectomy: outcomes comparison based on a large administrative database. *Ann Surg* 2004; 239: 43–52.
22. Jaschinski T, Mosch CG, Eikermann M, Neugebauer EAM, Sauerland S. Laparoscopic versus open surgery for suspected appendicitis. *Cochrane Database Syst Rev* 2018; (11). DOI: 10.1002/14651858.CD001546.pub4.