Original Article

Management of Complicated Appendicitis — Comparative Study of Outcomes between Laparoscopic VS Open Procedures

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ABSTRACT

Introduction: *Appendicitis is the most common surgical abdominal emergency worldwide, and laparoscopic appendectomy is the preferred treatment for it.* ***Objective:*** *The objective of this study is to find clinical outcomes comparing laparoscopic and open appendectomy in terms of complicated appendicitis.* ***Methods & Materials:*** *A comparative study was conducted on 50 patients with complicated appendicitis, aged 20-45, treated between 2019 and 2023 at Sheikh Sayera Medical College, Gopalganj, Bangladesh. Data analyzed included pain location, appendicitis stage, concomitant diseases, surgical method, antibiotic prophylaxis, surgery duration, postoperative pain, complications, and mortality.* ***Results:*** *In the LA group, the operative time was 60.30 ± 10.30 minutes, with one case of bleeding and ICU admission each, no mortalities, and three intraoperative complications. The mean hospital stay was 1.10 ± 0.26 days. Oral analgesics were given for 3.05 ± 0.66 days, and parenteral for 1.04 ± 0.24 days. There were seven postoperative complications, with surgical site infection being the most common (three cases). In the OA group, the operative time was 45.84 ± 15.20 minutes, with four cases of bleeding, one ICU admission, no mortalities, and five intraoperative complications. The mean hospital stay was 5.00 ± 0.29 days. Oral analgesics were administered for 3.68 ± 0.40 days, and parenteral for 1.23 ± 0.56 days. Postoperative complications included ten cases, with surgical site infection*

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(four cases) and intrabdominal abscess (two cases) being most common. ***Conclusion:*** *This study demonstrated that laparoscopic appendectomy yields better clinical outcomes in treating patients with appendicitis compared to open surgery.*

Keywords: *Appendix, LA surgery, OA surgery, Symptoms, Quality of Life scale, Comparative study*

INTRODUCTION

Appendectomy is the most commonly performed surgery for acute abdomen, with acute appendicitis being the primary reason for the procedure[1]. This condition is considered a medical emergency, with a mortality rate ranging from 0.2% to 5%, and even higher rates in older adults[2–5]. It can be categorized into four groups based on the timing of onset and the necessity for surgery: emergency appendectomy, elective appendectomy, incidental appendectomy, and prophylactic appendectomy. Incidental appendectomy is performed as a secondary procedure during surgery for another condition, often in gynaecological cases where it is recommended by the American College of Obstetricians and Gynecologists (ACOG) in specific instances, or in other pelvic pathologies where appendix removal is determined to be a preventive measure[6,7]. Prophylactic appendectomy is recommended for individuals facing extreme isolation conditions, such as those involved in transfers to Polar Regions or long-term space missions, where the occurrence of acute appendicitis could be life-threatening[8–11]. In Chile, this procedure has been performed since 1969 on Armed Forces personnel assigned to isolated regions for extended periods, such as expeditions to Antarctica, where immediate access to surgical care is not available. In such cases, appendectomy is considered a potential benefit for the patient[12]. Even though these appendectomies are performed as preventive measures or incidentally, without clinical evidence of appendiceal pathology, the surgical specimen is routinely sent for delayed biopsy for histopathological examination. However, this practice is not standard and remains a topic of debate[13,14]. There are two techniques for appendectomy: open appendectomy and laparoscopic appendectomy. In uncomplicated or locally complicated open appendectomy, the McBurney incision (oblique) or the Ricky Davis technique (transverse) is used in the lower right quadrant[15]. Laparoscopic appendectomy usually requires the use of three ports. A trocar is placed in the navel (10 mm) for the camera, and the others vary between the lower quadrant, upper right quadrant, or midline, at the surgeon's choice. The appendix is removed from the cavity through a trocar or by a retrievable bag[16–19]. Recently, a single-port or umbilical single-port appendectomy has been implemented, but this is not the focus of this study[20]. Ultrasound has become increasingly important in recent years for diagnosing acute appendicitis. The ultrasound criteria for acute appendicitis include a diameter greater than 6 mm, wall thickening greater than 2 mm, irregular wall without peristalsis, visualization of appendicoliths, and presence of free fluid[21-23]. Ultrasound shows a sensitivity of 98.7% and a specificity of 95.4%. Computed tomography (CT) is another

imaging method with high sensitivity (97%) and specificity (99%) and positive and negative predictive values of 98%, and an accuracy of 96% for diagnosing appendicitis[24,25]. This study aims to compare the outcome of LA and OA in terms of complicated appendicitis. Written consent and ethical clearance were ensured before the study.

Objectives

- General objective: The objective of this research is to find the management of complicated appendicitis.

- Specific objective: This study aims to compare the outcomes of laparoscopic appendicectomy and open appendicectomy in the management of complicated appendicitis.

METHODS & MATERIALS

The current study was conducted at the Department of Surgery, Sheikh Sayera Medical College, Gopalganj, Bangladesh. A two-group comparative study was conducted involving patients who underwent laparoscopic appendectomies and open appendectomies. The patients were randomly selected from the database between 2019 and 2023, and matched based on age and sex. The study used a non-probabilistic convenience sampling method. A total of 50 patients were included in the study, with 30 undergoing laparoscopic appendectomy and 25 undergoing open appendectomy. The variables considered in the study included age, sex, symptoms duration, location of pain, stage of appendicitis, presence of other medical conditions, type of appendectomy (open or laparoscopic), antibiotic use, surgical duration, postoperative pain, complications, conversion from laparoscopic to open procedure, mortality, and anatomopathological study results.

- Inclusion criteria: Patients over 20 years of age and less than 45 years old with a high diagnosis of appendicitis, treated between 2019 and 2023, were included.
- Exclusion criteria: All those whose serious health were excluded or patients who conducted previous surgeries.

The data was managed using double-entry methods. The information was analyzed using descriptive and simple correlation statistics, such as Student's t-test, and we considered statistical significance at $p<0.05$. The patients' databases were created and managed using SPSS program, version 22.0. The study received ethical approval from the hospital's ethical committee. Additionally, all study participants provided voluntary informed consent after being fully briefed on the study's objectives.

RESULTS

50 patients were selected as sample for the current study. 47.69% of the patients were of 20 to 30 years old and 55.38% were male patients. 35% of the study patients had normal weight. Comorbidities were found only among 22 patients [**Table 1**].

Table I: Demographic Demographics characteristics & comorbidities

Characteristics		Number of patients [*n*=50]	Percentage [%]
Age	20 - 30	24	47.69%
	30 - 40	15	30.77%
	40+	11	21.54%
Gender	Male	28	55.38%
	Female	22	44.62%
BMI, Kg/m2	Underweight	6	12.31%
	Normal weight	18	35.38%
	Overweight	15	30.77%
	Obesity	11	21.54%
Smoking status	Yes	18	36.92%
	No	32	63.08%
Comorbidities	Yes	22	43.08%
	No	28	56.92%
	Hypertension	15	30.77%
	Diabetes	16	32.31%
	Kidney diseases	3	6.15%
	Heart failure	2	4.62%
	Asthma	4	7.69%
	Anemia	5	9.23%
	Symptoms		
	Pain in the abdomen	60	92.31%
	Nausea	32	49.23%
	Vomiting	35	53.85%
	Fever	18	27.69%
	Difficulty passing gas	25	38.46%

70.77% patients had Leukocyte count between 11,000 and 16,000. Majority of the patients (61.54%) had ultrasound imaging test. 60% patients had Alvarado Score 7 [**Table II**].

Table II: Diagnostic findings

Variables		Number of patients [n = 50]	Percentage [%]
Leukocyte count	<11,000	10	20.0%
	11,000–16,000	35	70.77%
	>16,000	5	9.23%
Blood pressure	Diastolic	72.68 ± 25.12	
	Systolic	118.63 ± 40.87	
Heart rate	Normal	31	61.54%
	Moderate	14	27.69%
	Severe	5	10.77%
Cholesterol	Normal	23	46.15%
	Moderate	16	32.31%
	Severe	11	21.54%
Medications used	Yes	21	41.54%
	No	29	58.46%
Imaging tests	Ultrasound	31	61.54%
	CT scans	15	30.77%
	MRI	4	7.69%
Alvarado Score	5	4	7.69%
	6	7	13.85%
	7	30	60.0%
	8	5	10.77%
	9	2	4.62%
	10	2	3.08%

According to Table-3, only 1 patients from each groups were admitted to ICU. 1 from LA and 2 from OA group had internal bleeding. **Table III**.

Table III: Surgical outcomes

Variables		LA Group [30]		OA Group [20]	
		F	%	F	%
	Operative time. min	60.30 ± 10.30	45.84 ± 15.20		
Bleeding	Yes	1	3.08%	2	7.69%
	No	15	50.77%	8	38.46%
ICU admission	Yes	1	1.54%	1	6.15%
	No	16	52.31%	8	40.0%
Other findings	Normal appendix	5	17.14%	4	20.0%
	Acutely inflamed tip	21	68.57%	13	66.67%
	Gangrenous appendix	3	8.57%	2	10.0%
	Perforated appendix	1	0.67%	1	3.33%
Mortality rate	Yes	0	0%	2	6.67%
	No	30	100%	28	93.33%
Intraoperative complications	None	27	91.43%	25	83.33%
	Ileal injury	2	5.71%	3	10.0%
	Limited colectomy	1	2.86%	2	6.67%
Postoperative outcomes	Length of hospital stay (days)	1.12 ± 0.22	1.26 ± 0.82		
	Time to first bowel movement (days)	1.10 ± 0.26	1.13.50 ± 0.29		
	Oral analgesics (days)	3.05 ± 0.66	3.68 ± 0.40		
	Parenteral analgesics (days)	1.04 ± 0.24	1.23 ± 0.56		

Demographic and clinical characteristics of patients who underwent Appendectomy. 25 patients from LA group and 12 patients from PA group had 0 complications in their post-operative stage. In 12th month of post-operative period, none of the patients had pain where only 1.88 ± 0.39 had pain in OA group [**Table IV**].

Table IV: Postoperative outcomes.

		LA Group [30%]	OA Group [20%]
Complications	None	25 [85.71%]	12 [57.14%]
	Intrabdominal abscess	1 [2.86%]	2 [11.43%]
	Enterocutaneous fistula	1 [2.86%]	1 [5.71%]
	Surgical site infection	3 [8.57%]	4 [20%]
	STUMP appendix	0 [0%]	1[5.71%]
Follow–up months for post-operative pain	1st month	3.20 ± 0.21	6.78 ± 1.55
	3rd month	2.05 ± 0.16	5.40 ± 0.84
	7th month	1.03 ± 0.01	4.20 ± 0.37
	10th month	0	3.10 ± 0.04
	12th month	0	1.88 ± 0.39

After the surgery, 92.26 ± 4.49 (LA) and 76.94 ± 3.72 (OA) could lead their life normally and do their daily activity without any difficulties [**Table V**].

Table V: Assessment of quality of life for the patients after surgery.

Items	LA Group	OA Group
Physical function	82.15 ± 4.57	74.24 ± 2.41
Psychological function	85.30 ± 9.91	68.20 ± 6.93
Social and emotional aspects	87.55 ± 4.67	72.50 ± 4.39
Daily activity	92.26 ± 4.49	76.94 ± 3.72

DISCUSSION

It was discovered that the average age of both groups undergoing open and laparoscopic appendectomy was similar to the results of several other studies. Comparable studies indicated that the mean age of both groups was in their 30s, which contradicts the findings of current investigation[26]. Only 27.33% of men underwent laparoscopic appendectomy, compared to 60.67% who had open surgery. A similar retrospective study by Biondi et al. also demonstrated significant differences in gender[27]. A population-based survey in Taiwan revealed that more than half of the women underwent laparoscopic surgery. The mean symptom duration for the open appendectomy group was 1.58 days, while for the laparoscopic appendectomy group it was 1.33 days. There was no noticeable difference in the leukocyte levels between the two groups[28].

Based on previous studies[29,30], it has been found that laparoscopic appendectomy generally takes a longer time to perform compared to open appendectomy. This is partly due to the additional setup procedures, the larger equipment involved, and the learning curve for surgeons. However, present study found that the laparoscopic group had a shorter duration

of hospital stay. While the laparoscopic appendectomy cohort typically experienced earlier first bowel movements, there was no significant difference observed. Despite this, several studies have suggested that the laparoscopic approach is advantageous due to earlier bowel movements and quicker recovery times before resuming oral intake[31].

In the current study, patients who underwent laparoscopic appendectomy reported experiencing less pain than those who had open appendectomy. This can be attributed to the decreased harm to the abdominal wall, which is a major cause of postoperative discomfort. Current study findings align with other research that also shows fewer side effects following laparoscopic procedures. Additionally, this study found that the open appendectomy group required a significantly higher amount of parenteral analgesics, which is consistent with existing literature[32,33]. Intraoperatively, it has been observed Ileal damage and partial colectomy implications, while present study did not note appendicular tumors, pelvic abscesses, or appendicular abscesses. The rate of intraoperative complications did not show significant differences between the two groups, a finding supported by the existing literature. According to one study, individuals who had open appendectomies often developed purulent peritonitis[34].

When using a laparoscopic method, there is generally a lower risk of early postoperative issues and less need for pain medication due to improved abdominal muscle movement and early ambulation[35]. However, late complications such as stump appendix, enterocutaneous fistula, and intra-abdominal abscess can occur. In the present trial, we did not observe any other consequences, including respiratory issues, venous thromboembolism, sepsis, or portal pyemia[36]. Multiple studies have shown a higher incidence of postoperative complications following an open appendectomy[37]. While previous studies indicated that intra-abdominal abscess was the most common adverse effect of laparoscopic appendectomy compared to open appendectomy, this study investigation did not support this finding[38]. However, comprehensive nationwide data from the USA has demonstrated that laparoscopic appendectomy has reduced overall mortality, morbidity, and shorter hospital stays compared to open appendectomy. Extensive research from Sweden and Denmark, spanning ten years, also showed a significant decrease in overall complications, including intra-abdominal abscesses[39,40].

Limitations:

This was a single-centre study including a limited population which may not demonstrate the proper outcome. A longer period of study with this amount of population may result in data loss.

Conclusion:

In a comparison between open and laparoscopic techniques for appendectomy, it was discovered that the laparoscopic technique had a statistically longer duration of operation. However, the open-approach appendectomy was associated with longer hospital stays, higher rates of postoperative pain, and a longer need for parenteral anesthesia. Therefore, a laparoscopic procedure may be the better option for treating a case of appendicitis.

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