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Original Research Article

A COMPARATIVE STUDY OF EARLY VERSUS DELAYED LAPAROSCOPIC APPENDECTOMY IN ADULT PATIENTS WITH ACUTE APPENDICITIS

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ABSTRACT

Background: Acute appendicitis is a common surgical emergency, and laparoscopic appendectomy is the standard of care. While early appendectomy is traditionally recommended to reduce complications, recent evidence suggests that short, controlled delays may not adversely affect outcomes. This study aimed to compare the clinical outcomes of early versus delayed laparoscopic appendectomy in adults.

Materials and Methods: This prospective observational study was conducted at the Department of General Surgery, [Tertiary Care Center], including 100 adult patients with confirmed acute appendicitis. Patients were divided into two groups: early appendectomy (≤8 hours from admission, n=50) and delayed appendectomy (>8 hours, n=50). Demographic, clinical, imaging, perioperative, and postoperative outcomes—including complications, length of stay, and 30-day readmission—were analyzed. Statistical analysis was performed using Chi-square and t-tests, with $p<0.05$ considered significant.

Results: Baseline demographics, clinical presentation (except nausea), and imaging findings were comparable between groups. Early appendectomy was associated with a significantly shorter mean operative time (53.45 ± 21.38 min vs. 66.58 ± 31.17 min; $p = 0.015$). Overall postoperative complications, length of stay, and 30-day readmission rates did not differ significantly. Wound infections were more frequent in the delayed group (20% vs. 6%; $p = 0.05$), while other complications were similar.

Conclusion: Early and delayed laparoscopic appendectomy for acute appendicitis yield comparable postoperative outcomes. Short, controlled delays beyond 8 hours from admission appear safe and may allow for optimized perioperative planning without increasing morbidity. These findings support flexibility in surgical timing for selected patients while maintaining safety and quality of care.

Keywords: Acute appendicitis, laparoscopic appendectomy, early appendectomy, delayed appendectomy, postoperative outcomes.

INTRODUCTION

Acute appendicitis (AA) is one of the most common surgical emergencies worldwide, and appendectomy remains among the most frequently performed abdominal surgeries.[1] Traditionally, appendectomy performed open approach; however, laparoscopic appendectomy has become the preferred technique in many centers due to its advantages, including reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic outcomes.[1,2]

The pathogenesis of AA is not fully understood, but intraluminal obstruction of the appendix is considered the most widely accepted mechanism, leading to increased intraluminal pressure, bacterial overgrowth, ischemia, and potential perforation.[3] Diagnosis relies on a combination of clinical evaluation, laboratory testing, and imaging modalities.[3]

Conventionally, appendectomy is recommended as soon as possible after diagnosis to prevent disease progression and complications such as perforation,

peritonitis, and intra-abdominal abscess formation.[4] Early appendectomy is believed to reduce postoperative morbidity and length of hospital stay.[5] However, the timing of appendectomy remains debated. While some studies suggest that delays in surgery can worsen outcomes even if as short as 6 hours from initial presentation,[6] others report that a short, controlled delay for preoperative stabilization with intravenous fluids and antibiotics does not increase risks and may even prevent unnecessary surgery in cases of diagnostic uncertainty.[6]

Several studies have examined early versus delayed appendectomy. Research indicates that performing appendectomy 8–12 hours after admission does not increase the risk of perforation, operative duration, postoperative hospital stay, or morbidity and mortality.[7,8] While some studies support early appendectomy as the safer option with lower complication rates and shorter hospital stays,[9-11] others suggest that delayed appendectomy does not significantly affect outcomes and may even reduce complications when surgeries are performed during daytime hours with well-rested surgical teams.[9-11]

The optimal timing of appendectomy remains controversial. Most existing studies are retrospective, with inconsistent definitions and outcome measures, limiting the reliability of their conclusions. Most existing studies are retrospective, with inconsistent definitions and outcome measures, limiting the reliability of their conclusions.[9-11]

The aim of this study is to compare early versus delayed laparoscopic appendectomy in adult patients with acute appendicitis, focusing on operative timing, postoperative outcomes, and complication rates, in order to determine whether a short, controlled delay affects patient safety and clinical outcomes.

MATERIALS AND METHODS

This comparative study was conducted in the Department of General Surgery at a tertiary care center. A total of 100 patients diagnosed with acute appendicitis and admitted to the surgical ward were enrolled. Diagnosis was established based on clinical evaluation and confirmed using imaging modalities, including ultrasound or computed tomography when necessary. Patients aged ≥18 years with confirmed acute appendicitis were included, while those presenting with generalized peritonitis, managed conservatively without surgery, having significant comorbidities contraindicating surgery, or who were pregnant were excluded.

The study population was divided into two groups based on the interval from hospital admission to surgical intervention. The early appendectomy group (GroupI) included patients who underwent surgery within 8 hours of admission, and the delayed appendectomy group (Group II) included patients who underwent surgery after 8 hours. Demographic, clinical, radiological, and perioperative data were collected and compared between the two groups. Outcomes assessed included postoperative morbidity and mortality, length of hospital stay, and 30-day readmission rate.

Statistical Analysis

Statistical analysis was performed using SPSS 22 Categorical variables were expressed as frequencies and percentages, while continuous variables were reported as means ± standard deviations (SD) or, for skewed data, as medians with interquartile ranges (IQR). A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of Patients Undergoing Early versus Delayed Appendectomy

Variable	Early Appendectomy		Delayed Appendectomy		P-value
	No of cases	%	No of cases	%	
Mean age (years) (Mean ± SD)	41.80 ± 12.31		43.10 ± 13.22		0.61
Gender					
Male	28	56.00%	26	52.00%	0.69
Female	22	44.00%	24	48.00%	
Mean BMI (kg/m²)	26.27 ± 6.30		27.19± 7.13		0.49
History of abdominal surgery	16	32.00	12	24.00	0.44

[Table 1] shows the baseline demographics of patients. Age, gender, BMI, and history of abdominal surgery were similar between the early and delayed appendectomy groups, indicating comparable baseline characteristics.

Table 2: Clinical Symptoms in Early versus Delayed Appendectomy Groups

Symptoms	Early Appendectomy		Delayed Appendectomy		P-value
	No of cases	%	No of cases	%	
Diarrhea	9	18.00%	6	12.00%	0.44
Fever	7	14.00%	6	12.00%	0.78
Anorexia	18	36.00%	11	22.00%	0.19
Nausea	46	92.00%	27	54.00%	0.023

Most clinical symptoms were similar between groups, except nausea, which was significantly higher in the early appendectomy group.

Table 3: Imaging Modalities and CT Findings in Early versus Delayed Appendectomy

Imaging	Early Appendectomy		Delayed Appendectomy		P-value
	No of cases	%	No of cases	%	
CT scan	44	88.00%	43	86.00%	0.78
Ultrasound	13	26.00%	7	14.00%	0.13
MRI	0	0.00%	1	2.00%	-
CT findings					
Peri-appendiceal inflammation	47	94.00%	44	88.00%	0.29
Phlegmon/abscess	2	4.00%	1	2.00%	0.56
Fecolith	25	50.00%	22	44.00%	0.66

Imaging patterns were similar between the groups, with comparable use of CT, ultrasound, and MRI. CT findings, including peri-appendiceal inflammation, phlegmon/abscess, and fecolith, showed no significant differences.

Table 4: Peri operative Findings in Early versus Delayed Appendectomy

Variable	Early Appendectomy		Delayed Appendectomy		P-value
	No of cases	%	No of cases	%	
Time from ED arrival to incision (hours, median [IQR])	4.00 (2.0–5.5)		12.00 (9.9–14.4)		-
Time from symptom onset to incision (hours, median [IQR])	26.00 (16–52)		41.00 (31–82)		-
Mean operative time (minutes)	53.45 ± 21.38		66.58 ± 31.17		0.015
Pre-operative antibiotics	45	90.00%	45	90.00%	-
Post-operative antibiotics	13	26.00%	11	22.00%	0.68
Perforated appendicitis	4	8.00%	2	4.00%	0.41
Acute appendicitis	46	92.00%	47	94.00%	0.92

Early and delayed appendectomy groups had similar peri operative characteristics, including use of antibiotics and rates of perforated or acute appendicitis. Operative time was significantly shorter in the early appendectomy group (53.45 ± 21.38 vs. 66.58 ± 31.17 minutes, p = 0.015).

Table 5: Post surgical Outcomes in Early versus Delayed Appendectomy

Variable	Early Appendectomy		Delayed Appendectomy		p-value
	No of cases	%	No of cases	%	
Bleeding	1	2.00%	2	4.00%	-
Urinary tract infection	0	0.00%	2	4.00%	-
Surgical site infection	1	2.00%	3	6.00%	0.32
Multiple organ dysfunction syndrome	1	2.00%	1	2.00%	-
Pneumonia	1	2.00%	4	8.00%	0.18
Postoperative length of stay (hours, median [IQR])	19.40 (11.50–39.50)		19.70 (11.50–41.80)		0.64
Readmission within 30 days	1	2.00%	4	8.00%	0.18

Post surgical outcomes were largely similar between the groups. There were no significant differences in complications, length of stay, or 30 day readmission rates, although rates of pneumonia and readmission were slightly higher in the delayed appendectomy group, (p>0,05).

Table 6: Postoperative Complications in Early versus Delayed Appendectomy

Complication	Early Appendectomy		Delayed Appendectomy		P-value
	No of cases	%	No of cases	%	
Wound infection	3	6.00%	10	20.00%	0.05
Intra-abdominal abscess	0	0.00%	2	4.00%	-

Wound infections were more frequent in the delayed appendectomy group (20% vs. 6%, p = 0.05), while intra-abdominal abscesses were rare and occurred only in the delayed group.

DISCUSSION

Appendectomy remains one of the most commonly performed emergency surgical procedures. Traditionally, surgery is undertaken promptly after diagnosis to prevent disease progression. However, advances in antibiotic therapy have led to alternative management strategies, with interval appendectomy and conservative treatment showing favorable outcomes in selected cases of periappendiceal abscess and uncomplicated appendicitis.[12] Despite these evolving approaches, appendicitis is still widely considered a surgical condition. Considerable debate persists regarding the optimal timing of appendectomy. Several studies continue to support early or immediate appendectomy, citing lower postoperative complication rates, particularly reduced surgical site infections. While other study report comparable outcomes between early and delayed appendectomy, suggesting that short operative delays may be clinically acceptable.[13]

During the study period, 100 patients were included and divided equally into early appendectomy (within 8 hours of admission) and delayed appendectomy

groups. The mean age was 41.80 ± 12.31 years in the early group and 43.10 ± 13.22 years in the delayed group, with no statistically significant difference (p = 0.61). Of the total population, 54% were male and 46% were female.

In the present study, early laparoscopic appendectomy (Group I) was associated with significantly shorter operative delays. The median interval from emergency department arrival to surgical incision was markedly lower in Group I compared with Group II, and a similar reduction was observed in the duration from symptom onset to incision. In addition, the mean operative time was significantly shorter in the early appendectomy group, suggesting improved operative efficiency with earlier intervention.

These findings are consistent with previously published literature. Gupta et al,[14] and Seudeal K et al,[8] reported comparable timelines from symptom onset to emergency department presentation and from hospital arrival to surgical incision, supporting the feasibility and practical benefits of early operative management. Similarly, Shin et al. demonstrated that although baseline demographic and preoperative clinical characteristics were comparable between early and delayed appendectomy groups, significant differences existed in operative timing parameters, with early appendectomy resulting in shorter diagnostic and operative delays.

Abu Foul et al,[15] reported a relationship between surgical delay and disease severity. A significant positive correlation has been reported between prolonged PI and TI with increasing pathological grade, indicating progression of disease with delayed presentation. While, HI did not show a significant association with pathological severity, suggesting that short in-hospital delays do not contribute substantially to disease progression. In line with present study, early and delayed laparoscopic appendectomy groups showed no significant differences in baseline parameters, supporting the concept that controlled delays after hospital admission are clinically acceptable and do not adversely influence outcomes in selected patients.

In the present study, no statistically significant differences were observed between the early and delayed appendectomy groups with respect to overall postoperative complications. Although surgical site infection, pneumonia, and readmission beyond 30 days were higher in the delayed appendectomy group but the difference not statically significant. (p>0.05). Similarly, Previous study by Seudeal K et al,[8] and Ranjan et al,[16] reported delayed appendectomy performed more than 8 h was not associated with increased perioperative complications, postoperative length of stay, 30-day readmission rate, or mortality. Khan et al. also demonstrated no significant differences between early and delayed appendectomy in operative time, postoperative length of stay, perforation rates, mortality, surgical site infection, overall complications, or 30-day readmission. In a pooled analysis of six studies involving 2,428 patients, the overall complication risk remained comparable between groups (RR = 0.94; 95% CI: 0.71–1.25; p = 0.68), with low heterogeneity.

A systematic review by Danielle B. Cameron et al,[17] demonstrated, on the basis of level III–IV evidence, that performing appendectomy within 24 hours of hospital admission for AA is not associated with higher rates of perforation or other adverse outcomes, nor does it increase hospital costs or length of stay. Although evidence regarding patient or parent satisfaction is limited, the available data support the safety of appendectomy within the first 24 hours of presentation without compromising clinical outcomes.

Similarly, Li et al,[18] reported that prolonged delays from symptom onset, particularly beyond 24–48 hours, are strongly associated with an increased risk of complicated appendicitis. In contrast, short in-hospital delays were linked only to a modest increase in surgical site infection and did not significantly elevate the risk of complicated disease. Taken together, these findings underscore that overall symptom duration is a critical determinant of disease severity, whereas controlled in-hospital delays appear clinically acceptable and do not adversely affect major postoperative outcomes.

The study is limited by a small sample size, which may reduce the power to detect significant associations between independent variables and outcomes. Additionally, its single-center design limits generalizability and may introduce selection bias.

CONCLUSION

Early and delayed laparoscopic appendectomy are both safe and effective approaches for managing acute appendicitis. Early surgery offers the benefit of timely intervention, while short, controlled delays do not increase postoperative risk. Both approaches can be considered appropriate based on patient condition, hospital resources, and surgical feasibility.

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