

Management of the stump in complicated acute appendicitis: Conversion to open surgery or laparoscopic stapler?

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ABSTRACT

Introduction: This study aims to compare the efficacy and safety of using laparoscopic staplers versus conversion to open surgery in the management of the appendiceal stump in cases of complicated acute appendicitis (AA).

Materials and Methods: A total of 123 patients who underwent surgery for complicated AA at our clinic between 2020 and 2024 were included in the study. Of these, 98 (79.7%) underwent open appendectomy (OA), and 25 (20.3%) underwent laparoscopic appendectomy (LA) with a stapler. The patients were retrospectively analyzed and compared in terms of demographic characteristics, hospital stay duration, post-operative complications, and surgical site infections.

Results: The mean age of the patients was 37.60 ± 11.23 years, and the mean BMI was $28.77 \pm 3.90 \text{ kg/m}^2$. The mean hospital stay was 5.02 ± 1.77 days. Surgical site infections were more frequent in the OA group (27.6%) compared to the LA group (8.0%) ($p=0.040$). The mean hospital stay was longer in the OA group (5.16 ± 1.79 days) compared to the LA group (4.44 ± 1.58 days) ($p=0.049$). No significant difference was found in the incidence of post-operative complications between the two groups ($p=0.526$).

Conclusion: The findings suggest that completing the surgery laparoscopically results in better outcomes compared to converting to open surgery in cases of complicated acute appendicitis. The use of a laparoscopic stapler is associated with safer and more effective closure of the appendiceal stump, leading to fewer surgical site infections and shorter hospital stays. Prospective studies with larger patient populations are needed to confirm these findings.

Keywords: Acute Appendicitis, Appendiceal Stump Management, Laparoscopic Stapler, Laparoscopic Surgery

Introduction

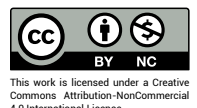
Among abdominal pathologies, the most common cause requiring emergency surgery is acute appendicitis (AA).^[1] Although open surgery is the most commonly used treat-

ment method, laparoscopic surgery has begun to replace open surgery with developments in technology in recent years.^[2] The popularity of laparoscopic appendectomy (LA) is due to the various advantages it offers patients.



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Since the laparoscopic approach requires smaller surgical incisions, it reduces postoperative pain, shortens hospital stay, and allows patients to return to normal activities more quickly compared to open appendectomy (OA).^[2,3] Additionally, cosmetic results are more satisfactory compared to open surgery. However, many factors determine the success of this surgical technique, and among these factors, the management of the appendix stump has an important place.

One of the most important differences between laparoscopic and open surgery is the method used to close the appendix stump. While this method is more standard in open surgery, there are different approaches in laparoscopic surgery such as stapler, endoloop, titanium clip, non-absorbable polymer clip (hem-o-lok clip), external knot tying, intracorporeal ligation, hand-made loop, ligasure, or simply using bipolar coagulation to cut the stump.^[4,5]

The choice between converting to open surgery or closing the stump with a stapler may depend on the surgeon's experience, the patient's clinical condition, and the specific conditions of the operation. However, studies on the effectiveness and safety of both methods provide important data to determine which method is more suitable to improve surgical outcomes. Closing the stump with a stapler is not standard practice in our clinic. In cases where the appendix is perforated close to the cecum or there is severe inflammation-edema in the cecum/appendix stump, the surgeon may prefer to close it with a stapler. However, sometimes to ensure the safety of the appendix stump, converting from laparoscopic to open surgery is also a viable method.

In this article, we aimed to examine the effectiveness and safety of using laparoscopic staplers to safely close the stump in cases of AA by comparing the perioperative process and early postoperative results (within the first month) of the stump closure.

Materials and Methods

The demographic characteristics, operation notes, and postoperative summaries of patients who underwent surgery due to complicated AA between 2020 and 2024 at the General Surgery Clinic of a major training and research hospital were retrospectively reviewed.

The study was approved by the Local Ethics Committee of our hospital (Approval number: 2024/206).

Patients with perforated, gangrenous appendicitis, or with edema-inflammation observed at the appendiceal root/cecum were considered to have complicated appendicitis.

According to the operation notes, 123 patients with complicated AA, whose appendices were identified laparoscopically but whose appendectomies were completed either with a stapler or by conversion to open surgery based on the surgeon's preference, were included in the study. A routine 12 mm laparoscopic stapler was used as the stapling device. Patients were compared based on age, gender, BMI, presence of comorbidities (Diabetes mellitus, hypertension, asthma, chronic obstructive pulmonary disease, and coronary artery disease), length of hospital stay, and postoperative clinical course, including pericecal inflammation/abscess observed in imaging (USG or CT) and detection of surgical site infection.

Patients who underwent open surgery from the beginning, those whose surgeries were converted to open due to the inability to visualize the anatomy, those whose appendiceal stumps were closed by methods other than a stapler, and those whose data were unavailable were excluded from the study.

All statistical analyses were performed using SPSS (Statistical Package for Social Sciences) for Windows version 25.0 (SPSS Inc., Chicago, IL, USA).

We used mean and standard deviation for the expression of study data. Additionally, numeric (n) values and percentages (%) were reported. The Chi-square test was employed for the comparison of two categorical variables. For the comparison of a categorical variable with a numeric value, the Mann-Whitney U test was used. All statistical calculations were two-sided, and a p-value of less than 0.05 indicated statistical significance at a 95% confidence interval.

Results

The data of 1717 patients who underwent appendectomy between 2020 and 2024 were retrospectively analyzed. The number of patients meeting the inclusion criteria was 123. Of these patients, 98 (79.7%) underwent open appendectomy, and 25 (20.3%) underwent laparoscopic stapler appendectomy. The mean age of the patients was 37.60 ± 11.23 years, and the mean BMI was 28.77 ± 3.90 kg/m². The average hospital stay was 5.02 ± 1.77 days. Among the patients, 85 were male (69.1%) and 38 were female

(30.9%). A total of 17 patients had comorbid conditions (13.8%). Postoperative complications were observed in 24 patients (19.5%), and surgical site infections were detected in 29 patients (23.6%).

In the OA group, the mean age was 36.98±10.82 years, while in the LA group, it was 40.04±12.65 years ($p=0.295$). The mean BMI in the OA group was 28.66±4.03, compared to 29.20±3.40 in the LA group ($p=0.370$). In the OA group, 69 patients (70.4%) were male, and in the LA group, 16 patients (64.0%) were male ($p=0.536$). In the OA group, 11 patients had comorbid conditions (11.2%), whereas in the LA group, 6 patients had comorbid conditions (24.0%) ($p=0.099$) (Table 1).

In the OA group, postoperative complications included peri-cecal inflammation in 14 patients and peri-cecal abscess in 4 patients, totaling 18 patients (18.4%). In the LA group, complications included peri-cecal inflammation in 4 patients and peri-cecal abscess in 2 patients, totaling 6 patients (24.0%) ($p=0.526$). Surgical site infections were observed in 27 patients (27.6%) in the OA group, compared to 2 patients (8.0%) in the LA group ($p=0.040$). The average hospital stay was 5.16±1.79 days in the OA group and 4.44±1.58 days in the LA group ($p=0.049$) (Table 2).

No early complications requiring re-operation or intestinal fistula were observed in any of our patients. There were no mortalities.

Discussion

This study indicates that the use of a laparoscopic stapler could be a viable option for the safe closure of the appendiceal stump in cases of complicated AA. The findings reveal no significant difference in the incidence of complications between the groups. Additionally, operations completed laparoscopically were associated with lower rates of surgical site infections and shorter hospital stays.

Ensuring the secure closure of the appendiceal stump is critical in appendectomy procedures, as an improperly closed stump can result in severe complications such as peritonitis, sepsis, or fistula formation, or necessitate subsequent surgeries.^[6]

Numerous controlled studies comparing laparoscopic and open surgical procedures report significant advantages of the laparoscopic technique. One of the most notable advantages is the reduced rate of surgical site infections. This reduction can be attributed to the near-complete prevention of abdominal wall contamination by the ports

Table 1. Clinical and demographic features

	OA n=98 (79.7%)	LA n=25(20.3%)	Total n=123	p
Age (years), Mean±SD	36.98±10.82	40.04±12.65	37.60±11.23	0.295
BMI, Mean±SD	28.66±4.03	29.20±3.40	28.77±3.90	0.370
Sex, n (%)				
Male	69 (70.4)	16 (64.0)	85 (69.1)	0.536
Female	29 (29.6)	9 (36.0)	38 (30.9)	
Comorbid Condition, n (%)	11 (11.2)	6 (24.0)	17 (13.8)	0.099

BMI: body mass index; OA: open appendectomy; LA: laparoscopic appendectomy; SD: standard deviation.

Table 2. Post-operative findings

	OA n=98 (38.5%)	LA n=25 (61.5%)	Total n=123	p
Surgical Site Infection, n (%)	27 (27.6)	2 (8.0)	29 (23.6)	0.040a
Hospital Stay, Mean±SD	5.16±1.79	4.44±1.58	5.02±1.77	0.049a
Post-operative Complication, n (%)	18 (18.4)	6 (24.0)	24 (19.5)	0.526

^aStatistically significant at the confidence level of 0.95; OA: Open appendectomy; LA: laparoscopic appendectomy; SD: standard deviation.

used during laparoscopic procedures.^[7-9] Similarly, in our study, surgical site infections were more frequently detected in open surgery.

Although this study does not focus on the use of hemo-lock clips or endo-loops, it is necessary to discuss their applications. The decision to use a stapler in cases of AA is primarily made in instances where severe inflammation extends to the appendiceal root. In contrast, a study by a Polish-German research group demonstrated that in 107 cases of severe inflammation (ulcerophlegmonous/gangrenous appendicitis), the appendiceal stump could be successfully closed using clips.^[10] However, the main issue lies in the diameter of the clips used. In situations where the cecum and appendiceal stump are significantly edematous, laparoscopic clips may not fully encircle the appendix. Similarly, concerns regarding endo-loop usage revolve around the potential for fistula formation following partial transection of the appendiceal root during tightening. Properly securing the loop knot, especially in cases of severe or prolonged inflammation where the appendiceal root is delicate, requires experience.^[11] As such, a single method cannot always be applied to all patients. Accordingly, a study in 2014 recommended that the optimal method for closing the appendiceal stump should be determined by the surgeon based on intraoperative findings.^[12]

A review of the literature shows that patients undergoing OA for complicated AA tend to have longer hospital stays compared to those undergoing LA.^[13,14] This difference is attributed to higher rates of surgical site infections, early intestinal adhesions, and greater pain in OA patients.^[15] Consistent with these findings, our study also demonstrated a significantly longer hospital stay for the OA group.

The incidence of postoperative intra-abdominal infection and abscess was found to be similar between the two groups in our study. There are many studies on this subject in the literature. In a study published in 2017 by the meta-analysis of a total of 26 studies, the rate of intra-abdominal abscess detection in the OA group was 8%, while this rate was found to be 6% in the LA group. However, no statistical difference was detected between the two groups.^[16]

Our study has some limitations. First of all, our study is a retrospective study. Our number of patients is limited. Cost analysis could not be performed because we did not have data to perform cost analysis. Surgery times were not calculated.

Conclusion

According to our study, we believe that completing the case laparoscopically rather than open surgery in complicated AA cases has better results. To achieve this, we think that the appendix stump can be closed safely with a laparoscopic stapler.

Disclosures

Ethics Committee Approval: This study was approved by Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital Ethics Committee (Approval number: 2024/206).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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