

Comparison of Hem-o-lok and Endoloop for Appendiceal Stump Closure in Laparoscopic Appendectomy: An Observational Retrospective Study

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Background: Laparoscopic appendectomy has gained prominence in the management of acute appendicitis, necessitating secure closure of the appendiceal stump. Two common techniques for this purpose are Hem-o-lok clips (HC) and endoloops (EL), each offering distinct advantages.

Aims: This retrospective study aimed to compare the outcomes of the HC and EL closure techniques. Specifically, the study focused on postoperative complications, hospital stays, and readmission rates.

Materials and Methods: A retrospective database review was conducted from November 2022 to August 2023. The study compared outcomes, postoperative complications, and the length of hospital stay in 123 patients who underwent appendiceal stump closure with HC and EL at the General Surgery Department of the Turkish Hospital in Doha, Qatar.

Results: Among the 123 patients who underwent laparoscopic appendectomy, appendiceal stump closure was performed with HC in 50 patients and EL in 73 patients. Six patients experienced infectious complications associated with the procedure. The hospital stays were similar in both groups (Group HC: 1.3 ± 2 days, Group EL: 1.4 ± 2 days), and there were two readmissions in each group.

Conclusion: The study supports the equivalence of HC and EL closure techniques. Both methods demonstrate comparable postoperative complications, hospital stays, and readmission rates. Surgeons can make informed decisions based on patient profiles and available resources.

Keywords: laparoscopic appendectomy; appendicitis; appendiceal stump closure; Hem-o-lok clips; endoloops

Introduction

The evolution of laparoscopic surgery has reshaped surgical interventions, offering benefits such as reduced postoperative pain, quicker recovery, and shorter hospital stays [1,2]. Among these advancements, laparoscopic appendectomy has gained popularity in treating acute appendicitis. Crucial to this procedure is the secure closure of the appendiceal stump, which significantly influences postoperative outcomes [3–5]. Two common techniques employed for appendiceal stump closure are Hem-o-lok clips (HC) and endoloops (EL), each with distinct advantages [6,7].

HC offer a secure and reliable method of closing the appendiceal stump. The clips provide direct compression on the tissue, minimizing the risk of stump leakage. They are relatively quick and easy to apply, potentially reducing the overall operative time, which can be especially beneficial in cases requiring prompt surgical intervention. The design of HC allows for visual confirmation of proper placement, ensuring that the stump is adequately sealed [8,9].

Endoloops are versatile and can be used effectively in various surgical contexts. They provide a broader margin for error in placement, making them suitable for less experienced surgeons. Additionally, they are generally more cost-effective than disposable polymeric clips, which can be a significant advantage, especially in resource-constrained settings. Endoloops (EL) distribute pressure more evenly over the tissue than clips, potentially reducing the risk of ischemic necrosis at the stump site. Furthermore, EL do not leave behind foreign material in the body after closure, which could benefit long-term biocompatibility [10].

Materials and Methods

This retrospective observational analysis, conducted at the Department of General Surgery at Turkish Hospital from November 2022 to August 2023, included 123 patients who underwent laparoscopic appendectomy. Since our study is a retrospective observational study, it is exempt from ethical approval but it was authorized by the hospital management. The patients were categorized into two groups: HC (n = 50) and EL (n = 73) according to appendiceal stump closure. Patients who underwent conversion to open appendectomy and those who required two or more closure procedures were excluded from the study. Variables including age, gender, radiologic appendix diameter, and American

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Society of Anesthesiologists (ASA) score of the patients, operative time, use of drain, complications (wound infection, intraabdominal abscess/collection, bleeding, brids, pulmonary, cardiac), and readmissions were recorded.

Surgical Technique

Two senior surgeons with 15 years of experience performed all operations. One surgeon utilized the EL technique, while the other employed the HC technique. Intravenous administration of 1 gram Cefazolin was standard for all patients as prophylaxis. Typically, a urinary catheter was employed to empty the bladder to prevent injuries. After establishing pneumoperitoneum with CO₂, a 10-millimeter port was consistently placed from the umbilicus, and a 30° scope was used following exploration of the abdominal cavity. For HC group patients, a 10 mm port was utilized, whereas for the EL group, a 5 mm trocar was inserted 4 cm above the pubis in the midline, and a third 5 mm trocar was positioned from the left lower quadrant with respect to the caecum's position. The mesoappendix was transected using a vessel sealer device. In the HC group, a single polymeric clip was placed at the base of the appendix and subsequently cut using a ligasure device. In contrast, in the EL group, a single endoloop was positioned at the base of the appendix. The decision to employ drains intraoperatively was based on various factors, including the presence of intraabdominal abscess/collection, the extent of surgical dissection, and the surgeon's preference. For cases of perforated appendicitis, a sample bag was utilized.

Statistical Analyses

To compare the distribution of age, gender, radiologic appendix diameter, and ASA score between the HC and EL groups, chi-square tests were employed for categorical variables, while *t*-tests were used for continuous variables. A *t*-test was conducted on the groups' mean operating for comparison purposes. Chi-square tests were also utilized to analyze the disparity in the use of drains and to assess any significant differences in readmissions and the occurrence of postoperative complications between the groups. Mann-Whitney U test was used to compare hospital duration between the groups.

For all statistical analyses, *p*-values less than 0.05 were considered statistically significant. Additionally, 95% confidence intervals were calculated where appropriate to provide additional insights into the precision of the estimates.

Results

In our study, we examined 123 patients who underwent laparoscopic appendectomy, with 50 patients (40.6%) in the HC group and 73 patients (59.4%) in the EL group. Among these patients, 78 (63.4%) were male, and 45 (36.4%) were female. The mean age of the patients was 29.3 years, ranging from 4 to 83 years. The age distribution of patients in the HC group was 30.4 years, ranging from 15 to 83 years,

with a standard deviation of ± 15.87 . In comparison, in the EL group, it was 28.2 years, ranging from 4 to 75 years, with a standard deviation of ± 17.04 . No statistically significant difference was observed between the two groups regarding patient ages ($p = 0.25$).

The diameter of the appendices ranged from 6 to 19 mm in the HC group, with a mean diameter of 9.12 mm (standard deviation ± 3.05). In the EL group, the appendices ranged from 5 to 21 mm in diameter, with a mean of 11.59 mm (standard deviation ± 4.71). There was no statistically significant difference in appendix diameter between the two groups ($p = 0.424$).

Patients' ASA scores between the HC and EL groups were compared, showing no significant difference ($p = 0.141$). The mean operating times were 44 minutes for the HC group and 45 minutes for the EL group, with no statistically significant difference between the two groups ($p = 0.321$). Notably, the EL group had a higher frequency of drain usage compared to the HC group ($p = 0.04$).

The mean duration of hospital stays was similar between the HC and EL groups, with 1.3 days (min:1 day, max:4 days) and 1.4 days (min:1 day, max:3 days), respectively. There were two readmissions in each group, with no statistically significant difference observed ($p = 0.24$). Postoperative complications occurred in six patients across both groups, with no significant difference between the HC and EL groups (12% and 8.2%, respectively, $p = 0.062$). Importantly, no cases of stump leakage were observed in either group (Table 1).

Discussion

Due to the increasing popularity of laparoscopy and technological advancements, laparoscopic appendectomy has become a more preferred method. Reduced postoperative ileus, less postoperative pain, quicker recovery, shorter hospital stays, lower wound infection rates, and superior cosmetic outcomes have all been demonstrated compared to the open approach [11, 12, 13, 14].

Another benefit of laparoscopy is its ability to distinguish between appendicitis and other disorders that can present with similar clinical symptoms [15, 16].

The most crucial step in laparoscopic appendectomy is the secure closure of the appendix stump to prevent significant problems such as stump leakage, peritonitis, collections, and intra-abdominal abscess. This closure method must be affordable, easy to use, safe, inexpensive, readily available, and associated with tolerable complication rates. Various techniques including extracorporeal/intracorporeal suturing, endoloops, clips, and endo staplers may be employed for secure stump closure in laparoscopic appendectomy [17].

The findings align with existing literature, indicating comparable outcomes between polymeric clips and endoloop closure techniques. The preference for polymeric clips stems from their simplicity, reduced operative time,

Table 1. Comparison of Groups.

Parameters	Group HC	Group EL	<i>p</i> -value
Patients	50	73	
Age (Mean \pm SD)	30.4 \pm 15.87	28.2 \pm 17.04	0.250
Mean operative time (minutes)	44	45	0.321
Use of drains (Significantly higher in Group B)	1	4	0.04
Mean hospital stay (days, days minimum and maximum)	1.3 (min:1 day max:4 days)	1.4 (min:1 day max:3days)	0.347
Readmissions	2	2	0.21
Postoperative complications (%)	12.0%	8.2%	0.062
Stump leakage (None observed in both groups)	None	None	

HC, Hem-o-lok; EL, Endoloops.

and secure stump closure, while endoloops offer cost-effectiveness and ease of application, catering to diverse surgical contexts. However, no method for covering the appendix root has yet been proven to be superior to the others [18–20].

In our study, no statistically significant difference was observed in terms of the duration of surgery times in both groups. However, this does not imply that polymeric clips are not feasible. In our analysis, it was determined that statistically, more drains were utilized in Group HC. We speculate that this may be attributed to the fact that patients in the HC group had more complicated cases. Mean surgery times for groups HC and EL were also comparable. Various complications, such as subileus, wound infections, urinary retention, and seroma, developed in 12 patients in both groups, but there was no statistically significant difference between the groups. These results closely parallel those reported in the literature (HC: 12% and EL: 8.2%, $p = 0.062$). According to several studies, extracorporeal knotting emerges as a feasible, secure, and cost-effective alternative to polymeric clips. Multiple comparisons between polymeric clips and endoloops have consistently favored polymeric clips, highlighting their ease of use, faster application, and cost-effectiveness [21–23]. In comparing patients undergoing intracorporeal knotting and those using endoloops, no statistically significant difference was observed between the groups, except for the shorter operation time [24, 25].

A comprehensive evaluation of ten studies on appendiceal stump closure methods, comprising seven prospective studies and one randomized controlled trial, involving 702 patients from 2000 to 2017, revealed that the safest method is the endoscopic stapler in cases where the appendix stump cannot be safely closed with other techniques [26].

Conclusion

Both HC and EL offer distinct advantages for appendiceal stump closure in laparoscopic appendectomy. The selection between these two techniques should be guided by a comprehensive assessment of patient characteristics, surgeon expertise, resource availability, and the specific surgical context. As the surgical landscape continues to evolve,

a balanced evaluation of these techniques ensures optimal outcomes regarding stump closure integrity, postoperative complications, and overall patient well-being. Further prospective studies could offer additional insights into the long-term results and comparative effectiveness of these closure methods.

Availability of Data and Materials

Data for the study can be made available upon request.

Author Contributions

CEG and GS have made substantial contributions to the conception or design of the manuscript, and ESG contributed to the data's acquisition, analysis, and interpretation. All authors have participated in drafting the manuscript, and CEG revised it critically. All authors read and approved the final version of the manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Since our study is a retrospective observational study, it is exempt from ethical approval and the consent was waived. But it was authorized by Turkish Hospital management. The confidentiality of the included subjects was maintained by not disclosing the identification details and using anonymized data. The study is in accordance with the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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