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Comparative Study of Stump Closure with Knot Tying Suture Versus Metallic Endoclip in Laparoscopic Appendectomy in Uncomplicated Acute Appendicitis in Terms of Organ Injury and Intraoperative Time Taken

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ABSTRACT

Introduction: Endoloops (EL), endoclips (both metallic and polymeric clips), linear stapler devices, suture closure via additional—corporeal sliding knots, or intracorporeal knot ligation and endocoagulation are some of the several laparoscopic closure techniques for the appendiceal stump that have been previously described. However, opinions on the best way to close appendiceal stumps are divided. **Study design:** Randomized controlled trial. **Study Period:** July 25, 2024, until January 24, 2025. **Methodology:** There were 300 patients between the ages of 18 and 70 years, regardless of gender, who have undergone laparoscopic appendiceal stump closure due to uncomplicated acute appendicitis were included. The following conditions were not included: conversion to open appendectomy, single incision appendectomy, diffuse or local peritonitis, inflammatory pelvic illness, and the use of alternative stump closure procedures. Group A patients were undergone metallic endo-clip and group B patients were undergone knot tying. Operative time and intra-operative organ injury were assessed. **Findings:** Group A (metallic clip) in my study had an average surgery time of 37.87 ± 6.52 minutes, while Group B (knot tying) had an average surgery time of 49.87 ± 4.52 minutes (p-value = 0.0001). 2.67% of patients in group A (met6allic clip) experienced organ injury, whereas 0.67% of patients in group B (knot tying) did the same. **Conclusion:** For patients with complex appendicitis, there are safe alternatives for appendiceal stump closure during laparoscopic appendectomy: metallic endoclips and intracorporeal sutures.

INTRODUCTION

One of the most frequent reasons for urgent surgery is acute appendicitis. About 7% of people will experience it at some point throughout their lives. A patient's history and physical examination are typically used to establish the diagnosis, which is then verified by imaging and laboratory techniques. Abdominal computed tomography (CT) and ultrasound (US) are imaging techniques frequently utilized for diagnosis.[1]

The best treatment for acute appendicitis is laparoscopic appendectomy. The advantages of laparoscopic appendectomy over open appendectomy include a shorter hospital stay, a lesser need for postoperative analgesics, early food tolerance, a faster return to work, and a decreased risk of wound infection. Furthermore, if the vermiform appendix is discovered to be unaltered, laparoscopy enables better imaging and detection of a variety of abdominal conditions that may mimic acute appendicitis. After an appendectomy, closing the appendiceal stump is essential to preventing serious side effects such sepsis, peritonitis, and postoperative fistula.[2]

Endoloops (EL), endoclips (both metallic and polymeric clips), linear stapler devices, suture closure via additional—corporeal sliding knots, or intracorporeal knot ligation and endocoagulation are some of the several laparoscopic closure techniques for the appendiceal stump that have been previously described. The best technique for closing appendiceal stumps, however, is up for debate.[3]

Cristalli et al. initially presented the metallic endo-clip approach for appendiceal stump closure in 1991. The endo-clip is a good substitute for appendix base closure and is typically used to ligate the cystic duct during laparoscopic cholecystectomy.[4] Even in cases of complex appendicitis, these clips have been shown to be safe and effective.[5]

Using a laparoscope to tie an intra-abdominal knot is extremely difficult due to the lack of space for movement, the wrist joints' inability to rotate, the stretched instruments' fulcrum for motion, the distance from the

desired site, and the requirement for great manual dexterity. Another popular alternate method is extracorporeal knotting. Making the knot outside of the body and then sliding it in to complete the task is the concept behind using extracorporeal sliding knots. The knot must be as fast, simple, and secure as the conventional ones.[6] Organ damage and operating time for metallic endo-clips and knot tying were 0% vs. 3.1% and 44.1±8.6 min vs. 39±7.5 min, respectively.[4]

To the best of my knowledge, there is a lack of data and not enough research studies have been carried out in Pakistan to compare the effectiveness of these two base closure techniques (metal endo-clips and extracorporeal knots). This study sought to determine which procedure will be safe and better by examining the substantial differences between extracorporeal knot (Roeder's knot) and metallic endo-clips, particularly in terms of operative time and organ injury. It will decrease a patient's morbidity. Additionally, it will enlighten our local data.

MATERIALS AND METHODS

This randomized clinical trial was conducted at the Department of Surgery, Allied hospital, Faisalabad from July 25, 2024, until January 24, 2025. 300 patients were selected using a consecutive non-probability selection technique. With 80% study power and a 95% confidence interval, the sample size of 300 (150 in each group) was determined, with organ injury in knot tying and metallic endo-clips as 0% vs 3.1%.[4] The WHO sample size calculator was used to determine the sample size. Patients between the ages of 18 and 70 years, regardless of gender, who have undergone laparoscopic appendiceal stump closure due to uncomplicated acute appendicitis were included. The following conditions were not included: conversion to open appendectomy, single incision appendectomy, diffuse or local peritonitis, inflammatory pelvic illness, and the use of alternative stump closure procedures.

Informed agreement was obtained from patients who met the inclusion criteria after the hospital ethical committee gave its approval. Using a computer-generated random number table, all patients undergoing laparoscopic appendiceal stump closure were split into two groups at random. Patients in groups A and B received metallic endoclips and knot tying, respectively. The same antibiotics (I/V ceftriaxone) and skin preparation (10% povidone-iodine solution) were given to each patient after they had been put to sleep. All patients had three ports: the supraumbilical with camera port, the hypochondrium, and the right side of the abdomen. In order to confirm appendicitis, the abdominal cavity was examined prior to starting surgery. The base of the appendix was then cleared by dissecting the mesoappendix. Three metallic end clips (Ethicon LigaclipsR and Titanium Clip Cartridge in two sizes) were put to group A so that two were near to the base in the opposite direction and the third was 5 mm away. The appendix was removed via a hypochondrium port after being sliced between the first two clips. In contrast, group B had Vicryl 2/0 tied with the appendix base in two knots (Roeder's knot) 5 mm apart, and the appendix was severed in between the knots. All wounds were closed with 2/0 prolene sutures and a suitable dressing was applied after appendectomy in all groups. According to the operational definition, intraoperative organ damage and operating time were evaluated. I gathered all the data on a custom created proforma, which is attached.

SPSS version 25 was used to enter and evaluate the data. The mean and standard deviation of numerical values such as age, symptom duration, and operating time were computed as descriptive statistics. For every qualitative indicator, including gender, ASA status, and organ injury, frequency and percentage were computed. Organ injury in two groups was compared using the chi square test. The two groups' operational times were compared using an independent sample t-test. Using stratification, effect variables such age, gender, ASA status, and symptom duration were controlled for. They employed the post-stratification chi-square test and the independent sample t-test. A 0.05 p-value was considered significant.

RESULTS

The study's participants ranged in age from 18 to 70, with a mean age of 46.37 ± 17.84 years. Patients in groups A and B had mean ages of 48.43 ± 16.29 and 46.07 ± 18.61 years, respectively. The majority of the 224 patients (74.67%) were in the 41–70 age range. With a male to female ratio of 1.2:1, 166 (55.33%) of the 300 patients were male and 134 (44.67%) were female. The illness lasted an average of 24.97 ± 11.51 hours. Table I displays the patient distribution by ASA status.

Group A (metallic clip) in my study had an average surgery time of 37.87 ± 6.52 minutes, while Group B (knot tying) had an average surgery time of 49.87 ± 4.52 minutes (p-value = 0.0001). 2.67% of patients in group A (met6allic clip) experienced organ injury, whereas 0.67% of patients in group B (knot tying) did the same (Table II).

Table I

Baseline demographic data.

		Group A (n=150)	Group B (n=150)
Age (years)	18-40	36 (24.0%)	40 (26.67%)
	41-70	114 (76.0%)	110 (73.33%)
Gender	Male	81 (54.0%)	85 (56.67%)
	Female	69 (46.0%)	65 (43.33%)
Duration of symptoms (hours)	≤48	83 (55.33%)	80 (53.33%)
	>48	67 (44.67%)	70 (46.67%)
ASA status	I	79 (52.67%)	72 (48.0%)
	II	71 (47.33%)	78 (52.0%)

Table II

Comparison of the outcome between both groups.

	Group A (n=150)	Group B (n=150)	p-value
Duration of surgery (minutes)	37.87 ± 6.52	49.87 ± 4.52	0.0001
Organ injury	01 (0.67%)	04 (2.67%)	0.176

Table III

Stratification of operative time with respect to age, gender, duration of symptoms and ASA status.

		Group A (n=150)		Group B (n=150)		P-value
		Operative time (min)		Operative time (min)		
		Mean	SD	Mean	SD	
Age	18-40	37.77	4.51	47.56	5.63	0.0001

(years)	41-70	38.12	5.87	49.87	4.23	0.0001
Gender	Male	38.05	5.83	48.27	4.10	0.0001
	Female	37.22	3.73	49.67	4.69	0.0001
Duration (hours)	≤48	38.31	6.60	47.42	5.72	0.0001
	>48	37.71	4.01	49.68	3.98	0.0001
ASA status	I	37.35	5.54	46.36	6.42	0.0001
	II	38.50	4.91	49.93	4.21	0.0001

Table IV

Stratification of operative time with respect to age, gender, duration of symptoms and ASA status.

		Group A (n=150) Organ injury		Group B (n=150) Organ injury		P-value
		Yes	No	Yes	No	
Age (years)	18-40	01 (2.78%)	35 (97.22%)	00 (0.0%)	40 (100.0%)	0.289
	41-70	03 (2.63%)	111 (97.37%)	01 (0.91%)	109 (99.09%)	0.469
Gender	Male	03 (3.70%)	78 (96.30%)	01 (1.18%)	84 (98.82%)	0.288
	Female	01 (1.45%)	68 (98.55%)	00 (0.0%)	65 (100.0%)	0.329
Duration (hours)	≤48	02 (2.41%)	81 (97.59%)	00 (0.0%)	80 (100.0%)	0.162
	>48	02 (2.99%)	65 (97.01%)	01 (1.43%)	69 (98.57%)	0.534
ASA status	I	01 (1.27%)	78 (98.73%)	00 (0.0%)	72 (100.0%)	0.338
	II	03 (4.23%)	68 (95.77%)	01 (1.28%)	77 (98.72%)	0.267

DISCUSSION

Our experiment is the first prospective randomized one that compares two stump closure methods in patients with complex appendicitis, as far as we are aware. That is a huge plus for our research. The other benefit is that our two groups' preoperative data did not differ significantly, which should reduce the likelihood of bias skewing our results in favor of one strategy over another. The usage of metallic clips was linked to a notable reduction in operating time in our study. Given that applying clips during the procedure is anticipated to take less time than performing two transfixing sutures, that is a reasonable outcome.

Other writers who compared the same two methods in patients with simple appendicitis validated our findings. According to Gonenc et al., the suturing group's operating duration ranged from 30 to 135 minutes (mean = 61.9 ± 27.1), whereas the metallic clip group's ranged from 20 to 100 minutes (mean = 46.3 ± 19.8).[7] According to Ates and his colleagues, the suturing group saw a considerably higher mean operating time of 62.81 ± 15.4 minutes (p = 0.001) than the metallic clip group, which had an average of 41.27 ± 12.2 minutes.[8] In our investigation, we did not come across any examples that required conversion to the open method. According to the literature, the reported range for conversion during laparoscopic appendectomy is between 0% and 47%.[9-12]

In our trial, all patients were released from the hospital within 24 hours following the surgery, provided they had consumed enough fluids and had not had vomiting. In cases of acute appendicitis, particularly complex ones, we support the idea of ambulatory surgery. This is based on a research by Gignoux et al. that concluded ambulatory surgery is a safe treatment for both non-complicated and complex appendicitis. The ambulatory surgery group experienced fewer complications than the conventional one, according to these authors (11.9% vs. 25%, respectively, p = 0.029).[13] In a low-income nation like Pakistan, that should be very advantageous because this strategy will result in lower healthcare costs. However, some writers noted that complex appendicitis treated with laparoscopy required a longer hospital stay.

According to Mohamed and Mahran, patients who met the same criteria spent 5.3 ± 2.1 days in the hospital.[14] Furthermore, the duration of hospitalization following laparoscopic appendectomy for severe appendicitis varied from 1 to 22 days (median = 3 days), according to Güler et al.[15] It is reasonable to anticipate some variation in that parameter among studies based on surgical facility procedure, perioperative problems, and patient criteria.

We found no discernible difference in the rates of organ damage between the two groups in the current investigation. Ates et al. similarly observed similar results in their statistical analysis (p = 0.939), with complication rates in the suturing and slip groups of 10% and 3.22%, respectively.[8] The incidence of organ damage did not significantly differ between the two closure techniques, according to our data. This is much less than the range of 3% to 25% that has been documented for the same adverse occurrence in the literature.[16] A 12.3% incidence of the same problem following laparoscopic appendectomy for severe appendicitis was described by other authors.[17]

Although there is a lower risk of surgical site infection with laparoscopy than with the open technique, a 2019 meta-analysis found that wound complications could develop with a range of 12.3% following laparoscopic treatment of complex appendicitis.[18] The same problem following appendectomy had an incidence rate of 9%, according to another study.[19] Regarding readmission or reoperation rates, we found no discernible differences between the two stump closure strategies. According to Gonenc et al., the suturing and clip groups had reoperation rates of 2.1% and 0%, respectively, and readmission rates of 8.7% and 4.9%.[7] Ates et al. also reported that the clip group had a reoperation rate of 3.22% and 0%, respectively.[8]

Our experiment addressed a distinct surgical viewpoint. It does have certain disadvantages, though. The primary one is the sample size that was gathered from a single surgical facility. That ought should motivate surgeons to carry out additional research to address the earlier issues.

CONCLUSION

For patients with complex appendicitis, there are safe alternatives for appendiceal stump closure during laparoscopic appendectomy: metallic endoclips and intracorporeal sutures. But the former might be more advantageous than the latter, as seen by the shorter operating duration.

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