

Outcome of Hemostasis Securing During Laparoscopic Appendectomy by Using Ligature Versus Vessel Sealing Devices

Hemostasis
Securing During
Laparoscopic
Appendectomy

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ABSTRACT

Objective: Present study was planned to compare the outcome of hemostasis securing during laparoscopic appendectomy by using ligature versus vessel sealing devices.

Study Design: Observational study

Place and Duration of Study: This study was conducted at the Aziz Bhatti Shaheed Teaching Hospital, Gujrat from January 2022- December 2022.

Materials and Methods: 60 patients were enrolled (30 in each group). Patients were randomly divided into 02 groups. In group A, patients undergone surgery by using vessel sealing devices. In group B, patients were undergone surgery by conventional method (ligature). During procedure; operative time was noted in minutes and blood loss. At end of surgery, number of suture unit required to close the mesoappendix was noted. After 24 hours, patients were assessed for pain by using visual analogue scale.

Results: In this study In Vessel sealing devices group the mean operative time of the patients was 27.35±1.42 minutes and in Ligature group the mean operative time of the patients was 30.67±2.92minutes (p-value=<0.001). In Vessel sealing devices group the mean blood loss was 7.92±10.27ml and in Ligature group the mean blood loss was 19.75±18.37ml (p-value=<0.001). In Vessel sealing devices group the mean number of suture was 2.67±1.4 and in Ligature group the mean number of suture was 7.50±1.75 (p value=<0.001). In Vessel sealing devices group the mean pain score was 1.57±0.50 and in Ligature group the mean pain score was 3.97±0.89 (p-value=<0.001).

Conclusion: This study concluded that Vessel sealing devices is significantly better and useful procedure as compared to ligature in terms of hemostasis outcome during laparoscopic appendectomy.

Key Words: Laparoscopic Appendectomy, Vessel Sealing Devices, Ligature.

Citation of article: Munawar H, Zahid MM, Ahmad K, Ahmed R, Javed HM, Mahmood S. Outcome of Hemostasis Securing During Laparoscopic Appendectomy by Using Ligature Versus Vessel Sealing Devices. Med Forum 2023;34(8):2-6. doi:10.60110/medforum.340801.

INTRODUCTION

Most common cause of acute abdomen presenting in surgical emergency is acute appendicitis this is why appendectomy is most common emergency surgical procedure. Appendectomy was performed by grid iron incision till 19th century. In the era of minimum access surgery laparoscopic approach became very common. 1st laparoscopic appendectomy was performed by Semm, a German surgeon in 1983.

Laparoscopic appendectomy has gained popularity, especially among laparoscopic surgeons.¹ The most critical part of this procedure is ligation of the mesoappendix to control bleeding. A variety of methods to ligate the mesoappendix are used; these can be broadly divided into traditional ligatures (such as intracorporeal or extracorporeal ligatures) and vessel sealing devices (ligasure, enseal, harmonic, bipolar). However, the optimal method depends on expertise of surgeon.²

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Received: March, 2023

Accepted: May, 2023

Printed: August, 2023

Vessel sealing devices for achieving hemostasis, is good alternative to suture ligatures, for ligating vessels up to 5 mm.⁵ Laparoscopic appendectomy using the vessel sealing devices system is a safe and efficient procedure for acute appendicitis. Use of the vessel sealing devices in laparoscopic appendectomy may simplify the operative procedure and reduce the operative time.³ One trial found that 1 patients in vessel sealing devices group had operating time (37.1 + 8.9 min vs. 63.8 + 10.9 min; P < 0.001), operative blood loss (125.5 + 33.2 mL vs. 264.6 + 70.4 mL; P < 0.001), requirement of surgical sutures (1.2 + 0.4 units vs. 8.2 + 0.4 units; p < 0.001), and less pain (2.0 + 0.6 vs. 3.7 + 0.7; P < 0.001).⁴

The aim of this study is to compare the outcomes of hemostasis during laparoscopic appendectomy using ligature versus vessel sealing devices. Previous literature suggests that vessel sealing devices are a more effective approach, as they can reduce both operative and postoperative complications. However, no studies have been conducted on this method within our specific population. Therefore, this study intends to evaluate the efficacy of vessel sealing devices in our population and provide evidence to support their implementation as a better technique for laparoscopic appendectomy. The findings from this study will contribute to our understanding and practice in the field, allowing for improvements in the local management of appendectomies.

MATERIALS AND METHODS

Total study duration was approx 1 year (January 2022-December 2022). This study was conducted in Aziz Bhatti Shaheed Teaching Hospital, Gujrat Pakistan. A total of 60 patients (30 in each group) were included in this study, calculated based on an 80% power of the study, 95% confidence level, and the expected difference in mean operating time. The mean operating time was estimated to be $27.35 + 1.42$ minutes with vessel sealing devices and $30.67 + 2.92$ minutes with ligature during laparoscopic appendectomy. The inclusion criteria for patient selection were as follows: age between 16 and 75 years, both genders, and undergoing laparoscopic appendectomy under general anesthesia (as per the operational definition). The exclusion criteria included patients classified as ASA IV, those with suspected perforated appendix, and patients with bleeding disorders.

After obtaining consent from the hospital's ethical committee, 60 patients who fulfilled the selection criteria were enrolled from the Department of Surgery at Aziz Bhatti Shaheed Teaching Hospital in Gujrat. Informed written consent was obtained from each patient. The demographic profile, including name, age, gender, BMI, duration of diagnosis, smoking history (>5 pack years), and hypertension, was recorded. The patients were then randomly assigned to two groups using a lottery method. Group A underwent surgery using vessel sealing devices, while Group B underwent surgery using the conventional ligature method. All surgeries were performed under general anesthesia by a single surgical team with the assistance of a researcher. During the procedure, the operative time in minutes and blood loss (as per the operational definition) were recorded. At the end of the surgery, the number of suture units required to close the mesoappendix was noted. After the surgery, the patients were transferred to the wards and observed for 24 hours. Pain assessment was conducted using the visual analogue scale (as per the operational definition) after 24 hours.

All data were entered and analyzed using SPSS version 20. Quantitative variables such as age, BMI, duration of diagnosis, operative time, blood loss, pain, and suture units were presented as mean \pm SD. Qualitative variables such as gender, smoking, and hypertension were presented as frequencies and percentages. Independent samples t-tests were used to compare the mean operative time, blood loss, pain, and suture units between the two groups. A p-value of less than 0.05 was considered statistically significant. The data was further stratified by age, gender, BMI, duration of diagnosis, hypertension, and smoking. After stratification, independent samples t-tests were performed for each stratum to compare the mean operative time, blood loss, pain, and suture units between the two groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients participated in this study. The average age of the patients was 27.33 ± 10.598 years. Among them, 58.33% (35) were male, and 41.67% (25) were female, resulting in a male-to-female ratio of 1.4:1. When comparing the two groups (Group A and Group B), there was no statistically significant difference in terms of age distribution (mean age of 27.57 ± 9.48 years in Group A and 27.10 ± 11.76 years in Group B, p-value=0.866). Regarding body mass index (BMI), the mean BMI was 23.69 ± 3.35 kg/m² in Group A and 24.39 ± 3.61 kg/m² in Group B. However, this difference was not statistically significant (p-value=0.439). The mean duration of diagnosis in Group A was 12.97 ± 5.68 , while it was 12.10 ± 5.83 in Group B. The comparison between the two groups showed no statistically significant difference in terms of the duration of diagnosis (p-value=0.562). In terms of operative time, the mean operative time was 27.35 ± 1.42 minutes in Group A and 30.67 ± 2.92 minutes in Group B. This difference was found to be statistically significant (p-value=<0.001). Similarly, the mean blood loss was 7.92 ± 10.27 ml in Group A and 19.75 ± 18.37 ml in Group B, indicating a significant difference between the two groups (p-value=<0.001). The mean number of sutures used in Group A was 2.67 ± 1.4 , whereas it was 7.50 ± 1.75 in Group B. The comparison of the number of sutures between the two groups showed a highly significant difference (p-value=<0.001). This difference in the number of sutures remained statistically significant when stratified by age, gender, and BMI (p-value<0.05). Additionally, when stratified by duration of diagnosis, hypertension (HTN), and smoking, the mean number of sutures still exhibited a statistically significant difference (p-value=<0.05).

Table No.1: Comparison of mean blood loss between study groups stratified by age, gender, BM, duration of diagnosis, HTN and smoking

		Study Groups	Blood Loss (ml)			p-value
			n	Mean	SD	
Age (Years)	≤ 40	A	27	8.03	10.84	0.009
		B	28	18.17	16.27	
	>40	A	3	6.89	1.01	0.194
		B	2	41.85	39.81	
Gender	Male	A	18	7.82	10.65	0.035
		B	17	20.03	20.83	
	Female	A	12	8.06	10.14	0.042
		B	13	19.39	15.38	
BMI	≤ 25	A	20	7.82	10.65	0.035
		B	15	20.03	20.83	
	>25	A	10	8.06	10.14	0.042
		B	15	19.39	15.38	
Diagnosis duration	≤ 10	A	8	4.97	1.76	0.012
		B	13	20.16	15.16	
	>10	A	22	8.98	11.84	0.056
		B	17	19.44	20.95	
Hypertension	Yes	A	11	4.71	1.49	0.005
		B	13	19.19	15.39	
	No	A	19	9.77	12.60	0.075
		B	17	20.19	20.81	
Smoking	Yes	A	17	5.65	1.63	0.010
		B	12	22.16	24.64	
	No	A	13	10.88	15.32	0.168
		B	18	18.15	13.25	

DISCUSSION

Laparoscopy has been used for over two decades to perform appendectomy, a surgical procedure to remove the appendix. Despite its reported advantages in outcomes, cosmetic results, and recovery time, laparoscopy has not gained widespread acceptance. This may be due to a few disadvantages associated with the technique. Laparoscopic appendectomy can be technically challenging, and it often takes longer to complete compared to the traditional open surgery. There are different techniques used for laparoscopic appendectomy, but all published reports to date involve tying off the base of the appendix before separating it. One specific tool commonly used for sealing blood vessels in laparoscopic surgeries is the Ligasure vessel sealing system. This device employs a bipolar feedback-controlled mechanism to effectively seal blood vessels during the procedure.⁵

In the study, the group of patients using vessel sealing devices had a mean operative time of 27.35±1.42 minutes, while the ligature group had a mean operative time of 30.67±2.92 minutes (p-value=<0.001). The vessel sealing devices group had a mean blood loss of 7.92±10.27 ml, whereas the ligature group had a mean blood loss of 19.75±18.37 ml (p-value=<0.001). Additionally, the vessel sealing devices group required

a mean number of sutures of 2.67±1.4, while the ligature group required a mean number of sutures of 7.50±1.75 (p-value=<0.001). Finally, the mean pain score for the vessel sealing devices group was 1.57±0.50, compared to 3.97±0.89 for the ligature group (p-value=<0.001).⁶

In a study conducted by Limor Helpman and Allan Covens, it was demonstrated that utilizing the Ligasure vessel sealing device resulted in a median total operative time of one hour. The duration of each appendectomy procedure was approximately five minutes. The median estimated blood loss per procedure was recorded to be 50 mL. Notably, there were no instances of conversions to laparotomy, and neither major intraoperative nor postoperative complications were observed. The findings indicate that performing an appendectomy using the Ligasure vessel sealing device to divide both the mesoappendix and the appendiceal base is a safe and feasible surgical approach for gynecological malignancies.⁷

A vessel-sealing system is capable of occluding the blood vessel by altering the structure of the vessel wall, specifically denaturing the collagen and elastin within it. This process effectively seals the vessel, providing complete closure. When performing liver parenchyma division, the vessel-sealing system proves highly effective in occluding vessels that are exposed through

clamp crushing or the use of an ultrasonic dissector. Consequently, utilizing the vessel-sealing system can significantly reduce liver transection time and minimize blood loss.⁸

The utilization of a bipolar radiofrequency-driven vessel sealer, along with bipolar electrocautery, effectively closed the stump in a rat appendicitis model. The results indicated safe closure with satisfactory bursting pressure values. Additionally, the procedure exhibited reduced operative time without compromising the healing process, which is an encouraging outcome.

In one clinical trial, it was discovered that patients who used vessel sealing devices experienced significant improvements compared to the control group. The vessel sealing devices group had shorter operating times (37.1 + 8.9 minutes vs. 63.8 + 10.9 minutes; $P < 0.001$), lower operative blood loss (125.5 + 33.2 mL vs. 264.6 + 70.4 mL; $P < 0.001$), fewer requirements for surgical sutures (1.2 + 0.4 units vs. 8.2 + 0.4 units; $P < 0.001$), and experienced less pain (2.0 + 0.6 vs. 3.7 + 0.7; $P < 0.001$).⁴

According to a study involving a porcine model focused on small-bowel sealing and division, it was found that the Ligasure technique is unsuitable for this purpose due to its low burst pressures. Different techniques using Ligasure showed burst pressures ranging from 11 to 27 mm Hg, in contrast to a stapling device which demonstrated a much higher burst pressure of 131 mm Hg. In normal appendices, the intraluminal pressure has been observed to be approximately 0, while in cases of inflammation or phlegmon, the pressure is significantly higher ranging from 15 to 93 mm.

A study conducted by Horng-Ren Yang and colleagues concluded that the utilization of the Ligasure system in laparoscopic appendectomy is a secure and effective procedure for acute appendicitis. This system simplifies the operative procedure and reduces the duration of the surgery. The average operative time was found to be 47 minutes, ranging from 22 to 120 minutes. No complications associated with the use of the Ligasure system were observed in any of the patients, and neither surgical endoclips nor an endostapler were utilized.⁹

According to Aydogan et al. (2009), the study revealed that the average duration of surgeries was 41 minutes for the Ligasure group and 54 minutes for the endoclip group. The conversion to open surgery occurred in 9.4% of patients (12 individuals) using Ligasure and in 11.1% of patients (17 individuals) using endoclips.¹⁰ The study did not find any significant differences in terms of hospital stay or complications, but it did observe statistically significant variations in surgical time and conversion rate between the two groups.

CONCLUSION

After conducting an extensive study, it has been determined that the utilization of vessel sealing devices during laparoscopic appendectomy is significantly superior and more beneficial than the traditional method of using ligatures in terms of achieving optimal hemostasis outcomes.

Acknowledgement: We would like to thank the Aziz Bhatti Shaheed Teaching Hospital, Gujrat for supporting this research.

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Conflict of Interest: The study has no conflict of interest to declare by any author.

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