The Egyptian Journal of Hospital Medicine (January 2025) Vol. 98, Page 755- 758

Outcome of Laparoscopic Appendectomy with Clipping versus Harmonic Scalpel for Closure of the Appendicular Stump: A Comparative Clinical Study

Sherif M. ElKaffas[1], Mohamed EL Azazy[2], Mohammed E. Ramadan[1]
[1] Department of General Surgery, Faculty of Medicine, Benha University, Benha, Egypt
[2] Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt
Corresponding author: Sherif M. ElKaffas, **Mobile:** 01154865562,
ORCID: 0000-0002-7438-1542, **Email:** Sherif.hussien@fmed.bu.edu.eg

ABSTRACT

Background: Many approaches were used to close the appendicular stump; some are costly as endoscopic linear cutting staplers; others are not present in some hospitals for example loop knots (endo-loops).

Aim: the current study aimed to compare clipping versus harmonic scalpel of the appendicular stump regarding the safety of the techniques, operative time, and outcomes.

Patients and Methods: 146 patients presented with acute appendicitis (AA) at the Emergency Department were divided randomly into two groups: Group A: where a harmonic scalpel (HS) was used to close the appendicular stump and Group B: where a metal clip (MC) was used. Follow-up was designed for at least 1 month for early postoperative complications

Results: Concerning postoperative sequelae, we reported a significant decrease in operative time in the HS group (p-value of 0.012*), regarding the hospital stay no significant difference was found between the two groups.

The complications were lower in the HS group. In the MC group, two patients developed localized abdominal collection and required readmission. Those patients were managed conservatively by ultrasound-guided percutaneous drainage of the collection and did not require reoperation.

Conclusion: Clipping and harmonic scalpel are effective in securing the appendicular stump. We prefer harmonic scalpel over clipping especially with a wide, and fragile appendiceal stump.

Keywords: AA, Appendiceal stump, Clipping, Harmonic Scalpel.

INTRODUCTION

Since the introduction of laparoscopic appendectomy in 1970, laparoscopic procedures have become more and more common as the go-to method for treating acute appendicitis, displacing open surgery [(1)].

During the residency period, appendectomy is the most common routine emergency surgery performed. Junior surgeons are now primarily introduced to the laparoscopic approach, which has the advantage of investigating the pelvic region and ruling out gynecological causes of acute abdomen. With the availability of laparoscopic appendectomy, the number of open appendectomies is currently declining [(2,3)]. Open appendectomy is still preferred over laparoscopic appendectomy in many centers [(4)]. There is an ongoing debate on the most effective method for closing the appendicular stump: endo GIA staplers, vascular ceiling devices, intra-corporal ligation, or clipping [(5)].

Laparoscopy generally leads to substantially less discomfort following surgery, a shorter hospital stay, better cosmetic outcomes, and a quicker return to regular daily activities. One further advantage of laparoscopic appendectomy as a diagnostic procedure was the exclusion of gynecological causes of acute abdomen [(6)].

Numerous techniques were employed to close the appendicular stump, some of which are expensive, such as endoscopic linear cutting staplers [(7,8)]. Other techniques, such as loop knots (endo-loops), are not available in all hospitals. Some studies have reported the closure of the appendicular stump, although not all of them. Building confidence in their own safety was the surgeons' first priority [(8)].

This study aimed to compare clipping versus harmonic scalpel of the appendicular stump regarding the safety of the techniques, operative time, and outcomes.

PATIENTS AND METHOD

Study design:

The present study was conducted from January 2022 to May 2024. 146 patients presented to the Emergency Department in Benha and Ain Shams University Hospitals with the diagnosis of acute appendicitis eligible for laparoscopic appendectomy were randomly divided into two groups according to the approach of closure of the appendicular stump: Group I: harmonic scalpel group (HS Group), and Group II: metal clip group (MC Group).

Patients presented with appendicular abscess or mass, as determined by ultrasonography as well as those with an appendix base perforation, were excluded. Before surgery, all patients gave a complete medical history, underwent a clinical examination, and had laboratory tests such as an abdominal ultrasound, a neutrophil percentage test, and a leucocytic count.

In every case, an examination under general anesth esia was conducted before to surgery.

The patient was eliminated from the research if a mass w as palpable.

Received: 12/09/2024
Accepted: 20/11/2024

Randomization: It was done by (Random Allocation Software 1.0, 2011).

Surgical procedures:

The operation was done under general anesthesia in Trendelenburg position and muscle relaxation. Firstly, the 10 mm trans-umbilical port was inserted then CO_2 was insufflated (camera port). Then, the 2nd 10-mm port was inserted left midclavicular 2 fingers from the left anterior superior iliac spine followed by the insertion of 5-mm port in the midline one finger above the symphysis pubis.

A full exploration of the abdominal cavity was done. The appendix was identified and de-vascularized by harmonic scalpel in HS group **(Figure 1 a, b)** or with hook connected to monopolar diathermy close to the wall of the appendix in MC group

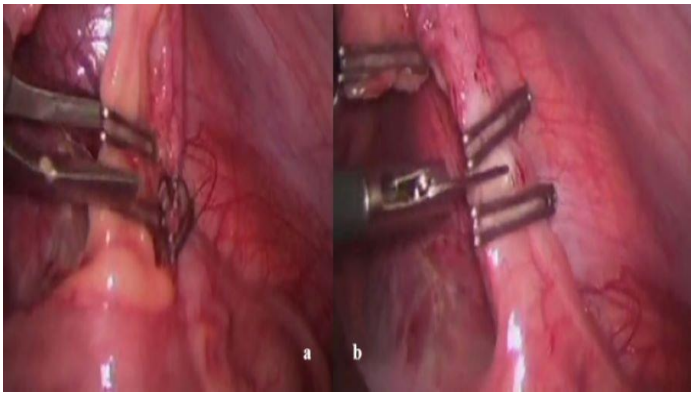

Figure 1 a, b: Securing the mesoappendix using harmonic scalpel.

In the harmonic scalpel group repeated application of harmonic scalpel in a stepwise manner at an output power of 3, was done to obliterate the lumen of the appendix **(Figure 2).** The procedure is completed when a constriction ring appeared at the site of the harmonic scalpel application and the appendix is resected proximal to that ring.

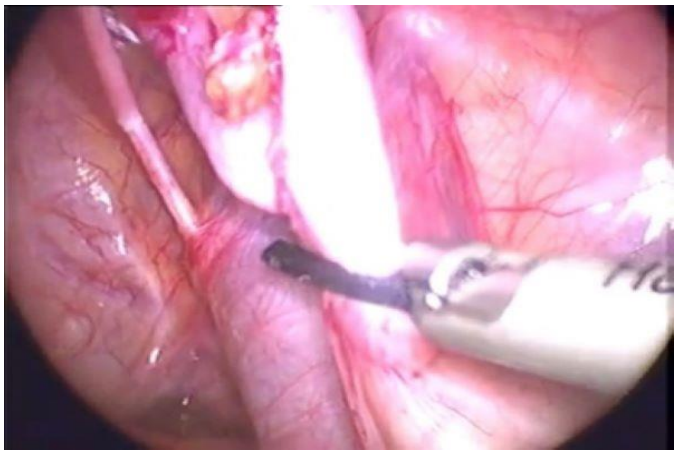

Figure 2: Closure of the appendicular stump using harmonic scalpel.

In the clipping group after de-vascularization the appendix was clipped by 3 clips, two proximally and one distally and cut in between **(Figure 3 a, b).**

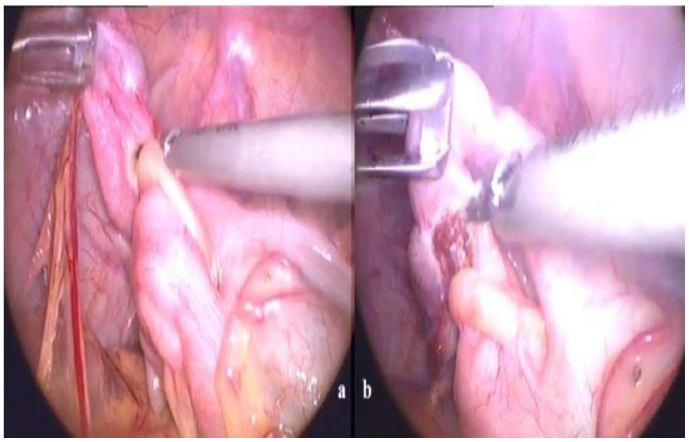

Figure 3 a, b: Secured clipping and cutting of the appendicular stump.

The appendicular stump was checked for any leakage.

The appendix was retrieved through the port in the left iliac fossa. Skin was closed with inverted dermal sutures polyglactin 2/0.

Follow up and Outcomes

The primary research objective was safe laparoscopic appendectomy with minimal postoperative complications The secondary research objective was decreased hospital stay and overall cost

Follow up was planned for 1 month.

Statistical analysis

Sample size

The primary outcome, the incidence of postoperative complications, was used to determine the sample size. Using G-power 3.1 software (Universities, Dusseldorf, Germany), a sample size of 73 in each group was taken into consideration with a power of 80%, a P value of 0.05, and an effect size of 0.7.

Version 21 of the SPSS (Statistical Package for the Social Sciences) was used to gather and examine the data. Numbers and percentages were used to display the qualitative data, which were compared by the chi-squared test or the Fischer's exact test. Mean and standard deviation (SD) were used to display the quantitative data, which were compared using student t-test or Mann-Whitey U-test. A P value of less than 0.05 was regarded as statistically significant.

Ethical Approval:

This study was ethically approved by the Institutional Review Board of the Faculty of Medicine, Benha University. Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World

Medical Association (Declaration of Helsinki) for studies on humans.

RESULTS

A total of 146 patients were sorted randomly into 2 groups, the first group I utilized the harmonic scalpel (HS group), and the second group II utilized metallic clips (MC group). No difference was reported between both groups as regards the patients' demographic data and the clinical and laboratory studies including leukocytic count, total duration of symptoms, and body temperature **(Table 1).**

Table 1: Sociodemographic data and clinical and laboratory characteristics

Variables		HS Group (n=73)	MC group (n=73)	P-value
Age (years)	**Mean ± SD**	23.4 ± 3.13	24.7 ± 2.12	0.52
Gender • **Male** • **Female**	**N(%)**	25(34.25%) 48(65.75%)	27(37%) 46(63%)	0.73
Clinical and laboratory results				
Leukocytic count (x10^9/L)	**Mean ± SD**	14.2 ± 3.52	13.21 ± 1.87	0.036
Neutrophils (%)	**Mean ± SD**	85.1 ±7.45	79.3 ±8.12	<0.001 *
Duration of symptoms (hours)	**Mean ± SD**	19.2 ±4.76	18.1 ±4.14	0.385
Body temperature (degree Celsius)	**Mean ± SD**	37.8 ±0.41	37.7 ± 0.52	0.20

*: Significant

Concerning operative and postoperative sequelae, we reported a significant decrease in operative time in the HS group, and regarding the hospital stay no significant difference was reported **(Table 2).**

The complications were lower in HS group. In the MC group, two patients developed localized abdominal collection and required readmission. Those patients were managed conservatively by ultrasound-guided percutaneous drainage of the collection and did not require reoperation.

Table 2: Operative data and postoperative complications

Variables		HS Group (n=73)	MC group (n=73)	P-value
Operative time (min)	**Mean± SD**	35.2 ±12.2	43±15.3	0.012*
Hospital stay (days)	**Mean± SD**	1.7 ±0.41	1.8 ±0.68	0.326
Complications				
Intraoperative Visceral injuries	**N(%)**	0(0%)	0(0%)	1.00
Ileus	**N(%)**	0(0%)	2(2.7%)	0.497
Abdominal collection	**N(%)**	0(0%)	2(2.7%)	0.497
Port-site infection	**N(%)**	2(2.7%)	2(2.7%)	1.00
Leakage	**N(%)**	0(0%)	1(1.35%)	1.00
Readmission	**N(%)**	0(0%)	2(2.7%)	0.497

*: Significant

DISCUSSION

The most frequent cause of acute abdomen is acute appendicitis, though it can occasionally be challenging to distinguish it from other causes. Surgeons are increasingly accepting and using laparoscopic appendices these days [7,9]. Compared to open appendectomy, laparoscopic appendectomy has demonstrated numerous benefits, including reduced pain, quicker recovery, and improved bowel functions. Moreover, fewer wound complications occur [10].

One of the most important steps in a laparoscopic appendectomy is securing the appendicular stump, since most difficulties stem from improper manipulation of this part [11]. Several studies have addressed various approaches to this stage. Over the past few decades, there have been significant advancements in laparoscopic surgery with regard to electrosurgical equipment [12].

For many years, it was believed that electrosurgical instruments in laparoscopy are deemed unsafe because of the spread of thermal energy to the surrounding structures either due to capacitive coupling or insulation failure [13,14]. However, the most recent electrosurgical instruments had a less thermal energy spread and eventfully fewer complications [15]. We can suggest that the ideal electrosurgical instrument is capable of good hemostasis and less thermal spread.

The harmonic scalpel thermal spread is less than 1.6 mm[16]. It can be deduced that the ultrasonic energy delivered through a harmonic scalpel is safe with minimal damage to the surrounding tissue [17].

Our study matched results of other studies reporting safety of using metallic clips for appendicular stump closure with less operative time and it makes the

procedure simple and provides a useful option when compared with intra-corporeal ligation [18,19].

In our study, we introduced another innovative technique in securing the appendicular stump using the harmonic scalpel and comparing it to metal clip sealing. We noticed a less operative time in the HS group compared to the MC group. This finding may be attributed to longer manipulation time in the clipping group. In our study, we reported no postoperative complications in the harmonic scalpel group. The complications may be observed in the MC group due to using a foreign material (clip) and occurrence of necrosis of appendicular stump above the clip application site, which falls off. This may be the cause of postoperative intraabdominal abscess and prolonged ileus in such patients [20]. The complication of metal clip closure varies in literature from 5.1% to 19.9% [19].

In literature, only few reports discuss the experience in harmonic scalpel in appendectomy. In the study by **Bajpai *et al.*** [21] they reported good results with no complications reported with harmonic scalpel appendectomy, same finding as observed in our study.

Same results were reported in another study by **Raza *et al.*** [22] in 63 patients performing laparoscopic appendectomy with harmonic scalpel and observed no complications with a mean operative time of 31.3 minutes. Further studies are needed to discuss the cost-effectiveness of different sealing techniques of the appendicular stump.

CONCLUSION

Clipping and harmonic scalpel are effective in securing the appendicular stump. We prefer harmonic scalpel over clipping especially with the wide, and fragile appendiceal stump.

Funding: The authors did not receive support from any organization for the submitted work.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare that they have no conflicts of interest.

REFERENCES

1. **Davila D, Russek K, Franklin M (2012):** Laparoscopic appendectomy: vascular control of the appendicular artery using monopolar cauterization versus clips. J Laparoendosc Adv Surg Tech A., 22(2):165-7.
2. **Mönttinen T, Kangaspunta H, Laukkarinen J *et al.* (2023):** Routine use of laparoscopic techniques in daily practice improves outcomes after appendectomy. Eur J Trauma Emerg Surg.,49(4):1763-1769.
3. **Horvath P, Lange J, Bachmann R *et al.* (2017):** Comparison of clinical outcome of laparoscopic versus open appendectomy for complicated appendicitis. Surg Endosc., 31(1):199-205.
4. **Sartelli M, Baiocchi G, Di Saverio S *et al.* (2018):** Prospective Observational Study on acute Appendicitis Worldwide (POSAW). World J Emerg Surg., 13:19.
5. **Mayir B, Ensari C, Bilecik T *et al.* (2015):** Methods for closure of appendix stump during laparoscopic appendectomy procedure. Ulus Cerrahi Derg.,18;31(4):229-31.
6. **Sinan H, Demirbas S, Ozer M *et al.* (2012):** Single-incision laparoscopic cholecystectomy versus laparoscopic cholecystectomy: a prospective randomized study. Surg Laparosc Endosc Percutan Tech.,22(1):12-6.
7. **Sahm M, Kube R, Schmidt S *et al.* (2011):** Current analysis of endoloops in appendiceal stump closure. Surg Endosc.,25(1):124-9.
8. **Safavi A, Langer M, Skarsgard E (2012):** Endoloop versus endostapler closure of the appendiceal stump in pediatric laparoscopic appendectomy. Can J Surg., 55(1):37-40.
9. **Yaghoubian A, Kaji A, Lee S (2012):** Laparoscopic versus open appendectomy: outcomes analysis. Am Surg. ,78(10):1083-6.
10. **Rashid A, Nazir S, Kakroo S *et al.* (2013):** Laparoscopic interval appendectomy versus open interval appendectomy: a prospective randomized controlled trial. Surg Laparosc Endosc Percutan Tech.,23(1):93-6.
11. **Sartori P, De Fina S, Colombo G *et al.* (2008):** Ligasure versus ultracision in thyroid surgery: a prospective randomized study. Langenbecks Arch Surg.,393(5):655-8.
12. **Pogorelić Z, Katić J, Mrklić I *et al.* (2017):** Lateral thermal damage of mesoappendix and appendiceal base during laparoscopic appendectomy in children: comparison of the harmonic scalpel (Ultracision), bipolar coagulation (LigaSure), and thermal fusion technology (MiSeal). J Surg Res., 15;212:101-107.
13. **Pogorelić Z, Perko Z, Druzijanić N *et al.* (2009):** How to prevent lateral thermal damage to tissue using the harmonic scalpel: experimental study on pig small intestine and abdominal wall. Eur Surg Res.,43(2):235-40.
14. **Gözen A, Teber D, Rassweiler J (2023):** Principles and initial experience of a new device for dissection and hemostasis. Minim Invasive Ther Allied Technol.,16(1):58-65.
15. **Schlosshauer T, Kiehlmann M, Riener M *et al.* (2019):** Comparative analysis on the effect of low-thermal plasma dissection device (PEAK PlasmaBlade) vs conventional electrosurgery in post-bariatric abdominoplasty: A retrospective randomized clinical study. Int Wound J.,16(6):1494-1502.
16. **Sutton P, Awad S, Perkins A *et al.* (2010):** Comparison of lateral thermal spread using monopolar and bipolar diathermy, the Harmonic Scalpel and the Ligasure. Br J Surg., 97(3):428-33.
17. **Družijanić N, Pogorelić Z, Perko Z *et al.* (2023):** Comparison of lateral thermal damage of the human peritoneum using monopolar diathermy, Harmonic scalpel and LigaSure. Can J Surg.,55(5):317-21.
18. **Ates M, Dirican A, Ince V *et al.* (2012):** Comparison of intracorporeal knot-tying suture (polyglactin) and titanium endoclips in laparoscopic appendiceal stump closure: a prospective randomized study. Surg Laparosc Endosc Percutan Tech., 22(3):226-31.
19. **Gonenc M, Gemici E, Kalayci M *et al.* (2012):** Intracorporeal knotting versus metal endoclip application for the closure of the appendiceal stump during laparoscopic appendectomy in uncomplicated appendicitis. J Laparoendosc Adv Surg Tech A., 22(3):231-5.
20. **Khanna S, Khurana S, Vij S (2004):** No clip, no ligature laparoscopic appendectomy. Surg Laparosc Endosc Percutan Tech.,14(4):201-3.
21. **Bajpai M (2014):** Technique of 'suture less' appendicectomy by laparoscopy in children: Preliminary communication. J Indian Assoc Pediatr Surg.,19(1):28-30.
22. **Raza V, Arshad D, Bhatti L *et al.* (2020):** Laparoscopic harmonic appendectomy: a novel approach. Glob J Surg., 8(2):32–36.