



STUDY OF VARIOUS METHODS TO SECURE BASE OF APPENDIX IN LAPAROSCOPIC APPENDECTOMY IN ACUTE APPENDICITIS- A RANDOMISED CONTROLLED TRIAL

Surgery

Dr Pramod D Nichat

Associate Professor Of General Surgery At Grant Government Medical College And Sir J.J Group Of Hospitals, Mumbai, India. ,guided and helped draft the manuscript, and reviewed it prior to submission.

Dr Guru Bharadwaj

General Surgery Resident At Grant Government Medical College And Sir J.J Group Of Hospitals, Mumbai, India. ,Helped Condense The Manuscript.

Dr Saurabh S Jagdale*

General Surgery Resident At Grant Government Medical College And Sir J.J Group Of Hospitals, Mumbai, India. , collected the data, drafted the manuscript. *Corresponding Author

ABSTRACT

Laparoscopic appendectomy is a safe procedure without the need for a full laparotomy with the advent of minimal access surgeries. The closure of the appendiceal stump is an important step in laparoscopic appendectomy surgeries because of dreadful post-operative complications from its inappropriate management. Options for securing base of appendix include endoscopic staplers, loop ligatures and hem-o-lock clips depending upon the surgeon's choice. This randomised controlled trial study aims to compare the safety and feasibility of using above mentioned methods for securing the base of the appendix in laparoscopic appendectomy.

150 patients who underwent laparoscopic appendectomy under general anaesthesia after confirmation of appendicitis, were included in this prospective study over a period of 25 months. Usage of endoscopic staplers, loop ligatures and hem-o-lock clips were compared in terms of mean duration of surgery, intraoperative complications, post operative complications, mean duration of hospital stay and cost effectiveness.

The mean duration of surgery was highest with loop ligatures and least with the usage of endoscopic staplers. Endoscopic stapler group had no intra operative or post operative complications. Loop ligature and hem-o-lock groups were associated with hemorrhage and intra operative appendicular rupture in one patient each and had to be converted into an open procedure. Post operative complications (post operative ileus, stump appendicitis, intra-abdominal abscess formation) were more pronounced with the usage of loop ligatures and least with endoscopic staplers. Hem-o-lock clips were most cost effective and staplers the least. Mean duration of hospital stay was maximum for loop ligatures and least for hem-o-lock clips.

The routine use of staplers to secure the appendiceal stump during laparoscopic appendectomy can contribute to a reduction in the complexity of the procedure and mean duration of the surgery. However, need for a larger port and its cost may be the limiting factors for its use. The usage of Hem-o-lock clips for closure of appendiceal stump is safe, feasible and cost effective procedure in patients with mild to moderately inflamed base of appendix. Loop ligatures are more cost effective than staplers but requires more time for surgery than other two methods and need to convert into an open appendectomy in case of intraoperative complications are the major concerns.

KEYWORDS

Acute appendicitis, Laparoscopic appendectomy, Base of appendix

INTRODUCTION

Acute appendicitis is the most common cause of acute abdomen with an incidence of 1 in 1000 person(1). Luminal obstruction of the appendix progresses to suppurative inflammation and may lead to perforation, peritonitis or an appendix mass/abscess, if timely intervention is not done(2). Classical features include anorexia, fever, periumbilical pain that migrates to the right iliac fossa tenderness and guarding in the right iliac fossa. Atypical presentations are particularly common in preschool children. Acute appendicitis is a clinical diagnosis(2). Inflammatory markers and an ultrasound scan/computed tomography are useful investigations when the diagnosis is difficult(3).

Gold standard Treatment is by emergency appendicectomy after appropriate fluid resuscitation, intravenous antibiotics and analgesics(3) Laparoscopic appendectomy is a safe and efficient operative procedure and provides beneficial advantages over open method including shorted hospital stay, decreased need for post operative analgesia, early food tolerance, lower incidence of wound infection and earlier return to work(4)

During a laparoscopic appendectomy, the closure of the appendiceal stump is an important step for its potentially serious postoperative complications due from an inappropriate management. The development of life-threatening events such as postoperative peritonitis, sepsis, fistulas have been noted(5). The guiding principles include the need for secure and an inert closure of the appendiceal stump without any injury to the cecum, with minimal risks of complication attributable to the closure technique.

Options for appendiceal stump closure span a variety of options including endoscopic staplers, loop ligatures and hem-o-lock clips(6,7). However, alternatives for appendiceal stump closure have advantages and disadvantages against the different clinical stages of acute appendicitis, Knowledge about and appropriate use of all of them are important for a safe and more cost-effective procedure.

PATIENTS AND METHODS

A prospective randomised control study was done over 150 patients over a period of 28 months. Using computerized randomisation, patients were assigned to three groups which denoted appendiceal stump closure using endoscopic staplers, loop ligatures, hem-o-lock clips in allocation ratio of 1:1:1.

All diagnosed cases of an acute appendicitis between the age group of 18-60 years irrespective of sex and previous abdominal surgeries were enrolled. Patients aged less than 18 years and more than 60 years, patients with pregnancy and formed appendicular lump were excluded.

All included patients underwent laparoscopic appendectomy after confirmation of a diagnosis under general anesthesia.

Patients were followed up post operatively at 1 week, 4 weeks and at 3 months to rule out post-operative wound infections (according to Clavian dindo classification), ileus, feculent discharge from the operative site (enterocutaneous fistula). Patients were followed up similarly to rule out stump appendicitis, collection in the right iliac fossa and ultrasonography or contrast enhanced tomography was used to confirm in suspected cases.

DISCUSSION:

Laparoscopic appendectomy is the preferred approach in uncomplicated appendicitis(8). However, there are many different techniques within procedure, including positioning of trochars and the closure of appendicular stump. The most important concern in laparoscopic appendectomy is the safety of the method used for the closure of appendicular stump. The preferred method for appendiceal stump closure varies among surgeons and institutions. In this prospective study we aim to compare the safety and feasibility of using endoscopic staplers, loop ligatures and hem-o-lock clips for securing the base of the appendix.

Table 1 Comparing Safety And Feasibility Of Various Methods To Secure Base Of Appendix In Laparoscopic Appendectomy

	Endo staplers	Loop ligatures	Hem-o-lock clips
Duration of surgery (hrs in mean $\pm$ SD)	33.1 $\pm$ 6.1	45.6 $\pm$ 5.9	42.6 $\pm$ 4.1
Intra operative complications	Hemorrhage (n) - 0 Bowel trauma (n) - 0 Intra operative appendicular rupture (n) - 0 Conversion to open procedure (n) - 0 Requirement of larger port (n) - 50	Hemorrhage (n) - 1 Bowel trauma (n) - 0 Intra operative appendicular rupture (n) - 1 Conversion to open procedure (n) - 2 Requirement of larger port (n) - 0	Hemorrhage (n) - 1 Bowel trauma (n) - 0 Intra operative appendicular rupture (n) - 1 Conversion to open procedure (n) - 2 Requirement of larger port (n) - 1
Post operative complications	Post operative ileus (n) - 0 Intra-abdominal abscess (n) - 1 Wound infection (n) - 0 Stump appendicitis (n) - 0 Reoperation (n) - 0 Enterocutaneous fistula (n) - 0	Post operative ileus (n) - 2 Intra-abdominal abscess (n) - 1 Wound infection (n) - 0 Stump appendicitis (n) - 1 Reoperation (n) - 1 Enterocutaneous fistula (n) - 1	Post operative ileus (n) - 1 Intra-abdominal abscess (n) - 1 Wound infection (n) - 0 Stump appendicitis (n) - 0 Reoperation (n) - 0 Enterocutaneous fistula (n) - 1
Duration of hospital stay (hrs in mean $\pm$ SD)	64.7 $\pm$ 13.9	65.2 $\pm$ 13.6	63.8 $\pm$ 13.5
Cost (INR)	6400	2100	800

In our study, mean duration of surgery was 33.1 minutes in endoscopic stapler, 45.6 minutes in loop ligature and 42.6 minutes in the hem-o-lock clip group. This is comparable to a study by Colak E et al, where duration of surgery was 64.7 $\pm$ 19.22 minutes in hem-o-lock group and 75.4 $\pm$ 23 minutes in loop ligature group(9).

In this study, hemorrhage was seen in one patient in both loop ligature and hem-o-lock clip group. There was no intra operative bowel trauma in any of the groups. One patient in loop ligature group and hem-o-lock group had intra operative appendicular rupture. Two patients each in loop ligature and hem-o-lock groups had to be converted to open appendectomy due to the above mentioned complications. All cases of endoscopic stapler group required a larger port, whereas only one patient in hem-o-lock required a larger port which is statistically significant (chi square= 52.17, p value=<0.0000001)

In a similar study conducted by Kliuchanok K et al. three cases of intraoperative hemorrhage occurred in hem-o-lock group. Three cases of hemorrhage, four cases of bowel injury and two cases of intraoperative respiratory complications occurred in stapler group(10).

In our study, post operative ileus was seen in two patients of loop ligature group and one patient of hem-o-lock group. All three groups had one case of post operative intra-abdominal abscess formation. Stump appendicitis complicated one case in the loop ligature group and, one case of enterocutaneous fistula was seen in both loop ligature and hem-o-lock clip group (chi square=4.167, p value= 0.8418). In a study done by Colak E et al, there was no statistically significant difference in overall non-surgically or surgically related complications. Post operative peri-appendicular abscess was developed in a patient from loop ligature group, who was successfully treated by interventional drainage(9).

Mean duration of hospital stay was reported to be 64.7 $\pm$ 13.9, 65.2 $\pm$ 13.6, and 63.8 $\pm$ 13.5 hours in endoscopic stapler, loop ligature and hem-o-lock groups respectively in our study. As per the study by Hue CS et al, the mean duration of post operative hospital stay was 5.3 $\pm$ 2.3 days in hem-o-lock group and 5.2 $\pm$ 1.6 days in endo loop group. In another study by Kliuchanok K et al, mean postoperative stay was 2.9 days in hem-o-lock clip group and 3.7 days in staplers group(10).

According to our study, endoscopic staplers are the costliest followed by loop ligatures and then hem-o-lock clips. This was also observed by Hue CS et al, where it was inferred that hem-o-lock clips are more economical than endo loop ligatures(11).

CONCLUSIONS:

The laparoscopic approach to appendicitis has improved the outcome of appendectomy, but requires laparoscopic skills of the surgical team. The routine use of staplers to secure appendiceal stump during laparoscopic appendectomy contribute to a reduction in the complexity and mean duration of the surgery. If staplers were as cheap

as hem-o-lock clips, the routine use of staplers in laparoscopic appendectomy would arguably be the better option. Hem-o-lock non absorbable plastic clips being the most effective and easy to apply, can be preferred in patients with mild to moderately inflamed appendix. Endo loops though frequently used, requires more duration for surgery, less cost effective than hem-o-lock with frequent post op complications.

Thus, we could conclude that ideal method for appendiceal stump closure can be decided based on intra-operative findings, possibility of inadvertent post-operative complications and the affordability of the patient.

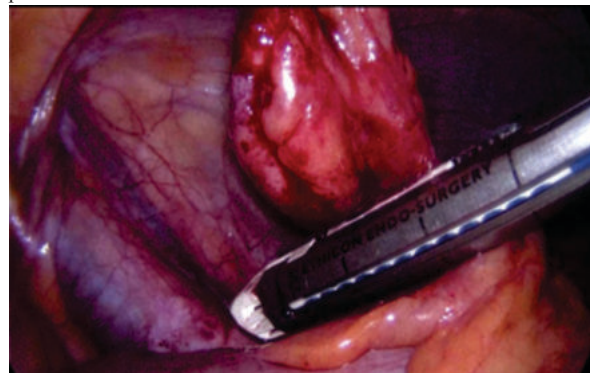


Figure 1: Application Of Endo-stapler For Securing Base Of Appendix In An Inflamed Appendix

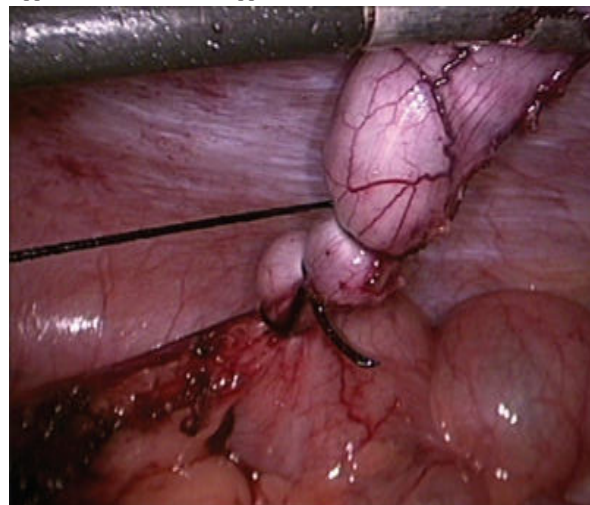


Figure 2: Securing Base Of Appendix With Endo-loop Ligature

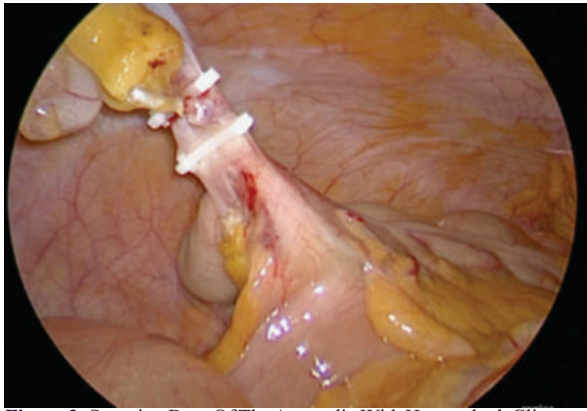


Figure 3: Securing Base Of The Appendix With Hem-o-lock Clips

REFERENCES:

1. Téoule P, Laffolie J de, Rolle U, Reissfelder C. Acute Appendicitis in Childhood and Adulthood. *Dtsch Arztebl Int.* 2020 Nov 6;117(45):764–74.
2. Stringer MD. Acute appendicitis. *J Paediatr Child Health.* 2017 Nov;53(11):1071–6.
3. Gomes CA, Nunes TA, Soares C, Gomes CC. The appendiceal stump closure during laparoscopy: historical, surgical, and future perspectives. *Surg Laparosc Endosc Percutan Tech.* 2012 Feb;22(1):1–4.
4. Biondi A, Di Stefano C, Ferrara F, Bellia A, Vacante M, Piazza L. Laparoscopic versus open appendectomy: a retrospective cohort study assessing outcomes and cost-effectiveness. *World J Emerg Surg.* 2016;11(1):44.
5. Flores-Marin K, Rodriguez-Parra A, Trejo-Ávila M, Cárdenas-Lailson E, Delano-Alonso R, Valenzuela-Salazar C, et al. Laparoscopic appendectomy in complicated appendicitis with compromised appendix base: a retrospective cohort study. *Cir Cir.* 2021;89(5):651–6.
6. Caglià P, Tracia A, Spataro D, Borzi L, Lucifora B, Tracia L, et al. Appendix stump closure with endoloop in laparoscopic appendectomy. *Ann Ital Chir.* 2014 Dec;85(6):606–9.
7. Graham CW, Komidar L, Perger L. Comparison of Polymeric Clips and Endoscopic Staplers for Laparoscopic Appendectomy. *J Laparoendosc Adv Surg Tech A.* 2019 Feb;29(2):240–2.
8. Neogi S, Banerjee A, Panda SS, Ratan SK, Narang R. Laparoscopic versus open appendectomy for complicated appendicitis in children: A systematic review and meta-analysis. *J Pediatr Surg.* 2022 Mar;57(3):394–405.
9. Colak E, Kement M, Ozlem N, Mutlu T, Yildirim K, Gurer A, et al. A comparison of nonabsorbable polymeric clips and endoloop ligatures for the closure of the appendicular stump in laparoscopic appendectomy: a prospective, randomized study. *Surg Laparosc Endosc Percutan Tech.* 2013 Jun;23(3):255–8.
10. Kliuchanok K, Keßler W, Partecke I, Walschus U, Schulze T, Heidecke CD, et al. A comparison of non-absorbable polymeric clips and staplers for laparoscopic appendiceal stump closure: analysis of 618 adult patients. *Langenbecks Arch Surg.* 2019 Sep;404(6):711–6.
11. Hue CS, Kim JS, Kim KH, Nam S-H, Kim KW. The usefulness and safety of Hem-o-lok clips for the closure of appendicular stump during laparoscopic appendectomy. *J Korean Surg Soc.* 2013 Jan;84(1):27–32.