

Closure of Appendicular Stump in Laparoscopic Appendectomy by Ligation and Clipping Methods

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Abstract

Background: Laparoscopic appendectomy (LA) is now the standard of management for cases of acute appendicitis. LA has the benefits of minimal access surgery. There are many methods for securing the base of the appendix, some of which are expensive others are not available or technically demanding. This study is aimed to compare between ligation and clipping techniques regarding feasibility, safety, efficacy, operative time, postoperative outcome and complications. Patients and methods: A randomized prospective clinical trial study included 90 patients with acute appendicitis. The patients were randomly distributed into 2 main groups (A&B): 54 patients we secured the base of the appendix by ligation methods (group A) and in 36 patients by clip application (group B). All patients were subjected to classic history taking and clinical examination. Radiological investigation: ultrasonography was routinely done for all patients. CT with contrast was requested when indicated in suspicion of complications. Surgical ligation or clipping were performed. Results: There is statistically non-significant difference between patients underwent different surgical techniques as regarding application of peritoneal drainor conversion to open. Two patients within ligation group (A) had been converted to open due to presence of friable base in one case and intra-operative bleeding in other case while three patients within clipping group (B) had been converted to open due to intestinal injury, friable base and intra-operative bleeding. Two cases in clipping group (B) had been converted to ligation techniques due to very wide base which can't be secured by clip application. Conclusion: Ligation and clipping techniques were effective, safe, feasible and same in complications rate. Clip application is related to less operative time, easier application and simpler for trainee than ligation techniques which require more experiences.

Keywords: acute appendicitis; Ligation; clipping; Laparoscopic Appendectomy

INTRODUCTION

Obstruction of the lumen is believed to be the major cause of acute appendicitis. The lumen of the appendix is small in relation to its length, and this configuration may predispose to closed-loop obstruction (1). Mixed intestinal organisms can usually be cultured from an inflamed appendix. Infection could be primary, leading to lymphoid hyperplasia, or secondary when bacteria gain-

access to the wall of the appendix through an area of epithelial erosion caused by pressure of an obstructing agent (2).

In Complicated Appendicitis, there is invasion of the appendix wall by bowel organisms leading to inflammation. If this is so, in the early stages of appendicitis there should be a well-defined area of inflammation distal to the obstruction (3). Once luminal pressure exceeds 85 mm Hg, Thrombosis of the venules that drain the appendix occurs in the setting of continued arteriolar inflow. vascular congestion and engorgement of the appendix become manifest. Lymphatic and venous drainages are impaired and ischemia develops (4). Repeated attacks of non-obstructive appendicitis leads to fibrosis and adhesions causing recurrent appendicitis (5).

Both the clinical and experimental data support the belief that some patients have repeated attacks of appendicitis. In fact, it is not unusual for one or more such episodes to precede a full blown acute appendicitis. Thus the term chronic appendicitis has been used. But, it definitely does not mean prolonged abdominal pain lasting weeks or months (6).

Several diagnostic scores have been developed to increase the diagnostic accuracy in acute appendicitis. Many studies in the literature are available on diagnostic scores for acute appendicitis as Alvarado Score, RIPASA Score, Tzanakis Score, Lintula score and many other scores (7). There is debate whether an appendix mass should require early surgery, or, whether conservative treatment is most appropriate (8).

The laparoscopic surgery permits a full exploration of the peritoneal cavity, thus representing a diagnostic tool in case of acute and complicated appendicitis (9). It is usual to do a delayed appendectomy 6-8 weeks later, even if the mass resolves on conservative treatment. However, about 15 -20% of patients will be readmitted with similar symptoms before the interval appendectomy (10). There are many methods for securing the base of the appendix, some of which are expensive others are not available or technically demanding including clipping and ligation (11).

The aim of the present study is to compare between ligation and clipping techniques regarding feasibility, safety, efficacy, operative time, postoperative outcome and complications.

PATIENTS AND METHODS:

A randomized prospective clinical trial study included 90 patients with acute appendicitis during the period from March 2019 to March 2020 in Zagazig University Hospitals. The patients were randomly distributed into 2 main groups (A&B): group (A): Ligation Group included (54) patients and group B: Clipping Group included (36) patients.

Inclusion criteria:

All cases of acute appendicitis with age starting from 16 years old and candidate for laparoscopic appendectomy were included in the study .

Exclusion criteria:

Appendicular mass which diagnosed either by US or by examination under anesthesia was excluded from the study. Cases with perforation at the base or generalized peritonitis. Cases with Appendicular Abscess formation or stump appendicitis. Patients which are not fit for laparoscopic appendectomy were excluded.

All patients were subjected to classic history taking and clinical examination. Radiological investigation: ultrasonography was routinely done for all patients. CT with contrast was requested when indicated in suspicion of complications.

Surgical techniques:

We used 3 ports; the first (optic port, 10-12mm) was inserted just above the umbilicus .We used 30 ° telescope or 0 ° telescope.The second port (5-10mm) was inserted in the left iliac fossa through which we inserted a non-traumatic grasper to do manipulation of viscera to do diagnostic laparoscopy.The other working port (5mm) was inserted either in the suprapubic region .

The patient was put in the Trendelenberg position with slight tilt to the left to facilitate the exposure of the caecum and appendix. Any free fluid or collections were aspirated at first.

The first step in all techniques is the devascularization of the mesoappendix by bipolar, monopolar diathermy, Harmonic or Ligasure in close proximity to the wall of the appendix (**Figure 1**). The second step in ligation groups is to pass a ligature of Vicryl (Polyglactin) 0 and perform 5 or 6 ICL Knots in 1st case in the study, ECL knots in 2nd case or Endoloop ligation in 3rd case in the study (**Figure 2**).

While, in clipping group is to clip the base by 2 or 3 Titanium clips (medium or large according to diameter of the base) in the 4th case or Polymeric clip in the 5th case in the study and so on in same order mentioned above (**Figure 3**). Cautery of the appendicular stump was done to all cases.

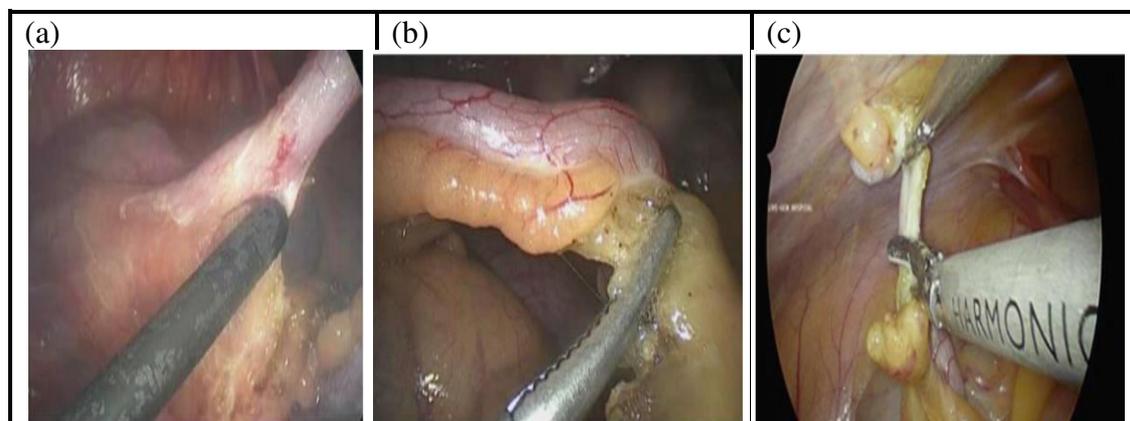


Figure (1): Devascularization of appendix, (a) using hook connected to diathermy, (b) using maryland, (c) using Harmonic Scalpel.

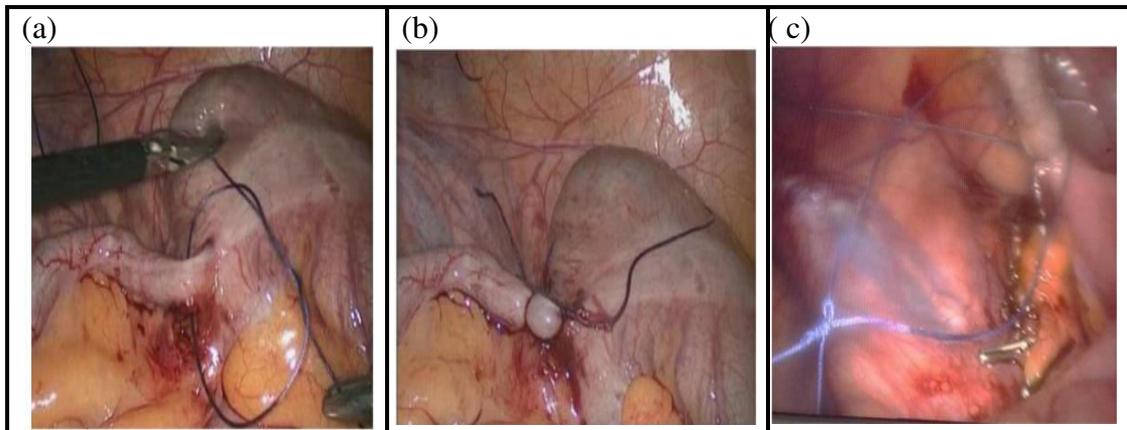


Figure (2):(a) Intra-corporeal Ligation of the base of appendix, (b) 2 knots ligation of the base of the appendix, (c) Applying Extra-corporeal Knot around appendix.

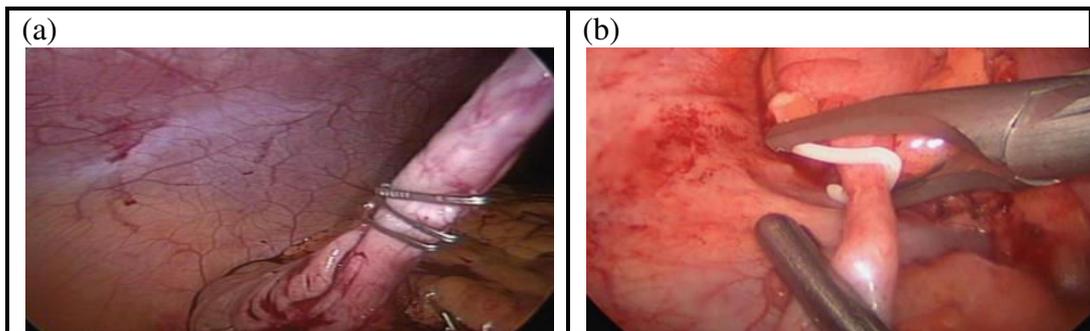


Figure (3): (a) Titanium clipping of base of the appendix and (b) Polymeric clipping of base of the appendix.

Statistical Analysis:

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 21 for Windows® (SPSS Inc, Chicago, IL, USA). Qualitative data was presented as number and percent. Comparison between groups was done by Chi-Square test. Quantitative data was presented as mean \pm SD and range. Student t -test was used to compare between two groups. $P < 0.001$ was considered to be statistically significant.

Results:

The attainable results showed a statistically non-significant difference between different surgical techniques regarding either age or gender (**Table 1**). There is statistically non-significant difference between patients underwent different surgical techniques as regarding anatomical site of appendix, condition of appendix, presence of other pathology, size of the base or presence of intra-operative complications (**Table 2**).

There is statistically significant difference between ligation (A) and clipping (B) techniques as regarding operative time which was longer in ligation

technique. There is statistically non-significant difference between both surgical techniques as regarding the hospital stay (**Figure 4**).

There is statistically non-significant difference between patients underwent different surgical techniques as regarding application of peritoneal drainor conversion to open. Two patients within ligation group (A) had been converted to open due to presence of friable base in one case and intra-operative bleeding in other case while three patients within clipping group (B) had been converted to open due to intestinal injury, friable base and intra-operative bleeding .Two cases in clipping group (B) had been converted to ligation techniques due to very wide base which can't be secured by clip application (**Table 3**).

There is statistically non-significant difference between patients underwent different surgical techniques as regarding presence of postoperative complications as fever, collection detected by ultra-sonography, port site infection, bleeding, ileus, stump leak or acute abdomen (**Table 4**).

Table (1): Comparison between different surgical techniques as regarding demographic characteristics:

	Surgical techniques		Test	
	Ligation (A)	Clipping (B)	χ^2/t	p
	N=54(%)	N=36(%)		
Gender				
Male	32 (59.3)	21 (58.3)	0.008	0.993
Female	22 (40.7)	15 (41.7)		
Age				
Mean \pm SD	28.67 \pm 10.12	27.5 \pm 10.34	0.531	0.597
Range	16 - 49	17 - 56		

Table (2): Comparison between ligation (A) and clipping (B) techniques as regarding anatomical site of appendix, pathology and intra-operative complications :

	Surgical techniques		Test	
	Ligation (A)	Clipping (B)	χ^2	p
	N=54 (%)	N=36 (%)		
Anatomical site:				
Retro-cecal	20 (37)	12 (33.3)		
Sub-cecal	10 (18.4)	8 (22.2)		
Para-colic	7 (13)	2 (5.6)	3.179	0.672
Pelvic	7 (13)	4 (11.1)		
Sub-hepatic	5 (9.3)	3 (8.4)		

Retro-ileal	5 (9.3)	7 (19.4)		
Condition of appendix:				
Inflamed	46 (85.1)	31 (86.1)	0.015	0.903
Not inflamed	8 (14.9)	5 (13.8)		
Other pathology:				
PID	0 (0)	1 (2.8)		
Ovarian cyst	6 (11.1)	4 (11.1)	5.325	0.255
Meckel's diverticulum	0 (0)	1 (2.8)		
Congenital adhesion	2 (3.8)	0 (0)		
Size of the base:				
Average	26 (48.1)	17 (47.2)	4.792	0.309
Very wide	28 (51.9)	19 (52.8)		
Intra-operative complications :				
No	52(96.2)	34(94.4)		>0.999
Bleeding	2 (3.8)	1(2.8)		
Intestinal injury	0 (0)	1(2.8)		

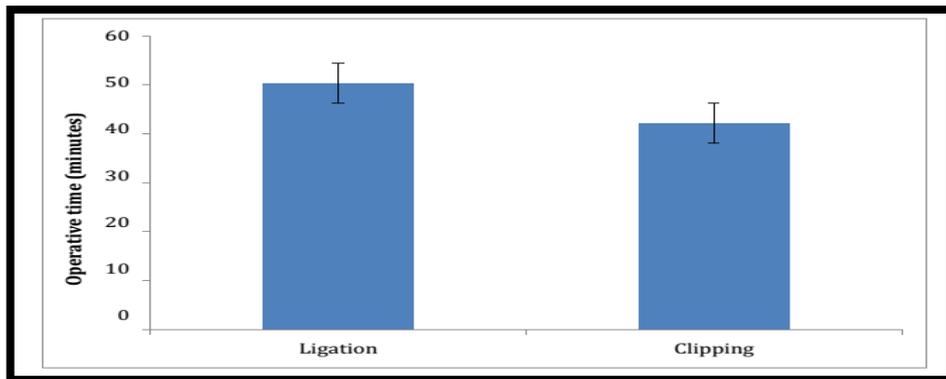


Figure (1): Simple bar chart showing comparison between the studied surgical techniques regarding operative time.

Table (3): Comparison between ligation (A) and clipping (B) techniques as regarding operative details:

	Surgical techniques		Test	
	Ligation (A)	Clipping(B)	χ^2	p
	N=54 (%)	N=36 (%)		
Applying of peritoneal drain :				
No	49 (90.7)	30 (83.3)	1.105	0.293
Yes	5 (9.3)	6 (16.7)		
Conversion to ligation due to very wide base :				
No		34 (94.4)		
Yes		2 (5.6)		
Conversion to open:				

No	52 (96.3)	33 (91.6)		0.385
Yes	2 (3.7)	3 (8.4)		
Cause of conversion to open :				
Intestinal injury	0 (0)	1 (2.8)	1.1716	0.634
Friable base	1 (1.9)	1 (2.8)		
Bleeding	1 (1.9)	1 (2.8)		

Table (4): Comparison between ligation (A) and clipping (B) techniques as regarding postoperative complications:

	Surgical techniques		P.value
	Ligation (A)	Clipping (B)	
	N=54 (%)	N=36 (%)	
Complications:			
Absent	45 (83.3)	28 (77.7)	0.749
Present	9 (16.7)	8 (22.3)	
Fever:			
No	53 (98.1)	34 (94.4)	0.561
Yes	1 (1.9)	2 (5.6)	
Collection by US:			
No	53 (98.1)	35 (97.2)	>0.999
Yes	1 (1.9)	1 (2.8)	
Bleeding:			
No	53 (98.1)	35 (97.2)	>0.999
Yes	1 (1.9)	1 (2.8)	
Port site infection			
No	52 (96.3)	34 (94.4)	>0.999
Yes	2 (3.7)	2 (5.6)	
Ileus:			
No	51 (94.4)	34 (94.4)	>0.999
Yes	3 (5.6)	2 (5.6)	
Stump leak:			
No	54 (100)	36 (100)	>0.999
Yes	0 (0)	0 (0)	
Acute abdomen:			
No	53 (98.1)	36 (100)	>0.999
Yes	1 (1.9)	0 (0)	

Discussion:

Appendicular stump closure is the most important step in laparoscopic appendectomy. Appendicular stump closure is done to prevent major post-operative complications

such as peritonitis, postoperative fistula formation, and sepsis. In open appendectomy, the appendix stump is buried into the cecum or by just ligating the appendicular base with suture without inversion. In laparoscopic appendectomy, ligation of the appendicular base can be difficult because intracorporeal knotting requires high surgical skill in laparoscopy or the surgeon may not be sure of the reliability of the knot. This problem has made surgeons find different alternatives for ligation of the appendicular stump (11).

Different methods of closure are described such as endoloop, titanium clips, stapler, non-absorbable polymer clips (Hem-o-Lok clip) and handmade loops. The ideal method should be a biocompatible, safe, easily available, less learning curve and cheap. The most appropriate method still remains to be a controversy. The advantages of laparoscopic surgery such as, shorter recovery, less post-operative pain and better cosmetic results are strongly present in laparoscopic appendectomy (12).

In our study, we compared between ligation and clipping for securing the appendicular stump as regard safety, simplicity, competence and complications related to each technique. We conducted the study in the period between March 2019 and March 2020 in Zagazig university hospitals on 90 patients. Patients were randomly distributed into 2 main groups (A&B).

In current study, male represented 61.2% and female represented 38.8% of the operated patients by titanium clipping and mean age was 27.44 years. This in agreement with **Dixit and Gogate, (13)** study where male represented 63.3% and female represented 36.7% of the operated patients and mean age was 29.53 years. In our study, male represented 55.6% and female represented 44.4% of the operated patients by polymeric clips and mean age was 27.56 years. Also, this in agreement with **Reinke et al., (14)** study where male represented 44% and female represented 56% of the operated patients and mean age was 41 years.

In our research, according to the condition of the appendix and experience of the surgeon the mean operative time was 56.44 minutes among patients operated by ligation. This agree with **Abou-Sheishaa et al., (15)** study where mean operative time was 54.6 minutes.

In current study, mean operative time of ligation was 47.94 minutes. This in agreement with **Dixit and Gogate,(13)** study where mean operative time was between

45 and 60 minutes in 60% of operated Patients. In our study, the mean operative time among patients operated with polymeric clip application was 41.89 minutes. This in agreement with **Reinke et al., (14)** study where the mean operative time was 45 minutes.

Our study concur with **Kiudelis et al.,(16)** revealed intra-corporeal ligation is a safe technique, and cheaper than endoloop technique. Compared with laparoscopic staplers end loops have an advantage as they are cheaper than stapling device, this was matching with our study since no major complications occurred with intra-corporeal ligation with less cost of course, as well as intracorporeal ligation is its applicability of intracorporeal ligation in the studied cases.

Also, our results confirmed by a study of **Deans et al.,(17)** reported an absorbable clip can sustain a high degree of intraluminal pressure and are lower in cost, beside their use is acceptable for securing the appendicular stump.

Our study matched with results of other studies, that using of metallic clips for appendicular stump closure is safe with less operative time due to simple procedure of laparoscopic appendectomy and provides a useful alternative of intra-corporeal ligation **(18)**. In addition, the ideal suture material should be biocompatible and react less to tissue. The ideal method for appendix stump closure in laparoscopy should be technically easy to use, safe, readily accessible, reliable, with less operative duration and less cost **(11)**.

In our study, the friability of the base in some cases is considered as limitation for both techniques which may lead us to open appendectomy to ensure safe stump closure.

Conclusion:

Ligation and clipping techniques were effective, safe ,feasible and same in complications rate. Clip application is related to less operative time , easier application and simpler for trainee than ligation techniques which require more experiences.

No conflict of interest.

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