

ORIGINAL ARTICLE

Different Options for Closure of Appendicular Stump in Laparoscopic Appendectomy.

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ABSTRACT

Background: The commonest cause of acute abdomen requiring surgical intervention is acute appendicitis. The classical incision used for appendectomy was Grid iron incision pioneered by McBurny in the 19th century. Laparoscopy had invaded most of the fields of surgery including emergency surgery. Various techniques have been used for securing the appendicular stump, some of which is expensive as endoscopic linear cutting stapler; others are not available in some hospitals as preformed suture loops (endoloops). Our aim to compare between ligation methods (Intracorporeal, Extra-corporeal or Endoloop ligation) and clip application with their different types (polymeric or titanium) for securing the appendicular stump at Zagazig university hospitals.

Methods: 90 patients were included in this randomized prospective clinical trial study. The patients were randomly distributed into 2 main groups (A&B): Group A: Ligation Group (54). Group B: Clipping Group (36). Then each group was further subdivided into subgroups.

Results: Intra-operative complications were bleeding in 2 cases of ligation group (A) and 2 cases of clipping group (B) was complicated by intestinal injury and bleeding. Two cases in clipping group (B) converted to ligation methods due to very wide base in which the stump was not secured well with clip application.

Conclusions: All techniques of ligation and clipping were feasible, safe and effective, with the same rate of complications; the only difference was regarding operative time as ligation techniques consume more time.

Keywords: laparoscopic appendectomy; Clipping vs Ligation; Appendectomy stump closure.



INTRODUCTION

The commonest cause of acute abdomen that requires surgical intervention is acute appendicitis. The classical incision used for appendectomy was Grid iron incision which was pioneered by McBurny in the 19th century [1].

Reports have confirmed the safety and feasibility of laparoscopic appendectomy and recommended it as the gold standard for the management of acute appendicitis [2].

All the benefits of minimal access surgery like (less postoperative pain, shorter hospital stay, better cosmetic result and rapid recovery) are strongly present in laparoscopic Appendectomy [3].

Another major advantage is the diagnostic laparoscopy done initially in any case of acute abdomen and is very helpful in doubtful cases especially in females [4].

Various techniques have been used for securing the appendicular stump, some of which is expensive as endoscopic linear cutting stapler; others are not available in some hospitals as preformed suture loops (endoloops) [5].

Base control also has been tried by metallic clips but not on a large scale, the problem of the technique of metallic clips is that some surgeons are not confident with its safety.

We aimed to compare between ligation methods (Intracorporeal, Extra-corporeal or Endoloop ligation) and clip application with their different types (polymeric or titanium) as methods for securing the appendicular stump regarding their feasibility, safety, efficacy, operative time, postoperative outcome and complications at Zagazig university hospitals. To compare between ligation and clipping techniques regarding feasibility, safety, efficacy, operative time,

postoperative outcome and complications. To compare between different techniques of ligation (ICL, ECL and End loop ligation) and two types of clipping (Titanium and Polymeric clips) and to compare between the simplicity of different techniques for trainees and to decrease complications related to laparoscopic appendectomy at Zagazig university hospitals

METHODS

These patients included in the study were admitted from those attending the surgical emergency department of Zagazig university hospitals. 90 patients were included in this randomized prospective clinical trial study. Sample size was calculated using OpenEpi program with confidence level 95% and power 80%.

Inclusion criteria were including all cases of acute appendicitis with age starting from 16 years old and candidate for laparoscopic appendectomy were included in the study

Exclusion criteria were involve 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 and patients which are not fit for laparoscopic appendectomy due to one or more of following causes: (COPD or cardiac disease or pulmonary HTN, Hypercoagulability status, Diseases like cirrhotic liver and sickle cell disease and portal HTN, Presence of Intra-peritoneal (IP) prosthetic mesh or ventriculo-peritoneal (VP) shunt, Mechanical intestinal obstruction (IO) and Pregnancy (in 3rd trimester).

Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Methods was done such as the patients were randomly distributed into 2 main groups (A&B): Group A: Ligation Group (54). Group B: Clipping Group (36). Then group (A) was further subdivided into 3 subgroups (A1, A2& A3): Subgroup A1: Intra-corporeal ligation (ICL) (18). Subgroup A2: Extra-corporeal ligation (ECL) (18). Subgroup A3: Endoloop ligation (EL) (18). And group (B) was further subdivided into 2 subgroups (B1&B2): Subgroup B1: Titanium clip (TC) (18). Subgroup B2: Polymeric clip (PC) (18). Method of randomization was in the following order: Case no. (1) Intra-corporeal ligation case. Case no. (2) Extra-corporeal ligation case. Case no. (3) Endoloop ligation case. Case no. (4) Titanium clip

case. Case no. (5) Polymeric clip case & so on. Inability to apply any of the techniques is considered failure and another technique was attempted.

All patients were subjected to classic history taking, examination and investigations. Laboratory investigations like CBC, CRP, RBS, Liver functions and virology. Radiological investigation such as Ultrasonography was routinely done for all patients. CT with contrast was requested when indicated in suspicion of complications.

Procedure: 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 meso-appendix by bipolar, monopolar diathermy, Harmonic or Ligasure in close proximity to the wall of the appendix and clipping of mesoappendix in some cases. The second step in ligation groups is to pass a ligature of Vicryl0 and perform 5 or 6 ICL Knots in 1st case in the study, ECL knots in 2nd case or Endoloop ligation in 3rd case. The second step 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. Cautery of the appendicular stump was done to all cases. The abdominal cavity was finally searched for any collections or bleeding. No drains were inserted except in cases. The appendix is retrieved through the port in left iliac fossa or the optic port and was sent routinely for HPE [Figures 1,2,3,4]

Post-Operative: Hospital stay, post-operative fever, port site sepsis and postoperative collection by US.

Follow up: All patients were followed up at surgery outpatient clinic for 6 months. However, all patients were instructed to seek our advice whenever they notice something abnormal. During follow-up visits, the following is inquired post-operative fever, port site sepsis and postoperative collection by US.

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 ± SD and

range. Student t-test was used to compare between two groups. P < 0.001 was considered to be statistically significant

RESULTS

Table (1): Comparison between different surgical techniques of ligation (A) and clipping (B) groups as regarding operative time and duration of hospital stay

	Ligation techniques (A)				P	Clipping techniques (B)		P	F	P
	ICL	ECL	Endoloop	Titanium		Polymeric				
	N=18 (%)	N=18 (%)	N=18 (%)	N=18 (%)		N=18 (%)				
Operative Time (min) :										
Mean ± SD	56.44 ± 3.4	47.94 ± 3.56	46.56 ± 0.92	<0.001	42.44 ± 2.83	41.89 ± 2.25	0.519	80.95	<0.001	**
Range	52 – 65	41 – 55	45 – 48	**	36 - 46	38 - 45				
Hospital stay(days):										
Mean ± SD	1.78 ± 0.43	1.72 ± 0.46	1.94 ± 0.24	0.212	1.5 ± 0.51	1.78 ± 0.55	0.197	1.842	0.128	
Range	1 – 2	1 – 2	1 – 2		1 – 3	1 – 3				

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

	Ligation techniques (A)			Clipping techniques (B)		χ ² /F	p
	ICL	ECL	Endoloop	Titanium	Polymeric		
	N=18 (%)	N=18 (%)	N=18 (%)	N=18 (%)	N=18 (%)		
Anatomical Site :							
Retro-cecal	9 (50)	7 (38.8)	7 (38.8)	7(38.8)	4 (22.2)		
Sub-cecal	2 (11.1)	4 (22.2)	4 (22.2)	4 (22.2)	4 (22.2)		
Para-colic	3 (16.7)	2 (11.1)	2 (11.1)	1 (5.7)	1 (5.6)	14.077	0.827
Pelvic	3 (16.7)	2 (11.1)	0 (0)	2 (11)	2 (11.1)		
Sub-hepatic	1 (5.5)	2 (11.1)	2 (11.1)	1(5.7)	2 (11.1)		
Retro-ileal	0 (0)	1(5.7)	3 (16.8)	3(16.6)	5 (27.8)		
Condition of appendix :							
Inflamed	17 (94.4)	15 (83.3)	14 (77.8)	16 (88.8)	15 (83.3)	2.338	0.674
Not inflamed	1 (5.6)	3 (16.7)	4 (22.2)	2 (11.2)	3 (16.7)		
Other pathology:							
PID	0 (0)	0 (0)	0 (0)	1 (5.6)	0 (0)		
Ovarian cyst	3 (16.6)	1 (5.6)	2 (11.1)	2 (11.1)	2 (11.1)		
Meckle's D.	0 (0)	0 (0)	0 (0)	0 (0)	1 (5.6)	13.792	0.314
Congenital adhesion	1 (5.6)	0 (0)	1 (5.6)	0 (0)	0 (0)		
Size of the base:							
Average	7 (38.8)	8 (44.4)	11 (61.2)	9 (50)	8 (44.4)	9.132	0.908
Very wide	11 (61.2)	10 (55.6)	7 (38.8)	9 (50)	10 (55.6)		
Intra-operative complications :							

	Ligation techniques (A)			Clipping techniques (B)		χ ² /F	p
	ICL	ECL	Endoloop	Titanium	Polymeric		
	N=18 (%)	N=18 (%)	N=18 (%)	N=18 (%)	N=18 (%)		
No	17 (94.4)	17(94.4)	18 (100)	17 (94.4)	17 (94.4)		
Bleeding	1 (5.6)	1(5.6)	0 (0)	0 (0)	1 (5.6)	7.069	0.529
Intestinal injury	0 (0)	0 (0)	0 (0)	1 (5.6)	0 (0)		

(Table 3) Comparison between different surgical techniques in ligation (A) and clipping (B) groups as regarding postoperative complications.

	Ligation techniques (A)			Clipping techniques (B)		x 2	P1	P2	P3
	ICL	ECL	Endoloop	Titanium	Polymeric				
	N=18 (%)	N=18 (%)	N=18 (%)	N=18 (%)	N=18 (%)				
Complications:									
Absent	15 (83.3)	15 (83.3)	15 (83.3)	13 (72.2)	15 (83.3)		>0.99	>0.999	
Present	3 (16.7)	3 (16.7)	3 (16.7)	5 (27.8)	3 (16.7)	1.16			0.885
Fever:									
No	18 (100)	17 (94.4)	18 (100)	16 (88.9)	18 (100)	5.51	>0.99	>0.999	0.238
Yes	0 (0)	1 (5.6)	0 (0)	2 (11.1)	0 (0)	7			
Collection by US:									
No	18 (100)	17 (94.4)	18 (100)	17 (94.4)	18 (100)	3.06	>0.99	>0.999	0.547
Yes	0 (0)	1 (5.6)	0 (0)	1 (5.6)	0 (0)	8			
Port site infection:									
No	17 (94.4)	18 (100)	17 (94.4)	17 (94.4)	17 (94.4)	1.04	>0.99	>0.999	0.903
Yes	1 (5.6)	0 (0)	1 (5.6)	1 (5.6)	1 (5.6)	7			
Bleeding:									
No	17 (94.4)	18 (100)	18 (100)	18 (100)	17 (94.4)	3.06	>0.99	>0.999	0.547
Yes	1 (5.6)	0 (0)	0 (0)	0 (0)	1 (5.6)	8			
Ileus:									
No	17 (94.4)	17 (94.4)	17 (94.4)	17 (94.4)	17 (94.4)	0	>0.99	>0.999	>0.999
Yes	1 (5.6)	1 (5.6)	1 (5.6)	1 (5.6)	1 (5.6)				9
Stump leak:									
No	18 (100)	18 (100)	18 (100)	18 (100)	18 (100)	0			>0.999
Yes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)				9
Acute abdomen:									
No	18 (100)	18 (100)	17 (94.4)	18 (100)	18 (100)	4.40	>0.99	>0.999	0.4
Yes	0 (0)	0 (0)	1 (5.6)	0 (0)	0 (0)	5			

Figure (1): Intra-corporeal Ligation of the base of appendix, Applying Extra-Corporeal Knot around appendix

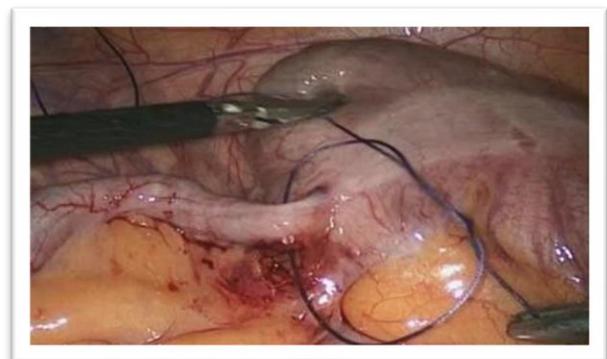
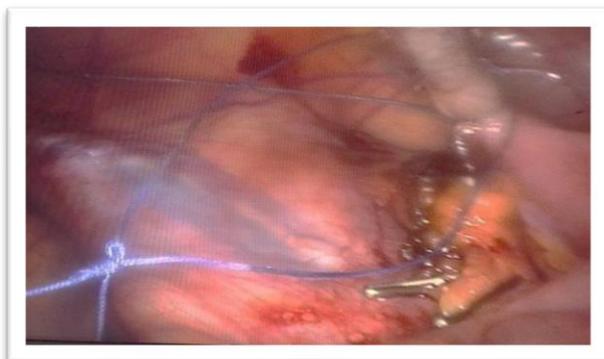


Figure (2): ligation of base of appendix using endoloop

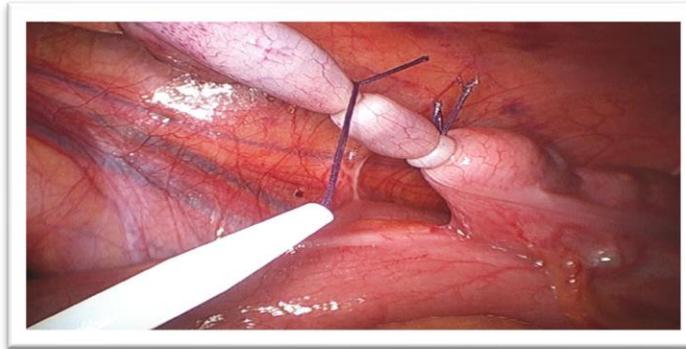
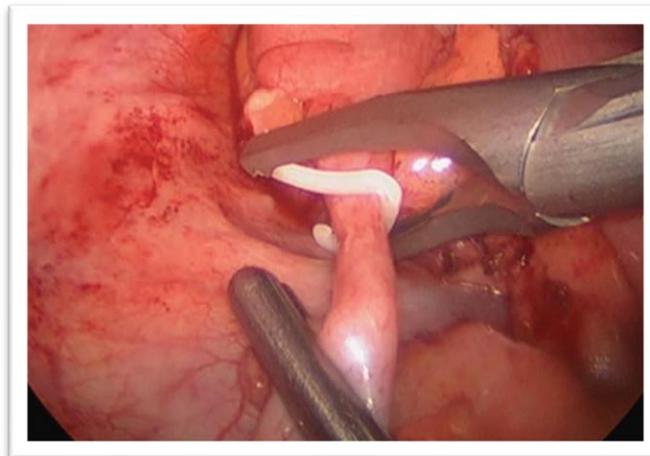


Figure (3): Titanium clipping of base of appendix.



Figure (4): polymeric clipping of the base of the appendix



DISCUSSION

Acute appendicitis is a common intra-abdominal inflammatory disease, which requires emergency surgery, and surgical appendectomy, either open or laparoscopic remains the treatment of choice [6]. The other major advantage of laparoscopic appendectomy is diagnostic laparoscopy done before delivery of the appendix and lower rate of wound infection. There is statistically non-significant difference between different surgical techniques as regarding either age or gender in our study.

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 ICL in agreement with Abou-Sheishaa study where mean operative time was 54.6 minutes. In current research, mean operative time of ECL was 47.94 minutes in disagreement with Dixit and Gogate study where mean operative time was between 61 and 75 minutes in 83.88% of operated patients. In current research, mean operative time was 46.56 minutes among patients operated by Endoloop ligation in disagreement with Safavi study where mean operative time was

23.31 minutes. In current research, mean operative time among patients operated with titanium clip application was 42.44 minutes in agreement with Dixit and Gogate study where mean operative time was between 45 and 60 minutes in 60% of operated Patients. In current research, mean operative time among patients operated with polymeric clip application was 41.89 minutes in agreement with Reinke study where the mean operative time was 45 minutes. Among patients operated by ICL, mean hospital stay was 1.78 days in agreement with Abou-Sheishaa study where mean hospital stay was 1.98 days. Among patients operated by ECL, mean hospital stay was 1.72 days in agreement with Dixit and Gogate study where mean hospital stay was 3.70 days. In our study, mean hospital stay was 1.78 days among patients operated by endoloop ligation in agreement with Safavi et al., study where mean hospital stay was 1.63 days. In our study, mean hospital stay was 1.5 days among patients operated by titanium clipping in disagreement with Dixit and Gogate study where mean hospital stay was 3.16 days. In current study, mean hospital stay was 1.78 days among patients operated by polymeric clipping in disagreement with Reinke et al., study where mean hospital stay was 2.4 days [7, 8, 9,10].

There is statistically significant difference between ligation and clipping techniques as regarding operative time in favor of clipping (B) techniques. Also, the difference is significant between ICL technique and each other techniques of ligation in favor of ECL and EL techniques. There is statistically non-significant difference between both techniques of clipping (titanium and polymeric).

In our study, 5.6% of operated patients by ICL had ileus, in disagreement with Abou-Sheishaa et al. where 6.8% of patient had ileus. In our study, 5.6% of operated patients by ECL had ileus, in disagreement with Dixit and Gogate study where 13.33% of patient had abdominal pain and one case of ECL had abdominal collection which required US guided aspiration only. In our study, 5.6% of operated patients by titanium clipping had ileus, in agreement with Dixit and Gogate study where 6.67% of patient had abdominal pain. In our trial, 5.6% of ICL operated patients had port site infection, in contrast with Abou-Sheishaa et al. in which 2.27% of patients had port site infection. In our study, nil of ECL-operated patients had port site infection, while 6.67% of patients had port site infection in Dixit and Gogate study. In current work, 5.6% of operated patients by endoloop ligation had port site infection, in disagreement with Safavi et al., study where 50% of patient had wound infection. In our study, 5.6% of operated

patients by titanium clipping had port site infection, in disagreement with Dixit and Gogate study where 0% of patient had port site infection. In our study, 5.6% of operated patients by polymeric clipping had port site infection, in agreement with Reinke et al. study where 4% of patient had suture abscess at umbilicus. In our study, no patients operated by ICL had collection, in agreement with Abou-Sheishaa et al. where no patient had abdominal abscess. In our study, 0% of operated patients by endoloop ligation had stump leak, in agreement with Safavi et al. study where 0% of patient had stump leak. No any patient in the 4 other subgroups had a stump leak also [7, 8, 9,10].

There is statistically non-significant difference between patients underwent different surgical techniques as regarding presence of postoperative complications as fever, intra-abdominal collection detected by ultra-sonography, bleeding, ileus, stump leak or acute abdomen.

Two cases were converted from clipping to ligation technique as the range of diameter of base was 3-20 mm and the two cases were more than 15 mm so converted to ligation methods to secure the base better than using clips. (one case was 17 mm and the other 19 mm).

CONCLUSION

All techniques of ligation and clipping were feasible, safe and effective, with the same rate of complications; the only difference was regarding operative time as ligation techniques consume more time than clipping techniques. The only limitation of the clip application is the very wide diameter of the base of the appendix, which can be managed by any available ligation method.

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