

Do the stump knotting technique and specimen retrieval method effect morbidity in laparoscopic appendectomy?

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ABSTRACT

BACKGROUND: Stump closure is the most important part of a laparoscopic appendectomy (LA). Closing the appendix base with knot tying is the most cost-effective method. The defined risk factor for surgical site infection (SSI) after LA is the contamination of trocar entry area by inflamed appendicitis. This study aims to compare the single and double knot technique for stump control and specimen removal methods in LA.

METHODS: The data of patients who underwent LA between January 2015 and January 2017 were obtained from prospectively collected database. Single and double knot technique, specimen removal method, operation duration, hospital stay, and perioperative–postoperative complications were compared.

RESULTS: Extracorporeal double knot was used in 134 patients (63%), and single knot was used in 79 patients (37%). There was no difference between operation duration in the two groups ($p=0.97$). No stump leakage was observed in any patient. Intraabdominal abscess developed in three patients (1.4%). Appendix was removed from the abdomen directly in 101 patients (47%) and using specimen retrieval bag in 112 (53%). SSI developed in five patients (2.3%), and appendices of all of these five patients were removed from abdomen without using specimen retrieval bag. No SSI was detected in the group that used the specimen retrieval bag ($p=0.02$).

CONCLUSION: Single or double knot(s) tying can be defined as safe and cost-effective stump closure method. The risk of developing SSI can be reduced using specimen retrieval bag.

Keywords: Extracorporeal knot tying; laparoscopic appendectomy; Specimen retrieval bag; stump; surgical site infection.

INTRODUCTION

Laparoscopic appendectomy (LA) was first performed by Semm in 1983; and since then, it has been widely used for minimally invasive treatment for acute appendicitis.^[1] Nowadays, LA is the standard method in many centers.

Laparoscopic appendectomy has advantages such as less postoperative pain, shorter hospital stay, better cosmetic results, lower wound infection risk, and faster return to normal

bowel function than open appendectomy.^[2–4] Potential disadvantages are high cost,^[5] long operation duration, especially during the learning curve, and encounter of more frequent intraabdominal abscess.^[2,3,6–8]

The most feared complication of LA is the fistula or intraabdominal sepsis that develops secondary to stump leaks. Several methods have been described to close the appendix stump such as endostapler, endoloop, clip, extracorporeal or intracorporeal knot tying, and stump transection with bipolar

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or ligation devices. But these methods have not been demonstrated to be superior to each other in terms of effectiveness or safety.^[4,9-17] Knot tying has cost advantages over other methods, but there is no consensus about tying method (single or double) in literature.

The defined risk factor for surgical site infection (SSI) after LA is the contamination of trocar entry area by inflamed appendicitis.^[18-20]

This study aims to compare the single and double extracorporeal knot technique for stump closure and specimen retrieval methods used in LA.

MATERIALS AND METHODS

Patients who underwent LA with diagnosis of acute appendicitis between January 1, 2015, and January 1, 2017, were included to the study. Patients with incomplete data and those who underwent interval or open appendectomy were excluded from the study.

Detailed information about laparoscopic and open appendectomy was given to all patients before surgery, and their written informed consent was obtained. Approval was taken from the local ethical committee for this study (date: November 26, 2017; decision no: 2017/25-36).

Acute appendicitis was diagnosed in patients who presented with abdominal pain to emergency service or polyclinic; with anamnesis, physical examination, complete blood test, and if necessary, abdominal ultrasonography (US) or computed tomography (CT) was used.

Operations were performed under general anesthesia; all patients received a single dose of first-generation cephalosporin prophylaxis. After Foley catheter insertion, three trocars were placed, 11 mm below the umbilicus, 5 mm above the pubis, and depending on the surgeon's preference 5 or 11 mm to the left side of the patient. In all operations, reusable trocars and reusable laparoscopic hand instruments were used. Inflammatory appendicitis defined as uncomplicated, gangrenous, or perforated appendicitis was defined as complicated appendicitis.^[21] High-frequency bipolar coagulation devices were used for dissection and sealing of the mesoappendix. The base of the appendix tied with single or double extracorporeal sliding knot and appendix was cut above the knot(s). The Duncan sliding knot technique (Fig. 1)^[22] and 150-cm 2.0 polyglactin non-needle suture were used in each operation.

All participant surgeons used either the single or double tying method. The choice of single or double knot method is randomly determined, regardless of the patient's clinic, complicated or uncomplicated appendicitis, and the diameter of appendix base.

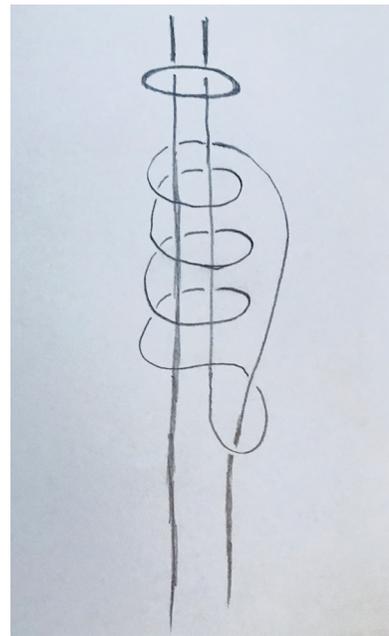


Figure 1. Duncan extracorporeal sliding knot method.

The specimen was removed from the abdomen through the umbilical trocar with (Fig. 2) or without using specimen retrieval bag. The four-quadrant abdominal irrigation was performed for patients with perforated appendicitis, and silicon drain was placed to pelvis.

Patient's age, sex, radiologic examinations, severity of appendicitis (inflamed, gangrenous, perforated, etc.), appendix base diameter, stump closure method, specimen retrieval method, operation duration, hospital stay, perioperative complications, and histopathologic findings were analyzed from the prospectively collected database. Complications were classified according to Clavien–Dindo (C-D) classification system.^[23]

All statistical analyses were performed using SPSS 16.0 statistical package (SPSS, Chicago, Ill). Independent samples t-test was used to compare normally distributed continuous variables. The non-normally distributed variables were compared with using the Mann–Whitney U test. Chi-square test was used for comparison of categorical data, and $p < 0.05$ was considered as statistically significant.

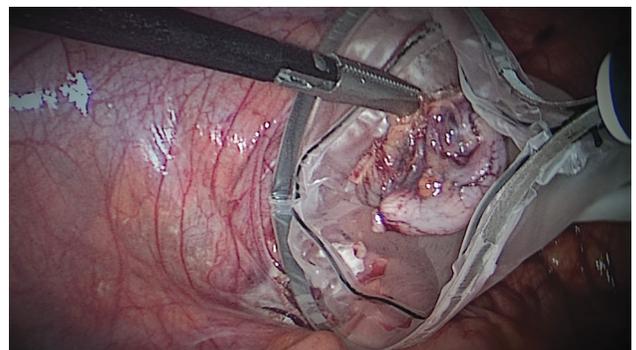


Figure 2. Specimen retrieval method using specimen bag.

RESULTS

Between January 1, 2015, and January 1, 2017, 213 consecutive patients [98 male (46%) and 115 female (54%)] were included in the study. The median age of patients was 33.5 ± 13.77 (range: 16–82) years. Ultrasonography was used in 79 patients (37%), CT in 109 (51%), and physical examination and complete blood count in 25 (12%).

Complicated appendicitis was detected in 49 patients (23%) [30 perforated appendicitis (14%) and 19 (9%) gangrenous appendicitis], inflamed appendicitis in 156 (73%), and no inflammatory sign in 8 (4%). The median appendix base diameter was 86.4 ± 24.7 mm (range 40–170). Extracorporeal double knot was used in 134 patients (63%), and single knot was used in 79 patients (37%). The median operation duration was recorded as 44.5 ± 10.2 (range 20–99) min. The median operation duration in the single and double knot groups was 44.58 ± 6.73 and 44.53 ± 11.94 min, respectively. There was no statistically significant difference between operation duration ($p=0.97$, independent samples t-test). Appendix was removed from the abdomen directly in 101 patients (47%) and using specimen retrieval bag in 112 patients (53%).

The median hospitalization duration was 2.7 ± 1.9 (range: 1–16) days. No stump leakage was observed in any patient during postoperative follow-up. Intraabdominal abscess developed in three patients (1.4%); two of them were treated

with interventional radiological methods, and the last patient underwent laparoscopic re-operation (2 C-D Grade IIIA; 1 C-D Grade IIIB). These three patients had perforated appendicitis. The rate of intraabdominal abscess in perforated group was 10% (3/30).

SSI developed in five patients (2.3%). Appendices of these five patients were removed from the abdomen without using specimen retrieval bag. No SSI was detected in the group that used the specimen retrieval bag ($p=0.02$; Fisher's exact test). The mean hospital stay of patients with and without SSI was 7.8 ± 3.96 and 2.8 ± 1.69 days, respectively. The hospitalization period of patients with SSI was significantly longer ($p<0.001$; Mann-Whitney U test). Patient demographics, operation, and follow-up data are summarized according to stump closure methods in Table 1.

DISCUSSION

The debate on two topics continues in the stump closure methods in LA: the cost and the safety. The ideal method for the stump closure should be safe, technically easy, and cost-effective. Endostaplers, clips, commercial endoloops, and intracorporeal or extracorporeal tying are the most commonly used methods in LA. Several experimental and clinical studies about using bipolar coagulation devices for stump closure have been published,^[24,25] but these devices have not been routinely used for stump control. Endostapler has some advantages

Table 1. Patient demographics, operation, and follow-up data

Stump closure method	Single knot	Double knot	All patients
	79 (37%)	134 (63%)	213
Sex			
Male	36	62	98
Female	41	74	115
Age (mean±SD)	33.91 ± 14.78	33.32 ± 13.2	33.5 ± 13.77
Status of appendix, n (%)			
Complicated	9 (11.4)	40 (29.9)	49 (23)
Uncomplicated	67 (84.8)	89 (66.4)	156 (73)
No inflammation	3 (3.7)	5 (3.7)	8 (4)
Median appendix base diameter (mm), (mean±SD)	82.4 ± 26.7	87.2 ± 29.6	86.4 ± 24.7
Perforation, n (%)	4 (5)	26 (19)	30 (14)
Operation time (minutes), (mean±SD)	44.58 ± 6.73	44.53 ± 11.94	44.5 ± 10.2
Using specimen retrieval bag, n (%)			
No	57 (72.2)	44 (32.8)	101 (47)
Yes	22 (27.8)	90 (67.2)	112 (53)
Surgical site infection, n (%)	1 (1.2)	4 (3)	5 (2.3)
Intraabdominal abscess, n (%)	0 (0)	3 (2.2)	3 (1.4)
Median hospital stay (days), (mean±SD)	2.85 ± 2.02	2.69 ± 1.84	2.7 ± 1.9

SD: Standard deviation.

such as ease of use and rapidity, which are preferred when the appendix base is necrotic and/or perforated,^[4] the high cost, and the 12 mm. Trocar requirement is seen as a disadvantage.

Prospective studies about titanium and polymer clips have been published. The stump closure with both types of clips has been evaluated as practical and safe, but there are concerns about using clip when the appendix base is large and/or inflammation is intense.^[26,27]

Tying the appendix base with standard non-needle suture is the most cost-effective method in all these stump closure methods. Closing the appendix base with knots is considered as safe as compared to other stump closure methods in various series.^[9-11,14,28] Single knot^[9] and double knot technique^[14] were used for closing the appendix stump in some studies, but there is no study in the literature that compares the single or double knot(s). In our study, no difference was observed in the median operation duration and stump safety in single or double knot(s) tying methods. In the light of these data and the literature, single or double knot(s) tying can be defined as safe and cost-effective stump closure method in the laparoscopic treatment of complicated or uncomplicated appendicitis.

The incidence of SSI after LA has been reported between 2.8% and 12.8%.^[18,19] The use of specimen retrieval bag reduces the ratio of SSI after LA.^[20] We obtained similar results with the literature; all of the five patients who developed SSI, their appendix were removed from the abdomen without using specimen retrieval bag. On the other hand, no SSI was observed in any of the patients in the group that used specimen retrieval bag. The risk of developing SSI, which is one of the factors that reduces the advantages of laparoscopic method, extends the length of hospital stay, which can be reduced with use of specimen retrieval bag in LA.

The risk of developing intraabdominal abscess after appendectomy is related to the presence of perforation, and it is more common in LA than in open appendectomy.^[8,29] Patients with perforated appendicitis can be safely treated by LA, despite the risk of developing intraabdominal abscess. In our series, intraabdominal abscess was detected in three patients. All of these patients had perforated appendicitis. The risk of intraabdominal abscess can be reduced by four-quadrant irrigation.^[30] We performed routine four-quadrant washout in perforated patients, this may explain our 10% intraabdominal abscess rate after LA in patients with perforated appendicitis, which reaches 24% in the literature.^[8]

The major limitations of our study are its retrospective design and no cost analysis. Our study includes the results of single center with heterogeneous surgeon group.

Conclusion

In conclusion, during LA, single or double knot tying method

can be safely used for stump closure in complicated or uncomplicated appendicitis. Our study shows that using the specimen retrieval bag reduces the SSI in LA, but further prospective multicenter studies evaluating the costs are needed.

Conflict of interest: None declared.

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ORİJİNAL ÇALIŞMA - ÖZET

Laparoskopik apendektomide güdük bağlama tekniği ve spesimen çıkarma metodu morbiditeyi etkiliyor mu?

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AMAÇ: Güdük kapatılması laparoskopik apendektominin (LA) en önemli aşaması olarak görülmektedir. Güdüğün dikiş ile kapatılması maliyet açısından en etkin yöntemdir. LA sonrası yara yeri enfeksiyonu gelişmesi için tanımlanmış risk faktörü, trocar giriş alanının inflame apendiks ile kontamine olmasıdır. Bu çalışmanın amacı apendiks güdüğü kapatılmasında tek-çift bağlama teknikleri ve spesimen çıkarma yöntemlerinin karşılaştırılmasıdır.

GEREÇ VE YÖNTEM: Ocak 2015 ve Ocak 2017 tarihleri arasında ameliyat edilen hastalara ait bilgiler ileriye dönük olarak doldurulan veritabanının geriye dönük olarak incelenmesi ile elde edildi. Tek-çift bağlama teknikleri, spesimen çıkarma yöntemleri, ameliyat süresi, hastane kalış süresi, peri-operatif ameliyat sonrası komplikasyonlar karşılaştırıldı.

BULGULAR: Yüz otuz dört hastada (%63) ekstracorporeal çift bağlama, 79 hastada (%37) ekstracorporeal tek bağlama ile güdük kapatıldı. İki grupta ameliyat süreleri arasında fark saptanmadı ($p=0.97$). Hiçbir hastada güdük kaçağı gelişmedi. Üç hastada (%1.4) intraabdominal apse gelişti. Yüz bir hastada (%47) apendiks direkt yöntemle çıkarıldı, 112 hastada (%53) ise spesimen torbası kullanıldı. Beş hastada yara enfeksiyonu gelişti (%2.3), bu beş hastanın tümünde spesimen torbası kullanılmamıştı ($p=0.02$).

TARTIŞMA: Tek veya çift bağlama, güvenli ve uygun maliyetli güdük kapatma yöntemi olarak tanımlanabilir. Spesimen torbası kullanımı ile yara yeri enfeksiyonu gelişme riski azaltılabilir.

Anahtar sözcükler: Cerrahi alan enfeksiyonu; ekstracorporeal düğüm bağlama; güdük; laparoskopik apendektomi; spesimen torbası.

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