



## Research Article

# Role of Laparoscopic Appendectomy Radix Ligation Techniques on the Formation of Inner Abdomen Abscess

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### Abstract

**Objectives:** Our aim was to study whether laparoscopic appendectomy radix ligation techniques were eutrophic in the development of intra-abdominal abscess.

**Methods:** Between September 2009 and April 2017, all emergency cases admitted to our surgery polyclinic were reviewed, and the results of the patients who underwent laparoscopic appendectomy were collected. Appendectomy radix ligation techniques were reviewed from surgical notes on discharge reports. Postoperative controls were also reviewed, and any cases with abscess formation were reported.

**Results:** A total of 350 patients were included in the study. Of these cases, 207 were males, and 143 were females. The mean age of the patients was 26.89±4.9 years. One hundred eighty-nine cases were found to have two endoloops placed on top of each other, whereas 161 cases had a 2 mm distance left in between the two endoloops and tied. None of the 189 cases who had endoloops placed on top of each other developed abscess formation. However, of the 161 cases who had endoloops with a 2 mm distance in between, 8 reported with abscess formation in the inner abdomen. Of these eight cases, seven had percutaneous abscess drainage by an interventional radiologist, whereas one was treated with relaparoscopy.

**Conclusion:** In the present study, patients who had endoloops placed on top of each other developed no abscess formation, whereas in the literature's gold standard procedure, those with a 2 mm distance left between two endoloops developed an inner abdominal abscess formation in 8 (4.9%) of the patients. We believe that this 2 mm dead space distance left between the two endoloops contributes to the formation of the abscess.

**Keywords:** Acute appendicitis; appendectomy; inner abdomen abscess; laparoscopic surgery.

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Acute appendicitis is the major cause of acute abdomen that is taken care of by general surgery clinics. There is a range of 7%–9% risk of appendectomy in a patient who undergoes abdominal surgery regardless of the cause; this is both the most common emergency surgery intervention and the most common inner abdomen operation.<sup>[1]</sup> Today,

acute appendicitis operations are performed via laparoscopic techniques. In the history of appendectomy, the first appendectomy was performed by Claudius Amyand in 1735; over the centuries, different methods have been developed, and the first laparoscopic appendectomy was performed in 1983 by Kurt Semm.<sup>[2]</sup> After 1983, with devel-

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oping technical support, decrease in the length of hospital stay, less postoperative pain, quicker return to work, and better cosmetic results were the advantages of laparoscopic appendectomy compared with open appendectomy.<sup>[3-5]</sup>

Within years of technical progression, increase in surgeon experience, and use of stronger antibiotic, the development of inner abdomen abscess formation post-laparoscopic appendectomy still remains a problem of both the patients and the surgeons. In the literature, diabetes mellitus, postoperative peritoneal irrigation, obesity, and young age are known risk factors without a definite result.<sup>[6,7]</sup>

The aim of the present study was to determine if stump ligation techniques via laparoscopic appendectomy have a role in abscess formation.

## Methods

Between September 2009 and April 2017, all emergency cases admitted to our surgery polyclinic were reviewed, and the results of the patients who underwent laparoscopic appendectomy were collected.

Age, gender, comorbidities, surgical pathology, operation time, appendix radix ligation type, hospital stay, and postoperative complications were recorded retrospectively. The postoperative controls of the same patient group were reviewed, and cases that developed abscess formation were reported.

Results were analyzed statistically using the SPSS 15.0 program (SPSS Inc., Chicago, IL, USA). Results are expressed as mean, standard deviation, and percentage ratio. Student's t-test is used for comparison of measured values, whereas chi-square test is used for comparison of categorical values.

## Results

Overall, 350 cases were included in the study. There were 207 (59%) male and 143 (40.8%) female patients. The mean age of the patients was 26.89±4.9 years. Of the patients, 189 were found to have two endoloops placed on top of each other, whereas 161 had a 2 mm distance left in between the two endoloops and tied. Patients with an endoloop placed on top of each other were classified in group 1 (n=189), and those with a 2 mm distance left between two endoloops were in group 2 (n=161) (Table 1). In group 1, 113 of 189 (59.78%) patients were males, and 76 (40.21%) were females. In group 2, 94 of 161 (58.38%) patients were males, and 67 (41.61%) were females. There was no statistical difference between the two groups for demographic data and comorbidity (p>0.05).

None (0%) of the patients in group 1 and 8 (4.9%) of the patients in group 2 were found to have an inner abdomen

abscess formation. There was a statistical difference between the two groups (p<0.05). Seven of these patients were found to have percutaneous abscess drainage by an interventional radiologist, whereas one patient was treated with relaparoscopy. Hospital stay was 1.1±0.5 days in group 1 and 1.2±0.8 days in group 2. Although hospital stay in group 2 was longer, there was no statistical difference (p>0.05) (Table 1).

According to surgical pathology, patients were divided into four: phlegmon, gangrenous, perforated, and perforated with abscess. Surgical pathologies were 86 phlegmon, 80 gangrenous, 20 perforated, and 3 perforated with abscess in group 1 and 80 phlegmon, 69 gangrenous, 10 perforated, and 2 perforated with abscess in group 2. No statistical difference was found between the two groups (p>0.05) (Table 2).

Linear regression analysis was performed to determine the significant factors for inner abdomen abscess formation. Age, sex, type 2 diabetes, hypertension, chronic obstructive pulmonary disease, coronary heart disease, hospital stay, radix ligation type, and surgical pathology were included in the analysis. Only radix ligation type was found to be significant for inner abdomen abscess formation (p>0.05) (Table 3).

**Table 1.** Demographic data, complications, and comorbidity

	Group 1 (n=189)	Group 2 (n=161)	p
Age (years)	26.9±6.2	26.9±6.7	0.93
Male	26.9±6.6	26±6	0.91
Female	26.8±5.6	28±7.3	0.89
Sex (M/F)	113/76	94/67	0.92
Complication			
Yes	2	10	0.042
No	187	151	
Abscess	0	8	0.034
Wound infection	2	2	0.91
Hospital stay	1.13±0.3	1.22±0.73	0.91
Comorbidity			
DM	3	3	0.93
HT	4	3	0.90
CHD	1	0	0.89
COPD	4	3	0.87

DM: diabetes mellitus; HT: hypertension; CHD: coronary heart disease; COPD: chronic obstructive pulmonary disease.

**Table 2.** Surgical pathology

	Group 1 (n=189)	Group 2 (n=161)	p
Phlegmon	86	80	0.65
Gangrenous	80	69	0.51
Perforated	20	10	0.35
Perforated+Abscess	3	2	0.69

**Table 3.** Linear regression analysis

	P	OR	95% CI	
			Min.	Max.
Age	0.515	0.001	-0.002	0.001
Sex	0.623	0.011	-0.017	0.029
DM	0.993	0.061	-0.12	0.119
HT	0.748	0.056	-0.093	0.13
COPD	0.747	0.08	-0.132	0.184
CHD	0.818	0.098	-0.17	0.215
Hospital stay	4.110	0.01	0.16	0.2
Radix ligation	<b>0.003</b>	0.011	0.011	0.057
Surgical pathology	0.414	0.069	0.016	0.089

CI: confidence interval; OR: odds ratio; DM: diabetes mellitus; HT: hypertension; COPD: chronic obstructive pulmonary disease; CHD: coronary heart disease; \*p<0.05 is statistically significant. Independent samples t-test/Mann-Whitney U test/chi-square test (Fisher's exact test).

## Discussion

It has been 32 years since the first application of laparoscopic appendectomy, and it is still not the gold standard procedure in medical literature. Open operation is still the most favored technique and gold standard.<sup>[8]</sup> Laparoscopic appendectomy is generally more frequently used for young female patients with an unspecified etiology.<sup>[9]</sup>

Laparoscopic appendectomy is frequently performed in our emergency department. Many studies have been published regarding the safety of laparoscopic appendectomy, and it has been reported in the literature that it does not increase inner abdomen abscess formation. In addition, it has been stated that laparoscopic appendectomy does not increase morbidity and mortality.<sup>[3]</sup> In previous meta-analysis studies of laparoscopic appendectomy complication, acute appendicitis cases have not shown to be a contributing risk factor for inner abdomen abscess development.<sup>[5]</sup>

Although the use of advanced imaging techniques, such as computed tomography, is now routinely used, the number of complicated cases of acute appendicitis is slowly increasing today.<sup>[10]</sup> In the study by Oliak et al.,<sup>[11]</sup> the incidence of complicated appendicitis was found to be between 12% and 30%. These increased complicated appendicitis cases have higher morbidity and wound infection rate than non-complicated cases. In the study by Humes et al.,<sup>[12]</sup> this rate was found to be 20% in complicated cases and 5% in non-complicated cases. There are still studies about the early diagnosis and diagnosis of complicated cases. Mihmanlı et al.<sup>[13]</sup> have shown that 5-hydroxyindole acid cannot be used as an indicator of acute appendicitis. In the study by Boshnak et al.,<sup>[14]</sup> increased platelet distribution width and elevated white blood cell and neutrophil counts may be used as diagnostic tests in cases of acute appendicitis. In the study

by Markides et al.<sup>[15]</sup> about complicated acute appendicitis, they have shown that laparoscopic appendectomy has no differences with open appendectomy in the development of intra-abdominal abscesses and has even better results in the development of wound infections. Ingraham et al.<sup>[16]</sup> have shown that laparoscopic appendectomy does not increase mortality and morbidity.

In complicated appendicitis cases, placing an inner abdomen drain was not found to decrease the risk of abscess formation. In the study by Narci et al.,<sup>[17]</sup> it was not shown that placing intra-abdominal drainage catheter reduces intra-abdominal abscess development risk.

After laparoscopic appendectomy, the risk of abscess formation is thought to increase in the elderly, patients with acute appendicitis, obese patients, and patients with comorbidities, increased C-reactive protein or white cell count; however, none of these were found to be the direct cause of inner abdomen abscess formation.<sup>[18]</sup> As a comorbid factor, diabetes needs to be mentioned. After controlled laparoscopic appendectomy, it was not found to be a risk factor in the formation of inner abdomen abscess formation; however, in uncontrolled diabetes, there are studies showing this as a risk factor for abscess formation.<sup>[18]</sup>

Many of the factors mentioned above are responsible for the development of intra-abdominal abscesses, but none of the reasons have been shown to be responsible for the abscess alone. Most surgeons have a habit of intra-abdominal irrigation with complicated and perforated appendicitis.

In the above-listed risk factors for abscess formation, the only parameter that has a statistical significance is inner abdominal irrigation.<sup>[19]</sup>

Previous studies have shown that although it is not proven in adult patients, in the pediatric age group, perforated appendicitis, obesity, and patients <6 years have a relationship with abdomen abscess formation.<sup>[20-21]</sup>

In the study by Taylor et al.,<sup>[22]</sup> after laparoscopic appendectomy, antibiotic use has been shown to decrease infectious complications. However, it has not been shown to decrease postoperative complications in supportive appendicitis cases.<sup>[23]</sup> The use of antibiotics in these cases has shown to benefit patients with complicated appendicitis; however, there are no guidelines for the length of use.<sup>[22]</sup>

In our study, laparoscopic appendectomy was acknowledged as the gold standard procedure whereby there is a 2 mm distance between the stunted appendix, and tying 3 mm to the radix is a contributing factor to inner abdominal abscess formation.

In the colon flora, every gram of feces contains 1011–1012 bacteria.<sup>[24]</sup> By tying the stunted appendix two times with

2 mm spaces, 2 mm in length, according to the diameter of the appendix and tying it approximately 8–15 mm in width, if we calculate the appendix diameter to be 10 mm, approximately 150 mm<sup>3</sup> volume of unperfused colon flora is left. We believe that this unperfused tissue develops necrosis and participates in the development of inner abdominal abscess.

## Conclusion

In a retrospective analysis of a total of 350 laparoscopic acute appendicitis cases, group 1 named after the 189 cases with endoloop placed on top of each other showed no development of abscess formation, whereas in the gold standard method in the literature used for 161 cases (group 2) with a 2 mm distance left between two endoloops, 8 (4.9%) patients were found to have an abscess formation.

By leaving a dead space between the two loops, we believe that this dead space contributes to inner abdomen abscess formation.

This was a retrospective study. We believe that for our hypothesis to be proven, prospective randomized clinical investigations are needed to be conducted in larger groups.

## Disclosures

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**Conflict of Interest:** None declared.

**Authorship contributions:** Concept – Ö.A.; Design – Ö.A.; Supervision – H.T.Y.; Materials – N.A.H.; Data collection &/or processing – N.A.H.; Analysis and/or interpretation – R.G.I.; Literature search – R.G.I.; Writing – R.G.I.; Critical review – H.T.Y.

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