

Comparison of treatment methods in plastron appendicitis: a tertiary center experience

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Abstract

Background

It is controversial which treatment method is superior in plastron appendicitis and the research is still going on. The aim of this study is to compare treatment methods for plastron appendicitis in the adult population with our experience.

Materials and Methods

The data of 92 patients who were diagnosed with plastron appendicitis in university hospital between 2015 and 2021 were analyzed retrospectively. Data were taken from the hospital database. The patients were divided into three groups: those treated with primary surgery, with interval appendectomy and only with conservative method.

Results

Interval appendectomy resulted in a lower rate of conversion to open surgery compared to primary surgery, shorter operative time, and lower complication rates. Surgical procedures were found to be superior in detecting neoplasms compared to conservative treatment. After conservative treatment, one of three patients was retreated with the diagnosis of acute appendicitis.

Conclusion

In plastron appendicitis, routine interval appendectomy can be performed due to its advantages over other treatments such as the frequency of attacks after conservative treatment, the risk of the tumor being overlooked in conservative treatment, and the high rate of complications and conversion to open surgery in the primary surgery group.

Keywords: Complicated appendicitis, Interval appendectomy, Surgical treatment

Introduction

Acute appendicitis is the most common cause of acute abdominal pain, and appendectomy is the most frequently performed abdominal surgery today¹. It occurs mostly in the second and third decades of life, and the lifetime incidence in an individual varies between 7-16%, although it varies in different populations^{2,3}. Acute appendicitis is examined in two categories complicated and non-complicated. The treatment method for non-complicated appendicitis is surgery, and laparoscopic treatment has been adopted in the last 2 decades^{4,5}. Complicated appendicitis is further divided into perforated and plastron appendicitis. In the case of peritonitis diagnosis in perforated appendicitis, surgical treatment must be preferred. In plastron appendicitis, the formation of the abscess when the appendix is surrounded by the omentum following the perforation, there is no fixed best practice for the treatment. While some surgeons recommend interval appendectomy after conservative treatment^{6,7}, others argue that surgical treatment to be performed right after admission is more successful^{8,9}. Another group recommends only conservative treatment^{10,11}. The aim of this study was to find the most appropriate treatment method by comparing the available treatment methods in the literature for plastron appendicitis in the adult population. Among the relevant literature, our study is one of the rare studies with a high number of patients treated for plastron appendicitis in adults.

Materials - Methods

The data of 92 patients diagnosed with plastron appendicitis out of 1267 patients treated for acute appendicitis in a tertiary

healthcare institution between January 2015 and January 2021 were analyzed retrospectively. The patients were classified into three groups according to the treatment methods. These treatment methods were primary surgery, conservative treatment only, and interval appendectomy after conservative treatment. Groups were compared in terms of demographic data, length of hospital stay, percutaneous catheter abscess drainage rates, complications, conversion rates, and total cost from admission to release. The frequency and duration of attacks after conservative treatment, the timing of interval appendectomy, and frequency of malignancy in pathology reports after surgical treatment were other parameters in the study. While performing the cost analysis of the patients, the perspective of the reimbursement institution and the direct patient cost perspective were evaluated, and an individual calculation was made for each patient.

Descriptive analyses were performed to provide information on the general characteristics of the study population. The Kolmogorov-Smirnov test was used to evaluate whether the distributions of numerical variables were normal. Since they were not normally distributed, the independent sample Mann-Whitney U test was used to compare the numeric variables between groups. The numeric variables are presented as the mean \pm standard deviation or median - minimum/maximum. Categorical variables were compared by the chi-square test and presented as counts and percentages. A p-value <0.05 was considered the threshold for statistical significance. Analyses were performed using SPSS statistical software (IBM SPSS Statistics, Version 25.0).

Table 1 : Comparison of patients who underwent conservative treatment and patients who underwent primary surgery

		Conservative treatment	Primary surgical	p	
Gender	Male	28 (49.1%)	29 (50.9%)	0.56	such as sex, age, and need for invasive procedures
	Female	15 (42.9%)	20 (57.1%)		
Age		47.1 ± 16.8	45.3 ± 18.4	0.47	When the group that underwent interval appendectomy was compared with the group that underwent primary surgery, there were statistically significant differences in terms of complication rates, conversion rates, and operation times ($p < 0.05$) but not for sex, age, total cost, total hospital stay, and incidence of malignancy ($p > 0.05$) (Table 2). The conservative treatment processes of the patients in the interval appendectomy group were also taken into account in the calculation of the cost and total length of stay. According to the pathology reports, malignancy were observed in two patients (13.2%) in the interval appendectomy group, in one of seven patients (14.3%) who were operated on with acute appendicitis after conservative treatment, and in eight patients (16.3%) in the primary surgical treatment group. There was no statistically significant difference between these groups.
Cost	Usd	5273 ± 1371	8307 ± 2718	< 0.05	
Percutaneous catheter abscess drainage	Absent	38 (46.3%)	45 (53,7%)	0.42	Among the complications in the group treated with primary surgery, nine of them were wound infections (64.2%), four were intra-abdominal abscesses (28.5%), and the other was incisional hernia (7.3%) in a farmer who was seen in the second month of control. No complications were observed in the interval appendectomy group. No complications were observed in nine patients who underwent surgery after having an attack
	Present	5 (55,6%)	4 (44,4%)		
Length of stay		4.1 ± 1.6	7.5 ± 3.3	< 0.05	

Armonk, NY: IBM Corp.) This study was approved by the Sakarya University Faculty of Medicine Ethics Committee (No.71522473/050.01.04/39914-371; date: 30.06.2021).

Results

Of the patients, 57 (62%) were male, and 35 (38%) were female, with a mean age of 46.1 (19-82). Conservative treatment was performed in 43 (46.7%) patients, and primary surgical treatment was performed in 49 (53.3%) patients. Routine laparoscopic interval appendectomy was performed in 15 of the patients who were treated conservatively. When the conservative treatment group was compared with the primary surgery group, statistically significant differences were observed in terms of cost analysis and length of stay ($p < 0.05$). There were no significant differences for variables

after conservative treatment. The mean follow-up period in all patient groups was 26.3 months (9-38 months).

In the patients with conservative treatment who were followed up, no signs of the acute abdomen were observed during hospitalization, and there was no need for emergency surgical treatment. After discharge, recurrent attacks were observed in nine (32.1%) of these patients. The mean timing of these attacks was 58.2 (27-150 days) days.

Discussion

The incidence of plastron appendicitis among the case series varies between 2-10%^{12,13,14}. Compared to non-complicated appendicitis, plastron appendicitis is associated with higher morbidity, and no guideline has been provided about which method should be applied in cases other than the presence

Table 2 : Comparison of patients who underwent interval appendectomy and those who underwent primary surgical treatment

Parameters		Interval appendectomy	Primary surgical treatment	p
Gender	Male	7 (19.4%)	29 (80.6%)	0.39
	Female	8 (28.6%)	20 (71.4%)	
Age		40.6 ± 16.2	45.3 ± 18.4	0.44
Total length of stay		5.1 ± 0.6	7.5 ± 3.3	0.57
Total cost		9241 ± 1218	8307 ± 2718	0.72
Operation time		35 ± 7	95 ± 23	< 0.05
Converting to open procedure		0 (0%)	19 (100%)	< 0.05
Complications	Absent	15 (30%)	35 (70%)	< 0.05
	Present	0 (0%)	14 (100%)	
Incidence of malignancy		2 (20%)	8 (80%)	0.36

was found to increase, especially after the treatment of plastron appendicitis^{18,19,20}. In current meta-analyses, conservative treatment alone may not be an adequate treatment method due to the high neoplasia rates detected after primary surgery or interval appendectomy. In the study, the malignancy rates observed in the interval appendectomy and primary surgery groups showed that these two treatment methods were superior in detecting malignancy compared to conservative treatment. However, when the primary surgery and interval appendectomy groups were compared, no significant difference was observed between them on this matter.

In cost and effectiveness analyses, the primary surgical method comes to the fore as it is inexpensive and does not require additional hospitalization. However, due to the high complication rates, prolonged hospital stay, and potential secondary surgeries performed in some cases together with additional interventions can increase this cost²¹. Although the complication rates in this study were consistent with the literature, no difference was found between the interval appendectomy group and the primary surgery group in the cost- effectiveness analysis. Since surgery was not performed only in the conservatively treated group and the hospital stay was shorter, the cost was lower than that in the primary surgery group, but there were problems of higher malignancy rates and more frequent attacks after conservative treatment (32.1%). This strengthened the study's hypothesis that 'interval

of generalized peritonitis¹⁵. In the conservative treatment method, international multicenter studies have shown that the frequency of attacks can exceed 30% within 1 year, and necessity of primary surgical treatment or treatment with interval appendectomy has been demonstrated^{16,17}. The attack rates observed in the sample of this study are also consistent with the literature. Although appendiceal tumors are a rare cause of acute appendicitis, the risk of neoplasms

appendectomy should be performed'. Primary surgical treatment is associated with increased morbidity, a high rate of conversion to open surgery, more complications, and the morbidity rate can reach up to 30%²². Wound infection, bowel injuries, stump closure problems, unnecessary ileocaecal resections, fecal fistula, and postoperative intra-abdominal abscesses are some of the complications reported. In this study, we observed a significant increase in complication

rates in the primary surgery group compared to the interval appendectomy group. One of the advantages of interval appendectomy compared to primary surgery is that it allows the laparoscopic completion of the operation. The superiority of laparoscopic surgery over open surgery has been clearly illustrated, and it has been associated with earlier postoperative return to work and less pain. Other positive aspects of laparoscopic interval appendectomy compared to primary surgery in this study were shorter operative time, lower risk of complications, and lower rates of conversion to open surgery.

Conclusions

We recommend performing routine interval appendectomy in plastron appendicitis because there are higher frequency of attacks after conservative treatment, the risk of missing tumors during conservative treatment, and the high rates of complication and conversion to open surgery in the primary surgery group. However, more studies with higher number of sample are needed on this subject.

References

- Meshikhes AW. Management of appendiceal mass: controversial issues revisited. *J Gastrointest Surg.* 2008;12(4):767-775. doi:10.1007/s11605-007-0399-1
- Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. *Am J Epidemiol.* 1990;132(5):910-925. doi:10.1093/oxfordjournals.aje.a115734
- Lee JH, Park YS, Choi JS. The epidemiology of appendicitis and appendectomy in South Korea: national registry data. *J Epidemiol.* 2010;20(2):97-105. doi:10.2188/jea.je20090011
- Di Saverio S, Birindelli A, Kelly MD, et al. WSES Jerusalem guidelines for diagnosis and treatment of acute appendicitis. *World J Emerg Surg.* 2016;11:34. Published 2016 Jul 18. doi:10.1186/s13017-016-0090-5
- Tzovaras G, Baloyiannis I, Kouritas V, et al. Laparoscopic versus open appendectomy in men: a prospective randomized trial. *Surg Endosc.* 2010;24(12):2987-2992. doi:10.1007/s00464-010-1160-5
- Lugo JZ, Avgerinos DV, Lefkowitz AJ, et al. Can interval appendectomy be justified following conservative treatment of perforated acute appendicitis?. *J Surg Res.* 2010;164(1):91-94. doi:10.1016/j.jss.2009.05.025
- Simillis C, Symeonides P, Shorthouse AJ, Tekkis PP. A meta-analysis comparing conservative treatment versus acute appendectomy for complicated appendicitis (abscess or phlegmon). *Surgery.* 2010;147(6):818-829. doi:10.1016/j.surg.2009.11.013
- Marya SK, Garg P, Singh M, Gupta AK, Singh Y. Is a long delay necessary before appendectomy after appendiceal mass formation? A preliminary report. *Can J Surg.* 1993;36(3):268-270.
- De U, Ghosh S. Acute appendectomy for appendicular mass: a study of 87 patients. *Ceylon Med J.* 2002;47(4):117-118. doi:10.4038/cmj.v47i4.3412
- Hoffmann J, Lindhard A, Jensen HE. Appendix mass: conservative management without interval appendectomy. *Am J Surg.* 1984;148(3):379-382. doi:10.1016/0002-9610(84)90476-8
- Deakin DE, Ahmed I. Interval appendectomy after resolution of adult inflammatory appendix mass--is it necessary?. *Surgeon.* 2007;5(1):45-50. doi:10.1016/s1479-666x(07)80111-9
- Andersson RE, Petzold MG. Nonsurgical treatment of appendiceal abscess or phlegmon: a systematic review and meta-analysis. *Ann Surg.* 2007;246(5):741-748. doi:10.1097/SLA.0b013e31811f3f9f
- Cueto J, D'Allemagne B, Vázquez-Frias JA, et al. Morbidity of laparoscopic surgery for complicated appendicitis: an international study. *Surg Endosc.* 2006;20(5):717-720. doi:10.1007/s00464-005-0402-4
- Willemsen PJ, Hoorntje LE, Eddes EH, Ploeg RJ. The need for interval appendectomy after resolution of an appendiceal mass questioned. *Dig Surg.* 2002;19(3):216-221. doi:10.1159/000064216
- Cheng Y, Zhou S, Zhou R, et al. Abdominal drainage to prevent intraperitoneal abscess after open appendectomy for complicated appendicitis. *Cochrane Database Syst Rev.* 2015;(2):CD010168. Published 2015 Feb 7. doi:10.1002/14651858.CD010168.pub2
- Di Saverio S, Sibilio A, Giorgini E, et al. The NOTA Study (Non Operative Treatment for Acute Appendicitis): prospective study on the efficacy and safety of antibiotics (amoxicillin and clavulanic acid) for treating patients with right lower quadrant abdominal pain and long-term follow-up of conservatively treated suspected appendicitis. *Ann Surg.* 2014;260(1):109-117. doi:10.1097/SLA.0000000000000560
- Svensson JF, Patkova B, Almström M, et al. Nonoperative treatment with antibiotics versus surgery for acute nonperforated appendicitis in children: a pilot randomized controlled trial. *Ann Surg.* 2015;261(1):67-71. doi:10.1097/SLA.0000000000000835Peltrini R, Cantoni V, Green R, et al. Risk of appendiceal neoplasm after interval appendectomy for complicated appendicitis: A systematic review and meta-analysis. *Surgeon.* 2021;19(6):e549-e558. doi:10.1016/j.surge.2021.01.010
- Carpenter SG, Chapital AB, Merritt MV, Johnson DJ. Increased risk of neoplasm in appendicitis treated with interval appendectomy: single-institution experience and literature review. *Am Surg.* 2012;78:339-43
- Furman MJ, Cahan M, Cohen P, Lambert LA. Increased risk of mucinous neoplasm of the appendix in adults undergoing interval appendectomy. *JAMA Surg.* 2013;148:703-6
- Mallinen J, Rautio T, Gronroos J, Rantanen T, Nordstrom P, Savolainen H, et al. Risk of appendiceal neoplasm in periappendicular abscess in patients treated with interval appendectomy vs follow-up with magnetic resonance imaging: 1-year outcomes of the peri-appendicitis acuta randomized clinical trial. *JAMA Surg.* 2019;154:200-7
- Sugiura K, Suzuki K, Umeyama T, Omagari K, Hashimoto T, Tamura A. Cost-effectiveness analysis of initial nonoperative management versus emergency laparoscopic appendectomy for acute complicated appendicitis. *BMC Health Serv Res.* 2020;20(1):1019. Published 2020 Nov 9. doi:10.1186/s12913-020-05839-6
- Cheng Y, Xiong X, Lu J, Wu S, Zhou R, Cheng N. Early versus delayed appendectomy for appendiceal phlegmon or abscess. *Cochrane Database Syst Rev.* 2017;6(6):CD011670. Published 2017 Jun 2. doi:10.1002/14651858.CD011670.pub2