ORIGINAL ARTICLE

Comparison of ileocecal resection and right hemicolectomy in the surgical treatment of complicated appendicitis

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ABSTRACT

BACKGROUND: Simple appendectomy with a complicated appendicitis diagnosis could prove difficult, sometimes requiring extended resection. Hence, we aimed to compare two procedures that are preferred for extended resection, ileocecal resection, and right hemicolectomy, in terms of patients' demographic data, preoperative laboratory values (white blood cell [WBC], Neutrophil-to-lymphocyte ratio [N/L], C-reactive protein [CRP]), operation times, postoperative complications, length of hospital stay, and 1-month mortality rates.

METHODS: We retrospectively reviewed patients who underwent extended resection with the diagnosis of complicated appendicitis in our clinic from February 2015 to December 2020. We divided the patients into two groups those who underwent right hemicolectomy and those who underwent ileocecal resection.

RESULTS: Among the 55 patients who underwent extended resection with the diagnosis of complicated appendicitis, 32 (58.1%) underwent right hemicolectomy and 23 underwent ileocecal resection (41.8%). The groups did not differ statistically significantly in terms of demographic characteristics, preoperative laboratory values (WBC, N/L, CRP), Clavien–Dindo classification scores, mean hospital stay, or 1-month mortality rates ($p>0.005$). However, there was a statistically significant difference between the groups in terms of operation time ($p<0.001$).

CONCLUSION: Ileocecal resection is a safe procedure for patients diagnosed with complicated appendicitis who are scheduled for extended resection.

Keywords: Complicated appendicitis; extended resection; ileocecal resection; right hemicolectomy.

INTRODUCTION

Acute appendicitis is the disease that most commonly necessitates surgical intervention in pediatric and adult patients who present to emergency units with acute abdominal pain; its incidence among such patients ranges from 7% to 9%.[1,2] On the basis of clinical and pathological findings, appendicitis is classified as complicated or uncomplicated. Complicated appendicitis is defined by abscess development, gangrene formation, phlegmon, or appendix perforation caused by the infection.[3] Approximately 25–30% of all appendicitis cases are complicated.[4-6]

Appendectomy is the "gold standard" of treatment of appendicitis and can be performed easily when the disease is diagnosed early. Delayed diagnosis or slow progression, however, may cause the appendix to be surrounded by a compensatory reaction and become an inflamed mass, or abscess formation may occur.[7]

Conservative management of complicated appendicitis has

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become common,[3,8] but research has shown that appendicitis recurs in 5–27% of cases treated conservatively.[9-11] Data concerning decisions and timing of surgery also remain conflicted.[12] Thus, the optimal treatment of complicated appendicitis is still controversial.

Appendectomy is technically more difficult for complicated appendicitis than for uncomplicated appendicitis; extended resections such as ileocecal resection or right hemicolectomy are sometimes required.[13] Extended resections are performed in 3–30% of cases of complicated appendicitis and are associated with higher rates of morbidity than simple appendectomy.[8,14]

We found no comparison of the two techniques that are applied for extended resection in cases of complicated appendicitis: ileocecal resection and right hemicolectomy. Therefore, we compared the patients who underwent ileocecal resection and right hemicolectomy for complicated appendicitis in our clinic in terms of their demographic characteristics, preoperative laboratory values (white blood cell [WBC] count, neutrophil–lymphocyte ratio [N/L], and C-reactive protein [CRP] level), operation times, postoperative complications, and length of hospitalization.

MATERIALS AND METHODS

Samples and Ethical Considerations

We investigated the files, surgery notes, and anesthesia records of patients who underwent extended resection by ileocecal resection or right hemicolectomy for complicated appendicitis in our clinic from February 2015 to December 2020. We retrospectively documented the patients' demographic data (age, sex, American Society of Anesthesiologists [ASA] score, and comorbidities), preoperative routine laboratory values (WBC count, N/L, and CRP level), perioperative data (specific procedure, operation time), postoperative complications, length of hospitalization, and mortality rates.

We obtained approval of this study from the local ethics committee.

Preoperative Preparation

Patients in whom appendicitis was diagnosed on the basis of anamnesis, physical examination findings, laboratory test results, and radiological images at their first admission to the hospital were admitted to the general surgery clinic. In accordance with guidelines of the World Society of Emergency Surgery, complicated appendicitis was defined either as gangrenous inflammation, with or without perforation and with or without abdominal abscess or as an inflamed mass.[15] Our clinic does not have an institutional protocol for the treatment of complicated appendicitis; therefore, the surgeon performed treatment and made all decisions about surgical technique (ileocecal resection or right hemicolectomy). However, indications for emergency surgery and postoperative follow-up and treatment were already established in the clinic.

Surgical Procedures and Postoperative Complications

Patients who underwent extended resection for complicated appendicitis were divided into two groups: those who underwent ileocecal resection and those who underwent right hemicolectomy. Postoperative complications were defined as wound infection, intra-abdominal abscess, postoperative ileus, and anastomotic leakage, detected up to 30 days after surgical treatment. Wound infection was diagnosed according to the guidelines of the U.S. Centers for Disease Control and Prevention.[16] An intra-abdominal abscess was defined as a localized infection in the abdomen and confirmed by the appearance of fluid accumulation on radiological tests. Paralytic ileus was considered present if oral food and fluid intake had been reduced for several days because of abdominal bloating, nausea, and vomiting. Anastomotic leakage was defined by the spread of intestinal contents into the abdomen with partial or complete disruption of anastomotic integrity.

The severity of postsurgical morbidity was classified according to the Clavien–Dindo classification. Grade III or worse complications were considered major adverse effects.[17] The length of hospitalization was defined as the number of nights spent in the postoperative hospital. Mortality was defined as death during hospitalization or within 30 days after surgery.

Inclusion Criteria

The study included patients aged 18 years or older who underwent extended resection because of the presence of gangrenous inflammation, abdominal abscess, inflamed mass, or appendiceal stump or cecum perforation, for which simple appendectomy was insufficient.

Exclusion Criteria

Patients with Crohn's disease, ulcerative colitis, or malignant disease and those with incomplete postoperative follow-up data were excluded from this study.

Statistical Analysis

We used the Shapiro–Wilk test to check whether the data had a normal distribution, Student's t-test to compare normally distributed data between the groups, and the Mann–Whitney U-test to compare nonnormally distributed data between the groups. We analyzed the correlations between categorical variables using the Pearson correlation and the Chi-square test. For descriptive statistics, numerical variables were calculated as means ± standard deviations, and categorical variables were calculated as frequencies and percentages. We used the IBM SPSS Statistics for Windows, Version 24.0 (IBM Corporation, Armonk, NY, USA), for statistical analysis, and a $p<0.05$ was considered statistically significant.

RESULTS

We included 55 patients who underwent extended resection for complicated appendicitis: 24 men (43.6%) and 31 women (56.4%). Right hemicolectomy was performed in 32 patients (58.1%), and ileocecal resection, in 23 (41.8%).

The mean age of the patients who underwent right hemicolectomy was 60.03±16.19 years; that of those who underwent ileocecal resection was 45.04±18.71 years. The most common comorbidity was hypertension (20%); most patients (63.6%) had no additional comorbidities. The most common preoperative ASA risk score was 2 (49%). We found no statistically significant difference between the two groups in terms of age, sex, comorbidity, or ASA scores. Table 1 lists the patients' demographic characteristics.

With regard to preoperative and perioperative results, we observed no statistically significant difference between the groups in levels of inflammatory markers in laboratory blood tests (WBC, N/L, or CRP). The mean duration of the right hemicolectomy was 98.59±5.85 min, and that for ileocecal resection was 86.3±8.29 min; the difference was statistically significant (p<0.001). Table 2 lists the patients' preoperative and perioperative data.

Among postoperative results, we found no statistically significant difference between the Clavien–Dindo classification scores of the two groups (p>0.005). We classified complications as grade III or above in 15.7% of the patients who underwent right hemicolectomy and 12.9% of those who underwent ileocecal resection. The rate of postoperative ileus was higher after right hemicolectomy (6.3% of patients), although the difference was not statistically significant. The wound infection rate was higher after ileocecal resection (4.3% of patients), but this difference was also not statistically significant. No intraabdominal abscess, fluid accumulation, or anastomotic leakage was detected in either group. Hospitalization was, on average, longer after right hemicolectomy (6.3%), but the difference was not statistically significant. Table 3 lists the patients' postoperative results.

DISCUSSION

Appendicitis is complicated more often among young and elderly individuals with concomitant diseases such as diabetes, coronary artery disease, or hypercholesterolemia and among people who smoke, as a result of delayed diagnosis and treatment.[2,18] Research has shown that in patients with complicated appendicitis, physical examination findings may vary, as may individual responses to inflammation, and some patients have a predisposition to complications such as transmural ischemia, gangrene, abscess, inflamed mass, or perforation.[19] Infection rates, length of hospitalization, and total complication rates are also known to be significantly greater with

Table 1. Patient characteristics and demographic data

Variables	Right hemicolectomy (n=32) (%)	Ileocecalresection (n=23) (%)	p-value
Age in years, mean±SD	60.03±16.19	45.04±18.71	0.053
Gender. n (%)			
Male	13 (40.6)	11 (47.8)	0.595
Female	19 (59.4)	12 (52.2)	
Co-morbidity, n (%)			
None	17 (53.1)	18 (78.3)	0.1
1. Chronic disease	8 (25)	4 (17.4)	03
2. Chronic disease	7 (21.9)	1 (4.3)	
ASA, n (%)	3 (9.4)	2 (8.7)	0.0
ASA 1	13 (40.6)	14 (60.9)	63
ASA 2	16 (50)	7 (30.4)	
ASA 3			

SD: Standard deviation; ASA: American society of anesthesiologists.

Table 2. Preoperative and peroperative data

Variables	Right hemicolectomy (n=32)	Ileocecalresection (n=23)	p-value
WBC (µl/ml) (mean±sd)	11759.38±9054.85	10969.57±4811.39	0.705
NLR (mean±sd)	8.78±6.82	8.98±13.04	0.942
CRP (mg/L) (mean±sd)	106.63±64.13	109.92±64.59	0.852
Operation time in minute (mean±sd)	98.59±5.85	86.3±8.29	<0.001

WBC: White blood cells; NLR: Neutrophil-to lymphocyte ratio; CRP: C-reactive protein; ASA: American society of anesthesiologists.

Table 3. Postoperative results

Variables	Right hemicolectomy (n=32) (%)	Ileocecal resection (n=23) (%)	p-value
Clavian-Dindo ≥3	5 (15.6)	3 (13)	0.789
Postoperative ileus, n (%)	2 (6.3)	1 (4.3)	0.759
Wound infection, n (%)	1 (3.1)	1 (4.3)	0.811
Mortality, n (%)	2 (6.3)	1 (4.3)	0.759

complicated appendicitis than with uncomplicated appendicitis, although different statistics have been reported.[19]

For many years, surgery has been the "gold standard" of treatment of acute appendicitis. Recent research has shown that conservative treatment is safe and feasible for the majority of adults and children.[9,20] However, the choice of surgical or conservative treatment for complicated appendicitis is difficult because conservative treatment has a high failure rate and the surgical techniques are difficult.[21] The guidelines of the World Society of Emergency Surgery suggest that a conservative approach for appendicitis, phlegmon, or appendicitis with abscesses is reasonable as first-line treatment, but surgery performed by experienced operators is a safe alternative to conservative treatment.[15] Hence, the optimal treatment for complicated appendicitis remains controversial.

In patients with complicated appendicitis, conservative treatment has been reported to have a failure rate of 7%.[9] Surgery may be performed because malignancy cannot be ruled out or because of the difficulty of percutaneous interventional procedures.

Traditionally performed for the diagnosis of appendicitis, simple appendectomy is one of the easiest and most common procedures. However, appendectomy is not appropriate for some cases of complicated appendicitis, in which extended resection is necessary, particularly in patients with delayed diagnoses, in patients with diffuse peritonitis findings, or elderly patients with severe comorbidities.[22] In one study, among patients with complicated appendicitis for which simple appendectomy was sufficient, rates of paralytic ileus and wound infection and the overall complication rate were lower, and hospitalization was shorter than among patients who underwent extended resection.[22] However, simple appendectomy may not be possible in cases of abdominal abscess, cecum perforation, inability to close the appendix stump safely, cecal ischemia, or inflamed mass. Higher morbidity rates have been reported among patients with these conditions who require extended resection.[23]

Extended resection has yet to be clearly defined in the literature. In general, ileocecal resection or right hemicolectomy is performed according to the surgeon's preference and experience. In the literature, however, we found no comparison of ileocecal resection and right hemicolectomy for complicated appendicitis. Our study is the first assessment and comparison of these two procedures for extended resection in treating complicated appendicitis.

We found no statistically significant difference in the preoperative characteristics of the two groups. Clavien–Dindo classification scores did not differ statistically significantly between the two groups, but classifications of grade III and above were more common among patients who underwent right hemicolectomy (15.7%). Similarly, postoperative ileus was more common among those who underwent right hemicolectomy (6.3%), although the difference was not significant. Hence, we believe that the ileocecal resection procedure, where the organ can be preserved with less anatomical resection, can provide better morbidity rates. Moreover, ileocecal resection was significantly shorter than right hemicolectomy ($p<0.001$). These results suggest that ileocecal resection entails a more limited dissection. Hence, we believe that ileocecal resection, in which more of the organ can be preserved, may mediate morbidity rates. Finally, hospitalization was, on average, shorter in patients who underwent ileocecal resection, although the difference between the two groups was not statistically significant.

This study had several limitations. First, it was retrospective research conducted at a single center, and the sample was small. Second, the procedure for extended resection was chosen by the surgeon; no clinical consensus of other medical professionals was involved in this choice. Further research with larger patient populations and at multiple centers is needed.

Conclusion

Ileocecal resection, which involves less anatomical resection than does right hemicolectomy, is a safe procedure for complicated appendicitis when extended resection is necessary. Nonetheless, further studies are needed to establish its superiority over right hemicolectomy.

Ethics Committee Approval: This study was approved by the Health Sciences University Derince Training and Research Hospital Clinical Research Ethics Committee (Date: 24.02.2022, Decision No: 2022-17).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Komplike apandisitin cerrahi tedavisinde ileoçekal rezeksiyon ile sağ hemikolektominin karşılaştırılması

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AMAÇ: Komplike apandisit tanısıyla basit apendektomi zor olabilir ve bu durumda bazen genişletilmiş rezeksiyona ihtiyaç duyulur. Bu nedenle genişletilmiş rezeksiyon olarak tercih edilen ileoçekal rezeksiyon ve sağ hemikolektomi prosedürlerini; hastaların demografik verileri ve preoperatif laboratuvar tetkiklerinden (WBC (White Blood Cell), N/L (Neutrophil-to-lymphocyteratio), CRP (C-reactive protein)) değerleri, ameliyat süresi, postoperatif komplikasyonlar, hastanede yatış süresi ve bir aylık mortalite olarak karşılaştırmayı amaçladık.
GEREÇ VE YÖNTEM: Kliniğimizde Şubat 2015- Aralık 2020 tarihleri arasında komplike apandisit tanısıyla genişletilmiş rezeksiyon yapılan hastalar geriye dönük olarak değerlendirildi. Sağ hemikolektomi veya ileoçekal rezeksiyon prosedürü uygulanan hastalar iki gruba ayırıldı.
BULGULAR: Komplike apandisit tanısıyla genişletilmiş rezeksiyon uygulanan 55 hastanın 32'sine (%58.1) sağ hemikolektomi ve 23'üne (%41.8) ileoçekal rezeksiyon yapıldı. Gruplar arasında demografik özellikler, preoperatif laboratuvar (WBC, N/L oranı, CRP) değerleri, Clavian-Dindo komplikasyon sınıflandırması, ortalama hastanede yatış süresi ve bir aylık mortalite açısından istatistiksel olarak anlamlı fark yoktu (p>0.005). Operasyon süresi bakımından ise gruplar arasında istatistiksel olarak anlamlı fark vardı (p<0.001).
TARTIŞMA: Genişletilmiş rezeksiyon planlanan komplike apandisit tanılı hastalarda ileoçekal rezeksiyon prosedürü güvenle tercih edilebilir.
Anahtar sözcükler: Komplike apandisit; genişletilmiş rezeksiyon; sağ hemikolektomi; ileoçekal rezeksiyon.

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