

The effect of COVID-19 pandemic period on acute appendicitis and its complications

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ABSTRACT

BACKGROUND: Acute appendicitis is the most common abdominal surgical emergency. This new type of coronavirus, also called SARS-CoV-2, causes severe acute respiratory syndrome, and this has turned into a pandemic. We aimed to determine the risk factors associated with appendectomy and complicated appendicitis during the COVID-19 pandemic period and to evaluate the effects on the surgical treatment of acute appendicitis and its outcomes. In the current comparative study, we analyzed its effects on appendectomy management and complicated appendicitis in patients with appendicitis during the COVID-19 pandemic and past year covering the same period.

METHODS: The patients in this study consisted of adult patients with acute appendicitis who applied to the Emergency Surgery Department of Kartal Dr. Lütfi Kırdar City Hospital General Surgery Clinic between March 1, and August 31, 2020 (COVID-19 period) (Group B) and the same period of 2019 (Group A). A comparative and retrospective study was planned. A total of 658 patients who presented with acute appendicitis were included in the study. Group A and Group B consist of 347 and 311 people, respectively.

RESULTS: No significant difference was found in the demographic and clinical characteristics of the study population. There was no significant difference between Group A and B in terms of the duration of the application of patient complaints, the duration of the procedure, the time the patient was admitted to the hospital, the time of the patient being taken to the surgery, the findings during the operation, and the post-operative complications. There were similar features in general appendectomy pathologies, but in our study, a significant decrease in catarrhal appendicitis was observed in Group B, namely, during the COVID-19 pandemic period ($p=0.04$).

CONCLUSION: During the COVID-19 pandemic, there was no significant increase in complicated appendicitis, but a significant reduction in negative appendectomies. This result shows that during the pandemic period, patients do not come to the emergency surgery unit unnecessarily and receive timely and appropriate surgical care.

Keywords: Acute appendicitis; complicated appendicitis; COVID-19 pandemic period.

INTRODUCTION

The novel type of coronavirus strain first appeared in Wuhan, China. This new type of coronavirus, also called SARS-CoV-2, causes severe acute respiratory syndrome. The World Health Organization officially named SARS-CoV-2, the disease caused by coronavirus infection, as COVID-19.^[1] COVID-19 presents with a wide range of clinical manifestations, often with pulmonary involvement, typically including fever, dry cough, myalgia, and fatigue. The first COVID-19 infection in

Turkey was reported by the Minister of Health on March 11, 2020. Later, many states announced the first cases in their country. COVID-19 has turned into a worldwide pandemic, first affecting China and then the whole world.^[2] Acute appendicitis is the most common condition in abdominal surgery emergencies. Similarly, acute appendicitis has been the most common abdominal surgical emergency during COVID-19 pandemic. There is insufficient information in the current literature to evaluate the effects of the COVID-19 pandemic on acute appendicitis and its surgical treatment. Therefore,

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this comparative study was conducted to report the management of appendectomy and its complications in patients with appendicitis during the COVID-19 pandemic and past year covering the same period. Negative appendectomies are seen in 3–14% of the pathological examinations performed on patients undergo appendectomy.^[3] The unprecedented global crisis caused by the COVID-19 pandemic has put a huge burden on medical systems worldwide and has also affected the emergency surgery department. Acute abdominal emergencies requiring surgery are one of the most common causes of non-traumatic hospitalizations. Given the negative impact caused by the COVID-19 pandemic in high capacity clinics, the number of emergency procedures is expected to remain unchanged.^[4] The aim of this study is; in patients admitted to the hospital in the COVID-19 pandemic, it is to examine the onset of symptoms, the time between the onset of symptoms and the time of admission to the hospital, and the time between admission to the hospital and the diagnosis of acute appendicitis. In addition, the effects of the COVID-19 pandemic on patients' surgical findings, length of hospital stay, and post-operative complications were also examined. Many surgical communities have published guidelines suggesting postponement of elective surgery.^[5] Some officials expressed their opinion that patients with low severity complaints during the pandemic period should not apply to emergency services to prevent the spread of the infection caused by COVID-19.^[6]

MATERIALS AND METHODS

This study was approved by the Kartal Dr. Lütfi Kırdar City Hospital Ethics Committee. (No: 202/514/16, Date: September 30, 2020). The patients in this study consisted of adult patients who applied to the Emergency Surgery Department of Kartal Dr. Lütfi Kırdar City Hospital General Surgery Clinic between March 1, and August 31, 2020 (COVID-19 period) and the same period of 2019 and who meet the criteria of the International Classification of Diseases-10 for acute appendicitis. The number of patients presenting with acute appendicitis and the rate of complicated appendicitis before and during the restriction period in the COVID-19 pandemic were determined. The directive for postponing elective surgeries was published by Kartal Dr. Lütfi Kırdar City Hospital on March 15, 2020. Groups were formed by determining two different time intervals; Group A covers the period from March 1, to August 31, 2019, while Group B covers the period from March 1, to August 31, 2020. Two long periods of 6 months of each year were studied to assess whether potential differences were caused by COVID-19 and related to temporary or seasonal changes.

Variables collected included patient age, gender, comorbidities, onset time of the complaint, pre-operative symptoms, imaging, and laboratory findings. The diagnosis, type of treatment, length of hospital stay, post-operative complications, and pathological results were examined.

In addition to demographic and clinical features, appendectomy and drain placement, different post-operative pathological diagnoses [catarrhal (negative) appendicitis, non-complicated acute appendicitis (includes phlegmonous appendicitis), and complicated appendicitis (includes gangrenous appendicitis and perforated appendicitis) and appendix malignancy] were determined. Negative appendectomies in our study were cases defined as catarrhal appendicitis in pathological examinations. However, appendectomies performed for gynecological reasons (ovarian cyst rupture, pelvic inflammatory diseases, ovarian torsion, etc.) and other surgical reasons (colectomies, intussusception, etc.) were not included in our study. Cases defined as malignancy in pathology samples after appendectomy are also indicated in the table. We predicted the differences to determine the impact of COVID-19 on our binary results. We divided these relationships into two groups using a univariate model.

The Statistical Package for the Social Sciences for Windows 22.0 was used for all statistical analyzes in the study. While evaluating the study data, student t-test was used to compare normally distributed parameters between groups in comparison of quantitative data as well as descriptive statistical methods (mean, standard deviation, and frequency). Chi-square test and Fisher's exact Chi-square test were used to compare qualitative data. The results were evaluated at a 95% confidence interval, and the significance level was $p < 0.05$.

RESULTS

A total of 658 patients who were admitted to our institution with acute appendicitis were identified during the specified periods in the study. In the study, Group A consisted of 347 patients, while Group B consisted of 311 patients. The demographic features, laboratory results, and clinical characteristics of the study population are shown in Table 1. Comparison between the two groups did not show a significant difference in variables such as age, gender, onset time of the complaint, time from hospital admission to surgery, and pre-operative laboratory values. Procedure time, use of drains, post-operative complications, and length of hospital stay were also similar between Groups A and Group B. Patients had longer admission to hospital after COVID-19 restrictions were imposed, but this was not statistically significant (Table 1).

The pathological results in our study are shown in Figure 1 (in percent) and Table 2 (in number). There were no significant differences in general appendectomy pathologies, but catarrhal appendicitis decreased significantly in Group B during the COVID-19 pandemic period in our study (Table 2).

DISCUSSION

In addition to being a serious threat to public health, the COVID-19 pandemic also seriously affects human life and wel-

Table 1. Demographic and clinical characteristics of the study population

Variables	2019 Group A	2020 Group B	Total	p-value
n (%)	347 (52.7)	311 (47.3)	658 (100)	
Average age, (min-max)	35.0 (15–84)	35.5 (15–84)	35.2 (15–84)	0.62
Female, n (%)	131 (37.8)	119 (38.3)	250 (38.0)	
Male, n (%)	216 (62.2)	192 (61.7)	408 (62.0)	
Length of complaints (days, +/-)	1.5 (+/-0.84)	1.8 (+/-2.3)	1.7 (+/-1.9)	0.73
Average time from admission to the hospital to surgery (hours) (SD)	9.5 (6.85)	10.3 (9.15)	10.1 (8.5)	0.55
WBC average (sd) ($\times 10^3/\mu\text{L}$)	13.3 (3.7)	13.1 (4.1)	13.2 (3.9)	0.41
NEU average (sd) ($\times 10^3/\mu\text{L}$)	10.8 (5.7)	10.4 (4.0)	10.6 (5.0)	0.36
Abdominal pain (+/%)	343 (98.8)	311 (100)	654 (99.4)	0.06
Nausea-Vomiting (+/%)	248 (71.5)	229 (74)	478 (72.6)	0.45
Fever (+/%)	53 (15.3)	36 (11.6)	89 (13.5)	0.17
Lack of appetite (+/%)	194 (55.9)	161 (51.8)	355 (54.0)	0.29
Drain (+/%)	50 (14.4)	36 (11.6)	86 (13.1)	0.28
Perforation (+)	37 (10.7)	31 (10)	68 (10.3)	0.77
Average length of hospitalization (days) (SD)	1.65 (1.4)	1.62 (1.6)	1.63 (1.5)	0.24

WBC: White blood cells; NEU: Neutrophils; SD: Standard deviation.

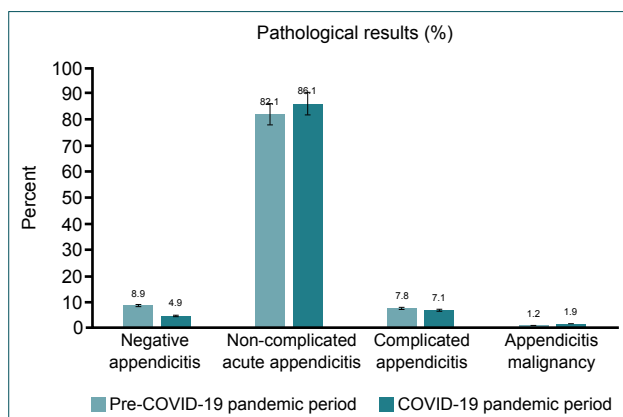
Table 2. Pathological results of the study population

Pathological variables	2019 Group A	2020 Group B	Total	p-value
Negative appendectomies, n (%)	31 (8.9)	15 (4.89)	46 (7.0)	0.04*
Non-complicated acute appendicitis, n (%)	285 (82.1)	268 (86.1)	553 (84.0)	ns
Complicated appendicitis, n (%)	27 (7.8)	22 (7.1)	49 (7.4)	ns
Appendicitis malignancy, n (%)	4 (1.2)	6 (1.9)	10 (1.5)	ns
Total	347	311	658	

*Statistically important. ns: Not significant.

fare. Extensive measures have been implemented to prevent person-to-person transmission to control this deadly virus. At present, positive results have been achieved throughout the country with the measures and control protocols imple-

mented by our country to prevent the spread of this emerging virus. However, the global spread has become alarming. One of the most effective ways to prevent transmission of the virus can be “staying home.” In this study, the delay in seeking medical helps for acute appendicitis after an epidemic or absenteeism according to the degree of complaints due to the risk of infection in the hospital; compared to the pre-epidemic cases, possible differences in treatment, the time from the onset of the first symptoms to hospitalization, and the time from hospitalization to surgery were observed. In addition, fewer patients were admitted to the hospital after the outbreak compared to cases before the outbreak, but there was no statistically significant difference between them. Besides, non-operative treatment with antibiotics may be appropriate in some patients.^[7,8] On the other hand, due to the high rate of complicated appendicitis, non-surgical treatment may not be suitable for elderly patients. Dhillon et al.^[9] found a close relationship between age and the prevalence of complicated appendicitis.

**Figure 1.** Pathological results.

A decrease in treatment intention, such as a fear of infection in the hospital, may be one reason patients deliberately delay treatment. This leads to a prolongation of the time from the onset of the first clinical symptoms to hospitalization. However, there may be situations where the lack of medical resources does not satisfy patients' desire to receive treatment during the epidemic period. As a result, we used the time from onset of clinical symptoms to hospitalization to evaluate patients' delayed admissions. An obvious shortage of medical facilities, health personnel, and resources was not observed in our country. In our study, the increase in the time until appendectomy in patients diagnosed with acute appendicitis is not a risk factor for complications. This situation is in line with the study of Yeh et al.^[10] As mentioned earlier, the number of patients with appendicitis was lower in the epidemic group than in the pre-epidemic group. In addition, no significant difference was observed between the two groups in terms of body temperature, WBC count, and neutrophil count.

During the current pandemic, special attention should be paid to the prevention and control of COVID-19. Every patient visiting the hospital should be asked to wear a surgical mask. A complete medical history should be taken, with emphasis on respiratory symptoms and the epidemiological history of the patient, their families and visitors in the previous 14 days, and body temperature should be measured at admission. Meanwhile, people who are not excluded from coronavirus infection should be restricted from visiting patients.^[11]

Before current patients are admitted to the hospital, each patient should be routinely examined by polymerase chain reaction (PCR) tests. Patients suspected of having COVID-19 infections should be taken to a single protected isolation room and it is recommended that the room be urgently equipped with at least one negative pressure system used in the operating room. In addition, an open appendectomy should be performed and the use of ultrasonic surgical instruments should be avoided to prevent the virus from spreading aerosol. All team members should be trained in knowledge, equipment, and skills related to COVID-19 infection prevention. In our study, in addition to PCR test positivity in three patients, there were findings in thoracic computer tomography in one patient and the patients were operated considering these conditions.

Findings highlighted in the study by Ganesh et al.,^[12] which includes the short-term results of the effect of the COVID-19 pandemic on acute appendicitis; demographic characteristics, hospital admission and operation time, surgical treatment, complications, and length of hospitalization which are in line with our study.

In the study conducted by Kumaira Fonseca et al.,^[13] a decrease in the number of appendectomies and an increase in the time from the onset of complaints to the hospital was

found during the COVID-19 pandemic. While the findings in our study are similar to this study, no statistically significant difference was found in contrast to this study.

In a multicenter and retrospective study conducted by Tankel et al.,^[14] a significant decrease was observed in the number of hospital admissions of patients with acute appendicitis, but there was no significant difference between the groups in terms of the duration of pre-operative symptoms, the need for post-operative peritoneal drainage, or the distribution of complicated and uncomplicated appendicitis, which is in line with our study.

In the study conducted by Gao et al.,^[15] in which the effect of the COVID-19 pandemic period on complicated appendicitis was examined, it was stated that the period from the beginning of the complaints of the patients to the hospital admission significantly increased, these findings are not compatible with our study.

In the study conducted by Orthopoulos et al.^[16] to investigate the effect of the COVID-19 pandemic period on complicated appendicitis, the number of patients decreased during the COVID-19 pandemic period, while an increase in complicated appendicitis was observed. However, in our study, no increase was observed in complicated appendicitis.

In a two-period comparative study by Meriç et al.,^[17] they found a significant increase in perforated appendicitis, and although there was an increase in perforations in our study, it was not statistically significant.

In our study, catarrhal appendicitis or negative appendectomy rates were found to be 8.9% before the COVID-19 pandemic and 4.89% during the COVID-19 pandemic, which is consistent with the overall rate. As a matter of fact, it is 6.6% in the study of Kinnear et al.^[3] In the same study, this rate in negative appendectomy general information input varied between 3 and 14%.

In addition to the higher rates of reports of complicated appendicitis findings in the pathological examinations of patients in the COVID-19 pandemic period, the hypothesis that patients have a more severe inflammatory prevalence compared to the pre-COVID-19 pandemic period is supported by many researchers. The results of our study were not consistent with this hypothesis. In the study of Rudnicki et al.,^[18] in addition to the significant increase in the number of acute complicated appendicitis during the COVID-19 pandemic period, our study shows parallelism with other clinical and pathological findings.

Some limitations of this study should be pointed out. First and foremost, this study is a retrospective study. Second, in our study, we presented the pathology results in detail, so we used some variables that were not reported in other studies.

When compared with other studies, we did not see any differences in complicated appendicitis for both periods, but we saw a significant decrease in the number of catarrhal appendicitis or negative appendectomy. The reason for this is that patients do not apply to the hospital before their complaints are fully evident due to the fear of virus contamination. We also attribute the cessation or limited performance of elective surgery to the fact that all surgeons focus their potential attention on emergency surgery cases.

The number of patients in our study decreased in the pandemic period compared to the pre-pandemic period, but this did not create a statistically significant difference, the reason for this can be explained by the fact that our hospital is the central hospital and the surrounding hospitals refer patients to our hospital.

Conclusion

Comparison of demographic characteristics, laboratory results, and clinical characteristics of the study population between the two groups did not show a significant difference in variables such as age, gender, pre-operative laboratory values, and vital values. Procedure time, post-operative complications, and admission time were also similar between different years, that is, Group A and Group B. Patients who admitted after COVID-19 restrictions were imposed had longer admission time, but this was not statistically significant.

No significant differences were observed in the general appendectomy pathologies in our study, but in our study, catarrhal appendicitis decreased significantly during the COVID-19 pandemic period.

During the COVID-19 pandemic, there was no significant increase in expected complicated appendicitis, but a significant reduction in negative appendectomies. With this result, we concluded that patients do not apply to the emergency surgery unit unnecessarily during the pandemic period. Again, during the COVID-19 pandemic, patients with acute appendicitis seem to receive timely and appropriate surgical care.

Ethics Committee Approval: This study was approved by the Kartal Dr. Lütfi Kırdar City Hospital Clinical Research Ethics Committee (Date: 30.09.2020, Decision No: 202/514/16).

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Conflict of Interest: None declared.

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ORİJİNAL ÇALIŞMA - ÖZ

COVID-19 pandemi döneminin akut apandisit ve komplikasyonları üzerine etkisi

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AMAÇ: Akut apandisit, en yaygın abdominal cerrahi acil durumdur. SARS-CoV-2'de koronavirüsün bu yeni tipi ciddi akut solunum yolu sendromuna neden olmaktadır ve bu durum küresel çapta bir pandemiye dönüşmüştür. COVID-19 pandemi döneminde apendektomi ve komplike apandisit ile ilişkili risk faktörlerini belirlemek akut apandisit cerrahi tedavisi ve sonuçları üzerindeki etkilerini değerlendirmeyi amaçlanmıştır. Mevcut karşılaştırmalı çalışma, COVID-19 pandemisi sırasında ve aynı dönemi kapsayan geçen yıl apandisitli hastalarda apendektomi yöntemi ve komplike apandisit üzerine etkileri analiz edildi.

GEREÇ VE YÖNTEM: Bu çalışmadaki hastalar 1 Mart–31 Ağustos 2020 COVID-19 pandemisi döneminde (Grup B) ve 2019 yılının aynı döneminde (Grup A) Kartal Dr. Lütfi Kırdar Şehir Hastanesi Genel Cerrahi Kliniği Acil Cerrahi Bölümü'ne başvuran akut apandisitli yetişkin hastalardan oluşmaktadır. Bu çalışma, karşılaştırmalı ve geriye dönük bir çalışma olarak planlandı. Çalışmaya akut apandisit ile başvuran toplam 658 hasta alındı. Grup A 347 hastadan oluşurken, Grup B 311 hastayı içeriyordu.

BULGULAR: Çalışma popülasyonunun demografik özellikleri ve klinik özelliklerinde anlamlı bir farklılık görülmedi. Hasta şikayetlerinin başvuru süresi, hastanın hastaneye geliş ile ameliyata alınma süresi, ameliyat esnasındaki bulgular ve ameliyat sonrası komplikasyonlarda da Grup A ve B arasında da anlamlı bir fark görülmedi. Genel apendektomi patolojilerinde benzer özellikler mevcuttu ancak çalışmamızda Grup B de yani COVID-19 pandemi döneminde kataral apandisitte istatistiksel olarak anlamlı derecede azalma görüldü ($p=0.04$).

TARTIŞMA: COVID-19 pandemisi sırasında komplike apandisitte önemli artış görülmedi ancak negatif apendektomilerde önemlide derecede azalma görüldü. Bu sonuç pandemi döneminde hastaların gereksiz acil cerrahi birimine gelmediklerini ve zamanında ve uygun cerrahi bakım aldıklarını göstermektedir.

Anahtar sözcükler: Akut apandisit; COVID-19 pandemi dönemi; komplike apandisit.

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