

Comparison of the Effects of COVID-19 Pandemic on Acute Appendicitis Treatment and Its Clinical Outcomes with the Pre-COVID-19 Pandemic Period

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Abstract

Aim: We aimed to compare the rate of admission to the hospital, duration of symptoms, prior admission to an external center, laboratory values, risk of complication development, and length of hospitalization of patients diagnosed with acute appendicitis and undergoing appendectomy during the pre- and Coronavirus disease-2019 (COVID-19) pandemic periods.

Materials and Methods: A total of 464 patients, male and female, over the age of 18 years who were operated on with the diagnosis of acute appendicitis in Gaziantep University Medical Faculty Hospital General Surgery Clinic were included in our retrospective study. All patients underwent an open appendectomy with the diagnosis of acute appendicitis. Periods are pre-COVID-19 pandemic (March 11, 2019-March 10, 2020) and COVID-19 pandemic period (March 11, 2020-March 10, 2021).

Results: Of the cases included in the study, 254 (54.7%) were admitted before the pandemic and 210 (45.3%) were admitted during the pandemic period. Of the patients, 238 (51.3%) were female and 226 (48.7%) were male. The mean duration of symptoms of the patients was 2.41 ± 2.38 days. In our study, it was found that only the duration of symptoms was prolonged during the pandemic period.

Conclusion: Because of our study, patients applied to our health center later due to limitations in social life and fear of contamination during the pandemic period. The pandemic period did not increase the complication risk of acute appendicitis cases.

Keywords: Acute appendicitis, pandemic, COVID-19, acute abdomen, duration of symptoms

Introduction

The most common cause of emergency surgery in the world is acute appendicitis (1,2). Acute appendicitis is the clinical picture that occurs due to inflammation in the appendix. Fecalitis and lymphoid tissue proliferation are the most common causes of acute appendicitis (3). Diagnosis is made by physical examination and supported using laboratory and imaging methods. It is most commonly seen in the second and third decades (4). Its incidence is 233/100,000 people in the world. It is more common in men (1). Each year, appendectomy is performed on 700000 people in Europe and 250000-300000 people in the USA. Currently, there are many different views and approaches in the management of acute appendicitis. But the gold standard in treatment is surgery. In late intervention, the clinic of simple appendicitis leaves its

place to perforation, and mortality increases in morbidity (5). The probability of the perforation of the appendix within 36 h after the onset of abdominal pain is between 16-36%. The longer the time, the higher the rate (6).

At the end of 2019, cases of pneumonia of unknown cause were reported in the city of Wuhan in the Hubei region of China. On January 7, 2020, it was reported that the cause of these pneumonia cases was an unprecedented new type of coronavirus (2019-nCoV). The World Health Organization (WHO) declared an emergency that threatens the health of the international community on January 30, 2020 and was declared a "pandemic" on March 11, 2020 by WHO (7). Coronavirus disease-2019 (COVID-19) studies started in Turkey on January 10, 2020 and the first scientific advisory board meeting was held on January 22, 2020. The first COVID-19



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case in Turkey was seen on March 11, 2020 (8). Since this date, changes have been made in surgical services in hospitals with the COVID-19 pandemic. Elective cases have been postponed, and there have been changes in treatment protocols for emergencies.

Our aim in this study was to compare the treatment and clinical outcomes of patients hospitalized with the diagnosis of acute appendicitis in the general surgery clinic of Gaziantep University Medical Faculty Hospital between the 1-year period from the beginning of the COVID-19 pandemic (March 11, 2020-March 10, 2021) and the 1-year period before the COVID-19 pandemic (March 11, 2019-March 10, 2020).

Materials and Methods

Gaziantep University Faculty of Medicine Clinical Research Ethics Committee approval was obtained for the study with protocol number 2021/255 dated August 5, 2021. A total of 464 patients, male and female, over the age of 18 years who were operated on with the diagnosis of acute appendicitis in Gaziantep University Medical Faculty Hospital General Surgery Clinic were included in our study. All patients underwent an open appendectomy with the diagnosis of acute appendicitis. The recorded data of the patients in the archive of Gaziantep University Faculty of Medicine, Department of General Surgery, and in the hospital database were analyzed retrospectively. Patients 1 year before the onset of the COVID-19 pandemic (March 11, 2019-March 10, 2020) and 1 year after the onset of the COVID-19 pandemic (March 11, 2020-March 10, 2021) were included in the study. In both periods, such as age, gender, admission status (admission to an external center), duration of pain, delayed admission (more than 3 days), appendix diameter, C-reactive protein (CRP) value, white blood cells (WBC) value, type of incision, perforated appendicitis, presence of abscess, complication, and length of hospitalization parameters were compared.

Statistical Analysis

Data were evaluated by statistical analysis with IBM Statistical Package for the Social Sciences 23 (IBM Inc., Chicago, IL, USA) program. Median 25% and 75% values were used in the descriptive statistics of continuous variables, while the number of people (n) and percentage (%) values were given in the definition of categorical variables. Relationships between categorical variables were examined by chi-square test analysis. Whether the continuous variables showed normal distribution was checked with Shapiro-Wilk's test of normality, and homogeneity of variance was checked with Levene's test. Bi-level comparisons were made with the independent sample median test in cases where normal distribution was not observed. A value of $p < 0.05$

was set as the significance in all analysis (n: number of people, p: p value).

Results

In our study, appendectomy was performed in 464 patients with the diagnosis of acute appendicitis, 254 (54.7%) before the pandemic and 210 (45.3%) during the pandemic period.

Of the patients included in the study, 238 (51.3%) were female and 226 (48.7%) were male. The youngest of the patients was 18 years old, the oldest was 90 years old, and the mean age was 35.34 ± 14.89 years (Table 1).

Of the patients included in the study, 114 (24.6%) were patients who had previously applied to an external center. The mean duration of symptoms of the patients was 2.41 ± 2.38 days, and there were 90 (19.4%) patients with symptom duration more than 3 days and 374 (80.6%) patients with symptom duration less than 3 days. The mean appendix diameter of the patients was 9.77 ± 2.44 mm, mean CRP value was 51.90 ± 68.81 mg/L, mean WBC value was 13.78 10³/L. McBurney incision was present in 389 (83.8%) patients, and midline incision was found in 75 (16.2%) patients. Perforation was observed in 79 (17.0%) patients, and periappendicular abscess was observed in 38 (8.2%) patients. Appendicitis was complicated in 90 (19.4%) patients. The mean hospital stay of the patients was 3.54 ± 2.61 days, and the patients were hospitalized for the shortest 1 day and the longest 25 days (Table 2).

The median age of the patients was 30 years before the pandemic and 31 years during the pandemic period. It was found that the median age of the patients did not have a statistically significant relationship with the pre-pandemic period ($p > 0.05$) (Table 1).

Before the pandemic, 115 (45.3%) of the patients were male and 139 (54.7%) were female; During the pandemic period, 111 (52.9%) were male and 99 (47.1%) were female. No statistically significant relationship was found between the gender and pandemic periods ($p > 0.05$) (Table 1).

It was found that there was no statistically significant relationship between the pandemic period and the patients' previous admission to an external center and their delayed admission ($p > 0.05$). There was no statistically significant difference in the median values of appendix diameter, CRP, and WBC of the patients before and during the pandemic period. It was found that there was no statistically significant difference ($p > 0.05$). While the median symptom duration of the patients before the pandemic was 1 day, it was obtained as 2 days for the patients in the pandemic period. It was observed that the median symptom duration was statistically significantly higher in patients in the pandemic period ($p = 0.008$) (Figure 1).

Before the pandemic, 210 (82.7%) patients had McBurney incision and 44 (17.3%) had midline incision; During the pandemic period, McBurney incision was observed in 179 (85.2%) patients and midline incision was observed in 31 (14.8%) patients. While there were perforation in 42 (16.5%) patients before the pandemic, it was seen in 37 (17.6%) patients during the pandemic period. Periappendicular abscess was observed in 24 (9.4%) of the patients before the pandemic and in 14 (6.7%) during the pandemic period. Complicated appendicitis was detected in 42 (20%) patients during the pandemic period and 48 (18.9%) before the pandemic. There was no statistically significant relationship between the pandemic period and the presence of incisions, perforations, periappendicular abscesses, or complicated appendicitis ($p>0.05$). There was no statistically significant difference in the median length of hospital stay of the patients before and during the pandemic ($p>0.05$) (Table 3).

Discussion

The COVID-19 pandemic has affected Turkey and other countries. WHO has determined rules to stop the transmission of the virus (9). Many measures have been taken, such as a curfew, interruption of face-to-face education, application to hospital, and visit restrictions unless there is an emergency. During the pandemic period, emergency and noncancer surgeries were postponed or canceled (10,11). During this period, there was a significant decrease in the hospital admissions. Some hospitals in cities have been accepted as pandemic hospitals, and only COVID-19 diagnosis and treatment have been given. Our center was not a pandemic hospital; elective surgeries were canceled when the pandemic peaked, and emergency and cancer surgeries continued. In our study, it was determined that 254 (54.7%) of 464 patients applied before the pandemic and 210 (45.3%) applied after the pandemic. In the study of Antakia et al. (12), 116 (56.03%)

Table 1. Comparison of general demographic characteristics of patients in pre- and post-pandemic groups

	Period				p
	Prepandemic (n=254)		Pandemic (n=210)		
	Median (25-75%)		Median (25-75%)		
Age	30 [24-45]		31 [24 -41]		0.929
	n	%	n	%	p
Gender					0.104
Male	115	45.3	111	52.9	
Female	139	54.7	99	47.1	

*A p value less than 0.05 (typically ≤ 0.05) is statistically significant

Table 2. Comparison of the pre-op characteristics of the patients in the pre- and post-pandemic groups

	Period				p
	Prepandemic (n=254)		Pandemic (n=210)		
	Median (25-75%)		Median (25-75%)		
External center application					0.100
Yes	70	27.6	44	21.0	
No	184	72.4	166	79.0	
Delayed application					0.314
Yes	45	17.7	45	21.4	
No	209	82.3	165	78.6	
	Median (25-75%)		Median (25-75%)		p
The duration of symptoms (day)	1 [1-3]		2 [1-3]		0.008*
Appendix diameter (Mm)	10 [8-11]		10 [8-11]		0.567
CRP (mg/L)	19.57 [5.8-66.58]		22.46 [6.1-81.56]		0.641
WBC ($10^3/\mu\text{L}$)	12.79 [9.52-16.84]		13 [10.11-16]		0.463

*A p value less than 0.05 (typically ≤ 0.05) is statistically significant.
CRP: C-reactive protein, WBC: White blood cells

of 207 patients applied before the pandemic and 91 (44.97%) during the pandemic period. He attributed this to isolation during the pandemic period. However, the number of patients did not significantly decrease in our study. The reason for this is that other state hospitals in our province do not receive surgical cases due to the pandemic, and these emergency cases are taken in our center.

While the median duration of symptoms was 1 day before the pandemic, it was 2 days during the pandemic period. In our study, the duration of symptoms was significantly higher during the pandemic period than before the pandemic. During the pandemic period, patients applied later than in the previous period. The reason for this is the fear of COVID-19 contamination,

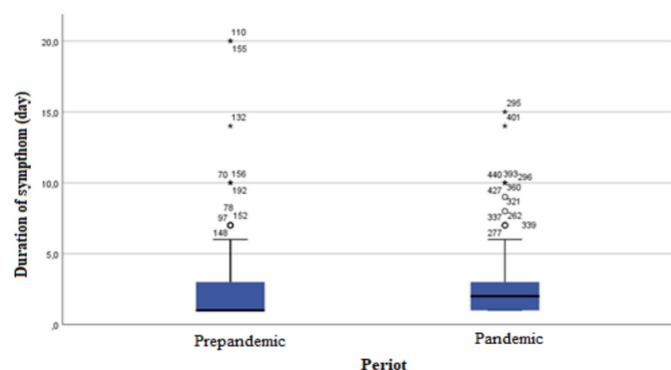


Figure 1. Comparison of symptom duration of patients during and before the pandemic

curfew, and transportation difficulties during the pandemic period. In the study of Tankel et al. (13), the median duration of symptoms was found to be 1.8 before the pandemic and 1.5 during the pandemic period. The reason why there was no significant difference in this study is that the study was conducted in an early period and in a short time.

In our study, 114 (24.6%) patients had previously applied to an external center. The rate of application to an external center was 27.6% before the pandemic and 21% during the pandemic period. The reason for this decrease is that patients apply directly to our center because other hospitals in the city center are pandemic hospitals.

Extending the length of stay increases the cost, the risk of infection, mortality, and morbidity. In our study, the duration of hospitalization of all patients was calculated as days, with an average of 3.54 ± 2.61 days. The patients were hospitalized for the shortest 1 day and the longest 25 days. The median length of stay in the pre-pandemic period was 3 days, and the pandemic period was 3 days. No significant difference was observed between the duration of hospitalization during and before the pandemic period ($p=0.978$). In the study of Tankel et al. (13), the average hospital stay was found to be 2.4 days, 2.5 days before the pandemic, and 2.3 days during the pandemic. No significant difference was found ($p=0.139$). Our study supports similar studies.

Table 3. Comparison of per- and post-op values of patients in the pre- and post-pandemic groups

	Period				p
	Prepandemic (n=254)		Pandemic (n=210)		
	n	%	n	%	
Incision					0.456
McBurney	210	82.7	179	85.2	
Midline	44	17.3	31	14.8	
Perforation					0.757
Yes	42	16.5	37	17.6	
No	212	83.5	173	82.4	
Periappendicular abscess					0.277
Yes	24	9.4	14	6.7	
No	230	90.6	196	93.3	
Complicated appendicitis					0.765
No	206	81.1	168	80.0	
Yes	48	18.9	42	20.0	
	Median (25-75%)		Median (25-75%)		p
The length of stay (days)	3 [2-4]		3 [2-4]		0.978

*A p value less than 0.05 (typically ≤ 0.05) is statistically significant

In our study, appendectomy was performed on all patients. No medical treatment was given. In the study of Ganesh et al. (14), 100% of them had appendectomy before the pandemic, while 56.3% of them underwent appendectomy during the pandemic period and a significant difference was observed ($p < 0.001$). In the study of Köhler et al. (15), surgical percentages did not change (91%) during and before the pandemic period, and no significant difference was found. In the study of Antakia et al. (12), the duration of medical treatment and hospitalization increased during the pandemic period compared with the pre-pandemic period, but it did not gain significance due to the short study period and the low number of patients included in the study. Medical treatment resulted in a longer length of stay and hospitalization with acute appendicitis clinic This extended the length of the hospital stay. The cost of a longer hospital stay increases the risk of hospital-acquired infection, mortality, morbidity, and most importantly, the risk of COVID-19 infection during the pandemic period. Therefore, we did not change our treatment during the pandemic period, as in the pre-pandemic period, and surgical treatment was applied to all patients with acute appendicitis.

In our study, perforated appendicitis was detected in 79 (17%) of all patients. Perforated appendicitis was detected in 42 (16.5%) patients before the pandemic and in 37 (37%) patients during the pandemic period. There was no significant difference in the incidence of perforated appendicitis during and before the pandemic ($p > 0.05$). In the study of Orthopoulos et al. (16), a 21% increase in the number of perforated appendicitis was observed during the pandemic period and it was found to be significant. In our study, there was an increase in perforated appendicitis, but it did not reach a significant value.

In our study, periappendicular abscess was found in 38 (8.2%) of all patients. Periappendicular abscess was detected in 24 (9.4%) patients before the pandemic and in 14 (6.7%) patients during the pandemic period. No significant difference was found in the occurrence of periappendicular abscess during and before the pandemic period ($p > 0.05$). In the study of Orthopoulos et al. (16), an increase in the number of periappendicular abscesses was observed during the pandemic period and it was found to be significant. In our study, a decrease was found in the number of periappendicular abscesses.

Complicated appendicitis was detected in 90 (19.4%) patients in all patients, while noncomplicated appendicitis was detected in 374 (80.6%) patients. Complicated appendicitis was detected in 48 (18.9%) patients before the pandemic and in 42 (20%) patients during the pandemic period. The rate of complicated appendicitis during and before the pandemic was high, but no significant increase was found. In the study of Tanel et al. (13),

the rates of complicated appendicitis were 15.9%, 13.1% before the pandemic, and 20.6% after the pandemic, and no significant difference was found in all patients. In the study of Bonilla et al. (17), the rates of complicated appendicitis were 35% before the pandemic and 33% during the pandemic, and no significant difference was found ($p = 0.870$). In our study, like these studies, there was no significant increase in the number of complicated appendicitis. The first goal for treating acute appendicitis is to treat the patient before complications develop. Because we did not change our treatment method in our study, there was no significant increase in the number of complicated appendicitis.

Study Limitations

The first limitation of our study is that it was conducted in a single center and in a single city. Larger populations should be studied to validate our data. The second limitation is that while other hospitals in the city are pandemic hospitals, our hospital continues to serve in a similar way to the pre-pandemic period. Therefore, no significant differences were detected.

Conclusion

We recommend not changing the treatment protocol for acute appendicitis during pandemic periods. In our study, using the same treatment protocol, it was observed that there was no increase in the incidence of complicated appendicitis and duration of hospitalization during the pandemic period. This shows that additional resources cannot be spent on acute surgical services during pandemic periods and can be diverted.

Ethics

Ethics Committee Approval: Gaziantep University Faculty of Medicine Clinical Research Ethics Committee approval was obtained for the study with protocol number 2021/255 dated August 5, 2021.

Informed Consent: Retrospective study.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.K., L.Y., A.A., Concept: M.K., L.Y., Design: M.K., L.Y., Data Collection or Processing: M.K., L.Y., A.A., Analysis or Interpretation: M.K., L.Y., Literature Search: M.K., L.Y., A.A., Writing: M.K., L.Y.

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