

# The effects of COVID-19 pandemic on patients with acute appendicitis

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## ABSTRACT

**BACKGROUND:** The effects of the COVID-19 infection on the world's health system began to be reported in a short time, with the spread of the infection all over the world and it gained a global acceptance as a pandemic. It was predicted that patients who require urgent surgical procedures may not be able to access appropriate treatment during this period and may suffer from this process. In this process, we planned to report the effects of the pandemic process to this patient group by evaluating patients with acute appendicitis, which is the most common cause of acute abdomen among general surgery emergencies.

**METHODS:** In our study, we compared the patients who applied to the Training and Research Hospital we collaborated, whose clinics were compatible with acute appendicitis, between March 11, 2020, and May 21, 2020, with those applied within the same time period with the year before. We evaluated clinical and pathological findings of the patients and the treatment applied.

**RESULTS:** In this study, there were 103 patients diagnosed with acute appendicitis before pandemic and 61 in pandemic period. We found that during the pandemic period, patients with acute appendicitis were admitted to the hospital less often, and in a later period, and more complicated clinical pictures were determined. Complicated appendicitis patients were higher in pandemic period compared with previous year (33.96% vs. 8.00% of patients, respectively;  $p < 0.05$ ).

**CONCLUSION:** We emphasized that diseases that need to be treated urgently should not be left behind during the pandemic. Furthermore, we shared our clinical practice to ensure early discharge of patients with acute appendicitis during the pandemic process.

**Keywords:** Acute appendicitis; clinical picture; COVID-19; pandemic.

## INTRODUCTION

It was predicted that during the COVID-19 pandemic period, patients who require urgent surgical procedures may not be able to access appropriate treatment.<sup>[1]</sup>

The most common hospital admission reasons of COVID-19 infection are severe respiratory system complaints, cough, dyspnea, fatigue, myalgia, and fever. It has been stated that the most frequently affected system after the respiratory system is the gastrointestinal system, with loss of sense of taste and smell, diarrhea, abdominal pain, nausea, vomiting, anorexia, and disruption in liver function tests.<sup>[2]</sup> The gastrointestinal

tract symptoms observed in COVID-19 patients are similar to the patients with appendicitis.<sup>[3]</sup>

Acute appendicitis is the most common emergency surgical pathology in the general surgery emergency department admissions. Although the annual incidence of acute appendicitis varies country to country, it has been reported to be 5.7–50/100,000.<sup>[4]</sup>

Ambulatory surgery means hospital stay inferior to 12 h without overnight hospitalization. Saint-Antoine scoring system has been described as a guide to reduce the duration of hospitalization for appendicitis patients (Table 1). It consists

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**Table 1.** Saint-Antoine Score

Variable	Point
Body mass index <28 kg/m <sup>2</sup>	1
White blood cell <15.000/μL	1
C-reactive protein <30 mg/L	1
No radiological signs of appendicitis perforation	1
Appendix diameter <10 mm	1

of five variables. In this scoring system, patients are evaluated according to their body mass index (<28 kg/m<sup>2</sup>), leukocyte count (<15.000/μL), C-reactive protein (CRP) value (<3 mg/dL), presence of perforation findings on computerized tomography (CT), and appendix diameter (10 mm). If the variable is positive, 1 point is given. The score ranges from 0 to 5. Based on the score obtained, patients are evaluated for early post-operative discharge. In the study by Lefrancois et al.<sup>[5]</sup> with 468 appendicitis patients, ambulatory appendectomy was accepted safe for patients with Saint-Antoine scores 4 and 5.

The aim of our study is to report the effects of the COVID-19 pandemic on appendicitis patients. We compared the clinical data, treatment processes, and pathology results of acute appendicitis patients in the pandemic period with pre-pandemic period. Moreover, we discussed our clinical practices with Saint-Antoine scoring system for early discharge of patients during the pandemic period.

## MATERIALS AND METHODS

In our study, K35 over the ICD codes among adult patients diagnosed with acute appendicitis between March 11, 2020, and May 21, 2020, which includes the COVID-19 pandemic period, and the same time period of the previous year (March 11, 2019–May 21, 2019) were evaluated. Patients were evaluated in terms of age, gender, time between the onset of

symptoms and admission to the hospital, leukocyte counts and CRP values, appendix diameter on CT, presence of complicated appendicitis findings on CT, peroperative complications, pathology results, and hospitalization times. Statistical Package for the Social Sciences for Windows®22.0 (IBM Corporation, Chicago, Illinois) software was used for data analysis while evaluating the data of patients. Mann–Whitney U-test was used as a comparison analysis. Significant P-value was accepted as <0.05. This retrospective study is approved by our Institutional Ethics Committee.

## RESULTS

Between March 11, 2019, and May 21, 2019, there were 103 patients diagnosed with acute appendicitis, and 61 patients between March 11, 2020, and May 21, 2020, including the pandemic period. Three of the patients diagnosed with acute appendicitis, had concurrent COVID-19 pneumonia at the time of admission. Two of these patients were treated medically with antibiotics. One patient underwent an open technique appendectomy.

Table 2 presents clinical data of patients with acute appendicitis. When the clinical data of the patients are compared, the distribution of findings including age, gender distribution, leukocyte count, and CRP value at the time of hospital admission and appendix findings on CT are similar between the groups before and during the pandemic period. There was a decrease in the number of patients diagnosed with acute appendicitis during the pandemic period while there was an increase in the average period between the onset of symptoms and admission in pandemic period ( $p<0.05$ ). When the treatments applied to the patients were evaluated, medical treatment was given to three patients before the pandemic, while 10 patients were followed up with medical treatment without surgery during the pandemic period. In the selection of antibiotic treatment, the complaints of nausea and vomiting were evaluated. Patients who tolerate oral intake were prescribed amoxicillin and clavulanic acid 1 g tablets to

**Table 2.** Clinical data of appendicitis patients

	Before the pandemic period	During the pandemic period
Total number of patients	103	61
Age (average years)	36.77	35.38
Gender (Female/Male)	36/67	19/42
Time from appearance of symptoms to hospital admission (average day)	1.15	1.95
Leukocyte count (average/μL)	12.88	15.01
CRP (average-mg/dL)	4.38	6.47
Appendix diameter on CT (average-mm)	10.70	11.56
Number of patients with complicated appendicitis findings on CT	12	7

CRP: C-reactive protein; CT: Computerized tomography.

be used orally if they did not have penicillin allergies while ciprofloxacin 500 mg and metronidazole 500 mg combinations were prescribed for those with penicillin allergies.<sup>[6]</sup> Four patients who could not tolerate oral intake were hospitalized and given antibiotic therapy intravenously. Two of the patients in medical treatment group had an increase in abdominal pain and increased CRP and leukocyte values during their follow-up and laparoscopic appendectomy was performed to them.

When the surgical treatment methods were evaluated, it was found that open appendectomy was performed in three patients before the pandemic and 22 patients during the pandemic period. On the other hand, laparoscopic appendectomy was applied to 97 patients before the pandemic and 31 patients during the pandemic period. In the light of these data, it was observed that the rates of conservative treatment and open surgery increased in the treatment options of acute appendicitis patients during the pandemic period ( $p < 0.05$ ) (Table 3).

The distribution of peroperative complications is shown in Table 4. Superficial wound infection, intra-abdominal abscess, and small intestine injury were the peroperative complications in the operated patients. Superficial wound infection and intra-abdominal abscess were statistically higher in open surgeries in pandemic period ( $p < 0.05$ ) and small intestine injury occurred in one patient in laparoscopic surgery in pandemic period ( $p < 0.05$ ). When the pathology results of the patients were evaluated, uncomplicated acute appendicitis with local peritonitis was found in 95 patients before the pandemic, in 35 patients during the pandemic period. Eight patients before the pandemic and 18 patients during the pandemic period had perforated phlegmonous or suppurative appendicitis ( $p < 0.05$ ) (Table 5). In the histopathological examination of cases of uncomplicated acute appendicitis, it was noted that acute inflammation findings were mild, mostly limited to the muscularis propria in the appendix wall. In the histopathological examination of the appendices of patients with perforated phlegmonous or suppurative appendicitis, which we tracked more frequently during the pandemic period, it was observed

**Table 3.** Treatments applied

	Before the pandemic period		During the pandemic period		p-value
	n	%	n	%	
Total number of patients	103	100	61	100	<0.05 (Mann-Whitney U)
Medical treatment	3	2.91	8	13.11	<0.05 (Mann-Whitney U)
Open surgery	3	2.91	22	36.06	<0.05 (Mann-Whitney U)
Laparoscopic surgery	97	94.17	31	50.81	>0.05 (Mann-Whitney U)

**Table 4.** Peroperative complications

	Before the pandemic period		During the pandemic period	
	Laparoscopic appendectomy	Open appendectomy	Laparoscopic appendectomy	Open appendectomy
Superficial wound infection	1 ( $p > 0.05$ )	6 ( $p > 0.05$ )	0 ( $p > 0.05$ )	8 ( $p < 0.05$ )
Intraabdominal abscess	2 ( $p > 0.05$ )	0 ( $p > 0.05$ )	1 ( $p > 0.05$ )	2 ( $p < 0.05$ )
Small intestine injury	0 ( $p > 0.05$ )	0 ( $p > 0.05$ )	1 ( $p < 0.05$ )	0 ( $p > 0.05$ )

**Table 5.** Pathological findings

	Before the pandemic period		During the pandemic period		p-value
	n	%	n	%	
Total number of specimens evaluated	100	100	53	100	
Uncomplicated acute appendicitis	92	92.00	35	66.03	<0.05 (Mann-Whitney U)
Perforated phlegmonous-suppurative appendicitis	8	8.00	18	33.96	<0.05 (Mann-Whitney U)

**Table 6.** Hospitalization duration

	Before the pandemic period	During the pandemic period	p-value
Hospitalization duration (average days)	1.28	1.44	>0.05 (Mann-Whitney U)

that the inflammation consisting of neutrophil leukocyte, lymphocyte, and plasma cells started from the appendix lumen and spread to the appendix wall. As a result of perforation in these areas, local peritonitis findings due to acute inflammation in the surrounding serosal tissue were noted. For appendicitis patients, the average length of hospitalization duration in the pre-pandemic period was 1.28 days and 1.44 days during the pandemic period ( $p>0.05$ ) (Table 6).

## DISCUSSION

In the light of the data we obtained, when the numbers of acute appendicitis patients before and during the pandemic were compared, a statistically significant decrease was found in the number of admissions of appendicitis patients to hospital during the pandemic period. When the patients with late hospital admissions were questioned, we learned that the patients preferred to use spasmolytics, stomach protective or analgesic drugs, or different alternative medicine products at home instead of coming to emergency service. Some of them used traditional methods such as putting hot water bags on their abdomen. Afterward, they applied to the emergency department when the pain did not cease. The decrease in the number of acute appendicitis patient referrals and clinical presentations we obtained was similar to the data in the world.<sup>[7,8]</sup> The literature data on which appendicitis patients can be cured by giving antibiotic treatment to reduce the use of operating rooms and hospital beds in COVID-19 crisis which was reviewed.

Findings in clinical and radiological imaging methods were used in the selection of antibiotic treatment of appendicitis patients. Because of the high risk of recurrence and perforation, patients with severe clinical findings and appendicolith detected in the lumen of the appendix on CT scans were not included in the medical treatment group in accordance with the literature data.<sup>[9,10]</sup> In the selection of antibiotics to be applied, drugs that are simple, inexpensive, easily accessible, and effective against Gram-negative and anaerobic bacteria were preferred.<sup>[6,9-11]</sup> In our clinic, during the pandemic period, more patients with acute appendicitis were treated with antibiotics without surgery. Our results show that, for the selected patients, medical treatment is also a safe option for the treatment of appendicitis. As Gok et al.<sup>[12]</sup> stated in their studies, efforts were made to select the most appropriate method to protect us and our patients who needed emergency intervention. While laparoscopic surgery was technically recommended in the previous period in the surgical treatment of appendicitis patients, there were publications

suggesting open surgery, considering that laparoscopic operations during the pandemic period may cause the spread of infection through aerosolization.<sup>[13,14]</sup> However, other studies have not shown clinical evidence for restriction of laparoscopic and robotic surgery.<sup>[15,16]</sup> In the light of these data, appendectomy was performed both by open method and laparoscopically in our hospital for the surgical treatment of appendicitis patients during the pandemic period. Compared to the pre-pandemic period, the number of patients treated with open appendectomy in our clinic increased during the pandemic period. For patients undergoing surgical treatment, efforts were made to keep the operation time short, try to control bleeding in the best way with meticulous surgical technique, and use drains as rare as possible by the way try to minimize the risk of wound infection.

When the pathology results of the patients were evaluated, the inflammation findings observed in the appendix during the pandemic period were more severe, and severe inflammation and local peritonitis findings were more common in the surrounding serosal surfaces. Patients with perforated phlegmonous or suppurative appendicitis have a significantly higher risk of morbidity and mortality compared to patients with uncomplicated acute appendicitis. The mortality risk is <0.1% for patients with uncomplicated acute appendicitis and up to 0.6% for patients with gangrenous appendicitis. It has been reported to increase up to 5% for perforated appendicitis patients.<sup>[4]</sup> This serious increase in risk reported for complicated appendicitis patients and highlights the importance of early diagnosis and treatment.

During the pandemic process, hospitalization periods were tried to be kept as low as possible in the treatment of patients. In our clinical practice, with guidance of Saint-Antoine scoring system, patients with score 4 or more were discharged earlier. However, a moderate increase was found in the mean hospitalization times during the pandemic period as the complicated appendicitis patients increased during the pandemic period.

In a recent study by Turanli et al.,<sup>[17]</sup> they tried to show the effects of the pandemic period on appendicitis patients. Two hundred and fourteen appendicitis patients were included to the study. In the end, it was shown that there was an increase in the diagnosis of complicated appendicitis during the pandemic period but no statistically significant increase in the number of perforated appendicitis. In that study, they reported the low number of the patients as the limiting fac-

tor. We would like to report that the number of the patients in our study is also low and a limitation for our study as well.

Another limitation of our study was the patients with plastron appendicitis. We thought that there were some patients with plastron appendicitis who did not admit to the hospital during the study periods, especially in the pandemic period. As the exact number of plastron appendicitis patients could not be reached, we did not include them to our study.

## Conclusion

The data we obtained as a result of our study proves that even acute appendicitis patients, which are the most common emergency types encountered by the general surgery department and have low morbidity and mortality risks, can be encountered with complicated situations during the pandemic period.

As reported at the beginning of the pandemic, we think that to prevent diseases requiring emergency treatment from being a victim of this crisis situation, it is necessary to develop evidence-based fast and effective treatment algorithms with multicenter studies involving more patients. By the way, the treatment of patients can be accelerated and their early discharge can be provided.

**Ethics Committee Approval:** This study was approved by the Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital Scientific Research Ethics Committee (Date: 19.08.2020, Decision No: 2020/10).

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**Conflict of Interest:** None declared.

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ORİJİNAL ÇALIŞMA - ÖZ

## COVID-19 pandemisinin akut apandisit hastaları üzerine etkileri

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**AMAÇ:** COVID-19 enfeksiyonunun tüm dünyada yayılması ve pandemi olarak kabul edilmesiyle birlikte enfeksiyonun dünya sağlık sistemindeki etkileri kısa sürede açıklanmaya başladı. Acil cerrahi işlem yapılması gereken hastaların, bu süreçte uygun tedaviye ulaşamayabilecekleri ve bu süreçten zarar görebilecekleri öngörüldü. Biz de, bu süreçte genel cerrahi acilleri içinde en sık karşılaştığımız akut karın nedeni olan akut apandisit hastalarını değerlendirerek pandemi sürecinin bu hasta grubuna etkilerini bildirmeyi planladık.

**GEREÇ VE YÖNTEM:** Bu çalışmada, çalıştığımız eğitim ve araştırma hastanesine 11 Mart–21 Mayıs 2020 tarihleri arasında başvuran, kliniği akut apandisit ile uyumlu hastalar, bir yıl önceki aynı zaman dilimi ile kıyaslandı. Hastaların klinik ve patolojik bulguları, uygulanan tedavi şekilleri değerlendirildi.

**BULGULAR:** Çalışmamıza alınan pandemi öncesi 103, pandemi döneminde 61 apandisit hastası vardı. Pandemi döneminde akut apandisit hastalarının daha az sayıda ve daha geç dönemde hastaneye başvurduklarını ve daha komplike klinik tablolar ile karşılaştığını saptadık. Komplike apandisit hastaları ile pandemi döneminde bir önceki yıla göre daha sık karşılaştık (sırasıyla, %33.96'a karşı %8.00;  $p<0.05$ ).

**TARTIŞMA:** Pandemi sürecinde, diğer acil olarak tedavi edilmesi gereken hastalıkların geri planda kalmaması gerektiğini vurguladık. Ayrıca akut apandisit hastalarının erken taburcu olabilmeleri için klinik uygulamamızı paylaştık.

**Anahtar sözcükler:** Akut apandisit; COVID-19; klinik tablo; pandemi.

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