



ORIGINAL ARTICLE

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The course of acute appendicitis disease in the COVID-19 period

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Abstract

The COVID 19 outbreak has changed the course of diseases requiring emergency surgery. Our aim in this study is to reveal whether the COVID 19 pandemic complicates acute appendicitis (AA) disease or not. We retrospectively investigated the patients who were diagnosed with AA in our city (Rize, Turkey). Our study includes two patient groups over 16 years of age who were operated on for AA. Group 2 includes patients operated between 11 March 2020 and 31 December 2020, while Group 1 includes patients who were operated on during the same period in 2019. There were 298 patients (57%) in Group 1 and 226 patients (43%) in Group 2. In Group 2, midline or paramedian incisions were used significantly more than the classical Mc Burney incision: (%10 vs %20, $p<0.003$). Postoperative complications were significantly higher in Group 2: (%5 vs %12, $p<0.004$). White blood cells and CRP were significantly different in Group 2 in the admission blood tests ($p<0.005$, $p<0.001$, respectively). Operation time and hospitalization time were significantly different in Group 2 ($p<0.001$, $p<0.014$, respectively). During the COVID-19 pandemic, there was a serious decrease in the number of patients admitted to the emergency services. Because people were afraid of being infected, they preferred to stay home and with the increase in complaints, they applied to the hospital. AA disease has also become more complicated, as people delayed their admission to the hospital. Serious changes happened in the course of the disease.

Keywords: COVID-pandemic, emergency surgery, appendectomy

Introduction

Patients presenting to the emergency department with abdominal pain have an important place in emergency service practice. Acute appendicitis (AA) continues to be the most common cause of surgical acute abdomen in all age groups [1]. The first cases of pneumonia caused by SARS-CoV-2, a new coronavirus, were reported in Wuhan, China in December 2019 and the disease was named COVID- 19 [2,3]. It was declared a global epidemic by the world health organization on March 11, 2020 [4].

The first case was seen in our country on the same day. COVID-19 started to spread rapidly all over the world, and the health of the whole world and especially healthcare workers were in danger [5]. With the circular issued by the Presidency and the Ministry

of Health on 20 March, all health institutions were accepted as pandemic hospitals, and the Turkish people were informed by the Ministry of Health on a live broadcast that they do not apply to health institutions when it is not necessary. As of March 11, the first cases of COVID-19 started to be seen in our country and elective surgical procedures were postponed with the decision of the Ministry of Health dated March 17, 2020. In the following process, warning messages were often given by the national media and government officials for citizens to stay at their homes. In line with all these measures, a significant decrease was observed in admissions to hospitals and emergency services. Although restrictions affected this reduction, the fear of catching COVID-19 affected patients' access to healthcare services. In parallel with this, it was predicted that patients with AA present to the emergency department late and there may be a significant increase in patients with complications by this delay. Georgios Orthopoulos et al. reported that there was a significant increase in complicated appendicitis and a significant decrease in uncomplicated appendicitis during the COVID- 19 pandemics [6].

In this study, we aimed to reveal whether there is any change in

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the course of AA as a result of the fear of catching COVID-19 in patients with abdominal pain and the pandemic measures recommended and implemented by all the world health authorities.

Materials and Methods

All procedures performed in this study were carried out following the Ministry of Health ethical approval (2021 01- 19T16_25_05), Recep Tayyip Erdoğan University Faculty of Medicine Clinical Research Ethics Committee approval (Number: 2021/46, Date:18/03/2021) and the 1964 Helsinki Declaration ethical principles. Our study includes patients who were operated on for AA in the emergency services of two hospitals in our city, one of which is secondary and the other is tertiary care.

It includes a comparative analysis of patients who were operated on for AA during the COVID-19 epidemic period and patients with AA treated for the same period a year ago. The patients were divided into two groups. We included patients treated for AA between March 11, 2019, and December 31, 2019, in Group 1, and patients treated for AA between March 11, 2020, and December 31, 2020, in Group 2 during the COVID-19 outbreak.

Patients' age, gender, preoperative laboratory findings, surgical treatment modality, use of drain, duration of operation, length of stay, postoperative complications, pathology result, and appendix diameter were recorded separately for Group 1 and Group 2. Differences between groups were compared.

Data were analyzed using PASW Statistics (Version 18.0. Chicago: SPSS Inc.). Data were analyzed using descriptive statistics and Chi-square and Mann-Whitney U tests. Statistical significance was set as $p < 0.05$.

Results

A total of 524 patients were included in the study. 336 (64%) of the patients were male, 188 (36%) were female and the average age was 38.3. There were 298 (57%) patients in Group 1 and 226 (43%) patients in Group 2 (Table 1). Group 1 consisted of 187 men (63%) and 111 women (37%); Group 2 consisted of 149 men (66%) and 77 women (34%). There was no significant difference between the two groups in terms of gender ($p < 0.453$; Table 1). There was no significant difference between the two groups in terms of mean age (Group 1 = 37.4 years, Group 2 = 39.2 years) ($p < 0.197$; Table 1).

Table 1. Demographic characteristics

	Group 1 (2019) n(%):298(57)	Group 2 (2020) n(%):226(43)	P
Gender, n(%)			
Male	187(63)	149(66)	0.453
Female	111(37)	77(34)	
Age, average (min-max)	37.4(16-87)	39.2(17-92)	0.197

White blood cell (WBC) and CRP values were compared for both groups in the blood tests performed when the patients were first admitted to the emergency service. In our laboratory tests, our reference value for WBC was $4-10 \times 10^3 / \mu\text{L}$, and our reference value for CRP was $0-5 \text{ mg / L}$. The groups were divided into two patients whose values were in the normal reference range and those who were above the reference range. Accordingly, WBC and CRP values were significantly higher in Group 2 (respectively $p < 0.005$, $p < 0.001$; Table 2).

While laparotomy was applied to 252 (84%) patients in Group 1, laparoscopic surgery was applied to 47 (16%) patients, laparotomy was applied to 203 (90%) patients in Group 2, and laparoscopic surgery was performed to 23 (10%) patients. Although our conventional surgery rate increased slightly in Group 2, it was not significant ($p < 0.064$; Table 2).

We classified the surgical incisions used during the surgery as classic McBurney incisions and other incisions (paramedian-midline incisions). In Group 1, 226 (90%) patients had McBurney, 26 (10%) patients had other incision options, while in Group 2, 162 (80%) patients had McBurney, and 41 (20%) patients had other incision options. Accordingly, the rate of using paramedian and midline incisions was significantly higher in Group 2 ($p < 0.003$; Table 2). No difference was found in the use of drains in patients ($p < 0.924$, Table 2).

When postoperative complications were evaluated, complications

developed in 16 patients (5%) in Group 1, while complications developed in 28 patients (12%) in Group 2 ($p = 0.004$; Table 2). If we examine; wound infection in 9 patients (3%), hematoma in 2 patients (0.7%), intraabdominal abscess in 3 patients (1%), extraperitoneal complication in 2 patients (0.7%) in Group 1; In Group 2, 18 patients (8%) developed wound infection, 6 patients (2.7%) intraabdominal abscess, 2 patients (0.9%) postoperative adhesion and 2 patients (0.9%) developed extraperitoneal complications (Table 2).

We divided the patients into 3 groups according to their pathology results: perforated, gangrenous, and AA. In Group 1, 37 (12%) patients were perforated, 26 (9%) patients were gangrenous, 236 (79%) patients were diagnosed with AA; In group 2, 31 (14%) patients were diagnosed with perforated, 35 (15%) patients with gangrenous and 151 (71%) patients with AA. Accordingly, there was no significant difference between the pathology results of the two groups ($p < 0.350$; Table 2). We also compared the appendix diameters in extracted specimens. Appendix diameter was 11.5 mm in Group 1 and 10.9 mm in Group 2, and the difference was not significant ($p < 0.290$, Table 2).

There was also a difference between the two groups in the evaluation made in terms of operation time. The average of 64.2 minutes in Group 1 was 73.6 minutes in Group 2 ($p < 0.001$; Table 2).

The average length of stay of the patients was 2.8 days in Group 1 and 3.4 days in Group 2 ($p < 0.014$; Table 2).

Table 2. Pathology features, postoperative information

	Group 1 (2019) n(%)	Group 2 (2020) n(%)	P
Total number of patients	298(57)	226(43)	
White blood cell			
Above reference	222(74)	182(81)	0.005
C-reactive protein (CRP)			
Above reference	118(40)	132(59)	0.001
Treatment Modality			
Laparotomy	252(84)	203(90)	0.064
Laparoscopy	47(16)	23(10)	
Incision Shape			
Mc burney	226(90)	162(80)	0.003
Paramedian or midline	26(10)	41(20)	
Drain,n(%)	115(38)	86(38)	0.924
Postop complication	16(5)	28(12)	0.004
Complications,n(%)			
None	283(95)	198(88)	
Wound Infection	9(3)	18(8)	
Hematoma	2(0.7)		
Intraabdominal Abscess	3(1)	6(2.7)	
Adhesion		2(0.9)	
Extraperitoneal complication (lung and cardiac problems)	2(0.7)	2(0.9)	
Pathology,n(%)			
Perforated	37(12)	32(14)	
Gangrenous	26(9)	35(15)	0.350
Acute appendicitis	236(79)	151(71)	
Appendix diameter, average(min-max)	11.5(6-38)	10.9(5-45)	0.290
Operation time, average (min-max)	64.2(30-225)	73.6(30-255)	0.001
Length of stay, average (min-max)	2.8(1-16)	3.4(1-22)	0.014

Discussion

COVID-19 negatively affected humanity in our country and the world in many ways. The epidemic has seriously changed the nature of health systems globally. The pandemic measures published by WHO were also implemented in our country. In line with the precautions taken with the decisions of the scientific committee formed by the Ministry of Health, it was decided to stop elective surgeries and continue cancer surgery with only emergency surgery. Besides, informative messages were frequently given by the national media and government officials to keep citizens in their homes. During this period, some of the patients with anorexia, nausea-vomiting, abdominal pain, and other accompanying complaints such as symptoms of other important and other diseases that may require urgent intervention preferred to do their treatments and wait at home instead of consulting a doctor because of fear of contacting COVID-19, and They applied to hospitals after they could not bear the symptoms.

In studies conducted in our country and around the world, it has been reported that patients who were operated on for AA during the COVID-19 epidemic period decreased [6-8]. It was observed that the number of patients who operated with a diagnosis of

AA in our city decreased compared to the previous year with the application of restrictions on COVID 19 (Table 1). The incidence of perforated and non-perforated AA and the number of performed appendicitis have been decreasing in recent years in the United States of America [9]. In addition, the incidence of AA increases in the summer months and decreases in the colder months [10,11]. Another possible reason for the decrease in the number of AA we have operated, other than the COVID-19 outbreak, may be the decreasing incidence of AA and seasonal variation of the disease in western countries in recent years. However, we could ignore the relationship between seasonal change and the number of cases, since we compared all time intervals except the first three months of the year similarly in both groups.

There are reports that COVID-19 disease changes many laboratory markers [12,13]. Meric et al. revealed that there was no significant change in the laboratory findings of AA patients operated on during the COVID period [7]. In our study, it was observed that the leukocyte and C reactive protein values of the patients who were checked in the emergency department were found to be higher, supporting that they were admitted to the health center at a later period (Table 2).

Many algorithms regarding the approach to emergency surgery patients have changed during the pandemic period. It was observed that in AA, approaches such as conservative applications with antibiotic treatment instead of surgery or laparotomy instead of laparoscopy were observed [14,15]. Besides, many articles have evaluated the precautions to be taken in surgical procedures to be performed under emergency and elective conditions during the COVID-19 pandemic [16-23]. It was found that the number of laparoscopic surgeries we performed decreased partially, although not significantly, during the pandemic period (Table 2). On the other hand, in the preoperative clinical and radiological evaluation, it was found that surgeons preferred paramedian and midline incisions in conventional surgery, and the operation times were significantly longer in case the disease was more complicated (Table 2). These findings show that cases are more complicated during the pandemic period.

In some studies, it has been reported that patients admitted to the hospital 24 hours after the onset of symptoms have a higher risk of having perforated appendicitis [24,25]. Snapiri et al. reported an increased incidence of complicated AA and higher complication rates in the period of COVID-19 [26]. However, Tankel et al. Reported that during the epidemic period, patients did not present late, the incidence of complicated AA did not increase, and the postoperative hospital stay did not prolong [8]. The reason for this may be the insufficiency of the number and distribution of complicated and uncomplicated appendicitis because the studies were conducted in a short period. On the other hand, Georgios Orthopoulos et al. found that the incidence of complicated AA increased [6]. In our series, it was found that the disease became more complicated due to late admission, postoperative complication rates, and length of hospital stay increased (Table 2). These findings showed us that patients with AA symptoms during the COVID-19 epidemic were admitted to healthcare facilities later, and as a result, the disease became complicated. In parallel with this, the postoperative length of stay of the patients was significantly prolonged (Table 2).

The reasons for late admission to health institutions, which were also determined in our study, can be explained by the fear of catching COVID-19 and the measures for staying home, except for emergencies, within the scope of the pandemic recommended and implemented by all world health authorities [27].

This study has several limitations. Our study is a retrospective study and it is impossible to randomize patients. Due to the evolving nature of the COVID-19 outbreak, its pathogenesis, and changes in health care provision, the evidence base of our results here may change in the future.

National measures taken regarding the epidemic and changes in the treatment algorithms of the health system are made in each country, and this may make international comparisons with our results unfavorable. The study is also limited in that it cannot identify patients being treated in primary care.

In addition, not all patients diagnosed with AA may have been identified because the wrong or different diagnostic codes may have been used. Finally, due to the short follow-up period, complications following supportive therapy may not have been detected in some of the patients included in the study.

Conclusion

Our study revealed that during the COVID-19 epidemic period, AA patients may confront us in a complicated state due to the fear of being infected and/or the pandemic measures applied.

The increase in the incidence of complicated appendicitis during the COVID-19 epidemic shows that patients requiring urgent surgical intervention do not receive timely health care, and it should be kept in mind that the length of stay and patient costs will increase with the delay.

We will need more public awareness to emphasize the correct timing of hospital admissions by addressing the fears of patients in the event of a new danger of possible new COVID-19 fluctuations or disease mutating.

More research is needed on the course of AA and the problems encountered in inpatient management for better planning and delivery of healthcare services during epidemic periods.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

All procedures performed in this study were carried out following the Ministry of Health ethical approval (2021 01- 19T16_25_05), Recep Tayyip Erdoğan University Faculty of Medicine Clinical Research Ethics Committee approval (Number: 2021/46, Date:18/03/2021) and the 1964 Helsinki Declaration ethical principles.

References

1. Hardin DM Jr. Acute appendicitis: review and update. *Am Fam Physician.* 1999;60:2027-34.
2. Pneumonia of Unknown Cause- China. <https://www.who.int/csr/don/05-january-2020-pneumonia-of-unknown-cause-china/en/> access date 03.04.2020.
3. Chan Jasper FW, Yuan SF, Kok KH et al. Novel coronavirus indicating person to person transmission: a study of a family cluster. *Lancet.* 2019; 395:514– 23.
4. WHO Director-General's opening remarks at the media briefing on COVID-19. <https://www.who.int/dg/speeches/detail/who-directorgeneral-s-opening-remarks-at-the-media-briefing-on-covid-19> access date 11.03.2020.
5. Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet.* 2020;395:565-74.
6. G. Orthopoulos, E. Santone, F. Izzo et al. Increasing incidence of complicated appendicitis during COVID-19 pandemic. *Am J Surg.* 2020;221:1056-60.
7. Meric S, Vartanoglu Aktokmakyan T, Tokocin M, et al. Comparative analysis of the management of acute appendicitis between the normal period and COVID-19 pandemic. *Ulus Travma Acil Cerrahi Derg.* 2021;27:22-5.
8. Tankel J., Keinan A., Blich O, et al. the decreasing incidence of acute appendicitis during COVID-19: A retrospective multi-center study. *World J Surg.* 2020;44:2458-63.
9. Ferris M., Quan S., Kaplan B.S. Molodecky N. The global incidence of appendicitis: a systematic review of population-based studies. *Ann Surg.* 2017;266:237–41.
10. Hsu Y.J., Fu Y.W., Chin T. Seasonal variations in the occurrence of acute appendicitis and their relationship with the presence of fecaliths in children. *BMC Pediatr.* 2019;19:443.
11. York T.J. Seasonal and climatic variation in the incidence of adult acute appendicitis: a seven year longitudinal analysis. *BMC Emerg Med.*

- 2020;20:24.
12. Ponti G, Maccaferri M, et al. Biomarkers associated with COVID-19 disease progression. *Crit Rev Clin Lab Sci.* 2020;57:389-99.
 13. Liu F, Li L, Xu M, et al. Prognostic value of interleukin-6, C-reactive protein, and procalcitonin in patients with COVID-19. *J Clin Virol.* 2020;127:104370.
 14. Di Saverio S, Khan M, Pata F, et al. Laparoscopy at all costs? Not now during COVID-19 outbreak and not for acute care surgery and emergency colorectal surgery: A practical algorithm from a hub tertiary teaching hospital in Northern Lombardy, Italy. *J Trauma Acute Care Surg.* 2020;88:715-18.
 15. Pata F, Khan M, Iovino D, et al. Laparotomy represents the safest option during COVID-19 outbreak: Authors' response to: The COVID-19 pandemic should not take us back to the pre-laparoscopic era; Emergency laparoscopic surgery during COVID-19: what can we do and how to do it safely. *J Trauma Acute Care Surg.* 2020;89:277-78.
 16. Di Saverio S, Pata F, Gallo G, et al. Coronavirus pandemic and colorectal surgery: practical advice based on the Italian experience. *Colorectal Dis.* 2020;22:625-34.
 17. De Simone B, Chouillard E, Di Saverio S, et al. Emergency surgery during the COVID-19 pandemic: What you need to know for practice. *Ann R Coll Surg Engl.* 2020;102:323-32.
 18. Coimbra R, Edwards S, Kurihara H, et al. European Society of Trauma and Emergency Surgery (ESTES) recommendations for trauma and emergency surgery preparation during times of COVID-19 infection. *Eur J Trauma Emerg Surg.* 2020;46:505-10.
 19. Guerci C, Maffioli A, Bondurri AA, et al. COVID-19: How can a department of general surgery survive in a pandemic? *Surgery.* 2020;167:909-11.
 20. Al-Balas M, Al-Balas HI, Al-Balas H. Surgery during the COVID-19 pandemic: A comprehensive overview and perioperative care. *Am J Surg.* 2020;219:903-06.
 21. Cocolini F, Perrone G, Chiarugi M, et al. Surgery in COVID-19 patients: operational directives. *World J Emerg Surg.* 2020;15:25.
 22. Hussain A, Mahawar K, El-Hasani S. The Impact of COVID-19 Pandemic on Obesity and Bariatric Surgery. *Obes Surg.* 2020;30:3222-23.
 23. Tarim IA, Derebey M, Ozbalei GS, et al. The impact of the COVID-19 pandemic on emergency general surgery: A retrospective study. *Sao Paulo Med J.* 2021;139:53-7.
 24. Williams N., Bello M. Perforation rate relates to delayed presentation in childhood acute appendicitis. *J R Coll Surg Edinb.* 1998;43:101-2.
 25. Kearney D., Cahill R.A., O'Brien E., et al. Influence of delays on perforation risk in adults with acute appendicitis. *Dis Colon Rectum.* 2008;51:1823-27.
 26. Snapiri O., Danziger CR., Krause I., et al. Delayed diagnosis of paediatric appendicitis during the COVID-19 pandemic. *Acta Paediatr.* 2020;109:1672-76.
 27. Where are all the patients? Addressing covid-19 fear to encourage sick patients to seek emergency care. <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0193> access date 14.05.2020.