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AIM: *The aim of this study was to compare the increase in the number of complicated cases in patients who underwent surgery for acute appendicitis during the COVID-19 pandemic and the previous year.*
MATERIAL AND METHODS: *A retrospective examination was made of the files of patients who presented at the Emergency Department and were diagnosed with acute appendicitis and underwent surgery within 24 hours or were followed up between 11 March and 1 June 2020 during the COVID-19 pandemic, and in the same period in the previous year. The patients in the pandemic period were named the pandemic group (PG) and the patients from the previous year, the control group (CG). The definition of complicated appendicitis included peri-appendicular abscess and perforated appendix.*
RESULTS: *The number of patients in the PG was 38.33% lower than in the CG. The duration of symptoms was 2 days in the PG and 1 day in the CG, and the difference was statistically significant (p=0.001). The mean neutrophil count was determined to be higher in the PG than in the CG (p=0.018). The rate of perforated appendix was determined to be 10.9 higher in the PG than in the CG.*
CONCLUSION: *The number of patients presenting at the Emergency Department reduced during the pandemic, especially during periods of lockdown, and it was seen that fewer but more complicated patients presented at our centre.*

KEY WORDS: Acute appendicitis, COVID-19, Perforation

Introduction

In December 2019, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) emerged as the agent of Coronavirus Disease 2019 (COVID-19) which manifested with symptoms of fever, dry cough, and weakness. The virus spread rapidly across the world and on 11 March 2020, the World Health Organisation (WHO) declared COVID-19 as a global pandemic. The diagnosis of COVID-19 is made with pulmonary radiographs, thoracic computed tomography (CT), and polymerase chain reaction (PCR) test positivity from oropharyngal smears. Prognosis is generally of mild-moderate severity, but the disease may be fatal at a rate of 5-10% [1-3].

The first case of COVID-19 in Turkey was recorded on 11 March and the first death due to COVID-19 occurred in the same month. A rapid increase in cases in April caused the implementation of societal restrictions including lockdowns and curfews. In that period, a decrease was seen in emergency surgery cases presenting at our hospital for reasons other than COVID-19. With progression of the infection and the increased need for beds, elective cases were postponed so that only emergency and cancer cases were treated in our hospital, as recommended by the European Society for Trauma and

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Emergency Surgery (ESTES)[4,5]. Although operations requiring emergency surgery continued in our hospital during the pandemic, there was a significant decrease in the number of patients presenting at the Emergency Department. Moreover, it was seen that because of the psychological effects of the rate of spread of the disease and because of the lockdown restrictions that started in April 2020, the emergency cases that presented at the hospital were more complicated cases.

Acute appendicitis is the most commonly encountered cause of acute abdomen in the Emergency Department [6]. During the COVID-19 pandemic, this pathology continued to be the most frequently seen cause of acute abdomen.

In this study, the number of patients who underwent surgery for a diagnosis of acute appendicitis during the COVID-19 pandemic was compared with the number of patients operated on for this diagnosis in the corresponding period of the previous year. It was also aimed to evaluate whether or not there was an increase in complicated appendicitis cases associated with delayed presentation at hospital compared to the previous year, and to evaluate the effect of the pandemic on emergency surgery cases, especially patients with acute appendicitis.

Material and Methods

A retrospective examination was made of the files of patients who presented at the Emergency Department and were diagnosed with acute appendicitis and underwent surgery within 24 hours or were followed up with medical treatment between 11 March and 1 June 2020 during the COVID-19 pandemic, and patients in the same period in the previous year. The patients were classified according to age, gender, infection parameters, symptom duration, type of surgery (open appendectomy/ laparoscopic appendectomy), and complicated appendicitis status (the presence of perforated appendix or peri-appendicular abscess). The patients who presented during the pandemic in 2020 were named the pandemic group (PG) and the patients from the same period in 2019, the control group (CG). The classified data were compared between the two groups.

The study exclusion criteria were defined as positive or suspected findings of COVID-19 on thoracic CT, which would cause a delay in diagnosis and treatment in patients in the PG.

Statistical Analysis

Data obtained in the study were analyzed statistically using SPSS vn. 20 software (Statistical Package Social Sciences). Conformity of the data to normal distribution was assessed with the Kolmogorov-Smirnov test. The non-parametric Mann Whitney U-test, the Kruskal Wallis test, and Chi-square analysis were used in the comparisons. In the comparison of perforation, periappendicular abscess, and treatment methods between the two time periods, logistic regression analysis was used. A two-tailed value of $p<0.05$ was accepted as statistically significant.

Results

The number of patients who presented at the hospital was 71 in the CG and 44 in the PG, showing a decrease

Table I - *Laboratory parameters and clinical data of the patients.*

Characteristic	Control Group Median (IQR)		Pandemic Group Median (IQR)		P Value[a]
Age (year)	29 (22-44)		28 (21-40,75)		0,338
Neutrophyl (10^3/ L)	12,5 (9,5-15)		14,2 (10,53-17,5)		0,018*
CRP (mg/L)	21 (4,7-71)		9,5 (2,4-72,75)		0,306
Length of symptoms (days)	1 (1-3)		2 (2-3,75)		0,001*
	n	**%**	**n**	**%**	**P Value**
Sex					
Female	15	21,2	14	31,8	0,199[b]
Male	56	78,8	30	68,2	
Uncomplicated appendicitis	68	95,8	28	63,64	<0.01[b]*
Complicated appendicitis					
Perforation	3	4,2	12	27,27	<0.01[b]*
Periappendiceal abscess	0	0	4	9,09	0,02[c]*
Treatment modality					
Open appendectomy	68	95,8	40	90,9	0,251[c]
Laparoscopic appendectomy	3	4,2	0	0	0,231[c]
Conservatively	0	0	4	9,1	0,02c*

a; Mann Whitney U test, b; Pearson Chi Square test, c; Fisher's Exact test. n: number; SD = standard deviation; CRP = C-reactive protein.* shows abnormal values.

of 38.33% in patient numbers during the pandemic.
The mean age of the patients was 33.95 years in the CG and 30.56 years in the PG, with no statistically significant difference determined between the groups (p=0.338). There was no significant difference between the groups in respect of gender distribution (p=0.199). The laboratory parameters and clinical data of the patients are shown in Table I.
In the evaluation in respect of surgical technique, open appendectomy was performed in 68 (95.8%) of 71 CG patients and in 40 (90.9%) of 44 PG patients. Laparoscopic appendectomy was performed in 3 (4.2%) CG patients and in none of the PG patients. Conservative treatment was not applied to any of the CG patients and was applied to 4 (9.1%) of the PG patients. When the groups were compared in respect of open appendectomy, no statistically significant difference was determined (p=0.251). In the comparisons of laparoscopic appendectomy and conservative treatment, there were more patients who had laparoscpic appendectomy in the CG but the difference was not statistically significant (p=0.231), and a statistically significant difference was determined in respect of conservative treatment in the PG (p=0.02).
In the examinations of the laboratory parameters, the median neutrophil count was determined as $12500^{10-3}/\mu L$ in the CG, and $14200^{10-3}/\mu L$ in the PG. The difference between the groups was found to be statistically significant (p=0.018). C-reactive protein level was calculated as 21mg/L in the CG and 9.5mg/L in the PG, with no difference determined between the groups (p=0.306). The symptom duration was found to be 1 day in the CG and 2 days in the PG. The difference between the groups was determined to be statistically significant (p=0.001). The laboratory parameters and symptom durations of the patients are shown in Fig. 1.
Perforation developed in 3 (4.2%) of the 71 CG patients and in 12 (27.3%) of the 44 PG patients. The difference between the groups in respect of perforation development was statistically significant (p=0.001). When the reason for this was questioned, it was learned that the patients were reluctant to come to the hospital during the pandemic because of the fear of infection from patients diagnosed with COVID-19 in hospital. The rate of perforation was determined to be 10.9 times higher in the PG than in the CG (OR = 10.92).
When the patients with and without perforation were compared, a statistically significant difference was determined between the two groups in respect of symptom duration (p<0.005). No statistically significant difference was determined between the groups with and without perforation in respect of neutrophil count and CRP (p=0.517, p=0.452, respectively).
Peri-appendicular abscess was not present in any of the CG patients and was determined to have developed in 4 (9.1%) PG patients. The difference was found to be statistically significant (p=0.02).
In the comparison of patients with and without peri-appendicular abscess, symptom duration, neutrophil count, and CRP increase were found to be statistically significant (p=0.001, p=0.011, p=0.003, respectively).

Discussion

Quarantine and lockdown restrictions were strategies applied by many countries during the COVID-19 pandemic to prevent the spread of infection, alleviate the burden on hospitals, and reduce mortlity rates. However, there are concerns about patients not accessing necessary health care because of these regulations [7].
In a study by Romero et al., there was determined to be a significant decrease in the number of patients treated for a diagnosis of acute appendicitis and an increase in complications [7]. Lazzerini et al. reported that presentations at the Paediatric Emergency Department dur-

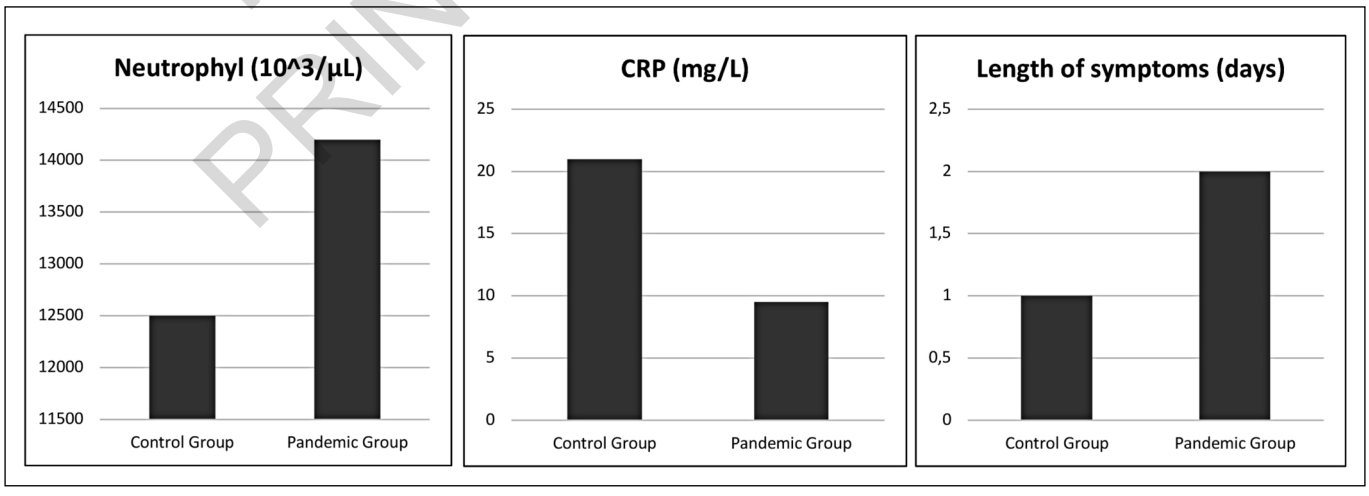

Fig. 1: Laboratory parameters and symptom durations of the patients.

ing the pandemic in Italy in 2020 decreased significantly by 73%-88% compared to the same period in the previous year [8]. It was also reported that a significant majority of those who presented were patients with a high risk of morbidity and mortality who required follow up in the Intensive Care Unit (ICU). Other large healthcare institutions have also reported a decrease in the number of patients applied with imaging during the pandemic [9,10]. In the study of Amendola et al., a total of 75 patients underwent emergency surgery in 2020, while this number was 165 in 2019 [11]. In another study by Orthopoulos et al., there was reported to be a higher rate of perforation and associated complications in patients diagnosed with acute appendicitis, and the reason for this was said to be presentation at 24 hours or more after the onset of symptoms [12]. From an examination of the current literature, it was seen from other studies that there was determined to be a decrease in the number of patients presenting at hospital and diagnosed with acute appendicitis during the pandemic, similar to the findings of this study [13].

The number of patients presenting at the Emergency Department of our hospital between March and June 2020, under the pandemic conditions, who were diagnosed with acute appendicitis was significantly reduced in comparison to the same period in the previous year. In a study of 378 patients by Tankel et al., no significant difference was found in respect of symptom duration between patient groups diagnosed with acute appendicitis before and during the pandemic [13]. In contrast, in a study of 235 patients, Yang et al. reported that symptom duration was statistically significantly longer in patients who presented during the pandemic. In the current study, the symptom duration of patients who presented in 2020 was determined to be statistically significantly longer than that of patients who presented in 2019 [14].

Perforation may be seen at the rate of 16%-40% in acute appendicitis. Compared to non-perforated appendicitis, a perforated appendix is related to increased morbidity and mortality, with a reported mortality rate of 5%[15]. A recent study compared acute appendicitis patients before and during the pandemic and reported a significantly high rate of complicated appendicitis determined during the pandemic [7]. Wang et al. determined perforation in 20% of 80 patients diagnosed with acute appendicitis, and this was attributed to late presentation at hospital during the pandemic [16]. In a study that included a total of 107 patients, Finkelstein et al. compared presentations before and during the pandemic. Of 59 patients who presented before the pandemic, perforation was determined in 10, and of 48 patients who presented during the pandemic, perforation was determined in 16, and it was observed that the time to presentation was significantly longer in the patients determined with perforation [17]. Gao et al. also reported significantly higher rates of perforation, gangrene, and periappendicular abscess in patients who were diagnosed with acute appendicitis and operated on during the pandemic compared to the period before the pandemic [18].

As a result of the study conducted by Frediani et al. with 53 patients between March 2020 and May 2020, they stated that nasopharyngeal swab results should not be expected if the patient's clinical condition is bad or tends to worsen [19]. For this reason, we planned the operations of the patients by only performing thoracic tomography in terms of COVID-19 in order not to delay the surgery.

Limitations of the current study can be considered to be the relatively low number of patients as it was a single-centre study, and that the experience of the surgeon was a determining factor in the selection of surgical method.

Conclusion

In conclusion, the results of this study showed that the rate of perforated appendix determined in the pandemic group was 10.9 fold higher than in the control group, and this significant increase was consistent with the findings of other studies in the literature. There was also determined to be a significant difference in the time of presentation at hospital according to the symptom duration, which was attributed to patients being reluctant to go to a hospital during the pandemic and because of the lockdown and curfew restrictions.

Riassunto

Lo scopo di questo studio era confrontare l'aumento del numero di casi complicati nei pazienti sottoposti a intervento chirurgico per appendicite acuta durante la pandemia di COVID-19 e l'anno precedente.

È stato effettuato un esame retrospettivo delle cartelle dei pazienti che si sono presentati al Pronto Soccorso e ai quali è stata diagnosticata un'appendicite acuta e sono stati sottoposti a intervento chirurgico entro 24 ore o sono stati seguiti tra l'11 marzo e il 1 giugno 2020 durante la pandemia di COVID-19, e nello stesso periodo dell'anno precedente. I pazienti nel periodo pandemico sono stati nominati gruppo pandemico (PG) e i pazienti dell'anno precedente gruppo di controllo (CG). La definizione di appendicite complicata includeva l'ascesso peri-appendicolare e l'appendice perforata.

RISULTATI: il numero di pazienti nel PG era del 38,33% inferiore rispetto al CG. La durata dei sintomi era di 2 giorni nel PG e 1 giorno nel CG e la differenza era statisticamente significativa (p=0,001). La conta media dei neutrofili è stata determinata come maggiore nel PG rispetto al CG (p=0,018). Il tasso di appendice perforata è stato determinato essere 10,9 più alto nel PG rispetto al CG.

Conclusione: Il numero di pazienti che si presenta al Pronto Soccorso si è ridotto durante la pandemia, soprattutto durante i periodi di lockdown, e si è visto che nel nostro centro si sono presentati meno pazienti ma più complicati.

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