ORIGINAL ARTICLE

Impact of COVID-19 pandemic on pediatric appendicitis hospital admission time and length of hospital stay

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ABSTRACT

BACKGROUND: Appendicitis is one of the most common surgical emergencies among children. In this retrospective clinical study, we attempted to determine the effects of the COVID-19 pandemic period on hospital admission time and length of hospital stay (LOS) in pediatric appendicitis cases.

METHODS: We retrospectively compared pediatric appendectomies from the date of the first reported COVID-19 case to June 1, 2020, which is considered as the start of the normalization process, with pre-pandemic pediatric appendectomies of the same number of days in terms of age, gender, hospital admission time, LOS, parental educational level, laboratory values, and histopathological findings.

RESULTS: There was an average increase of 2 days in the time from the onset of symptoms to hospital admission in pediatric appendicitis patients in the COVID-19 period (p=0.001). Furthermore, C-reactive protein value was statistically significantly higher in the COVID-19 period (p=0.018). Given the LOS, it was calculated as an average of 5 days in the pre-pandemic period and 4 days in the COVID-19 period, and this difference was statistically insignificant (p=0.273). There was no significant difference between the groups in terms of histopathological findings (p=0.176). The parental educational level had no effect on the admission time.

CONCLUSION: The hospital admission time of pediatric appendicitis patients is significantly prolonged in the COVID-19 pandemic, but this prolongation had no histopathological effect. During the pandemic, the recovery of patients who required urgent treatment during the "stay-at-home" period was also negatively affected. Notwithstanding, we are of the opinion that the absence of an increase in the LOS may be due to the willingness of both families and physicians to keep the LOS as short as possible. Despite the increase in hospital admission time in pediatric appendicitis during the Covid 19 pandemic process, the lack of increase in the rate of complicated appendicitis may be an indicator of the importance of other factors in the development of complicated appendicitis.

Keywords: Appendicitis COVID-19; hospital admission time; length of hospital stay; parental educational level.

INTRODUCTION

Shortly after the first patients were seen in Wuhan, China in mid-December 2019, the COVID-19 virus spread to 197 countries, and the World Health Organization reported on March 12, 2020 that the virus reached pandemic status.[1–3] The first case of COVID-19 in Turkey was seen on March 10, 2020, and elective surgical operations in our country were postponed on March 17, 2020, while emergency surgical interventions could be performed continuously without any restrictions.

Appendicitis is inflammation of the vermiform appendix,[4] and its incidence in children has been calculated to be approximately 8.6% for boys and 6.7% for girls.[5] The diagnosis of pediatric appendicitis may be delayed or result in negative exploration depending on many factors, including the differences in clinical presentation, the difficulty in establishing

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communication, and performing a physical examination.[4–6] If not treated timely and appropriately, gangrenous appendicitis, phlegmonous appendicitis, perforated appendicitis, or plastron appendicitis may develop.[7] The development of complicated appendicitis increases morbidity and mortality and prolongs the length of hospital stay (LOS).[6–8]

The COVID-19 pandemic is considered to be the biggest public health crisis since World War II.[2] A study revealed an 88% decrease in pediatric emergency admissions during the pandemic period.[9] A limited number of studies have been published to investigate the effects of the COVID-19 pandemic on pediatric cases of appendectomy, which is the most common emergency surgical procedure.[10–16] There is no consensus among these publications. In our study, we primarily aimed to examine the effects of the pandemic on pediatric appendicitis patients, considering hospital admission time, LOS, histopathology and laboratory results, as well as parental educational level. Our secondary aim was to investigate the effect of family education level in the presence of an effect of the COVID-19 pandemic on appendicitis.

MATERIALS AND METHODS

This study was conducted with the approval of the Non-Invasive Clinical Research Ethics Committee of Health Sciences University Samsun Training and Research Hospital and the Ministry of Health, dated June 18, 2020 and numbered September 6, 2020. A retrospective observational study was conducted on pediatric appendectomies between the age of 0 and 18, performed in Sinop Ataturk State Hospital Pediatric Surgery Clinic and İnonu University Turgut Özal Medical Center Pediatric Surgery Department from December 20, 2019, to June 01, 2020. Patients were classified into two groups according to onset of the COVID-19 pandemic. Group 1 (Pandemic group) includes appendectomies from March 11, 2020, the date of the first reported COVID-19 case, to June 01, 2020 when the normalization process started. Group 2 (Control group, Pre-pandemic Group) includes appendectomies between December 20, 2019, and March 10, 2020. We compared hospital admission time, LOS, gender, radiological appendix diameter, histopathological and biochemical findings (White Blood Cells [WBC] and C-Reactive Protein [CRP], and parental educational level. Patients who were diagnosed with appendicitis, left the hospital before surgery, patients with positive SARS-CoV PCR, and elective appendectomy performed for other reasons were excluded from the study.

Patients whose physical examinations were consistent with appendicitis were primarily evaluated using ultrasonography by radiologists. An Abdominal Computed Tomography examination was performed and appendix diameters were measured in patients with suspicious ultrasonographic findings. WBC count was measured as 10^3/mL and CRP as mg/L. Appendicitis cases were pathologically divided into non-complicated and complicated cases. Patients who were evaluated as negative exploration as a result of laparotomy were not included in our study. Separating the maternal and paternal educational levels ranging from illiterate to university graduate, the mothers were evaluated among themselves and the fathers among themselves.

Statistical Analysis

The data were summarized as median (minimum-maximum) or number (percentage). The normality of quantitative variables was analyzed by the Shapiro–Wilk test. Whether there was a significant difference between group categories in terms of quantitative variables, which was analyzed using the Mann–Whitney U test. The Pearson's Chi-square test was used to analyze, whether there was a significant difference between group categories in terms of qualitative variables. The level of statistical significance was set at $p \leq 0.05$. IBM SPSS Statistics 26.0 package software was used for the analyses.

RESULTS

Our study included a total of 76 children between the ages of 4 and 18 years, with a median age of 12.11 years. Of the children, 55.3% were male and 44.7% were female. The age range of the 47 patients in the pre-COVID-19 group was 4–18 years, with a median value of 12–3 years. In the COVID-19 group, there were 29 patients in the age range of 5–17 years, with a median age of 11–7 years. There was no statistical difference in terms of age groups and gender.

The time from the first complaints of all patients and their hospital admission was a minimum of 1 day and a maximum of 8 days, with a median value of 2 days. In the pre-COVID-19 group, the admission time was a minimum of 1 day and a maximum of 8 days, with a median value of 2 days. In the COVID-19 group, the admission time ranged from 1 to 8 days, with a median value of 4 days. There was a statistically significant difference between the two groups ($p<0.001$) (Table 1). The LOS was a minimum of 2 days and a maximum of 15 days for all our patients, with a median LOS of 4 days. The median LOS was 5 days in the pre-COVID-19 group and 4 days in the COVID-19 group. There was no statistically significant difference between both groups (Table 1).

Although there was no significant difference between the two groups in terms of WBC values, the CRP measurements were higher in the COVID-19 group. The CRP comparison of the two groups revealed a significant difference ($p=0.018$). In our study, 68 patients underwent radiological examination. Eight patients whose physical examination was consistent with acute abdomen underwent direct surgical exploration. There was no statistically significant difference between the pre-COVID-19 group and the COVID-19 group (Table 1).

Separating the histopathological findings as complicated and uncomplicated, the COVID-19 period and the pre-COVID-19

Table 1. Comparison of the patients before COVID-19 and COVID-19 period with age, hospital admission time, length of hospital stay, radiological appendix diameter, WBC and CRP

	Pre COVID-19			COVID-19			p
	Min.	Maks.	Arith.mean	Min.	Maks.	Arith.mean	
Age	4	18	12.36	5	17	11.72	0.387
Hospital admission time (day)	1	8	1.94	1	8	3.66	<0.001
Length of hospital stay (day)	2	15	5.43	2	10	4.55	0.273
Radiological appendix diameter (mm)	6	19	9.37	2	13	8.3	0.514
WBC (10^3/mL)	3.6	29.7	15.39	7.4	28.29	16.76	0.264
CRP (mg/L)	1	259	37.57	1.7	322	79.06	0.018

WBC: White blood cells; CRP: C-reactive protein.

Table 2. Parental educational level

	Maternal educational level				Paternal educational level			
	Pre COVID-19	COVID-19	Total	p	Pre COVID-19	COVID-19	Total	p
	n (%)	n (%)	n (%)		n (%)	n (%)	n (%)	
No reading or writing	0 (0.00)	1 (3.40)	1 (1.30)	0.24	0 (0.00)	0 (0.00)	0 (0.00)	0.973
Literate	1 (2.10)	1 (3.40)	2 (2.60)		0 (0.00)	0 (0.00)	0 (0.00)	
Primary school	8 (17.00)	2 (6.90)	10 (13.20)		3 (6.40)	2 (6.90)	5 (6.60)	
Elementary school	12 (25.50)	10 (34.50)	22 (28.90)		10 (21.30)	5 (17.20)	15 (19.70)	
High school	22 (46.80)	9 (31.00)	31 (40.80)		21 (44.70)	13 (44.80)	34 (44.70)	
University	4 (8.50)	6 (20.70)	10 (13.20)		13 (27.70)	9 (31.00)	22 (28.90)	
Total	47 (100.00)	29 (100.00)	76 (100.00)		47 (100.00)	29 (100.00)	76 (100.00)	

period were statistically compared. The comparison showed no significant difference between the groups (Fig. 1).

The mothers and fathers were grouped among themselves based on the educational level, ranging from illiterate to university graduate. There was no statistical difference between the groups (Table 2).

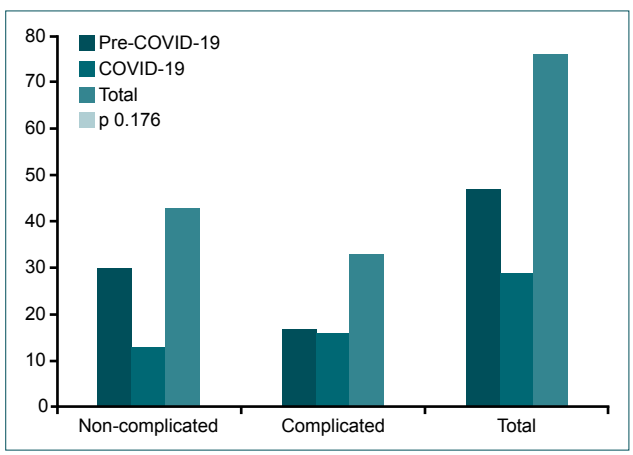

Figure 1. Histopathological findings.

DISCUSSION

COVID-19 is a fast spreading infectious disease, leading to unpredictable clinical outcomes ranging from asymptomatic infections to severe and life-threatening situations. It has led to many psychosocial interactions, especially anxiety, in the society.[3,17] In the period after the declaration of the COVID-19 infection as a pandemic, false and negative information spread rapidly through social media. The unpredictable course of COVID-19 combined with misinformation led to the development of "Coronaphobia" in the society.[17] Coronaphobia has been so dramatic that it has reduced pediatric emergency admissions by 88%.[9] In our study, we wanted to investigate the effects of coronaphobia on appendicitis, the most common emergency surgery indication in children. We compared patients operated with a diagnosis of appendicitis from December 20, 2019, to June 01, 2020, when the partial normalization started in terms of age, gender, admission time, LOS, parental education level, biochemical tests (WBC and CRP), radiological appendix diameter, and histopathological findings. In our study, the hospital admission times were 2-day increased during the COVID-19 period. In addition, our CRP value was statistically significantly higher in the COVID-19

period. However, there was no significant difference in the pathological results and WBC of our patients. As stated by some authors, we are of the opinion that this may be due to genetic predisposition, microbial profile, comorbid diseases, pediatric age group, or antibiotics given to children by families before admission to the hospital.

There is no consensus on the effects of the COVID-19 pandemic on appendicitis. Although some authors indicate an increase in the rate of complicated appendicitis and hospital admission times during the COVID-19 pandemic period, there are studies stating that there is no effect in pediatric appendicitis and even a decrease in the incidence of appendicitis as a result of the use of antibiotics at home due to the fear of families to visit the hospital.[10,16] According to our study, despite the increase in hospital admission time in the COVID-19 pandemic period, there was no increase in the complicated appendicitis rate and no decrease in the appendectomy frequency. Therefore, there is no difference in the LOS in our series. In fact, according to our study, the average LOS is 1-day shorter during the COVID-19 pandemic period. We believe that this is due to the earlier discharge of patients and their families due to the fear of getting infected with the Sars-CoV virus. We are of the opinion that the prolonged admission time independently of family education may show that coronaphobia affects the whole society equally.

Although some authors indicated low maternal and paternal educational level as a risk factor for complicated appendicitis, our study also showed that the maternal and paternal educational levels were not associated with the development of complicated appendicitis.[6,18–20] Moreover, regardless of the parental educational level, hospital admission time increases and LOS decreases equally during the pandemic period. This may indicate that coronaphobia affects society at the same level regardless of education level.

Many laboratory analyses have been studied for the diagnosis of appendicitis, but no specific marker has been defined.[8,9,21–23] However, in the presence of examination findings for appendicitis, a WBC count of 12,000/mm^3 and a CRP level of >3 mg/L have been defined as supportive for the diagnosis of appendicitis. For this reason, in our study, we used WBC and CRP values as biochemical markers. There was an increase in the CRP values of the patients due to the delay in hospital admission time. There was no difference between the groups in terms of radiology results and this showed that the initial hospital admission time was not significant in the development of complicated appendicitis.

The number of home accidents has increased due to "stay-at-home" recommendations, and accordingly, the number of patients treated in pediatric burn centers has increased.[24] Furthermore, during this period, mortality rates have increased due to delayed diagnosis in pediatric tumor cases.[25] During the pandemic period, healthcare workers had to intervene in emergency cases in a more complicated way due to coronaphobia while fighting against Sars-CoV infection. According to our study, the LOS is 1 day shorter during the pandemic period. We are of the opinion that the shorter LOS may be due to physicians' willingness to reduce the possibility of getting infected with Sars-CoV for patients and their relatives.

The major limitations of our study are its retrospective design, and not interviewing with families and children about the psychosocial effects of the COVID-19 pandemic. In addition, the small number of patients in our study is another limitation.

Conclusion

The COVID-19 disease has directly affected individuals infected with the virus and indirectly affected the recovery of patients who have other diseases and need urgent treatment negatively, as a result of misleading information spread through social media. The prolonged initial hospital admission time in pediatric appendicitis is an indicator of this. However, no increase in the rate of complicated appendicitis suggests that factors other than hospital admission time may be involved in the development of complicated appendicitis.

Ethics Committee Approval: This study was approved by the Samsun Training and Research Hospital Non-interventional Clinical Research Ethics Committee (Date: 16.06.2020, Decision No: 2020/9/6).

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ORİJİNAL ÇALIŞMA - *ÖZ*

COVID-19 pandemi sürecinin çocuk apandisitlerinde hastane başvuru süresi ve hastane kalış süresine etkileri

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AMAÇ: Çocuklarda en sık cerrahi acillerden biri apandisittir. Bu geriye dönük klinik çalışmada COVID-19 pandemi sürecinin, çocuk apandisit olguların da hastaneye başvuru süresi ve hastanede yatış süresi üzerine olan etkilerini belirlemeye çalıştık.
GEREÇ VE YÖNTEM: Türkiye de ilk COVID-19 olgusunun rapor edildiği tarihten normalleşme sürecinin başlangıcı olarak kabul edilen 01 Haziran 2020 tarihine kadar yapılan pediatrik açık cerrahi apendektomileri; aynı gün sayısında pandemi öncesi dönem çocuk apendektomilerle geriye dönük olarak yaş, cinsiyet, hastaneye başvuru süresi, hastane kalış süresi, ebeveyn eğitim düzeyi, laboratuvar değerleri ve histopatolojik bulgularla karşılaştırdık.
BULGULAR: Çocuk apandisit hastalarında COVID-19 döneminde semptomların başlamasıyla hastaneye başvuru arasında geçen sürede ortalama iki günlük bir artış mevcuttur (p=0.001). Diğer taraftan C-reaktif protein (CRP) değeri COVID-19 döneminde istatiksel olarak anlamlı şekilde yüksek bulunmuştur (p=0.018). Yatış sürelerine bakıldığında ise, pandemi öncesi dönemde ortalama beş gün iken COVID-19 döneminde ortalama dört gün olarak hesaplanmıştır, bu fark istatistiksel olarak önemsizdir (p=0.273). Histopatolojik bulgular açısından da gruplar arasında anlamlı farklılık saptanmamıştır (p=0.176). Ebeveyn eğitim düzeyinin başvuru süresi üzerinde etkisi yoktur.
TARTIŞMA: COVID-19 pandemisinde çocuk apandisitlerinde hastaneye başvuru süreleri anlamlı şekilde uzamış olup bu uzamanın etkisi histopatolojik olarak saptanmamıştır. Pandemi sürecinde "evde kal" döneminde acil tedavi edilmesi gereken hastaların da sağlıklarına kavuşmalarını olumsuz yönde etkilenmiştir. Buna karşın hastanede kalış sürelerinde artışın olmaması hem ailelerin hem de hekimlerin mümkün olduğunca hastanedede kalış süresini kısa tutmak isteklerinden kaynaklanabileceğini düşünmekteyiz.
Anahtar sözcükler: Apandisit; COVID-19; ebeveyn eğitim düzeyi; hastane başvuru süresi; hastane kalış süresi.

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