ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

DOI: 10.5336/medsci.2022-95123

Comparison of the 'Patient Management and Outcomes' of the Pediatric Patient Groups Who Had Appendectomy During the COVID-19 Pandemic Period and the Pre-Pandemic Period in Terms of the Efficiency of the Management Plan: Cross-Sectional Research

COVID-19 Pandemi Dönemi ve Pandemi Öncesi Dönemde Apendektomi Uygulanan Pediatrik Hasta Gruplarının Hasta Yönetimi ve Sonuçlarının Yönetim Planının Etkinliği Açısından Karşılaştırılması: Kesitsel Araştırma

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ABSTRACT Objective: The restrictions in national policies applied in hospital and patient admissions during the coronavirus disease-2019 pandemic have been observed to have caused delays and additional problems in patient management. The aim of this study was to compare the number and rates of negative appendectomy and complicated appendicitis in patients who underwent appendectomy before and during the pandemic in our clinic. **Material and Methods:** Patients who presented with abdominal pain to our clinic or were consulted between January 2019 and May 2021 were evaluated retrospectively. The cases were categorized into two groups pre-pandemic (1.1.2019-29.2.2020) and pandemic period (11.3.2020-31.5.2021). In both periods, patients underwent laparoscopic appendectomy. In addition, patients were grouped as negative, non-complicated, and complicated according to pathology results. **Results:** 324 patients were hospitalized during the pre-pandemic period due to "abdominal pain." Exploration was done in 184 (M-F: 59%-41%) patients with suspected appendicitis. On histopathological examination, negative appendectomy was found in 16 (8.7%), non-complicated in 113 (68.48%), and complicated in 55 (31.52%) of the patients who were operated on. Post-pandemic period, 232 patients were hospitalized due to abdominal pain. Exploration was done in 162 (M-F: 59%-41%) patients. On histopathological examination, negative appendectomy was found in 11 (6.8%), non-complicated in 100 (66.23%), and complicated in 51 (33.7%) of the patients who were operated on. **Conclusion:** According to the results of the data, no adverse effects were observed on complications or misdiagnosis due to the changing patient management regarding inpatient follow-up and surgical intervention in our clinic during the pandemic period.

Keywords: COVID-19; appendicitis; pediatric; abdominal pain; acute abdomen

ÖZET Amaç: Koronavirüs hastalığı-2019 pandemi döneminde hastane başvuruları ve hasta kabulünde uygulanan ulusal programlardaki kısıtlamaların hasta yönetiminde gecikme ya da ek sorunlara neden olduğu gözlemlenmiştir. Bu çalışmada kliniğimizde pandemi öncesi dönemde ve pandemi döneminde apendektomi uygulanan hastaların negatif apendektomi ve komplike apandisit sayı ve oranları yönünden karşılaştırılması amaçlanmıştır. **Gereç ve Yöntemler:** Kliniğimize Ocak 2019-Mayıs 2021 tarihleri arasında karın ağrısı şikâyeti ile başvurmuş veya konsülte edilmiş hastalar geriye dönük olarak değerlendirildi. Olgular pandemi öncesi dönem (1.1.2019-29.2.2020) ve pandemi dönemi (11.3.2020-31.5.2021) olmak üzere 2 gruba ayrıldı. Her iki dönemde de hastalara laparoskopik apendektomi uygulandı. Hastalar patoloji sonuçlarına göre negatif apendektomi, nonkomplike apandisit ve komplike apandisit olarak gruplandırıldı. **Bulgular:** Pandemi öncesi dönemde toplam 324 hasta "karın ağrısı" nedeniyle kliniğimize yatırıldı. Apandisit şüphesi olan 184 (E-K: %59-%41) hastaya laparoskopik apendektomi uygulandı. Histopatolojik incelemede opere edilen hastaların 16'sında (%8,7) negatif apendektomi, 113'ünde (%68,48) nonkomplike apandisit, 55'inde (%31,52) komplike apendisit saptandı. Pandemi döneminde 232 hasta karın ağrısı nedeniyle kliniğimize yatırıldı. 162 (E-K: %59-%41) hastaya laparoskopik apendektomi uygulandı. Histopatolojik incelemede opere edilen hastaların 11'inde (%6,8) negatif apendektomi, 100'ünde (%66,23) nonkomplike apandisit, 51'inde (%33,7) komplike apandisit saptandı. **Sonuç:** Toplanan verilerin istatistiksel değerlendirme sonuçlarına göre pandemi döneminde kliniğimizde yatarak izlem ve cerrahi girişim ile ilgili değişen hasta yönetiminin; komplikasyon veya yanlış tanı üzerine olumsuz etkisi gözlenmemiştir.

Anahtar Kelimeler: COVID-19; apandisit; pediatri; karın ağrısı; akut batın

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Peer review under responsibility of Turkiye Klinikleri Journal of Medical Sciences.

Received: 28 Dec 2022 ***Received in revised form:*** 16 Apr 2023 ***Accepted:*** 22 May 2023 ***Available online:*** 02 Jun 2023

Appendicitis is the most common cause of emergency surgery in children.[1] The essential step in diagnosing appendicitis is the detailed history and physical examination.[1,2] The accepted treatment of appendicitis is an appendectomy, and the use of laparoscopy on the rise.[1,3] Early diagnosis and treatment are essential points in the prevention of appendicitis complications.[4]

New coronavirus infection, may present with gastrointestinal symptoms such as abdominal pain, nausea, and vomiting as the first symptom, which can mimic acute abdomen. However, studies in children and clinical manifestations of coronavirus disease-2019 (COVID-19) do not fully explain the natural history of infection in children, and the involvement of gastrointestinal tract is not fully understood.[5]

Because the symptoms are similar to those of acute abdomen and can cause Pediatric Inflammatory Multisystemic Syndrome (PIMS), which can seriously endanger the lpatients, patient, early detection is important for starting treatment.[6] In these patients, due to the similarity of the symptoms, it is essential to make the differential diagnosis of appendicitis, the treatment of which is surgical. In addition, the fact that COVID-19 disease increases the risk of anesthesia-related complications is crucial in patient management, accurate diagnosis, and treatment guidance.

A recent review of 72,314 cases by the Chinese Center for Disease Control and Prevention showed that less than 1% of cases were in children younger than ten years old.[7] In addition, unlike infected adults, most infected children appear to have a milder clinical course, and asymptomatic infections are not uncommon. As a result, children have milder symptoms, recover faster, and have a better prognosis.[8,9]

This study is aimed at comparing the diagnostic algorithms applied to the patients who came to our clinic with the pre-diagnosis of the acute abdomen before and during the pandemic and to show that there was no late diagnosis and treatment of appendicitis during the pandemic period.

MATERIAL AND METHODS

This study was conducted in pediatric surgery departments in concordance with international ethical standards and the World Health Organization's Helsinki Declaration. The Ege University Medical Research Ethics Committee approved the study, and informed consent was obtained from all of the subjects (date: September 17, 2021, no: 21-9T/23). The study was approved by the Ministry of Health Scientific Research Platform COVID-19 Scientific Research Evaluation Commission.

PATIENT MANAGEMENT

Patients who came to our clinic with abdominal pain were evaluated according to the new scoring system (NSS). An NSS score of 12 and higher was considered the cut-off level for the diagnosis of appendicitis.[9]

All patients who came with the complaint of abdominal pain in pre-pandemic and pandemic periods were evaluated according to NSS, and those suspected of acute abdomen were hospitalized with the aim of follow-up or operation.

However, during the pandemic period, due to similar symptoms and the risk of surgical complications, COVID-19 polymerase chain reaction (PCR) samples were obtained from hospitalized patients. Surgery was on hold pending PCR test results. In both periods, patients underwent laparoscopic appendectomy. Patients with a recent COVID-19 infection or contact history and those whose acute abdomen findings could not be supported radiologically were first referred to pediatrics department for evaluation in terms of PIMS.

STUDY DESIGN

Patients who came to our clinic or were consulted due to complaint of abdominal pain between January 2019 and May 2021 were evaluated retrospectively. The cases were divided into two groups pre-pandemic (1.1.2019-29.2.2020-control patient group) and pandemic period (11.3.2020-31.5.2021-research group). Age, gender, duration of pain, non-pain symptoms (nausea, vomiting, fever, dysuria, diarrhea, constipation), laboratory findings, radiological evaluation method (ultrasound, computed tomography), and outcome records of the patients were evaluated from the patient files. Hospitalization time, operation time, and time between hospitalization and operation were evaluated among these patients hospitalized in

our clinic with the pre-diagnosis of "appendicitis." Unlike the control group, patients in the study group had a COVID-19 PCR sample taken during hospitalization. PCR time, result time, and time between PCR result and operation were evaluated. The pathology results of the operated patients were examined, and the patients were compared in terms of the number and rates of negative appendectomy and complicated appendicitis. Pathology results were evaluated in three groups negative, non-complicated (acute and phlegmonous), and complicated (gangrenous and perforated). The results obtained were statistically compared with the IBM SPSS Statistics 25.0 (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) program. The chi-square method was used.

RESULTS

In the pre-pandemic period (between 1.1.2019-29.2.2020), a total of 836 patients from the emergency department, pediatrics polyclinics, wards, and the pediatric intensive care unit were consulted to the Pediatric Surgery Department due to "abdominal pain." Three hundred twenty-four of them were followed up in our clinic. Two hundred seventy-eight of the hospitalized patients were hospitalized with a preliminary diagnosis of appendicitis. In the follow-up, 94 patients who were hospitalized with the suspicion of appendicitis were discharged without any surgical intervention because their complaints regressed. Forty-six patients were hospitalized for reasons other than appendicitis [ovarian cyst, torsion, cholelithiasis, ileus, duodenal ulcer perforation (DUP), invagination, etc.], and 29 patients were operated on; no surgical intervention was done to 17 patients (Table 1).

Of the hospitalized patients, 184 [109 (59%) males and 75 (41%) females] were operated on with a preliminary diagnosis of "appendicitis." The mean age of the operated patients was 11.059±3.862. The mean time between hospitalization and operation was 8.3±6.649 hours.

On histopathological examination, negative appendectomy was found in 16 (8.7%) patients, acute in 113, gangrenous in 6, and perforated appendicitis in 49 of the patients who were operated on.

According to the histopathological examination, 113 of 168 patients who were found to have "appendicitis" were evaluated as non-complicated (68.48%) and 55 as complicated (31.52%).

From 11.03.2020, when the first case of COVID-19 was announced in Türkiye, until 31.05.2021, a total of 537 patients from the emergency department, pediatrics polyclinics, wards and the pediatric intensive care unit were consulted to the pediatric surgery department due to "abdominal pain." Two hundred thirty-two of them were followed up in our clinic. One hundred ninety-seven of the hospitalized patients were hospitalized with a preliminary diagnosis of appendicitis. In the follow-up, 35 patients who were hospitalized with the suspicion of appendicitis were discharged without any surgical intervention because their complaints regressed. Forty-six patients were hospitalized for reasons other than appendicitis (ovarian cyst, torsion, cholelithiasis, ileus, DUP, invagination, etc.), and 15 patients were operated on; No surgical intervention was done to 20 patients (Table 1).

TABLE 1: Analysis of patients hospitalized with the suspicion of "acute abdomen" in the pre-pandemic and pandemic period.

		Time			
		Pre-pandemic period		Pandemic period	
		Operated	Non-operated	Operated	Non-operated
Patients hospitalized with suspicion of appendicitis	Number	184	94	162	35
	%	66.2	33.8	82.3	17.7
Patients hospitalized with suspicion of non-appendicitis acute abdomen	Number	29	17	15	20
	%	63.1	36.9	42.8	57.2

Of the hospitalized patients, 162 [95 (59%) male, 67 (41%) female] were operated on with a preliminary diagnosis of "appendicitis." The mean age of the operated patients was 11.16±4.08. The mean time to result in the COVID-19 PCR test taken during hospitalization was 5.195±2.138 hours; The mean time between hospitalization and operation was found to be 13.321±8.402 hours in patients whose PCR results were expected before the operation.

On histopathological examination, negative appendectomy was found in 11 (6.8%) patients, acute in 100, gangrenous in 3, and perforated appendicitis in 48 of the patients who were operated on.

According to the histopathological examination, 100 of 151 patients who were found to have "appendicitis" were evaluated as non-complicated (66.23%) and 51 as complicated (33.7%).

When the number and rates of negative appendectomy in patients who underwent appendectomies in the pre-pandemic and pandemic period were compared, the p value was calculated as 0.510 (>0.05) (Table 2).

When the number and rates of complicated appendicitis were compared in the same group of patients, the p value was calculated as 0.844 (>0.05) (Table 3).

294 (35%) of 836 patients consulted in the pre-pandemic period were hospitalized and followed up in our clinic with the suspicion of "appendicitis." During the pandemic, 197 (37%) of 537 patients consulted were hospitalized with the suspicion of "appendicitis" and followed up. Before the pandemic, 94 of 278 patients hospitalized with suspected appendicitis were discharged without any surgical intervention because their complaints regressed during the follow-up period; during the pandemic, 35 of 197 patients with suspected appendicitis were not operated on because their complaints regressed (p: <0.0005) (Table 4).

The significantly low rate of patients discharged without surgery during the pandemic period is attributed to the reduced number of beds within the framework of pandemic measures, and in order to reduce the risk of contact/contamination, the approach in the selection of hospitalized patients was changed, and therefore only highly suspected patients were admitted to the clinic.

According to the results obtained, when the pre-pandemic and pandemic periods are compared, in the two groups of patients with similar age and gender characteristics, no statistically significant difference was found between the rates of negative appendectomy and complicated appendicitis, despite changing

TABLE 2: Negative appendectomy statistics in pre-pandemic and pandemic period.

		Time	
		Pre-pandemic period	Pandemic period
Negative appendectomy	Number	16	11
	%	8.7	6.8
Appendicitis	Number	168	151
	%	91.3	93.2
Total	Number	184	162
	%	100.0	100.0

TABLE 3: Complicated appendicitis statistics in pre-pandemic and pandemic period.

		Time	
		Pre-pandemic period	Pandemic period
Non-complicated appendicitis	Number	113	100
	%	67.3	66.2
Complicated appendicitis	Number	55	51
	%	32.7	33.8
Total	Number	168	151
	%	100.0	100.0

TABLE 4: Statistics of patients hospitalized with suspected appendicitis but discharged without surgery in the pre-pandemic and pandemic period.

		Time	
		Pre-pandemic period	Pandemic period
Non-operaded	Number	94	35
	%	33.8	17.8
Operated	Number	184	162
	%	66.2	82.2
Total	Number	278	197
	%	100.0	100.0

patient management. There was a significant difference between the rates of patients discharged without surgery.

According to the results of the statistical evaluation of the collected data, the changing of patient management regarding inpatient follow-up and surgical intervention in our clinic during the pandemic period; had no negative results in terms of complications or misdiagnosis.

These results show that there was no late diagnosis and treatment of appendicitis during the pandemic period and that despite similar symptoms, the differential diagnosis of COVID-19-related conditions and appendicitis was made successfully.

In line with the results obtained from our comparison, there was no significant change in our approach to patients with suspected appendicitis after the pandemic.

DISCUSSION

The first symptoms in the pediatric patient group of COVID-19 disease are similar to acute abdomen symptoms, and this similarity has caused changes in the approach to the acute abdomen in this period all over the world.[10]

An excellent clinical record and thorough physical examination should be done, blood tests and imaging tests should be analyzed to look for the characteristic signs of COVID-19, and other abdominal pathologies should be ruled out.[6]

As the COVID-19 outbreak spread to the United States, hospitals across the country suspended non-emergency surgeries to reserve capacity for anticipated patient growth, and some centers managed non-complicated appendicitis non-operatively, with one-year failure rates of 0-29%.[11] In our clinic, laparoscopic surgery was performed in patients diagnosed with appendicitis in both periods. A postoperative hospital stay for non-complicated appendicitis is 8-36 hours, and it is thought to be shorter than the duration of antibiotic therapy planned for nonoperative management. In some centers in our country, changes have been made in the surgical and medical treatment preferences applied for appendicitis management. While the laparoscopic appendectomy method was preferred for appendicitis in the pre-pandemic period, During the pandemic period, open appendectomy was preferred in cases of complicated appendicitis with an appendiceal mass that cannot be separated by external manipulation, generalized peritonitis with massive abdominal distension, and COVID-19 PCR positivity.[12] At the beginning of the pandemic period, the idea that laparoscopic surgery increased contact with patient secretions and that the duration of the operation, increased the risk of COVID-19 transmission, was suggested and this idea was effective in this approach. Laparoscopic surgery has been the preferred treatment method for patients diagnosed with appendicitis during the pandemic period in our clinic. During the COVID-19 pandemic period, all appendectomies were performed laparoscopically during the period included in the study.

During the pandemic period, from April 2020, after the decision was taken in our hospital, COVID-19 PCR samples were taken from the patients before the operation. COVID-19 PCR samples were taken from the patients admitted to our clinic with the suspicion of appendicitis, and the results of the test were awaited for the operation. Although there were patients with COVID-19 contacts among those included in the study, there were no patients with positive PCR tests.

Appendectomy was performed in 2 patients who were not included in the study (after May 2021) in our clinic, whose COVID-19 PCR test was positive. Laparoscopic appendectomy was also preferred in these patients known to be COVID-19 positive. Two patients with perforated appendicitis were followed up in the pediatric infectious diseases service in the postoperative period.

During this period, there was no transmission of COVID-19 through laparoscopic surgery in the teams participating in the operation.

It is known that there has been a decrease in the number of patient admissions to emergency services due to lockdowns and fear of contamination during the pandemic period. In this period, it has been reported that there is an increase in the rate of compli-

cated appendicitis in patients with appendicitis due to the delays in going to the emergency department and the time elapsed while waiting for the pre-operative COVID-19 PCR result.[12] However, due to the similarity of symptoms, it has been reported that there is an increase in the rates of patients with the operation and negative appendectomy with the wrong diagnosis of appendicitis.

Patients who were consulted to our clinic with the suspicion of appendicitis in the pre-pandemic period and during the pandemic; were evaluated according to NSS.[9] Furthermore, those whose findings were highly suspicious of appendicitis were hospitalized and followed up.

In the pandemic period, unlike in the previous period, it was determined that the COVID-19 disease increased the risk of anesthesia-related complications. In addition, as of April 2020, in order to minimize the risk of transmission, apart from emergency surgeries (trauma-ovarian or testicular torsion-foreign body aspiration, etc.), preoperative COVID-19 PCR samples were a requirement for all patients before the surgery. PCR samples were taken during hospitalization from patients who were scheduled for appendectomy, and surgery was on hold pending the PCR test results.

In the pre-pandemic period, the average time between the patients' hospitalization and the operation was 8.31 hours. In patients who underwent PCR testing before operations during the pandemic, the average time for test results was 5.2 hours; The mean time between hospitalization and operation was found to be 13.32 hours. It has been observed that the longer time between hospitalization and operation during the pandemic period did not increase the rate of complicated appendicitis. In addition, in our study, no statistically significant difference between the rates of "negative appendectomy" in appendectomies performed between the two periods was noted.

A case report published in the USA described a severe case of COVID-19 in a previously healthy adolescent patient who initially presented with gastrointestinal symptoms and isolated acute mesenteric adenopathy on imaging. This study showed that children whose clinical findings are highly suspicious for acute appendicitis might be cases of COVID-19 with atypical presentation.[13] In another article published in India, a case of a patient who presented with acute abdomen symptoms but whose radiological images were not significant in terms of acute abdomen was reported. A diagnosis of "COVID-19-related acute inflammation" with a positive COVID-19 PCR test on the 10th day of follow-up was made.[6] A study published in Italy deals with a newborn case who was followed up for Meckel's Diverticulum perforation and whose COVID-19 PCR test was positive in the postoperative period. With this, the necessity of creating standard protocols to perform pre-operative screening was mentioned.[14]

In the pre-pandemic period (between 1.1.2019-29.2.2020), a total of 836 patients; from 11.03.2020, when the first COVID-19 case was announced in Türkiye, to 31.05.2021, a total of 537 patients were consulted to our clinic due to "abdominal pain." Considering the difference between the two periods, it can be deduced that lockdowns and fear of contagion caused a decrease in hospital admissions, as also reported in the literature.[12]

LIMITATIONS

The COVID-19 infection status of the patients is unknown during the period from March, when the pandemic started in Türkiye, to April when COVID-19 PCR samples were routinely taken from hospitalized patients.

CONCLUSION

In our clinic, as in the rest of the world, patient management regarding the inpatient follow-up and surgical intervention of patients who presented with abdominal pain during the pandemic period has changed. No adverse effects on complications or misdiagnoses were observed despite changing patient management.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Ahmet Çelik, Denizay Avcı;* ***Design:*** *Ahmet Çelik, Denizay Avcı, Ülgen Çeltik;* ***Control/Supervision:*** *Ahmet Çelik, Denizay Avcı, Ülgen Çeltik, Mustafa Orkan Ergün, Emre Divarcı, Geylani Özok;* ***Data Collection and/or Processing:*** *Ahmet Çelik, Denizay Avcı, Ülgen Çeltik, Mustafa Orkan Ergün, Emre Divarcı, Geylani Özok;* ***Analysis and/or Interpretation:*** *Ahmet Çelik, Denizay Avcı, Ülgen Çeltik, Mustafa Orkan Ergün, Emre Divarcı, Geylani Özok;* ***Literature Review:*** *Ahmet Çelik, Denizay Avcı, Ülgen Çeltik;* ***Writing the Article:*** *Ahmet Çelik, Denizay Avcı, Ülgen Çeltik;* ***Critical Review:*** *Ahmet Çelik, Denizay Avcı, Ülgen Çeltik, Mustafa Orkan Ergün, Emre Divarcı, Geylani Özok.*

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