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WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

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Observational Study

Effect of the COVID-19 pandemic on patients with presumed diagnosis of acute appendicitis

Sami Akbulut, Adem Tuncer, Zeki Ogut, Tevfik Tolga Sahin, Cemalettin Koc, Emek Guldogan, Ertugrul Karabulut, Elif Seren Tanriverdi, Ali Ozer

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Abstract

BACKGROUND

Acute appendicitis (AaP) is the most frequent cause of acute abdominal pain, and appendectomy is the most frequent emergency procedure that is performed worldwide. The coronavirus disease 2019 (COVID-19) pandemic has caused delays in managing diseases requiring emergency approaches such as AaP and trauma.

AIM

To compare the demographic, clinical, and histopathological outcomes of patients with AaP who underwent appendectomy during pre-COVID-19 and COVID-19 periods.

METHODS

The demographic, clinical, biochemical, and histopathological parameters were evaluated and compared in patients who underwent appendectomy with the presumed diagnosis of AaP in the pre-COVID-19 (October 2018-March 2020) and COVID-19 (March 2020-July 2021) periods.

RESULTS

Admissions to our tertiary care hospital for AAP increased 44.8% in the COVID-19 period. Pre-COVID-19 ($n = 154$) and COVID-19 ($n = 223$) periods were compared for various parameters, and we found that there were statistically significant differences in terms of variables such as procedures performed on the weekdays or weekends [odds ratio (OR): 1.76; $P = 0.018$], presence of AAP findings on ultrasonography (OR: 15.4; $P < 0.001$), confirmation of AAP in the histopathologic analysis (OR: 2.6; $P = 0.003$), determination of perforation in the appendectomy specimen (OR: 2.2; $P = 0.004$), the diameter of the appendix ($P < 0.001$), and hospital stay ($P = 0.003$). There was no statistically significant difference in terms of interval between the initiation of symptoms and admission to the hospital between the pre-COVID-19 (median: 24 h; interquartile range: 34) and COVID-19 (median: 36 h; interquartile range: 60) periods ($P = 0.348$). The interval between the initiation of symptoms until the hospital admission was significantly longer in patients with perforated AAP regardless of the COVID-19 or pre-COVID-19 status ($P < 0.001$).

CONCLUSION

The present study showed that in the COVID-19 period, the ultrasonographic determination rate of AAP, perforation rate of AAP, and duration of hospital stay increased. On the other hand, negative appendectomy rate decreased. There was no statistically significant delay in hospital admissions that would delay the diagnosis of AAP in the COVID-19 period.

Key Words: SARS-CoV-2; COVID-19 pandemic; Acute appendicitis; Perforated appendicitis; Negative appendectomy

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Core Tip: The World Health Organization declared the coronavirus disease 2019 (COVID-19) pandemic as a public health emergency of international concern. Previous studies have shown that the anxiety related with the fear of the COVID-19 pandemic has caused individuals to avoid admission to hospitals even in very urgent conditions. The present study showed that the complicated acute appendicitis rate increased, which has led to prolonged hospital stays during the COVID-19 pandemic. The present study also showed that the negative appendectomy rate decreased during the pandemic.

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INTRODUCTION

Coronavirus disease 2019 (COVID-19) emerged as a severe acute viral pneumonia in Wuhan city of Hubei province in China. Soon, investigations showed that a new type of coronavirus caused this condition, and it was genotyped and renamed as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and the disease was renamed as COVID-19[1-5]. Soon the disease spread throughout the globe and caused a world-wide catastrophe[2]. On January 30, 2020, the World Health Organization declared the disease as a public health emergency of international concern (in other words a pandemic). In the beginning of the pandemic, there were no effective antiviral treatments or preventive vaccinations, which led to promotion of isolation methods such as social distancing, masking, and staying at home to prevent transmission of the disease between individuals[1]. The first confirmed case of COVID-19 in Turkey was declared on March 11, 2020. Rapidly, the Turkish Ministry of Health established a scientific advisory board, and various guidelines were determined in accord with the recommendations of the World Health Organization for the prevention and management of the COVID-19 pandemic. Cancer surgeries, emergent cases such as appendectomy, viscus perforations, and trauma were allowed provided that necessary precautions were taken in the operating theatre and inpatient wards. It was recommended that any elective procedure shall be postponed if it was for non-life threatening condition [6,7].

In general, acute appendicitis (AAP) is the most frequent cause of acute abdominal pain that requires hospital admissions, and appendectomy is the most frequent emergency procedure that is performed[2, 4,8,9]. Appendectomy is the gold standard treatment for AAP; however, nonoperative treatment can be

performed in selected cases (non-complicated AAp) and during global crisis such as the COVID-19 pandemic[9-11]. The delay in the diagnosis and management of AAp leads to life threatening conditions such as uncontained perforation, peritonitis, and abscess formation[2,11].

Studies have shown that SARS-CoV-2 infection had a significant impact on the physical and psychological health of individuals. The anxiety related with the fear of contracting the COVID-19 has caused individuals to avoid admission to hospitals even in very emergent conditions[2]. This condition had also an impact on patients with AAp. Patients with AAp had delayed hospital admissions and majority of these patients preferred nonoperative treatments such as antibiotic therapy during the pandemic[2,9,12-16]. Studies have reported that a delay in hospital admissions of patients with AAp have led to increased complication rates[2,17]. There are also contradictory studies that show that hospital admissions did not show significant differences during the COVID-19 pandemic[18-22].

The aim of the present study was to comparatively evaluate the impact of the COVID-19 pandemic with the pre-pandemic period regarding the patients who underwent operations for AAp in terms of negative appendectomy rates and perforation rates. Our secondary aim was to evaluate the impact of the pandemic on the hospital admission rates of the patients with AAp.

MATERIALS AND METHODS

In Turkey, the first confirmed case of COVID-19 was declared on March 11, 2020. Between March 2020 and July 2021, 223 patients underwent operations on with the presumed diagnosis of AAp at the Department of Surgery, Inonu University Faculty of Medicine, Malatya, Turkey. These patients were included in the COVID-19 group (case group). To evaluate the impact of the COVID-19 pandemic on patients' behavioral patterns, 154 patients who underwent appendectomy between October 2018 and March 2020 were included in the pre-COVID-19 group (control group).

The study parameters included age (years), gender (female, male), timing of surgery (daytime *vs* night-time), timing of surgery by working days (weekdays *vs* weekends), ultrasonographic (US) findings (AAp present or absent), histopathologic findings (AAp present or absent), status of appendiceal perforation (present or absent), type of surgery (open *vs* laparoscopic), postoperative antibiotic use (yes or no), other histopathological features detected in surgical specimens (neuroendocrine tumor, granulomatous appendicitis, serrated adenoma, cystadenocarcinoma, mucinous adenocarcinoma, fibrous obliteration, hyperplastic polyps, lymphoid hyperplasia, *etc.*), white blood cell (WBC), neutrophil, lymphocyte, platelets, plateletcrit, red cell distribution width, platelet distribution width, mean corpuscular hemoglobin, mean platelet volume, mean corpuscular volume, C-reactive protein (CRP), total bilirubin, neutrophil to lymphocyte ratio, platelet to lymphocyte ratio, white cell neutrophil ratio, white cell lymphocyte ratio, length of appendix (mm), width (diameter) of appendix (mm), duration of hospital stay (days), and pre-admission interval (hour). The city that our institution is situated, Malatya city, has a total population of 806156 people. Our institution has 301 intensive care unit bed and 1368 beds in inpatient wards. Our institution is the largest referral center in the region. Additionally, the state hospital in Malatya became the pandemic center for referral of patients with COVID-19 and for this reason, our hospital became the referral center for all emergency cases.

Diagnostic work-up of the patients in our institution

The diagnosis of AAp was established using the results of a combination of patient symptoms, anamnesis, findings of physical examination, plain abdominal radiography, complete blood cell count, CRP, and urinalysis. In patients with a suspicion of AAp, follow-up visits in the emergency department were performed to re-evaluate the complaints and findings of the physical examination. In our institution, we use the Alvarado scoring system for evaluation of patients with right lower quadrant pain. In summary, patients with a low Alvarado score ranging between 1-4 were discharged because they had a low risk of AAp. Patients with an Alvarado score ranging between 5 to 6 were followed closely. We chose to perform imaging techniques such as US, abdominal computerized tomography (CT), and magnetic resonance imaging in this group of patients. The patients with Alvarado scores ranging between 7 to 10 were considered to have AAp, and emergency operation was planned. The majority of the patients admitted to the emergency department with the complaint of abdominal pain that were considered to have AAp underwent appendectomy. The nonoperative management (NOM) that consists of antibiotic therapy was performed to a limited number of patients, and these patients were excluded from our study[23,24].

During the COVID-19 pandemic, every patient that was admitted to the emergency department with abdominal pain was tested for SARS-CoV-2 by polymerase chain reaction (PCR) test, and chest X-ray was performed for surveillance of the patients. The patients with suspected lung lesions were further evaluated with thorax CT. Some patients were referred from other centers with all the diagnostic work-up performed including the PCR and thorax CT. These patients had already confirmed diagnoses of AAp, no further tests were performed in our institution, and emergency operation was planned. The patients with high suspicion of COVID-19 infection such as symptoms of pneumonia, fever, or respiratory tract, traveled abroad in the prior 2 wk, or had a history of contact with patients with

COVID-19 infection were quarantined after the PCR test and the thorax CT ruled out COVID-19 infection[3,25]. No emergency operation was postponed related to the COVID-19 status of the patients. Precautions were taken in the operating room and the patient wards to protect the staff and other patients. Retrospectively, 35 patients in our COVID-19 cohort had a positive COVID-19 PCR test, and 22 of these patients were infected in a median of 146 d [interquartile range (IQR): 219] following the operation. The remaining 13 patients were infected in median of 162 d (IQR: 146) prior to appendectomy. None of the patients had contracted COVID-19 during the early perioperative period.

Study protocol and ethics committee approval

This retrospective case-controlled study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. First, the required official administrative permissions from the Directorate of Surgery were granted (2021/61490). Then, ethical approval was obtained from the Inonu University Institutional Review Board for non-interventional studies (2021/2293). This study was registered in Research Registry, where the protocol and data collections proforma can be accessed (Research Registry UIN: researchregistry7378). Strengthening the reporting of observational studies in epidemiology guidelines were utilized to assess the likelihood of bias and overall quality for this study[26].

Statistical analysis

The statistical analyses were performed using IBM SPSS Statistics v25.0 (Statistical Package for the Social Sciences, Inc, Chicago, IL, United States). The continuous variables were expressed as median, IQR and 95% confidence interval (CI) for median value. The categorical variables were reported as number and percent (%). Kolmogorov-Smirnov were used to assess normality of continuous variable distribution. Non-parametric Mann Whitney *U* test was used to compare continuous variables. Pearson's χ^2 test was used to compare categorical variables. $P \leq 0.05$ was considered statistically significant.

RESULTS

General characteristics of the study population

Three hundred and seventy-seven patients with ages ranging between 17-92 years (median: 36, IQR: 27) were included for analysis in the study. Two hundred and twenty-five (59.7%) of the patients were male, and 152 (40.3%) were female. Among them, 154 patients (40.8%) underwent appendectomy in the pre-COVID-19 pandemic period, and 223 patients (59.2%) underwent appendectomy during the COVID-19 pandemic period. There was a 44.8% increase in the number of patients admitted to our hospital with presumed diagnosis of AAp. Two hundred patients (53.1%) underwent appendectomy during the daytime, and 177 (46.9%) patients underwent appendectomy during the night-time. Two hundred and seventy-four patients (72.7%) underwent appendectomy on the weekdays, and 103 patients (27.3%) underwent appendectomy during the weekends. Two hundred and forty-five patients received laparoscopic appendectomy (65.0%), and 132 patients (35.0%) underwent conventional open appendectomy. In 4 of the 132 patients who underwent open appendectomy, the procedure started with laparoscopy and was converted due to technical difficulties. Histopathological analysis showed that 79 patients (21.0%) had appendiceal perforation, and 42 patients (11.1%) underwent negative appendectomy. Therefore, 335 of the 377 patients (88.9%) included in the study had confirmed AAp with histopathologic analysis.

Comparison of pre-COVID-19 vs COVID-19 groups

The patients in the study were divided into two groups: Pre-COVID-19 ($n = 154$) and COVID-19 ($n = 223$). The two groups did not show statistically significant differences in terms of age, timing of the operation (daytime *vs* night-time) WBC, neutrophil, lymphocyte, or platelet counts, plateletcrit, red cell distribution width, platelet distribution width, mean corpuscular hemoglobin, mean platelet volume, mean corpuscular volume, total bilirubin concentration, CRP, neutrophil to lymphocyte ratio, platelet to lymphocyte ratio, platelet-to-neutrophil ratio, white cell lymphocyte ratio, white cell neutrophil ratio, and the length of the appendectomy specimen.

On the other hand, the groups were statistically different in terms of surgery being performed on the weekends *vs* weekdays ($P = 0.018$), detection of AAp on US ($P < 0.001$), histopathologic confirmation of AAp ($P = 0.003$), presence of perforation in the surgical specimen ($P = 0.004$), diameter of the appendiceal surgical specimen ($P < 0.001$), and duration of hospital stay ($P = 0.003$). Evaluation of our results show that during the COVID-19 pandemic, appendectomy was 1.76 times more frequent during the weekends, the diagnostic rate (AAp) of US was 15.4 times higher, negative appendectomy rate was reduced by 2.6 fold, and the perforation rate was increased by 2.2 fold. The duration of the hospital stay following appendectomy in the pre-COVID-19 and COVID-19 groups were 1 d to 11 d (mean $\pm$ SD: 2.2 ± 1.5) and 1 d to 17 d (mean $\pm$ SD: 3.3 ± 3.2), respectively. The sensitivity, pulse pressure variation and

accuracy of US during the COVID-19 pandemic period were 97%, 93%, and 90%, respectively. The sensitivity, pulse pressure variation, and accuracy in the pre-COVID-19 period were 77%, 83%, and 68%, respectively. The results of the univariate analysis of the patients are presented in Tables 1 and 2.

We aimed to evaluate the correlation between the pre-admission interval and the COVID-19 pandemic. We used telephone interviews of the patients included in the study to obtain the interval between initiation of the pain and admission to the hospital in both groups. In total 60 patients gave accurate answers to the questions that we asked. The pre-admission interval in the pre-COVID-19 and the COVID-19 groups were 4 h to 96 h (median: 24, IQR: 33, 95%CI: 17-48) and 4 h to 192 h (median: 36, IQR: 60, 95%CI: 18-48), respectively. This difference in the pre-admission intervals between the groups was not statistically significant ($P = 0.348$).

We evaluated the pre-admission intervals of the patients regardless of the COVID-19 or pre-COVID-19 period. The pre-admission intervals of the patients with and without perforation were 9 h to 192 h (median: 72, IQR: 48) and 4 h to 120 h (median: 18, IQR: 24), respectively ($P < 0.001$). In the pre-COVID-19 period, the median pre-admission time interval of the perforated and non-perforated AAp cases were 48 h (IQR: 36) *vs* 20 h (IQR), respectively ($P = 0.048$). During the COVID-19 pandemic, the median pre-admission intervals of the patients with perforated and non-perforated AAp were 72 h (IQR: 48) *vs* 12 h (IQR: 16), respectively ($P < 0.001$).

DISCUSSION

Since the World Health Organization declared COVID-19 as a public health emergency of international concern (*i.e.*, a pandemic), 236132082 people have been infected with COVID-19, and 4822472 (2.04%) people have died due to severe COVID-19 infection or complications related to it. The recommendations of wearing a mask, social distancing, and social isolation were effective in controlling the spread of the disease. Despite all the preventive measures, COVID-19 had devastating effects on the global health and socio-economic status[4]. In other words, COVID-19 became a serious public health problem that threatened the physical, psychological, and social well-being of individuals globally.

The fear of COVID-19 infection has prevented people who are seriously ill to seek medical attention [2]. This has led to a delay in the diagnosis and the management of life-threatening conditions such as myocardial infarction, embolism, AAp, acute cholecystitis, perforation, trauma, and cancers[27-30]. Nourazari *et al*[31] showed that there was a 32% drop in the rate of emergency department admissions during the COVID-19 pandemic when compared to previous periods. The results of the study by Göksoy *et al*[32] showed that there was a 25% drop in admissions to emergency surgery, and 20% of the patients admitted refused the surgical treatment recommended by the attending physicians. Furthermore, they stated that the majority of surgeons preferred open surgical procedures during the COVID-19 pandemic[32].

AAp is one of the most common causes of emergency department admissions, and rapid diagnosis and management are crucial factors regardless of the conditions. The current literature regarding "COVID-19 and AAp" emphasize three main arguments: (1) Delay in hospital admissions (prolongation of the pre-admission period) and in-hospital delay of the patients (prolongation of the preoperative period due to overwhelming work load of the hospital staff and facilities) until the definitive treatment is performed; (2) Increase in complication rates related with AAp (such as perforation, abscess formation, and plastron); and (3) Change in the treatment modality (open *vs* laparoscopic or surgical *vs* medical therapies) increasing the complication rate in the postoperative and post-treatment course. We would like to evaluate these main arguments in accord with our results.

The hospital admissions in the COVID-19 era are a matter of debate. The hospital admission rates have dropped during the quarantine. We evaluated 25 studies related with COVID-19 and AAp, and 23 of these articles reported that there was a 24% (IQR: 15%-39%; min-max: 5.4%-81%) drop in the hospital admissions due to AAp during the quarantine regulations[1-4,10,12,14-22,33-39]. In only 1 of the 25 studies, there was a 7% increase in the hospital admissions[40]. The results of our study have shown that there was a 44.8% increase in the hospital admissions due to AAp and subsequent appendectomies that were performed. The studies emphasized that the reasons for the drop in the hospital admissions were due to fear of disease transmission and the perception that the hospitals were sources of the disease. This has caused an increase in the rate of pre-admission self-medication with antibiotics and nonsteroidal anti-inflammatory drug use.

Gao *et al*[2] showed that pre-admission self-medication with antibiotics increased by 8.7 fold in the COVID-19 period when compared to the pre-pandemic period [odds ratio (OR): 8.7; 55.2% *vs* 12.4%; $P < 0.001$]. The results of the study by Yang *et al*[4] showed that pre-admission antibiotic use increased by 2.76 fold during the pandemic when compared to the pre-pandemic period (OR: 2.76; 18.9% *vs* 7.8%; $P = 0.011$). In our study we found an increase in the hospital admissions due to AAp because the municipal hospital in our city was re-organized as the pandemic hospital while our institution treated all the non-COVID-19 emergencies in our city. In larger metropolitans, even the private hospitals were organized as pandemic hospitals because of the overwhelming cases.

Table 1 Comparison of pre-coronavirus disease 2019 era and coronavirus disease 2019 groups in terms of categorical variables

Parameters	Pre-COVID-19, n = 154	COVID-19, n = 223	OR (95 %CI)	P value
Sex			NS	0.140
Male	85 (55.2)	140 (62.8)		
Female	69 (44.8)	83 (37.2)		
Surgery time			NS	0.160
Daytime	75 (48.7)	125 (56.1)		
Nighttime	79 (51.3)	98 (43.9)		
Surgery time			1.8 (1.1-2.9)	0.018
Weekdays	122 (79.2)	152 (68.2)		
Weekend	32 (20.8)	71 (31.8)		
US findings, n = 343			15.4 (4.6-52.6)	< 0.001
AAP (+)	120 (80.5)	191 (98.5)		
AAP (-)	29 (19.5)	3 (1.5)		
Histopathological findings			2.6 (1.4-5.1)	0.003
AAP (+)	128 (83.1)	207 (92.8)		
AAP (-)	26 (16.9)	16 (7.2)		
Appendiceal perforation			2.2 (1.3-3.9)	0.004
Yes	21 (13.6)	58 (26.0)		
No	133 (86.4)	165 (74.0)		
Type of surgery			1.5 (1.0-2.4)	0.046
Open appendectomy	63 (40.9)	69 (30.9)		
Lap appendectomy	91 (59.1)	154 (69.1)		
Postoperative antibiotics use			NS	0.596
Yes	14 (9.1)	24 (10.8)		
No	140 (90.9)	199 (89.2)		
Histopathological features				
AAP (+)	105	145		
AAP (+), granulomatous	0	1		
AAP (+), diverticulitis	0	1		
AAP (+), hyperplastic polyps	0	1		
AAP (+), serrated adenoma	0	1		
AAP (+), perforated	21	56		
AAP (+), perforated (NET)	0	1		
AAP (+), perforated ¹	0	1		
AAP (+), LAMN	2	0		
AAP (-), cystic adenocarcinoma	1	0		
AAP (-), mucinous adenocarcinoma	0	1		
AAP (-), fibrous obliteration	8	4		
AAP (-), lymphoid hyperplasia	15	6		
AAP (-), LAMN	0	1		
AAP (-), NET	0	1		
AAP (-), diverticulosis	0	1		

AAP (-), appendix vermiform	2	2
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¹Perforated AAP + endometriosis + Crohn's disease.

AAP: Acute appendicitis; CI: Confidence interval; COVID-19: Coronavirus disease 2019; LAMN: Low-grade appendiceal mucinous neoplasms; NET: Neuroendocrine tumor; NS: Not significance; OR: Odds ratio; US: Ultrasound.

Table 2 Comparison of pre-coronavirus disease 2019 era and coronavirus disease 2019 groups in terms of continuous variables

Parameters	Pre-COVID-19, n = 154		COVID-19, n = 223		P value
	Median (IQR)	95%CI	Median (IQR)	95%CI	
Age	35 (22)	30-38	36 (28)	33-39	0.347
WBC	12.5 (6.3)	11.7-13.1	12.7 (5.9)	11.9-13.4	0.798
Neutrophil	9.7 (5.7)	8.7-10.7	9.5 (5.9)	8.9-10.3	0.659
Lymphocyte	1.8 (1.3)	1.5-2.0	1.7 (1.1)	1.50-1.80	0.500
PLT	238 (94)	224-256	242 (108)	231-254	0.682
PCT	0.24 (0.1)	0.20-0.30	0.25 (0.1)	0.24-0.26	0.545
RDW	13 (1.6)	12.8-13.2	13 (1.4)	12.9-13.2	0.746
PDW	11.5 (2.5)	11.1-12.0	11.5 (2.5)	11.2-11.9	0.795
MCH	28.7 (3.1)	28.2-29.0	29 (2.8)	28.7-29.2	0.376
MPV	10.2 (1.3)	10.0-10.4	10.2 (1.3)	10.1-10.3	0.601
MCV	84 (5.5)	83.5-85.1	84 (6.7)	83.4-85.1	0.725
TBil	0.76 (0.7)	0.64-0.88	0.78 (0.7)	0.70-0.87	0.444
CRP	1.8 (6.3)	1.11-3.33	2.0 (7.0)	1.43-3.31	0.379
NLR	5.2 (7.2)	4.7-6.6	5.8 (6.9)	5.10-6.40	0.584
PLR	139 (100)	127-154	137 (87)	131-151	0.947
PNR	25 (21)	22.7-28.2	24 (19)	21.6-27.4	0.462
WLR	6.9 (7.6)	6.20-8.10	7.3 (7.6)	6.60-8.10	0.697
WNR	1.3 (0.3)	1.30-1.40	1.3 (0.2)	1.30-1.30	0.731
Appendix length	60 (24)	60-65	60 (20)	60-65	0.633
Appendix width	9 (5)	8-10	11 (7)	10-12	< 0.001
Hospital stay	2 (2)	2.0-2.0	2 (3)	2.0-2.0	0.003
Time to admission (h)	24 (33)	17-48	36 (60)	18-48	0.348

CI: Confidence interval; COVID-19: Coronavirus disease 2019; CRP: C-reactive protein; IQR: Interquartile range; MCH: Mean corpuscular hemoglobin; MCV: Mean corpuscular volume; MPV: Mean platelet volume; NLR: Neutrophil to lymphocyte ratio; PCT: Plateletcrit; PDW: Platelet distribution width; PLR: Platelet to lymphocyte ratio; PLT: Platelets; PNR: Platelet-to-neutrophil ratio; RDW: Red cell distribution width; TBil: Total bilirubin; WBC: White blood cell; WLR: White cell lymphocyte ratio; WNR: White cell neutrophil ratio.

The second argument is the hypothesis that the COVID-19 pandemic caused a prolongation of the re-admission period of the patients. This may be due to hesitation of the patients to seek medical help or may be related with overwhelmed hospitals that could not provide the necessary medical care for these patients. Twenty-five studies have been evaluated COVID-19 and AAP, and six of these studies stated that the interval between the initiation of symptoms and hospital admission had been prolonged[1,2,4,15,17,36]. Particularly, in 2 of these 6 studies, this difference in pre-admission intervals during the COVID-19 pandemic was evaluated and confirmed with different regression models.

Gao *et al*[2] stated that prolonged pre-hospital intervals (OR: 1.075; $P = 0.005$) and reluctance of patients towards the recommended surgical/medical therapy (OR: 1.848; $P = 0.007$) were independent risk factors for increased rates of complicated AAP. Similarly, Rudnick *et al*[17] found that prolongation of the interval between initiation of symptoms and hospital admission was an independent risk factor for development of complicated AAP (OR: 1.139; $P = 0.032$). In various other studies it was reported that there was no statistically significant difference in the pre-admission intervals between the pandemic and

pre-pandemic periods[18,19,22,37]. However, detailed analysis of the results of these studies showed that pre-admission intervals were longer during the pandemic period[18,19,22,37].

In our study the pre-admission intervals in the pre-pandemic and pandemic periods were 24 h and 36 h, respectively. Our literature analysis showed that there is only one study that reported a prolonged pre-admission interval in the pre-pandemic period[40]. On the other hand, overwhelming circumstances during the pandemic may have delayed the intended surgical treatment planned for the patients. Of the 25 studies regarding AAP during COVID-19, we found 5 studies reporting the intervals before the operation. Three of these studies reported a prolonged interval before the planned operation[4,35,37]. On the other hand, prolonged preoperative intervals were reported during the pre-pandemic period in two studies[15,18]. There were two studies that concluded that the diagnostic process was prolonged during the COVID-19 period[10,13]. One important point that should be emphasized regarding the reported intervals in studies is that all were self-reported intervals. This means that the patients were retrospectively interviewed, and they stated the intervals if they remembered them accurately. Similarly, in the present study we interviewed our patients by telephone and tried to obtain similar information. Only 60 patients could accurately remember the pre-admission and preoperative intervals. Therefore, the results of these studies (including our own) should be evaluated with a certain level of skepticism.

The impact of the COVID-19 pandemic on the use of radiologic imaging modalities for the diagnosis of AAP is another argument that should be emphasized. Analysis of the results of the study reported by Ganesh *et al*[12] showed that the use of radiologic imaging modalities such as CT or magnetic resonance imaging have increased by 42 fold during the pandemic period (OR: 42; 60.9% *vs* 100%). Somers *et al*[16] reported that radiologic imaging modalities have been used 1.26 times more frequently during the COVID-19 period (OR: 1.26; $P = 0.007$). The authors stated that all three radiological instruments (US, CT, and magnetic resonance imaging) are used more frequently during the COVID-19 period. Antakia *et al*[18] reported that during the COVID-19 pandemic, they have used CT 2.6 times more frequently (OR: 2.6; $P = 0.008$), but the use of US was reduced by 1.6 fold (OR: 1.6; $P = 0.227$). Khan *et al*[13] showed that US was performed less frequently, and use of CT for the diagnosis of AAP increased during the pandemic period (OR: 3.7; $P < 0.001$).

The COVID-19 pandemic changed the way we evaluate the patients. Patients who are admitted to the emergency departments with various major complaints who have concomitant respiratory symptoms and/or a fever are initially evaluated by thorax CT. Therefore, any patient with an abdominal complaint receives both thorax and abdominal CT during the evaluation process. This may be the reason explaining the increased CT use during the pandemic period. In contrast to the majority of the studies, Romero *et al*[41] reported that the use of CT dropped by 61% during the COVID-19 pandemic. In our study we found that radiologic evaluation for the diagnosis of AAP in the pre-pandemic and pandemic periods were 96.7% and 86.8%, respectively ($P = 0.001$). This drop in the use of radiologic evaluation in our study can be due to two factors. First, the delay in the hospital admissions of the patients led to prominent symptoms that did not need any radiologic evaluation. The second reason can be due to the fact that these patients were evaluated in other centers or private hospitals where the radiologic modalities were performed and the patient was sent to our institution once the diagnosis was established.

We would like to emphasize the impact of the pandemic on the occurrence of complications (perforated AAP, gangrenous AAP, and peri-appendicular abscess) seen during the course of AAP. In the literature, there is no consensus on the definition of complications (plastron, abscess, phlegmon, gangrene, perforation, peri-appendicular abscess, pelvic abscess, and severe peritonitis) that are related to AAP. Ten of the 25 studies that are related to the COVID-19 pandemic and AAP reported that perforation rates significantly increased during the pandemic period (5.0%-45.6%)[1-4,9,13,15,16,40]. In addition, another 2 of the 25 studies reported an increase in the perforation rates (17.5%-31.0%) that did not reach statistical significance[37,38]. Interestingly, perforation rates were reported to be reduced (5.0%-10.7%) during the COVID-19 pandemic in two studies[14,17]. Five studies in our literature review reported that peri-appendicular and pelvic abscess rates (5.6%-33.9%) increased during the pandemic period[2,13,17,18,35]. Some of the studies reported all complications as “complicated AAP”. In 12 studies, the frequency of complicated AAP (15.9%-64.4%) was reported to be increased during the pandemic period. Nine of the 12 studies reported that the pre-admission interval was longer during the pandemic period. Only two studies used a logistic regression model and showed that longer pre-admission intervals were a risk factor for the development of complicated AAP[2,17]. Analysis of the results of all these studies showed that the delay in hospital admissions during the COVID-19 pandemic was correlated with the incidence of complicated AAP.

Negative appendectomy is an important concept in the treatment of AAP. This has been a matter of debate, and the consensus states that there should be a balance between negative appendectomy and perforated AAP rates to ensure patient safety. Ten of the 25 studies that were reviewed gave their results regarding negative appendectomy rates. The results of these studies showed that negative appendectomy rates dropped during the COVID-19 pandemic[1,6,13-16,18,33,34,39]. Five of the ten studies stated that this drop showed statistical significance. In our study, we observed that negative appendectomy dropped by 2.6 times during the pandemic period (OR: 2.6; 16.9% *vs* 7.2%; $P = 0.003$). These results suggested that during the pandemic period the patients were more meticulously

evaluated before establishing the diagnosis and performing surgery for AAP. Another reason can be attributed to the fact that patients did not come to the hospital until the definitive symptoms of AAP developed because of the reluctance due to the COVID-19 pandemic.

Another point that needs to be emphasized is the impact of the COVID-19 pandemic on the demographic, clinical, and laboratory parameters of the patients with AAP. All 25 studies that have been analyzed in our literature search have shown that pandemic and pre-pandemic periods did not differ significantly in terms of age and body mass index. However, one study reported that significantly older patients were admitted to the hospital for AAP during the COVID-19 period[13]. Differences in gender were analyzed in four studies in the literature. Three of these studies stated that female gender was predominant[13,17,20], and in the remaining study male gender was the predominant gender during hospital admissions related to AAP[38]. One study reported that the American Society of Anesthesiologists scores were higher in the pre-pandemic period[18]. In another study, the comorbidity rate was higher in patients treated for AAP during the COVID-19 pandemic[3]. The frequency of smokers were not different in patients in the COVID-19 and pre-COVID-19 periods[15,18,38].

The data regarding the leukocyte counts were presented in 18 studies, and 14 of them showed no difference before and after the COVID-19 pandemic. Three studies showed lower WBC counts in patients with AAP during the pandemic period[13,14,41]. One study reported a higher WBC count in patients with AAP during the COVID-19 pandemic[22]. CRP levels were reported in 12 studies, and in 3 of these studies the CRP levels were significantly different between the COVID-19 and pre-COVID-19 periods[1,13,40]. In one of these studies CRP was significantly higher in patients with AAP in the COVID-19 period, and in the remaining two studies it was higher in AAP cases in the pandemic period. Gao *et al*[2] have suggested that the CRP levels and WBC count did not show significant changes because of the high rate (reaching 55% of the patients) of pre-admission self-medication with antibiotics during the COVID-19 pandemic. In the literature, studies are usually retrospective in nature, and there is no data regarding the nonsteroidal anti-inflammatory drug and antibiotic use of the patients. For this reason, we believe that there is no data to support the hypothesis of Gao *et al*[2].

We have analyzed all markers of inflammation that have been mentioned above, and we could not find a significant difference between the two different time intervals. When the pandemic and pre-pandemic periods are internally grouped according to the perforation status of the patients, inflammatory markers are found to be significantly elevated in patients with perforated AAP. For this reason, prospective studies are needed to further evaluate this specific topic.

Furthermore, COVID-19 causes multisystem inflammatory syndrome that can occasionally manifest itself as acute abdomen, especially in vulnerable populations such as children. It is the result of immune dysregulation and causes gastrointestinal symptoms that mimic AAP. Multiple systemic inflammatory reaction during or after COVID-19 generally implies active infection or complication of COVID-19 that is misdiagnosed as AAP[42]. In the present study, the pre-admission duration in both AAP and perforated AAP increased during the pandemic period when compared to the pre-pandemic period. Furthermore, the US and histopathologic confirmation rate of AAP increased, while the negative appendectomy rate decreased. Our results suggest that during the pandemic period, the surgical team took more time in diagnosing AAP, which increased preoperative waiting period. This is also reflected as the increase in the perforation rates in our patients. Therefore, our diagnostic accuracy increased during the pandemic, which rules out COVID-19 related multiple systemic inflammatory reaction.

Although the studies related to the association of AAP and COVID-19 infection are lacking, it is quite possible that dysregulated inflammatory reaction in infected patients may cause expansion of the Peyer patches causing lymphoid hyperplasia related obstruction of the appendiceal lumen leading to increased incidence of AAP. In accordance with our study, the case series presented by Anderson *et al* [42] showed that there was increased lympho-histiocytic infiltration in the submucosa and mesoappendix.

The treatment modality of choice for patients with AAP during the COVID-19 pandemic is also a matter of debate and needs to be clarified. The two alternatives are appendectomy *vs* NOM. The studies performed in the last two decades show that the two treatment alternatives have no superiority over the other. This discussion is crucial during the COVID-19 pandemic. The meta-analysis published by Emile *et al*[43] suggests that during the COVID-19 pandemic patients treated with NOM had significantly lower complication rates and a shorter duration of hospitalization. However, it has been shown that in young, male, and complicated AAP patients, the success of NOM is lower than appendectomy. The authors have shown that the success rate of NOM did not change significantly between the pre-pandemic and pandemic periods. Yang *et al*[44] recently published the results of their meta-analysis regarding AAP in the pre-COVID-19 period and showed that NOM reduced complication rates and duration of hospitalization in both complicated and non-complicated AAP. Furthermore, they showed that appendectomy was a highly effective treatment with reduced relapse rates. Javanmard-Emamghissi *et al*[45] performed a multicentric study regarding AAP during the COVID-19 pandemic and found that complication rates and duration of hospitalization was significantly lower in the patients with AAP who received NOM.

A multicentric study organized by the Italian Association of Surgery in 66 countries with contributions of 706 surgeons showed that during the pandemic surgeon preference of treatment modality for non-complicated AAP shifted from laparoscopic approach (57.2% *vs* 22.5%) to open appendectomy (7.2% *vs* 15.0%) or NOM (6.6% *vs* 23.7%)[46]. Furthermore, surgeons participating in the study stated

that their preferred treatment for complicated AAP shifted from laparoscopic appendectomy (62.5% *vs* 33.7%) to open appendectomy (14.0% *vs* 28.1%), NOM (2.4% *vs* 5.3%) or NOM and percutaneous drainage (21.1% *vs* 32.9%). The guidelines of the American College of Surgeons recommend the use of oral/parenteral antibiotics as the first line treatment of patients with complicated or non-complicated AAP during the COVID-19 pandemic. These guidelines that recommend appendectomy should be performed in patients with a relapse of the disease[34]. Also, it is suggested that in patients with abscess, perforation, or failure to NOM minimally invasive or conventional surgical treatment should be performed[34].

Moletta *et al*[47] analyzed various treatment guidelines and recommendations for AAP published during the COVID-19 pandemic and stated that in non-complicated AAP, NOM should be performed. On the other hand, in complicated cases and in patients whom NOM failed, surgical therapy should be the treatment of choice[44]. Our literature review including 25 studies showed that in 6 studies the rate of NOM increased during the COVID-19 pandemic. Our experience regarding NOM is very limited. Therefore, we cannot share any data regarding NOM in AAP in our study. However, in our opinion and clinical practice, we do not use NOM for elderly patients (because of high rates of complicated AAP), patients with complicated AAP, and patients who refuse to choose NOM. In our opinion, during the COVID-19 pandemic, instead of a considerable duration of hospitalization and parenteral antibiotic use, we recommend appendectomy especially in patients with complicated AAP.

The efficacy of laparoscopy in the treatment of AAP has been extensively studied in patients and in specialized groups such as gravid patients, pediatric patients, elderly patients, and non-complicated AAP patients. Jaschinski *et al*[48] performed a systematic review for the Cochrane database and showed that laparoscopic appendectomy was associated with reduced surgical site infections, shorter duration of hospitalization, earlier return to work, and better quality of life when compared to conventional appendectomy. However, the intraabdominal abscess rate was higher in laparoscopic appendectomy. The main concern of the physicians regarding laparoscopy during the pandemic is aerosolization of the virus and risk of transmission due to insufflation and exsufflation of the abdomen. Moletta *et al*[47] analyzed different guidelines and four original studies. They concluded that laparoscopic surgery can be performed provided that the medical staff take the necessary precautions, and the fume extraction-ventilation of the operating room is provided. The authors stated that laparoscopy is based upon the creation and maintenance of a pneumoperitoneum, and the use of energy devices results in formation of smoke bioproducts. Aerosolization of blood born viruses has been previously detected in surgical smoke during laparoscopy. Therefore, a potential risk of aerosol exposure must also be considered for COVID-19 even though it is not currently demonstrated. In conclusion, there is no clear cut evidence showing increased risk of disease transmission during laparoscopy, and therefore there is no reason to stop laparoscopic procedures[49].

The postoperative complications and prolonged postoperative antibiotic therapy and hospital stay is another argument regarding the COVID-19 pandemic and AAP. Fourteen articles in our literature presented data regarding the duration of hospital stay in AAP during the pandemic. Ten of these studies showed no difference in duration between the different time intervals[4,13,19-22,35,36,39,40], while one study reported a prolonged hospital stay[1] and another study reported that the duration was shorter during the pandemic[14]. In addition, three studies reported that although there was no statistical difference, the duration of hospitalization during the pandemic tended to be longer[3,10,18]. Seven studies reported data regarding postoperative complications, and five of these studies reported that the rate of complications did not change. In one study, surgical site infection rate (1.9% *vs* 6.9%) was found to be increased during COVID-19 pandemic. In another study, the postoperative complication rates (25.0% *vs* 16.7%) were found to be reduced during the pandemic. In the present study, we found that the duration of hospital stay was longer in patients treated during the COVID-19 pandemic ($P = 0.003$). This was related with the high rates of complicated AAP observed during this period. In the present study, we could not find a significant difference in terms of duration of postoperative antibiotic use and complication rates.

There are various limitations of the present study. The main limitation was the significant recall bias regarding the hospital admissions and interval to operation. The main reason for this is the telephone interview of the patients to receive these data. This is especially important for patients operated in the pre-pandemic era. The retrospective study design for obtaining the data analyzed in the present study is another limitation of our study. However, our results are striking because we observed a higher incidence of AAP as well as perforation rate during the COVID-19 era. In addition, our data regarding the COVID-19 infection rates in the pre- and postoperative period in our patients are missing, which should be noted as a limitation of our study.

CONCLUSION

The results of our study suggest that the complicated AAP rates increased, which led to a prolonged duration of hospitalization during the COVID-19 pandemic. The number of patients treated for AAP increased during the pandemic, which is attributed to the shift of role of the two state hospitals in our

city. Fortunately, although the rate of complicated AAP increased, this did not increase the postoperative complication rates. Therefore, we can conclude that during global catastrophes such as the COVID-19 pandemic more complicated forms of the diseases such as AAP can be seen. Although the system is overwhelmed by the workload of the patients with COVID-19 infection, this should not change our attitude towards performing surgical therapy in these patients because any delay will lead to dismal consequences and prolonged hospital stays.

ARTICLE HIGHLIGHTS

Research background

Although emergency procedures were allowed during the coronavirus disease 2019 (COVID-19) pandemic provided that necessary precautions were taken in the operating theatre and inpatient wards, it was believed that there were serious disruptions in the management of patients with acute appendicitis (AAP).

Research motivation

AAP management is critical because AAP is the most common cause of acute abdominal pain, and appendectomy is the most frequent emergency procedure.

Research objectives

The present study aimed to comparatively evaluate the impact of the COVID-19 pandemic to the pre-pandemic period regarding patients who underwent appendectomy for AAP in terms of negative appendectomy and perforation rates. Our secondary aim was to evaluate the impact of the COVID-19 pandemic on the hospital admission rates of patients with AAP.

Research methods

Demographic, clinical, and histopathological characteristics of 223 patients (COVID-19 group) who underwent appendectomy with a preliminary diagnosis of AAP between March 2020 and July 2021 were compared with 154 patients (pre-COVID-19 group) who underwent appendectomy with the same indication between October 2018 and March 2020.

Research results

There was a 44.8% increase in the number of patients admitted to our hospital with a presumed diagnosis of AAP during the pandemic. Significant differences were found between pre-COVID-19 and COVID-19 groups in terms of procedures performed on the weekdays or weekends [odds ratio (OR): 1.76; $P = 0.018$], presence of AAP findings on ultrasonography (OR: 15.4; $P < 0.001$), confirmation of AAP in the histopathologic analysis (OR: 2.6; $P = 0.003$), determination of perforation in the appendectomy specimen (OR: 2.2; $P = 0.004$), the diameter of the appendix ($P < 0.001$), and hospital stay ($P = 0.003$).

Research conclusions

The results of our study suggest that the perforated AAP rates increased, which led to prolonged hospital stays during the COVID-19 pandemic. The number of patients treated with AAP increased during the pandemic, which is attributed to the shift of roles of the two state hospitals in our city. Fortunately, although the rate of complicated AAP increased, this did not increase our postoperative complication rates. Therefore, we can conclude that during global catastrophes such as the COVID-19 pandemic more complicated forms of the diseases such as AAP can be seen.

Research perspectives

This study has shown that even diseases that require emergency management, such as AAP, can be ignored during the COVID-19 pandemic. It is known that this situation is directly related to both patient behavior and the increased workload of healthcare professionals. The most important way to overcome this problem is to learn from the pandemic process, implement preventive measures properly, and create social awareness.

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FOOTNOTES

Author contributions: Akbulut S, Tuncer A, Ogut Z, Tanriverdi ES, and Koc C collected data; Akbulut S and Ozer A performed statistical analysis; Akbulut S and Sahin TT wrote the manuscript; Akbulut S, Sahin TT, and Yilmaz S contributed to project development and reviewed the final version.

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REFERENCES

- Burgard M, Cherbanyk F, Nassiopoulou K, Malekzadeh S, Pugin F, Egger B. An effect of the COVID-19 pandemic: Significantly more complicated appendicitis due to delayed presentation of patients! *PLoS One* 2021; **16**: e0249171 [PMID: 34032800 DOI: 10.1371/journal.pone.0249171]
- Gao Z, Li M, Zhou H, Liang Y, Zheng C, Li S, Zhang T, Deng W. Complicated appendicitis are common during the epidemic period of 2019 novel coronavirus (2019-nCoV). *Asian J Surg* 2020; **43**: 1002-1005 [PMID: 32863144 DOI: 10.1016/j.asjsur.2020.07.019]
- Meriç S, Vartanoglu Aktokmakyan T, Tokocin M, Aktimur YE, Hacım NA, Gülcicek OB. Comparative analysis of the management of acute appendicitis between the normal period and COVID-19 pandemic. *Ulus Travma Acil Cerrahi Derg* 2021; **27**: 22-25 [PMID: 33394473 DOI: 10.14744/tjtes.2020.46487]
- Yang Y, Li Y, Du X. Acute complex appendicitis during the COVID-19 epidemic: A single-institution retrospective analysis based on real-world data. *Am J Emerg Med* 2021; **46**: 74-77 [PMID: 33740569 DOI: 10.1016/j.ajem.2021.03.022]
- Sahin TT, Akbulut S, Yilmaz S. COVID-19 pandemic: Its impact on liver disease and liver transplantation. *World J Gastroenterol* 2020; **26**: 2987-2999 [PMID: 32587443 DOI: 10.3748/wjg.v26.i22.2987]
- Karaca AS, Ozmen MM, uÇar AD, Yasti AÇ, Demİrler S. General Surgery Operating Room Practice in Patients with COVID-19. *Turk J Surg* 2020; **36**: i-v [PMID: 32637887 DOI: 10.5578/turkjsurg.202001]
- Sungur Z, Ergil J, Karaaslan K, Tomak Y, Turgut N, Kurtipek Ö. Recommendation for Resuming Elective Surgery during the Normalising Period in COVID-19 Pandemic. *Turk J Anaesthesiol Reanim* 2021; **49**: 58-62 [PMID: 33718907 DOI: 10.5152/TJAR.2021.1255]
- Akbulut S, Bahçe ZS, Öztaş T, Gümüş S, Söğütçü N, Sakarya H, Gök AFK, Yağmur Y. Assessment of demographic, clinical and histopathological features of patients who underwent appendectomy due to a presumed diagnosis of acute appendicitis. *Ulus Travma Acil Cerrahi Derg* 2021; **27**: 315-324 [PMID: 33884602 DOI: 10.14744/tjtes.2020.73537]
- Zaikos TD, Boudiab EM, Peshel EC, Wu AA, Dyer E, Haut ER, Salimian KJ. Acute appendicitis severity during the early COVID-19 pandemic period. *Trauma Surg Acute Care Open* 2021; **6**: e000809 [PMID: 34466662 DOI: 10.1136/tsaco-2021-000809]
- Dreifuss NH, Schlottmann F, Sadava EE, Rotholtz NA. Acute appendicitis does not quarantine: surgical outcomes of laparoscopic appendectomy in COVID-19 times. *Br J Surg* 2020; **107**: e368-e369 [PMID: 32710551 DOI: 10.1002/bjs.11806]
- Lotfallah A, Aamery A, Moussa G, Manu M. Surgical Versus Conservative Management of Acute Appendicitis During the COVID-19 Pandemic: A Single-Centre Retrospective Study. *Cureus* 2021; **13**: e14095 [PMID: 33927917 DOI: 10.7759/cureus.14095]

- 12 **Ganesh R**, Lucocq J, Ekpote NO, Ain NU, Lim SK, Alwash A, Bibi S, Alijani A. Management of appendicitis during COVID-19 pandemic; short-term outcomes. *Scott Med J* 2020; **65**: 144-148 [PMID: [32878574](#) DOI: [10.1177/0036933020956316](#)]
- 13 **Khan MNH**, Jamal AB, Faraz A, Shafique H, Rasool MU, Ilyas MW, Jamshed MH, Riaz W, Usman M. Management of Acute Appendicitis During the COVID-19 Pandemic is Significantly Different: A Retrospective Single UK Hospital Study. *J Multidiscip Healthc* 2021; **14**: 2415-2420 [PMID: [34511924](#) DOI: [10.2147/JMDH.S327568](#)]
- 14 **Pringle HCM**, Donigiewicz U, Bennett MR, Walker E, Fowler GE, Narang S, Ball S, Bethune RM. Appendicitis during the COVID-19 pandemic: lessons learnt from a district general hospital. *BMC Surg* 2021; **21**: 242 [PMID: [33980191](#) DOI: [10.1186/s12893-021-01231-1](#)]
- 15 **Scheijmans JCG**, Borgstein ABJ, Puylaert CAJ, Bom WJ, Bachiri S, van Bodegraven EA, Brandsma ATA, Ter Brugge FM, de Castro SMM, Couvreur R, Franken LC, Gaspersz MP, de Graaff MR, Groenen H, Kleipool SC, Kuypers TJL, Martens MH, Mens DM, Orsini RG, Reneerkens NJMM, Schok T, Sedee WJA, Tavakoli Rad S, Volders JH, Weeder PD, Prins JM, Gietema HA, Stoker J, Gisbertz SS, Besselink MGH, Boermeester MA; SCOUT Collaborative Study group. Impact of the COVID-19 pandemic on incidence and severity of acute appendicitis: a comparison between 2019 and 2020. *BMC Emerg Med* 2021; **21**: 61 [PMID: [33980150](#) DOI: [10.1186/s12873-021-00454-y](#)]
- 16 **Somers K**, Abd Elwahab S, Raza MZ, "Grady S, DeMarchi J, Butt A, Burke J, Robb W, Power C, McCawley N, McNamara D, Kearney D, Hill ADK. Impact of the COVID-19 pandemic on management and outcomes in acute appendicitis: Should these new practices be the norm? *Surgeon* 2021; **19**: e310-e317 [PMID: [33750630](#) DOI: [10.1016/j.surge.2021.01.009](#)]
- 17 **Rudnicki Y**, Soback H, Mekiten O, Lifshiz G, Avital S. The impact of COVID-19 pandemic lockdown on the incidence and outcome of complicated appendicitis. *Surg Endosc* 2022; **36**: 3460-3466 [PMID: [34312724](#) DOI: [10.1007/s00464-021-08667-9](#)]
- 18 **Antakia R**, Xanthi A, Georgiades F, Hudson V, Ashcroft J, Rooney S, Singh AA, "Neill JR, Fearnhead N, Hardwick RH, Davies RJ, Bennett JMH. Acute appendicitis management during the COVID-19 pandemic: A prospective cohort study from a large UK centre. *Int J Surg* 2021; **86**: 32-37 [PMID: [33465496](#) DOI: [10.1016/j.ijssu.2020.12.009](#)]
- 19 **Finkelstein P**, Picado O, Muddasani K, Wodnicki H, Mesko T, Unger S, Bao P, Jorge I, Narayanan S, Ben-David K. A Retrospective Analysis of the Trends in Acute Appendicitis During the COVID-19 Pandemic. *J Laparoendosc Adv Surg Tech A* 2021; **31**: 243-246 [PMID: [33181062](#) DOI: [10.1089/Lap.2020.0749](#)]
- 20 **Sartori A**, Podda M, Botteri E, Passera R, Agresta F, Arezzo A; CRAC Study Collaboration Group. Appendectomy during the COVID-19 pandemic in Italy: a multicenter ambispective cohort study by the Italian Society of Endoscopic Surgery and new technologies (the CRAC study). *Updates Surg* 2021; **73**: 2205-2213 [PMID: [34219197](#) DOI: [10.1007/s13304-021-01126-z](#)]
- 21 **Wang AW**, Prieto J, Ikeda DS, Lewis PR, Benzer EM, Van Gent JM. Perforated Appendicitis: An Unintended Consequence During the Coronavirus-19 Pandemic. *Mil Med* 2021; **186**: e94-e97 [PMID: [33275655](#) DOI: [10.1093/milmed/usaa527](#)]
- 22 **Willms AG**, Oldhafer KJ, Conze S, Thasler WE, von Schassen C, Hauer T, Huber T, Germer CT, Günster S, Bulian DR, Hirche Z, Filser J, Stavrou GA, Reichert M, Malkomes P, Seyfried S, Ludwig T, Hillebrecht HC, Pantelis D, Brunner S, Rost W, Lock JF; CAMIN Study Group. Appendicitis during the COVID-19 Lockdown: results of a multicenter analysis in Germany. *Langenbecks Arch Surg* 2021; **406**: 367-375 [PMID: [33550453](#) DOI: [10.1007/s00423-021-02090-3](#)]
- 23 **Akbulut S**, Koç C, Şahin TT, Şahin E, Tuncer A, Demyati K, Şamdancı E, Çolak C, Yılmaz S. An investigation into the factors predicting acute appendicitis and perforated appendicitis. *Ulus Travma Acil Cerrahi Derg* 2021; **27**: 434-442 [PMID: [34213000](#) DOI: [10.14744/tjtes.2020.60344](#)]
- 24 **Koç C**, Akbulut S, Coşkun EI, Sarıcı B, Yılmaz S. Comparison of the demographic and clinical features of pregnant and non-pregnant patients undergoing appendectomy. *Ulus Travma Acil Cerrahi Derg* 2020; **26**: 555-562 [PMID: [32589240](#) DOI: [10.14744/tjtes.2020.12544](#)]
- 25 **Başkiran A**, Akbulut S, Şahin TT, Tunçer A, Kaplan K, Bayındır Y, Yılmaz S. Coronavirus Precautions: Experience of High Volume Liver Transplant Institute. *Turk J Gastroenterol* 2022; **33**: 145-152 [PMID: [35115295](#) DOI: [10.5152/tjg.2022.21748](#)]
- 26 **Vandenbroucke JP**, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, Poole C, Schlesselman JJ, Egger M; STROBE Initiative. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. *Int J Surg* 2014; **12**: 1500-1524 [PMID: [25046751](#) DOI: [10.1016/j.ijssu.2014.07.014](#)]
- 27 **Erol MK**, Kayıkçıoğlu M, Kılıçkap M, Güler A, Yıldırım A, Kahraman F, Can V, İnci S, Baysal SS, Er O, Zeybey U, Kafkas Ç, Yayla Ç, Arin CB, Aktaş I, Yalçın AA, Genç Ö. Treatment delays and in-hospital outcomes in acute myocardial infarction during the COVID-19 pandemic: A nationwide study. *Anatol J Cardiol* 2020; **24**: 334-342 [PMID: [33122486](#) DOI: [10.14744/AnatolJCardiol.2020.98607](#)]
- 28 **Kuzuu K**, Misawa N, Ashikari K, Kessoku T, Kato S, Hosono K, Yoneda M, Nonaka T, Matsushima S, Komatsu T, Nakajima A, Higurashi T. Gastrointestinal Cancer Stage at Diagnosis Before and During the COVID-19 Pandemic in Japan. *JAMA Netw Open* 2021; **4**: e2126334 [PMID: [34546368](#) DOI: [10.1001/jamanetworkopen.2021.26334](#)]
- 29 **Melazzini F**, Reduzzi M, Quaglini S, Fumoso F, Lenti MV, Di Sabatino A. Diagnostic Delay of Pulmonary Embolism in COVID-19 Patients. *Front Med (Lausanne)* 2021; **8**: 637375 [PMID: [33996852](#) DOI: [10.3389/fmed.2021.637375](#)]
- 30 **Patt D**, Gordan L, Diaz M, Okon T, Grady L, Harmison M, Markward N, Sullivan M, Peng J, Zhou A. Impact of COVID-19 on Cancer Care: How the Pandemic Is Delaying Cancer Diagnosis and Treatment for American Seniors. *JCO Clin Cancer Inform* 2020; **4**: 1059-1071 [PMID: [33253013](#) DOI: [10.1200/CCI.20.00134](#)]
- 31 **Nourazari S**, Davis SR, Granovsky R, Austin R, Straff DJ, Joseph JW, Sanchez LD. Decreased hospital admissions through emergency departments during the COVID-19 pandemic. *Am J Emerg Med* 2021; **42**: 203-210 [PMID: [33279331](#) DOI: [10.1016/j.ajem.2020.11.029](#)]
- 32 **Göksoy B**, Akça MT, İnanç ÖF. The impacts of the COVID-19 outbreak on emergency department visits of surgical patients. *Ulus Travma Acil Cerrahi Derg* 2020; **26**: 685-692 [PMID: [32946100](#) DOI: [10.14744/etd.2020.67927](#)]
- 33 **Abramov R**, Neymark M, Harbi A, Gilshtein H. Laparoscopic Appendectomy in the Days of COVID-19. *Surg Laparosc*

- Endosc Percutan Tech* 2021; **31**: 599-602 [PMID: [34049368](#) DOI: [10.1097/SLE.0000000000000952](#)]
- 34 **Aharoni M**, Barash Y, Zager Y, Anteby R, Khalilieh S, Amiel I, Klang E, Goldes Y, Gutman M, Horeish N, Rosin D. Management of Acute Appendicitis during the COVID-19 Pandemic: A Single Tertiary Center Experience. *Isr Med Assoc J* 2021; **23**: 269-273 [PMID: [34024041](#)]
 - 35 **Angeramo CA**, Dreifuss NH, Schlottmann F, Rotholtz NA. More Severe Presentations of Acute Appendicitis During COVID-19. *J Gastrointest Surg* 2021; **25**: 1902-1904 [PMID: [33469887](#) DOI: [10.1007/s11605-020-04892-0](#)]
 - 36 **Kumaira Fonseca M**, Trindade EN, Costa Filho OP, Nacul MP, Seabra AP. Impact of COVID-19 Outbreak on the Emergency Presentation of Acute Appendicitis. *Am Surg* 2020; **86**: 1508-1512 [PMID: [33156694](#) DOI: [10.1177/0003134820972098](#)]
 - 37 **Lee KY**, Lee J, Park YY, Oh ST. Effect of the COVID-19 pandemic on surgical treatment of acute appendicitis: A single-center retrospective study. *Asian J Surg* 2021; **44**: 800-801 [PMID: [33863628](#) DOI: [10.1016/j.asjsur.2021.03.012](#)]
 - 38 **Patel VK**, Ye K, In H, Scheinfeld MH. Non-operative Management for Acute Appendicitis During the COVID-19 Pandemic Does Not Increase the Rate of Complications. *J Gastrointest Surg* 2021; **25**: 1327-1329 [PMID: [33140319](#) DOI: [10.1007/s11605-020-04844-8](#)]
 - 39 **Salgaonkar H**, Aladeojebi A, Murcott D, Nnaji M, Tsiamis A, Cheruvu CV. Emergency appendectomy during COVID-19 pandemic— A single UK centre experience. *Pol Przegl Chir* 2021; **93**: 33-39 [PMID: [33949323](#) DOI: [10.5604/01.3001.0014.8090](#)]
 - 40 **Wichmann D**, Schweizer U, Wulff D, Thiel K, Beltzer C, Königsrainer A, Archid R. Incidence of Perforated Appendicitis during the COVID-19 Pandemic: Lessons to Be Considered in the Second Wave. *J Gastrointest Surg* 2021; **25**: 2404-2406 [PMID: [33555522](#) DOI: [10.1007/s11605-021-04915-4](#)]
 - 41 **Romero J**, Valencia S, Guerrero A. Acute Appendicitis During Coronavirus Disease 2019 (COVID-19): Changes in Clinical Presentation and CT Findings. *J Am Coll Radiol* 2020; **17**: 1011-1013 [PMID: [32610104](#) DOI: [10.1016/j.jacr.2020.06.002](#)]
 - 42 **Anderson JE**, Campbell JA, Durowoju L, Greenberg SLM, Rice-Townsend SE, Gow KW, Avansino J. COVID-19-associated multisystem inflammatory syndrome in children (MIS-C) presenting as appendicitis with shock. *J Pediatr Surg Case Rep* 2021; **71**: 101913 [PMID: [34026490](#) DOI: [10.1016/j.epsc.2021.101913](#)]
 - 43 **Emile SH**, Hamid HKS, Khan SM, Davis GN. Rate of Application and Outcome of Non-operative Management of Acute Appendicitis in the Setting of COVID-19: Systematic Review and Meta-analysis. *J Gastrointest Surg* 2021; **25**: 1905-1915 [PMID: [33772399](#) DOI: [10.1007/s11605-021-04988-1](#)]
 - 44 **Yang Z**, Sun F, Ai S, Wang J, Guan W, Liu S. Meta-analysis of studies comparing conservative treatment with antibiotics and appendectomy for acute appendicitis in the adult. *BMC Surg* 2019; **19**: 110 [PMID: [31412833](#) DOI: [10.1186/s12893-019-0578-5](#)]
 - 45 **Javanmard-Emamghissi H**, Hollyman M, Boyd-Carson H, Doleman B, Adiamah A, Lund JN, Moler-Zapata S, Grieve R, Moug SJ, Tierney GM; COVID: HAREM (Had Appendicitis and Resolved/Recurred Emergency Morbidity/Mortality) Collaborative Group. Antibiotics as first-line alternative to appendectomy in adult appendicitis: 90-day follow-up from a prospective, multicentre cohort study. *Br J Surg* 2021; **108**: 1351-1359 [PMID: [34476484](#) DOI: [10.1093/bjs/znab287](#)]
 - 46 **Ielpo B**, Podda M, Pellino G, Pata F, Caruso R, Gravante G, Di Saverio S; ACIE Appy Study Collaborative. Global attitudes in the management of acute appendicitis during COVID-19 pandemic: ACIE Appy Study. *Br J Surg* 2021; **108**: 717-726 [PMID: [34157090](#) DOI: [10.1002/bjs.11999](#)]
 - 47 **Moletta L**, Pierobon ES, Capovilla G, Costantini M, Salvador R, Merigliano S, Valmasoni M. International guidelines and recommendations for surgery during Covid-19 pandemic: A Systematic Review. *Int J Surg* 2020; **79**: 180-188 [PMID: [32454253](#) DOI: [10.1016/j.ijsu.2020.05.061](#)]
 - 48 **Jaschinski T**, Mosch CG, Eikermann M, Neugebauer EA, Sauerland S. Laparoscopic versus open surgery for suspected appendicitis. *Cochrane Database Syst Rev* 2018; **11**: CD001546 [PMID: [30484855](#) DOI: [10.1002/14651858.CD001546.pub4](#)]
 - 49 **de Leeuw RA**, Burger NB, Ceccaroni M, Zhang J, Tuynman J, Mabrouk M, Barri Soldevila P, Bonjer HJ, Ankum P, Huirne J. COVID-19 and Laparoscopic Surgery: Scoping Review of Current Literature and Local Expertise. *JMIR Public Health Surveill* 2020; **6**: e18928 [PMID: [32406853](#) DOI: [10.2196/18928](#)]



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