Effect of COVID-19 on the Treatment of Acute Appendicitis

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Research article

Keywords: Acute appendicitis, COVID-19, SARS-CoV-2, appendectomy, postoperative complication

Posted Date: November 18th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-106374/v1

Abstract

Background: There has been debate on delaying an appendectomy for acute appendicitis because of the possibility of a severe acute respiratory syndrome coronavirus 2 infection being present and operating immediately due to the high possibility of complications from delaying the surgery. This study aimed to investigate the safety of delaying surgery for acute appendicitis in patients with a confirmed coronavirus disease (COVID-19) status.

Methods: Patients admitted for acute appendicitis during the same period in 2019 and 2020 were enrolled in the study. We categorized them into 2 groups: those admitted before the outbreak of the COVID-19 pandemic in 2019 and those admitted after the outbreak in 2020. Clinical variables including demographics, operative and postoperative factors were analyzed. Statistical analyses was performed for the two groups. The primary end point was postoperative complication.

Results: A total of 200 consecutive patients (127 from 2019 and 73 from 2020) were included in the study. There was no statistically significant difference in demographics and laboratory findings between the groups. In 2020, it took a longer time between a visit and surgery (6.3 *vs* 14.4 hours, $p < 0.001$); there was no difference in the type of surgery, appendix pathology, and postoperative complications.

Conclusion: Our results demonstrated that, during the COVID-19 pandemic, it is safe to delay a surgery for acute appendicitis until after determining a patient's COVID-19 status with the possibility of COVID-19 transmission.

Background

Acute appendicitis is one of the most common benign diseases requiring emergency surgical treatment. When diagnosed with acute appendicitis, if surgery is delayed, perforation of the appendix can occur thereby increasing postoperative complications [1]. It is therefore recommended that surgery be performed as soon as possible after diagnosis [2].

It has been reported that, due to the recent coronavirus disease (COVID-19) pandemic, patients are generally avoiding going to hospital, and patients with acute appendicitis are being admitted to hospital in a more severe condition [3, 4]. Snapiri et al. reported that the complication rate in these patients has increased during the pandemic [4].

In these unprecedented times of COVID-19, antibiotics alone might be an option for uncomplicated appendicitis [5]. However, early appendectomy should be performed to achieve a shorter hospital stay than that required in conservative management and to avoid complications after failed conservative management [6].

Recent literature reports that COVID-19 can cause gastrointestinal (GI) symptoms [7]. In addition, fever accompanying acute appendicitis adds a suspicion of COVID-19 infection. Therefore, in our hospital,

patients presenting with acute appendicitis have undergone surgery after we obtained the results of their COVID-19 tests because our hospital does not have a unit for treating COVID-19.

However, there have been no reports on the difference in surgical outcomes when surgery was performed with the same protocol as our hospital. Therefore, we aimed to determine changes in the clinical variables of acute appendicitis, its overall effect on surgery, and postoperative complications.

Methods

Patient selection

We divided patients into two groups: pre-corona outbreak (May 11 to July 1 in 2019) and corona pandemic period (May 11 to July 1 in 2020) for comparison during the same period. Patients admitted through the emergency room for acute appendicitis during the entire designated period were enrolled in the study. We included cases of acute appendicitis confirmed by radiologists through computer tomography (CT) and ultrasound. Exclusion criteria were as follows: 1) hospitalization to perform interval appendectomy, 2) acute appendicitis during hospitalization due to other diseases, 3) colorectal cancer mistaken for acute appendicitis (cecal cancer or appendix cancer), or 4) pelvic inflammatory disorder or colitis, mistaken for acute appendicitis. This study was approved by the institutional review board (IRB) of the Catholic University of Korea. The study was performed in accordance with the relevant guidelines and regulations of IRB. The investigation conformed with the principles outlined in the Declaration of Helsinki of 1964. Informed consent for participation was waived under approval from the IRB of the Catholic University of Korea. (IRB number: UC20RISI0124)

Process

If acute appendicitis is clinically suspected, a preoperative CT or ultrasound for pregnant women is performed to confirm the diagnosis. Prior to the outbreak of COVID-19, emergency surgery was performed when acute appendicitis was confirmed. In the case of a periappendiceal abscess where drainage was possible, broad spectrum antibiotic therapy was administered after percutaneous drainage until the inflammation improved. At the discretion of the attending physician, patients with early appendicitis or uncomplicated appendicitis with a poor general condition were treated with antibiotics only.

Following the pandemic spread of COVID-19, a COVID-19 polymerase chain reaction (PCR) test using samples collected through nasopharyngeal swab/oropharyngeal (throat) swabs was performed for all hospitalized patients with acute appendicitis, and patients were hospitalized after confirming a negative result. The PCR test took 6-8 hours. If the COVID-19 test result was positive, the patient was transferred to a hospital capable of treating COVID-19. In the case of suspected sepsis due to generalized peritonitis, emergency surgery was performed while wearing personal protective equipment in a negative pressure operating room before the COVID-19 PCR test result was obtained.

After surgery, patients were discharged when abdominal pain improved, and oral intake was possible. An outpatient follow-up visit was scheduled to check for wound complications 7-10 days after surgery.

Variables

Clinical variables before surgery (sex, age, white blood cell [WBC], C-reactive protein [CRP], segment neutrophil count), factors related to surgery (operation name, appendix pathology, duration of operation), postoperative clinical findings (duration of hospital stay, postoperative complications) were investigated. The appendix pathology was divided into the following categories: hyperemic, suppurative, gangrenous, and perforated.

Statistical analysis

In order to compare the continuous variables between the two groups, a Mann-Whitney U test was performed for variables showing non-normal distribution, and a Student's t-test was performed for variables showing a normal distribution. A Kolmogorov-Smirnov test was used to assess the assumption of a normal distribution. For categorical variables, the Chi-square test, Fisher's exact test, and linear-by-linear association were performed where appropriate. We used an SPSS version 21.0 for Windows (IBM Corp, Armonk, NY, USA) for analysis. A p-value of < 0.05 was considered statistically significant

Results

The number of patients diagnosed with acute appendicitis was 134 in 2019 and 82 in 2020. After applying the inclusion and exclusion criteria, 127 patients in 2019 and 73 in 2020 were included in the analysis (Fig. 1). There were no patients who were diagnosed with COVID-19.

The demographics and clinical characteristics of the two groups are shown in Table 1. The median ages for 2019 and 2020 were 37 and 41 years old, respectively and there were more males than females in both groups. The duration of the symptoms before the visit to the hospital was 20 hours in 2020, about 7 hours longer than in 2019, but there was no statistically significant difference ($p = 0.086$). Additionally, there was no significant difference in laboratory findings (Table 1).

At the discretion of the attending physician, there were 5 and 2 patients who used only antibiotics and 2 and 1 patients who inserted the drainage tube into the periappendiceal abscess in 2019 and 2020, respectively, as shown in Fig. 1.

In the analysis of the surgery and postoperative factors of patients who underwent surgery, it took a longer time from admission to surgery (6.3 *vs* 14.4 hours, $p < 0.001$) in 2020 than in 2019. There was no significant difference in the type of surgery, appendix pathology, or postoperative complications (Table 2).

Postoperative complications occurred in 11 (9.2%) and 6 (8.6%) cases in 2019 and 2020, respectively. The complications that occurred in 2019 included 7 cases (5.8%) of superficial surgical site infection, 2 cases (1.6%) of intraabdominal abscess formation, and 2 cases (1.6%) of postoperative ileus.

Complications that occurred in 2020 included 3 cases (4.2%) of superficial surgical site infection, 2 cases (2.9%) of intraabdominal abscess formation, and 1 case (1.4%) of voiding difficulty.

Re-admission occurred in 1 case of conservative management for ileus and 2 cases of percutaneous drainage and laparoscopic exploration for intraabdominal abscess formation, in 2019 (total: 3 cases (2.5%)). In 2020, there was 1 case (1.4%) of antibiotic therapy for intraabdominal abscess formation.

Discussion

This study showed that following the outbreak of COVID-19, there was no increase in postoperative complications although there was a delay in the time from the diagnosis of acute appendicitis to surgery. Although the number of patients was relatively decreased within this period, there was no significant difference in clinical variables including demographics and clinical data. This proved that it is safe to wait for about 14 hours to perform a surgery after the confirmation of results of the COVID-19 PCR test.

Romero et al. reported that after the outbreak of COVID-19, not only did the number of patients with acute appendicitis decline, but also the patients who visited were in a more severe condition [3]. Snapiri et al. reported that the incidence of complications increased in pediatric patients due to late presentation to hospital, because their parents feared that they would contract COVID-19 at the hospital [4]. However, unlike these reports, the severity of inflammation such as WBC count and CRP level and the appendix pathology after surgery was similar between the two groups in our study. Accordingly, the delay in surgery did not increase the frequency of complications.

Apart from cases of perforated appendicitis with generalized peritonitis, our hospital performed surgeries after confirming the COVID-19 PCR test result, which delayed the time from admission to surgery by about 6-8 hours compared to before the pandemic. A previous study has already reported that the incidence of complications does not increase if surgery is performed within 24 hours of presentation at hospital [8]. Most patients at our hospital underwent surgery within 24 hours after visiting the hospital; accordingly, our findings are consistent with presented in the literature.

Appendicitis is often accompanied by fever; it is therefore difficult to rule out a COVID-19 infection. In addition, some COVID-19 patients are asymptomatic [9] and the symptoms of COVID-19 itself include GI symptoms [7]. Therefore, the COVID-19 test has been routinely performed before admission and surgery in our hospital after the outbreak of the pandemic.

Some patients may be treated with antibiotics only in the case of uncomplicated appendicitis following the outbreak of COVID-19 [5]. However, due to the possibility of treatment failure with antibiotic treatment alone, the treatment of choice for appendicitis is surgery. Therefore, the results of our research have great significance in that they demonstrate that it is safe to wait to perform surgery until after the COVID-19 PCR test result has been obtained.

The limitations of our study are that it is a retrospective, single-institutional study and is likely to have an information and selection bias. Therefore, it is necessary to conduct a multicenter study with our protocol using the same COVID-19 test that provides the results within 6-8 hours.

In conclusion, it is safe to delay performing surgery for acute appendicitis until the COVID-19 test results have been obtained, provided that the delay is not more than 8 hours.

Declarations

Acknowledgements/Funding: Not applicable

Conflicts of interest: Not applicable

Ethics approval: This study was approved from the institutional review board (IRB) of the Catholic University of Korea. The study was performed in accordance with the relevant guidelines and regulations of IRB. The investigation conformed with the principles outlined in the Declaration of Helsinki of 1964.

Consent to participate: Informed consent for participation was waived under IRB approval from the institutional review board of the Catholic University of Korea.

Consent for publication: Not applicable

Availability of data and material: Not applicable

Competing Interests: None of the authors have any conflict of interest.

Funding: Not applicable

Code availability: Not applicable

Authors' contributions

KYL and JIL designed the study. KYL and JIL collected the data and performed the statistical analysis. KYL, JIL, YYP and STO interpreted the results of the analysis and prepared the manuscript. All authors contributed extensively to the work presented.

Acknowledgements: Not applicable

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Tables

Table. 1. Clinical characteristics of study participants

	2019 (n=127)	2020 (n=73)	p-value
Age (years)	37.0	41.0 (IQR 20-52)	0.806
Sex			0.439
Male	75 (59.1%)	39 (53.4%)	
Female	52 (40.9%)	34 (46.6%)	
Duration of symptom (hours)	13.0 (IQR 5-28))	20.0 (IQR 10-33.5)	0.086
WBC (10^3/uL)	13.1 ± 3.95	13.9 ± 4.7	0.169
CRP (mg/dl)	1.3 (IQR 0.21-4.73)	1.7 (IQR 0.545-6.88)	0.192
Segment neutrophil (%)	79.3 (IQR 70.6-86.9)	81.6 (IQR 74.25-86.75)	0.504
Hospital stay (days)	2.0 (IQR 2-4)	3.0 (IQR 3-4)	0.017

Abbreviations: IQR, interquartile range; White blood cell, WBC; C-reactive protein, CRP

Table 2. Factors related to operation between the two groups

	2019 (n=120)	2020 (n=70)	p-value
Admission to OR (hr)	6.3 (IQR 4.35-9.4)	14.4 (IQR (9.558-18.4))	<0.001
Duration of Operation (min)	35.0 (IQR 30-50)	42.0 ((IQR 30-62.5))	0.26
Operation			0.595
Appendectomy	117 (97.5%)	64 (91.4%)	
Cecectomy	0	6 (8.6%)	
Ileocecectomy	2 (1.7%)	0	
Right hemicolectomy	1 (0.8%)	0	
Appendix pathology			0.902
Hyperemic	7 (5.8%)	3 (4.3%)	
Suppurative	60 (50.0%)	37 (52.9%)	
Gangrenous	39 (32.5%)	21 (30.0%)	
Perforated	14 (11.7%)	9 (12.9%)	
Postoperative Complication	11 (9.2%)	6 (8.6%)	0.89

Abbreviations: IQR, interquartile range; OR, operating room;

Figures

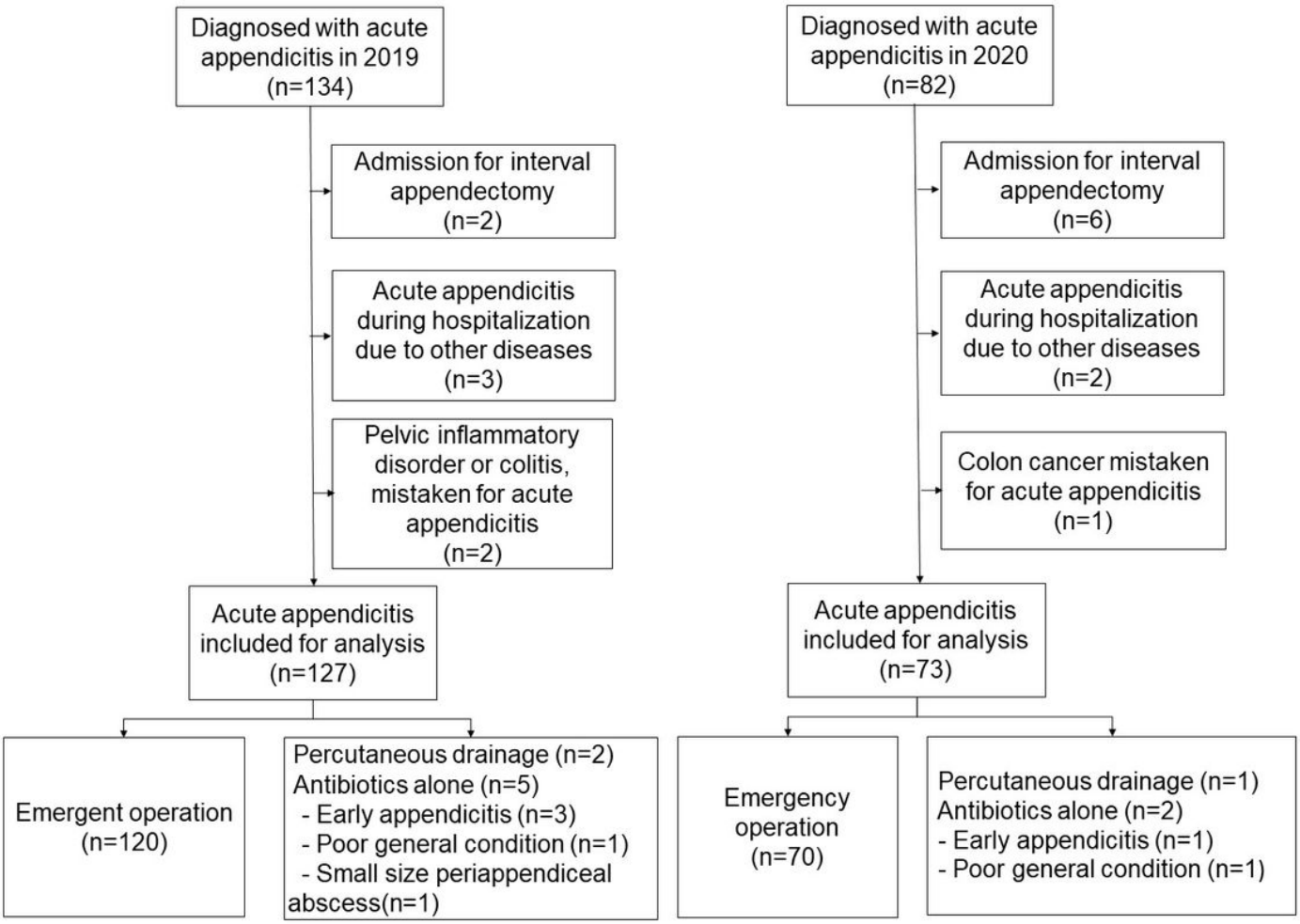

Figure 1

Flow chart of patient selection