ORIGINAL ARTICLE

Impact of the COVID-19 pandemic on emergency general surgery outcomes: A single-center retrospective cohort study

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ABSTRACT

BACKGROUND: The COVID-19 pandemic has affected the health-care system unpredictably. Restrictions and precautions have had a significant impact on the volume and nature of admissions in emergency services. In this study, we hypothesized that the pandemic would result in a change in the number of emergencies admitted to the general surgery inpatient service and a worse patient outcome compared to the previous year.

METHODS: A retrospective analysis of emergency general surgical admissions during the first 6 months of the pandemic and the same period in 2019 was conducted. Demographics, laboratory assessments, diagnosis, treatment strategies, and postoperative outcomes were analyzed.

RESULTS: 761 patients were admitted to the general surgery service during two 6-month periods (392 vs. 369, respectively). This represented a 5.9% reduction in admissions. However, in the first 2 months of the pandemic, the number of emergency general surgical admissions decreased by 37.1% and 43.7%, respectively. Comparison of periods demonstrated no significant differences in demographics, laboratory values, incidence of emergencies, treatment strategies, and hospital stay. Acute appendicitis, cholecystitis, and bowel obstruction were the three most common surgical emergencies in the pandemic. However, there was no significant difference in outcomes between the periods when each surgical emergency was evaluated separately.

CONCLUSION: Pandemic appears to affect general surgical admissions with a fluctuating pattern, an increasing trend following a significant 2-month decrease. These findings suggest that patients presented with a delayed presentation; however, contrary to concerns, there was no difference in patient outcomes between the two periods. This study provides a perspective in management strategies for surgical emergencies in such unusual conditions.

Keywords: COVID-19; emergency treatment; general surgery; pandemic; severe acute respiratory syndrome coronavirus 2.

INTRODUCTION

The COVID-19 pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) globally has affected the health system as well as economic and social life unpredictably.[1] The World Health Organization declared a Public Health Emergency of International Concern regarding COVID-19 on January 30, 2020, and characterized the outbreak as a pandemic on March 11, 2020. The first COVID-19 case seen in Turkey was also recorded on March 11, 2020.[2] While the changes and adaptation processes in the health system are being developed all over the world, studies toward standardization of approaches started to take place in the literature quickly.[3,4] In many hospitals, elective surgeries were put on hold as hospitals were transformed into COVID-19 centers.[5] Some hospitals were reorganized to both manage COVID-19 patients and continue the treatment of other patients, as in our hospital. Naturally, a significant change occurred in all treatment processes and routine health functioning. However, sufficient data on how emergency surgical diseases and

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interventions are affected by the pandemic process have not yet been fully understood.[6,7]

At the onset of the pandemic, there was a significant decrease in both emergency service and hospital admissions as a result of restrictive measures such as lockdown and concerns over the pandemic.[8] Although this situation can be evaluated as a partial reduction of unnecessary admissions to emergency services, it is thought that individuals may be afraid to apply to the hospital, and therefore there may be delays in real emergencies. Besides, clinical evaluation of patients has also been modified, such as routine computed tomography (CT) scans to exclude the COVID-19 for patients in need of emergency treatment.[9] All these situations caused legitimate concerns about the risk of diseases becoming more complicated during admissions.[10] As the COVID-19 pandemic spread quickly, surgeons have witnessed one of the most dramatic changes in their practices with decreasing numbers of elective surgical procedures.[11] As in other medical conditions, how general surgery practices will be affected by the pandemic has been raised as a common source of apprehension for surgeons.[12,13] This study aimed to compare the incidence of general surgical emergencies before and during the COVID-19 pandemic and to assess the effects of the pandemic on the disease severity, management approaches, and outcomes of these emergencies.

MATERIALS AND METHODS

Study Design

This was a retrospective, observational cohort study comparing outcomes from 2 time periods of general surgical emergency patients admitted to the general surgery department at Gülhane Training and Research Hospital, a tertiary healthcare hospital. All consecutive patients admitted during the first 6 months of the pandemic, from March 11 to September 11, 2020, were included in the study. As a historical comparison group, similar data were collected on patients admitted to the general surgery department during the same period in 2019. Patients younger than 18 years, positive for COVID-19, required elective surgery, or re-operated because of a postoperative complication of an elective surgical procedure were excluded from the study. Patients with perioperative COVID-19 diagnosis were separately presented.

The study was performed in line with the principles of the Declaration of Helsinki. Ethical approvals were obtained from both the Ethics Committee of Gülhane Training and Research Hospital (approval no: 2020-258) and the Ministry of Health Science Committee. The study was registered at clinicaltrials.gov (NCT04686708) and results were reported in accordance with STROCSS criteria.[14]

Data Collection

Data collected included age, sex, initial leukocyte, and C-reactive protein (CRP) levels, diagnosis, treatment strategies, and complications. Study outcomes included also the length of hospital stay, 30-day rehospitalization rate, and 30-day reoperation rate. For the surgical treatment of appendicitis and cholecystitis, the approach (open or laparoscopic) was also evaluated. Complications were graded according to the Clavien-Dindo classification system.[15] Tokyo Guidelines 2018/2013 (TG18/TG13) severity grading was used to assess the severity of the acute cholecystitis.[16] Complicated appendicitis was defined as abscess, gangrenous appendicitis, and/or perforation of the appendix noted on radiological imaging studies, operative notes, or pathology results of the specimen.

Clinical, laboratory, and post-operative characteristics of patients undergoing emergency surgery who had COVID-19 diagnosis confirmed within 7 days before or 7 days after surgery were also evaluated. The diagnosis of COVID-19 was determined by a positive real-time reverse transcriptase polymerase chain reaction (PCR) for SARS-CoV-2 from nasopharyngeal swabs or positive findings on chest CT.

Outcomes

The main outcome of this study was to compare the incidence of general surgical emergencies such as acute appendicitis, acute cholecystitis, bowel obstruction, incarcerated or strangulated hernia, ulcer perforation, diverticulitis, mesenteric ischemia, acute pancreatitis, abdominal trauma, and perianal abscess before and during the COVID-19 pandemic. The secondary aim was to assess the effects of the pandemic on the outcomes of general surgical emergencies and the characteristics or severity of patients during the pandemic period compared to the prepandemic period.

Statistical Analysis

We present the raw data using descriptive statistics. Continuous variables were presented as medians and ranges. For dichotomous data, we presented frequencies and percentages. Differences in patient characteristics and outcomes were assessed for the two groups using the Pearson χ^2 test or Fisher's exact test for categorical variables and Wilcoxon Mann-Whitney U test for continuous variables. Locally Weighted Scatterplot Smoothing was used to illustrate the relationship between weeks and the number of patient admissions, stratified by time period. All analyses were performed with Statistical Package for the Social Sciences (SPSS) for Windows, version 16.0 (SPSS Inc., Chicago, USA). Graphical representation was produced using RStudio statistical software, version 1.3.1093 (Rstudio, Inc., Boston, MA, USA) and the ggplot2 package. All tests were two-sided, and $p<0.05$ was considered statistically significant.

RESULTS

Patient Characteristics

In all, 369 patients were admitted to the general surgery service in the first 6 months of the pandemic and 392 patients

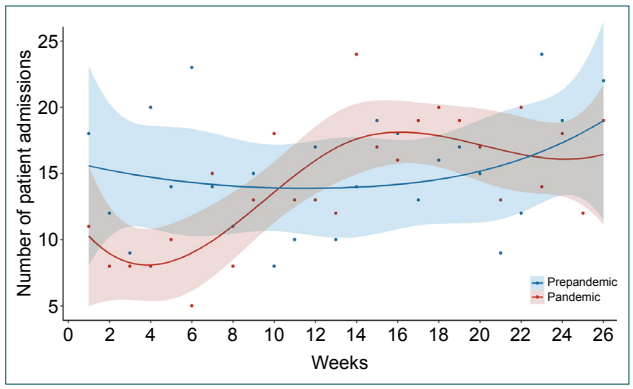

Figure 1. Locally weighted scatterplot smoothing graph of weekly emergency surgical admissions over time in patients admitted during the prepandemic (blue) and pandemic (red) period. Dots are mean weekly number of admissions and smoothed line is the locally weighted scatterplot smoothing curve with shaded areas showing the 95% confidence interval.

were identified in the same period in 2019. The mean number of patients per week was 14.2±4.9 during the pandemic compared with 15.0±4.4 during the prepandemic period (mean difference −0.8, 95% confidence interval −0.15 to −1.47). The numbers of patient admissions per week were plotted against the months of the year in Figure 1. In the first 2 months of the pandemic, the number of patients admitted to the general surgery service statistically significantly decreased by 37.1% and 43.7%, respectively, compared to the previous year. However, for the 6 months, this rate was only 5.9%. Comparison of the two periods demonstrated no significant differences in variables such as the age, sex, initial laboratory values, incidence of diseases, treatment strategies, and hospital stay as summarized in Table 1.

Acute appendicitis, acute cholecystitis, and mechanical bowel obstruction were the three most common surgical emergencies in both periods. While an increase in the incidence of acute appendicitis and bowel obstruction was observed in the pandemic period compared to the prepandemic period, there was a decrease in acute cholecystitis. However, the trends were not statistically significant (Table 2).

Acute Appendicitis

In the prepandemic period, a total of 206 patients with acute appendicitis were identified, of which 42 (20.4%) were complicated, and in the pandemic period, 201 patients of which 51 (25.4%) were complicated (p=0.231). There was no difference in the age, sex, initial leukocyte and CRP, length of hospital stay, as well as complication, 30-day rehospitalization, and 30-day reoperation rates (Table 3).

While only three patients (1.5%) were managed conservatively in the pandemic period, all patients in the prepandemic period underwent an appendectomy. Compared to the 2019 cohort, there was a non-significant decrease in the rate of laparoscopic procedures for the 2020 cohort (29.1% vs. 21.2%, p=0.067).

Acute Cholecystitis

In the prepandemic period, a total of 68 patients with acute cholecystitis were admitted to the general surgery service,

Table 1. Comparison of the patients treated in the prepandemic period and pandemic period

	Prepandemic period (n=392)	Pandemic period (n=369)	p-value
Age (year)	41.0 (18–93)	40.0 (18–93)	0.801
Sex, n (%)			0.899
Female	159 (40.6)	148 (40.1)	
Male	233 (59.4)	221 (59.9)	
Time periods, n (%)			
First month	62 (15.8)	39 (10.6)	0.033
Second month	71 (18.1)	40 (10.8)	0.005
Third month	50 (12.8)	64 (17.3)	0.076
Fourth month	66 (16.8)	83 (22.5)	0.049
Fifth month	61 (15.6)	77 (20.9)	0.058
Sixth month	82 (20.9)	66 (17.9)	0.291
Leucocyte (x10^9/L)	12.7 (3.4–28.6)	13.3 (2.5–31.7)	0.065
C-reactive protein (mg/L)	27.5 (0.2–372.5)	25.0 (0.1–505.7)	0.950
Treatment strategies, n (%)			0.098
Medical/Conservative treatment	96 (24.5)	72 (19.5)	
Surgical/Interventional approach	296 (75.5)	297 (80.5)	
Hospital stay (day)	3 (1–31)	3 (1–33)	0.601

Table 2. Comparison of the incidence of general surgical emergencies admitted in the prepandemic period and pandemic period

	Prepandemic period (n=392)	Pandemic period (n=369)	Difference (95% CI)	p-value
	n (%)	n (%)		
Acute appendicitis	206 (52.6)	201 (54.5)	1.9% (–5.2 to 9.0)	0.596
Acute cholecystitis	68 (17.3)	48 (13.0)	–4.3% (–9.5 to 0.8)	0.096
Mechanical bowel obstruction	50 (12.8)	51 (13.8)	1.0% (–3.8 to 5.9)	0.665
Incarcerated/Strangulated hernia	27 (6.9)	20 (5.4)	–1.5% (–4.9 to 2.0)	0.401
Ulcer perforation	8 (2.0)	12 (3.3)	1.2% (–1.1 to 3.5)	0.297
Diverticulitis	5 (1.3)	10 (2.7)	1.4% (–0.5 to 3.4)	0.155
Mesenteric ischemia	1 (0.3)	1 (0.3)	0.02% (–0.71 to 0.74)	1.000
Acute pancreatitis	3 (0.8)	0 (0)	–0.8% (–1.7 to 0.1)	0.250
Abdominal trauma	15 (3.8)	17 (4.6)	0.8% (–2.1 to 3.6)	0.592
Perianal diseases	9 (2.3)	9 (2.4)	0.1% (–2.0 to 2.3)	0.897

CI: Confidence interval.

Table 3. Comparison of the clinical characteristics of patients treated for appendicitis in the prepandemic period and pandemic period

Outcomes	Prepandemic period (n=206)	Pandemic period (n=201)	p-value
Age (year)	29.5 (18–82)	30.0 (18–72)	0.360
Sex, n (%)			0.225
Female	78 (37.9)	88 (43.8)	
Male	128 (62.1)	113 (56.2)	
Leucocyte (x10^9/L)	13.7 (6.1–28.6)	14.2 (4.6–31.7)	0.314
C-reactive protein (mg/L)	17.2 (0.2–273.5)	21.6 (0.4–505.7)	0.315
Treatment strategies, n (%)			0.120
Medical treatment	0	3 (1.5)	
Appendectomy	206 (100)	198 (98.5)	
Surgical procedure, n (%)†			0.067
Open	146 (70.9)	156 (78.8)	
Laparoscopic	60 (29.1)	42 (21.2)	
Status of appendix, n (%)			0.231
Non-complicated appendicitis	164 (79.6)	150 (74.6)	
Complicated appendicitis	42 (20.4)	51 (25.4)	
Hospital stay (day)	2 (1–15)	2 (1–16)	0.051
Clavien-Dindo classification, n (%)†			0.498
No	176 (85.4)	162 (81.8)	
Grade I-II	26 (12.6)	33 (16.7)	
Grade III-V	4 (1.9)	3 (1.5)	
30-day rehospitalization, n (%)	1 (0.5)	3 (1.5)	0.367
30-day reoperation, n (%)†	1 (0.5)	1 (0.5)	1.000

†Subgroup analysis was performed for patients who underwent appendectomy (n=404).

and in the pandemic period, 48 patients were admitted. No statistically significant difference was observed between the two cohorts in terms of demographic features and initial findings as well as the post-operative outcomes (Table 4). Patients who managed in the pandemic period had a higher rate of Grade II or III cholecystitis than those managed in the

Table 4. Comparison of the clinical characteristics of patients treated for acute cholecystitis in the prepandemic period and pandemic period

Outcomes	Prepandemic period (n=68)	Pandemic period (n=48)	p-value
Age (year)	58.0 (24–92)	51.5 (24–91)	0.054
Sex, n (%)			0.156
Female	36 (52.9)	19 (39.6)	
Male	32 (47.1)	29 (60.4)	
Leucocyte (x10^9/L)	12.7 (5.2–26.4)	14.1 (5.1–31.7)	0.221
C-reactive protein (mg/L)	109.1 (1.4–372.5)	142.5 (1.0–481.7)	0.509
TG18/TG13 severity grading, n (%)			0.394
Grade I	42 (61.8)	25 (52.1)	
Grade II	21 (30.9)	21 (43.8)	
Grade III	5 (7.4)	2 (4.2)	
Treatment strategies, n (%)			0.190
Medical treatment	38 (55.9)	30 (62.5)	
Percutaneous cholecystostomy	10 (14.7)	10 (20.8)	
ERCP	5 (7.4)	0	
Cholecystectomy	15 (22.1)	8 (16.7)	
Surgical procedure, n (%)†			0.345
Open cholecystectomy	6 (40.0)	1 (12.5)	
Laparoscopic cholecystectomy	9 (60.0)	7 (87.5)	
Hospital stay (day)	5 (1–31)	5 (2–24)	0.703
Clavien-Dindo classification, n (%)†			0.369
No	10 (66.7)	7 (87.5)	
Grade I-II	5 (33.3)	1 (12.5)	
Grade III-V	0	0	
30-day rehospitalization, n (%)	3 (4.4)	3 (6.3)	1.000
30-day reoperation, n (%)†	0	0	NS

†Subgroup analysis was performed for patients who underwent cholecystectomy (n=23). ERCP: Endoscopic retrograde cholangiopancreatography; NS: Non-significant; TG18/TG13: Tokyo Guidelines 2018/2013 severity grading for acute cholecystitis.

prepandemic period; however, there was no statistical difference between the two groups (47.9% vs. 38.2%, p=0.394).

A proportional increase in medical treatment (55.9% vs. 62.5%) and percutaneous cholecystostomy (14.7% vs. 20.8%), and a decrease in cholecystectomy (22.1% vs. 16.7%) was noted in the pandemic cohort compared to the prepandemic cohort. However, these differences did not reach statistical significance (p=0.190).

Mechanical Bowel Obstruction

Fifty-one patients with bowel obstruction were treated on an inpatient basis in the pandemic period, and 50 patients during the same period in 2019. Comparing the two periods, no significant differences were revealed in the age, sex, initial laboratory values, treatment strategies, intraoperative findings, complications, length of hospital stay, 30-day rehospitalization rate, and 30-day reoperation rate (Table 5).

In all, 19 (38.0%) patients in the prepandemic cohort and 27 (52.9%) patients in the pandemic cohort underwent a surgical procedure. Sub-group analysis of patients undergoing a surgical procedure showed a significant increase in the rate of partial small bowel resection (36.8% vs. 70.4%, p=0.027). While 7 (25.9%) patients were diagnosed with complicated bowel obstruction (perforation or intra-abdominal abscess) during the pandemic period, 4 (21.1%) patients were diagnosed during the same period in 2019.

Other Surgical Diseases

Twenty-seven patients in 2019 and 20 patients in 2020 were treated for an incarcerated or strangulated hernia. All patients in the pandemic period were managed with a surgical approach. The rate of bowel resection was higher in the pandemic period compared to the prepandemic period, but it did not reach a statistical significance (16.7% vs. 15.0%, p=1.000). There were no differences in the incidence of oth-

Table 5. Comparison of the clinical characteristics of patients treated for bowel obstruction in the prepandemic period and pandemic period

Outcomes	Prepandemic period (n=50)	Pandemic period (n=51)	p-value
Age (year)	68.5 (21–92)	66.0 (21–87)	0.305
Sex, n (%)			0.055
Female	24 (48.0)	15 (29.4)	
Male	26 (52.0)	36 (70.6)	
Leucocyte (x10^9/L)	10.4 (4.2–19.9)	11.3 (4.1–23.2)	0.300
C-reactive protein (mg/L)	33.5 (0.4–309.3)	15.8 (0.6–446.0)	0.347
Treatment strategies, n (%)			0.132
Conservative treatment	31 (62.0)	24 (47.1)	
Surgical approach	19 (38.0)	27 (52.9)	
Surgical procedure, n (%)†			0.027
Bridectomy	4 (21.1)	6 (22.2)	
Partial small bowel resection	7 (36.8)	19 (70.4)	
Palliative ileostomy/colostomy	5 (26.3)	1 (3.7)	
Colectomy	3 (15.8)	1 (3.7)	
Intraoperative findings, n (%)†			0.703
Non-complicated	15 (78.9)	20 (74.1)	
Complicated	4 (21.1)	7 (25.9)	
Hospital stay (day)	5 (1–27)	6 (1–33)	0.279
Clavien-Dindo classification, n (%)†			0.612
No	7 (36.8)	13 (48.1)	
Grade I-II	8 (42.1)	11 (40.7)	
Grade III-V	4 (21.1)	3 (11.1)	
30-day rehospitalization, n (%)	4 (8.0)	7 (13.7)	0.356
30-day reoperation, n (%)†	2 (10.5)	1 (3.7)	0.561

†Subgroup analysis was performed for patients who underwent a surgical procedure due to mechanical bowel obstruction (n=46).

er less common surgical emergencies such as ulcer perforation, diverticulitis, mesenteric ischemia, acute pancreatitis, abdominal trauma, and perianal abscess before and during the COVID-19 pandemic. Comparison of the outcomes of these emergencies is given in Table 6.

COVID-19 Positive Patients

In the study period, seven patients who had COVID-19 underwent emergency surgery. COVID-19 was diagnosed preoperatively in 3 (42.9%) of seven patients and postoperatively in 4 (57.1%) patients. COVID-19 diagnosis was confirmed by a positive SARS-CoV-2 PCR test of nasopharyngeal swab specimen in four patients. In the suspected cases who had a negative PCR test, the diagnosis was made based on a thorax CT scan. While, emergency surgery was done in six patients, one patient with acute cholecystitis was treated with intravenous antibiotics and percutaneous cholecystostomy. Indications for surgery were acute appendicitis in two patients, mechanical bowel obstruction in two patients, peptic ulcer perforation in one patient, and mesenteric ischemia in one patient. 30-day mortality was 42.9% (3 of 7) (Table 7).

DISCUSSION

As of March 11, 2020, informing the people about the disease, risk groups, social distancing, and personal protections gained momentum through written and visual media after the COVID-19 pandemic in Turkey. Within the scope of the fight against the pandemic, the government took measures such as closing schools, universities, and all social gathering places. Some hospitals were designated as COVID-19 centers and some were divided into COVID-19-free and COVID-19-positive areas. While seeking answers to all the unknowns associated with this versatile and dangerous process that has not been encountered before, all efforts have been made to ensure that the necessary health services are not interrupted despite the lack of previous pandemic experience and uncertainties. Health-care staff and patients immediately changed their priorities and habits to adapt to the process. Unfortu-

Table 6. Comparison of other surgical emergencies encountered in the prepandemic period and pandemic period

Incarcerated/Strangulated hernia	**Prepandemic period (n=27)**	**Pandemic period (n=20)**	**p-value**
Age (year)	60.0 (21–93)	60.0 (39–93)	0.590
Male sex, n (%)	12 (44.4)	11 (55.0)	0.474
Treatment strategies, n (%)			0.251
Reduction of hernia	3 (11.1)	0	
Surgical approach	24 (88.9)	20 (100)	
Surgical procedure, n (%)[†]			1.000
Hernia repair	20 (83.3)	17 (85.0)	
Bowel resection + hernia repair	4 (16.7)	3 (15.0)	
Hospital stay (day)	3.0 (1–31)	4 (1–11)	0.458
Gastric/Duodenal ulcer perforation	**Prepandemic period (n=8)**	**Pandemic period (n=12)**	**p-value**
Age (year)	44.5 (22–80)	47.0 (27–88)	0.700
Male sex, n (%)	7 (87.5)	9 (75.0)	0.465
Treatment strategies, n			1.000
Conservative treatment	0	1 (8.3)	
Surgical approach	8 (100)	11 (91.7)	
Hospital stay (day)	6 (3–12)	6.5 (3–15)	0.586
Diverticulitis	**Prepandemic period (n=5)**	**Pandemic period (n=10)**	**p-value**
Age (year)	51.0 (45–59)	53.0 (36–73)	0.902
Male sex, n (%)	3 (60.0)	3 (30.0)	0.329
Treatment strategies, n (%)			0.231
Conservative treatment	5 (100)	6 (60.0)	
Surgical approach	0	4 (40.0)	
Hospital stay (day)	6 (2–14)	4.5 (4–24)	0.899
Abdominal trauma	**Prepandemic period (n=15)**	**Pandemic period (n=17)**	**p-value**
Age (year)	25.0 (18–48)	28.0 (19–70)	0.092
Male sex, n (%)	14 (93.3)	13 (76.5)	0.338
Treatment strategies, n (%)			0.082
Conservative treatment	6 (40.0)	12 (70.6)	
Surgical approach	9 (60.0)	5 (29.4)	
Hospital stay (day)	6 (1–15)	4 (1–33)	0.478
Perianal diseases[§]	**Prepandemic period (n=9)**	**Pandemic period (n=9)**	**p-value**
Age (year)	49.0 (28–84)	50 (25–82)	0.860
Male sex, n (%)	8 (88.9)	6 (66.7)	0.576
Treatment strategies, n (%)			1.000
Medical treatment	2 (22.2)	3 (33.3)	
Surgical approach	7 (77.8)	6 (66.7)	
Hospital stay (day)	5 (2–28)	4 (1–19)	0.796

[†]Subgroup analysis was performed for patients who underwent a surgical procedure due to incarcerated or strangulated herni (n=44).
[§]Including perianal abscess, hemorrhoidal disease, and Fournier's gangrene.

nately, the COVID-19 pandemic has undoubtedly disrupted essential health services and affected the incidence and mortality of other diseases.[3] In Turkey, elective surgeries are still restricted in many hospitals, and these procedures are only ongoing at ambulatory surgical centers and non-COVID hospitals since the pandemic declaration.[7]

Table 7. Clinical, laboratory, and postoperative characteristics of patients with perioperative COVID-19 diagnosis

Case	Age	Sex	ASA score	Timing of COVID-19 diagnosis	COVID-19 diagnosis	Leucocyte ($x10^9/L$)	CRP (mg/L)	D-dimer (mg/L)	Surgical diagnosis	Surgical procedure	Hospital stay	30-day mortality
1	35	Male	2	Preoperative	PCR	26.5	238.0	3.1	Appendicitis	Appendectomy	14	No
2	42	Male	1	Postoperative	Radiological	13.2	1.9	0.5	Appendicitis	Appendectomy	2	No
3	91	Female	3	Postoperative	PCR	16.2	481.7	2.2	Cholecystitis	Percutaneous cholecystostomy	19	Yes
4	54	Male	2	Preoperative	Radiological	6.4	27.6	7.2	Bowel obstruction	Bridectomy	9	No
5	30	Female	1	Preoperative	PCR	7.2	6.5	3.8	Bowel obstruction	Bridectomy	13	No
6	81	Male	3	Postoperative	PCR	18.6	76.7	4.4	Ulcer perforation	Primary repair	15	Yes
7	83	Male	3	Postoperative	Radiological	8.6	185.1	1.3	Mesenteric ischemia	Partial small bowel resection	18	Yes

ASA: American Society of Anesthesiologists; CRP: C-reactive protein; PCR: Polymerase chain reaction.

The number of studies associated with the COVID-19 pandemic and its relation to emergency general surgical procedures was limited. In this study, we hypothesized that the COVID-19 pandemic would result in a change in the number of emergencies admitted to the general surgery and a worse patient outcome compared to the prepandemic period. Thus, we performed a historic cohort analysis based on 761 patients with a general surgical emergency, 369 of whom were admitted in the first 6 months of the pandemic and aimed to evaluate the effects of the COVID-19 pandemic on the disease severity, management approaches, and outcomes of the emergencies. In the present study, while there was a statistically significant 37.1% decrease in inpatient admissions to the general surgery service for the 1st month of the pandemic, only a 5.9% decrease was noted for the 6-month interval compared to the same period of the previous year (392 vs. 369, respectively). These findings are aligned with recent studies showing a 25% reduction in emergency department admissions in the United Kingdom and a 26% decrease in emergency general surgical admission in the New Zealand.[17,18] Both uncertainties in the early stages of the pandemic and efforts to treat diseases such as acute cholecystitis with outpatient medical treatment in the first days without a hospitalization may be the reasons for this decrease in inpatient admissions. Besides, patients might have tended to postpone admission to hospitals even in real emergencies, which could potentially result in poorer patient outcomes in the latter period. However, since our center is one of the largest hospitals in the region or it was reorganized to both manage COVID-19 patients and continue the treatment of other patients, reduction in the number of emergency admissions to the general surgery clinic shown in the first days has become normal and even there was a significant rebound increase in the following days.

Comparative studies, conducted in the first months of the pandemic, most of which evaluating only a specific disease, supports the interactions mentioned above. Surek et al.[19] reported a significant decrease by 59.1% in the number of emergency surgeries during the first 2 months of the pandemic compared to the same period of the previous year. In addition, they indicated a 73% reduction in the number of patients undergoing appendectomies and a significant increase in complicated appendicitis rate (from 16.8% to 42.9%) in the pandemic period compared to the previous year. Similarly, Orthopoulos et al.[20] showed a significant increase in complicated appendicitis during the pandemic. Therefore, it was speculated that patients requiring urgent surgical intervention are not seeking appropriate and timely surgical care. Conversely, Turanli et al.[21] did not report a statistically significant difference in the rate of perforated appendicitis compared to the prepandemic period, although perforation rates were slightly higher in the pandemic period. In the present study, it was found a non-significant increase in the rate of complicated appendicitis (20.4% vs. 25.4; p=0.231). In addition, there were no significant differences in initial leukocyte and CRP levels as well as complications, 30-day rehospital-

ization rate, and 30-day reoperation rate among patients managed in prepandemic and pandemic period. Although not statistically significant, laparoscopic appendectomy was less preferred during the pandemic period. This is likely due to concerns about aerosolization of viral particles through the pneumoperitoneum during laparoscopic surgery, which was highly speculated, especially in the early days of the pandemic.

In our study, compared with prepandemic period, there was a borderline significant decrease in the admission rate of patients with acute cholecystitis from 17.3% to 13.0% (p=0.096). This decrease in acute cholecystitis during the onset of the pandemic possibly represents the efforts to manage it with conservative treatment without hospitalization or reduction in hospital admissions for mild cholecystitis. Although a higher rate of Grade II or III cholecystitis, and higher levels of leukocyte and CRP were found in the pandemic cohort, there was no statistical difference between the two cohorts with respect to the length of hospital stay and 30-day outcomes. Similarly, Surek et al.[19] reported a 47.3% decrease in the number of patients admitted for acute cholecystitis in the pandemic. Another study noted a decrease also in patients undergoing surgery for acute cholecystitis during the pandemic period (15.8% vs. 5.0%).[22] In our study, despite non-significant differences between the cohorts, proportional increases in medical treatment and percutaneous cholecystostomy and a decrease in the rate of cholecystectomy were observed in the pandemic period.

In a single-center cohort study from the UK, McLean et al.[8] compared the volume and severity of emergency general surgery admissions between the 1-month period before lockdown and 1-month period immediately after lockdown. While they reported a similar rate of acute appendicitis, biliary pathology, diverticular disease, gastrointestinal (GI) bleeding, hernia, inflammatory bowel disease, ischemic bowel, pancreatitis, and trauma in both groups, patients were significantly more likely to present with GI obstruction, GI perforation, and GI cancer and less likely to be admitted with non-specific abdominal pain and superficial infections or abscess. Regarding treatment strategies, they were significantly more likely to use open surgery, antibiotic treatment choices, and interventional approaches during the lockdown period. In our study, there was no significant difference in the rates of surgical emergencies and treatment strategies in the two periods. In the same study, McLean et al.[8] also reported a significantly longer hospital stay, higher rates of Clavien-Dindo Grade ≥3 complications, and higher rates of mortality in the lockdown cohort. These findings were in contrast to our study, though both samples included a considerable high number of patients. Rapid reaction to changing conditions, such as a change in the treatment strategies of emergency surgical patients and while the reorganization of the complex hospitals, as simpler structures (COVID and non-COVID units), might have resulted in similar patient outcomes in the pandemic period, as in the prepandemic period.

Besides, non-operative treatment options for surgical emergencies started to come to the fore with the uncertainties of pandemic processes.[23] Antibiotherapy came up as a good alternative to surgery in non-complicated appendicitis. In a study conducted by Javanmard-Emamghissi et al.[24] in which comparing outcomes between conservative and operative management of patients with acute appendicitis, non-operative management was shown to be safe and effective in the short-term. In our study, only three patients with uncomplicated appendicitis were treated with medical treatment, all of them during the pandemic period. Considering all surgical emergencies, there was a statistically not significant proportional decrease in the preference of the medical or conservative management in the treatment approach (24.5% vs. 19.5%). The reason for this unexpected finding may be that although medical treatment approaches were more likely preferred in the treatment of acute cholecystitis; surgical management was performed more frequently in cases of mechanical bowel obstruction, due to delayed presentation.

Some limitations to this study need to be acknowledged. First, there are limitations inherent in any retrospective analysis. Second, the health-care system, hospital conditions, or allocating medical resources may differ in different centers. Our tertiary health-care hospital, which was reorganized in the pandemic period to both manage COVID-19 patients and continue the treatment of other patients, is one of the largest hospitals in the region. Therefore, our results may not be generalizable to all hospitals. Third, patients may have preferred less risky hospitals during the pandemic. The findings of this study should be carefully interpreted considering these limitations. Further comprehensive, multicenter, and prospective studies of standardized conservative approaches are needed to overcome these constraints.

Conclusion

In response to the COVID-19 pandemic, unprecedented and dramatic changes to clinical practice have necessarily been applied. This study revealed more than a one-third reduction in the number of admissions to general surgery service during the first months of the pandemic. This is a multifactorial issue and is probably due to patients' increased anxiety or fear about attending hospital, compliance with government instructions, and the efforts of surgeons to treat patients in an outpatient setting to reduce both the risk of the COVID-19 exposure and overburdening the health-care system. Although the findings of this study contain evidence showing that patients presented to the hospital with a delayed presentation; contrary to concerns, it was observed that these delays did not increase morbidity and mortality rates, which supports that we used the appropriate treatment pathway for managing surgical emergencies in the pandemic era. However, patients may have been managed at a more complicated stage of the disease due to the delay in admissions. To minimize the potential effects of the pandemic

that could affect the outcomes of surgical emergencies, it is important to address patients' concerns/fears, emphasize the importance of early diagnosis and intervention for surgical emergencies, and optimally organize health-care resources. These findings provide a perspective in management processes for surgical emergencies and may provide insight and direction for the future possible new COVID-19 surges or other possible pandemics.

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Ethics Committee Approval: The study was performed in line with the principles of the Declaration of Helsinki. Ethical approvals were obtained from both the Ethics Committee of Gülhane Training and Research Hospital and the Ministry of Health Science Committee (Date: 09.06.2020, Decision No: 2020-258).

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ORİJİNAL ÇALIŞMA - *ÖZ*

COVID-19 salgınının acil genel cerrahi sonuçlarına etkisi: Tek merkezli geriye dönük bir kohort çalışması

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AMAÇ: COVID-19 salgını sağlık sistemini öngörülemeyecek düzeyde etkilemektedir. Kısıtlamalar ve önlemler, acil servislere hasta kabullerinin hacmi ve niteliği üzerinde önemli etkilere yol açmıştır. Bu çalışmada, önceki yıla göre, pandeminin genel cerrahi servisine kabul edilen acil vakaların sayısında değişikliğe ve daha kötü hasta sonuçlarına neden olacağı varsayımında bulunduk.

GEREÇ VE YÖNTEM: Pandeminin ilk altı ayında ve 2019 yılının aynı döneminde acil genel cerrahi başvurularının geriye dönük analizi yapıldı. Demografik bilgiler, laboratuvar değerlendirmeleri, tanı, tedavi stratejileri ve ameliyat sonrası hasta sonuçları analiz edildi.

BULGULAR: Altı aylık iki dönem sürecinde 761 hasta genel cerrahi servisine kabul edildi (sırasıyla, 392 ve 369). Bu sonuç, hasta kabullerinde %5.9'luk bir azalma olduğunu gösterdi. Ancak pandeminin ilk iki ayında acil genel cerrahi başvurularında sırasıyla %37.1 ve %43.7 azalma görüldü. İki dönem karşılaştırıldığında, demografik özellikler, laboratuvar sonuçları, acil cerrahi hastalıkların insidansı, tedavi stratejileri ve hastanede kalış süreleri açısından önemli bir fark saptanmadı. Akut apandisit, kolesistit ve bağırsak tıkanıklığı pandemide en sık görülen üç acil cerrahi durumdu. Bununla birlikte, her acil cerrahi durum ayrı ayrı değerlendirildiğinde de dönemler arasında hasta sonuçları açısından anlamlı bir fark saptanmadı.

TARTIŞMA: Pandeminin, genel cerrahi başvurularını iki aylık önemli bir azalmanın ardından artan bir eğilim sergileyerek dalgalı bir modelle etkilediği görülmektedir. Bu bulgular, hastaların başvurularında bir gecikme olduğunu düşündürse de endişelerin aksine, iki dönem arasında hasta sonuçları açısından bir fark yoktur. Bu çalışma, bu tür olağandışı koşullarda acil cerrahi durumlar için yönetim stratejilerine bir bakış açısı sağlamaktadır.

Anahtar sözcükler: Acil tedavi; COVID-19; genel cerrahi; pandemi; şiddetli akut solunum sendromu koronavirüs 2.

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