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Effect of COVID-19 pandemic on general surgery trauma surgeries: a single-center, retrospective cross-sectional study

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Abstract. – OBJECTIVE: This study aims to assess the impact of trauma surgeries performed in our clinic before and during the COVID-19 pandemic on surgical indications, procedure types, perioperative course, and final outcomes.

PATIENTS AND METHODS: We conducted a retrospective single-center clinical study. The study group (n=88) comprised trauma patients who presented to the emergency department during the COVID-19 pandemic and underwent emergency surgeries. The control group (n=115) consisted of trauma patients who sought emergency care and underwent surgeries in the same period of the previous year, before the pandemic. We compared the number of patients, demographic data, clinical findings, diagnoses, and surgical interventions.

RESULTS: The study group exhibited a 13.3% decrease in the number of patients compared to the control group during the COVID-19 pandemic. The study group and control group had similar age and gender distributions. The study group had a lower rate of surgical intervention. Among the study group, liver laceration was the most common diagnosis in 19 patients (7.4%), compared to 30 patients (11.7%) in the control group. Mortality rates were 1.0% in the study group and 2.0% in the control group. There were no significant differences in mortality (p=0.632) or patient diagnoses (p=0.357) between the COVID-19 pandemic and control periods.

CONCLUSIONS: This study demonstrates a decline in the number of trauma patients admitted to the hospital and undergoing surgery during the COVID-19 pandemic. The pandemic has affected the management of patients requiring urgent surgical intervention, resulting in a lower rate of surgical procedures in the study group. However, despite the preference for medical treatment in trauma patients, surgical interventions remain necessary for appropriate indications.

Key Words:
COVID-19 pandemic, Trauma, General surgery, Emergency surgery.

Introduction

Coronavirus disease 2019 (COVID-19) is a contagious respiratory disease caused by the new type of severe SARS-CoV-2. COVID-19 is the most important global health crisis since the 1918 flu pandemic period[1,2]. As a result of the social and financial negative effects of this disease globally, it was declared a pandemic by WHO on March 11, 2020[3]. Restrictive measures have been taken around the world to delay and reduce the peak of the epidemic. Thus, it was aimed to alleviate the burden on health systems[4].

The COVID-19 pandemic, in conjunction with the implemented restrictive measures, has exerted a profound influence on societal dynamics in Turkey. These measures, encompassing the interruption of educational activities, implementation of social isolation protocols, and imposition of curfews, have contributed to a reduction in societal engagement. Consequently, a discernible impact has been observed[5] in the etiology of emergency surgeries, and the composition of trauma cases admitted to hospitals.

Hospitals play a pivotal role as high-risk and well-managed institutions during the COVID-19 outbreak. The healthcare landscape has undergone a significant transformation due to the COVID-19 pandemic, resulting in a profound shift in healthcare demand. Within hospital settings, intensive care units (ICUs) and operating rooms (ORs) pose the highest risks. Since the emergence of the pandemic, patients presenting with acute clinical conditions have received altered treatment ap-

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proaches. This necessitated a focus on augmenting ICU capacity and minimizing non-essential clinical services. Substantial reallocation of hospital resources has been directed towards combating the surge in COVID-19 cases[6].

These adaptations naturally exerted an influence on surgical departments, leading to the deferral of elective procedures in order to prioritize the care of COVID-19 patients[6-8]. In response, various national surgical associations and regional healthcare institutions have made concerted efforts to formulate patient-specific protocols for surgical procedures, underpinned by a shared objective[9-12]. Nonetheless, despite the considerable focus of the healthcare system on addressing the epidemic, the prompt evaluation and timely management of patients necessitating urgent general surgery continue to be of paramount importance.

The primary objective of this study was to evaluate the impact of trauma cases necessitating immediate surgical intervention in our clinic, both prior to and during the COVID-19 pandemic, with a focus on alterations in surgical indications, procedural classifications, perioperative trajectories, and ultimate outcomes.

Patients and Methods

This retrospective, single-center study was carried out after obtaining approval from the Ethics Committee of Ege University School of Medicine (decision No. 2022/22-9.1T/11). The investigation centered on trauma patients who were admitted to the emergency department and underwent immediate surgical interventions within the general surgery clinic, both prior to and during the COVID-19 pandemic, spanning the time frame from October 2018 to July 2021. The patient cohort was stratified into two distinct groups: the control group (n=115), encompassing trauma patients who underwent surgery before the initiation of the COVID-19 pandemic, and the study group (n=88), comprising trauma patients who underwent emergency surgical procedures within the general surgery clinic during the pandemic period. The study encompassed a total of 203 patients. The primary objective of this research endeavor was to juxtapose and compare surgical indications, procedural classifications, perioperative trajectories, and ultimate outcomes between the study and control groups.

The study encompassed adult participants aged 18 years and older, who sought medical attention within the emergency department and underwent assessment for urgent general surgical intervention. Those individuals who fulfilled the predefined inclusion criteria and did not meet the specified exclusion criteria were considered eligible for inclusion in the study. The exclusion criteria included individuals under the age of 18, pregnant individuals, trauma patients necessitating immediate general surgery who unfortunately passed away while in the emergency department, and patients for whom the recorded data system lacked sufficient information. In instances where the traumatized individual was situated within a vehicle during the accident, the incident was categorized as an "in-vehicle traffic accident", whereas if the occurrence transpired outside the vehicle, it was classified as an "out of vehicle traffic accident".

A comprehensive dataset encompassing demographic attributes, initial symptoms, diagnostic assessments, details of surgical interventions, clinical progression, and mortality status was meticulously documented for all eligible patients.

Statistical Analysis

Statistical analysis was performed using SPSS version 17.0 software (SPSS Inc., Chicago, IL, USA). The conformity of the variables to the normal distribution was examined using analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). In descriptive analyses, the variables were given as mean ± standard deviation. Frequency and percentage values of demographic characteristics and categorical variables were given. In continuous data, the Mann-Whitney U test was used to compare binary groups. Pearson's Chi-Square or Fisher's Exact Chi-Square test was used to analyze categorical data. Cases with a p-value below 0.05 were considered statistically significant.

Results

The study comprised a total of 203 patients, with 88 (43.3%) assigned to the study group and 115 (56.7%) to the control group, all meeting the predetermined inclusion and exclusion criteria. Notably, there was a 13.3% reduction in the number of patients in the study group during the COVID-19 pandemic compared to the control group. The study and control groups exhibited similar age and gender distributions during both periods. Specifically, the control group consisted of 18 female patients (8.9%), while the study

group had 10 female patients (4.9%) (p=0.109). The mean age of the control group was 38.5±16.1 (IQR: 22, range: 18-90) years, while the study group had a mean age of 35.7±13.2 (IQR: 20, range: 19-76) years. These observed differences in age were not statistically significant (p=0.518).

When analyzing the most frequently observed trauma types in the control group, it was found that 39 patients (19.2%) had stab wounds, 20 patients (9.9%) were involved in in-vehicle traffic accidents, and 14 patients (6.9%) experienced out-vehicle traffic accidents. In contrast, within the study group, 17 patients (8.4%) had stab wounds, 15 patients (7.4%) were involved in in-vehicle traffic accidents, and 15 patients (7.4%) suffered from gunshot wounds. Notably, statistically significant differences were observed in these trauma types between the two groups (p=0.032). Detailed information regarding the demographic characteristics and trauma types of the patients can be found in Table I.

The "injury severity score (ISS)" values of the study and control groups were 16.5±1.01 and 15.4±2.23, respectively (p=0.097). The "revised trauma score (RTS)" values of both groups were 7.3±1.13 and 7.2±0.93, respectively (p=0.066). There was no statistically significant difference between ISS and RTS between the groups.

Table II presents a comprehensive summary of the operated organs, corresponding diagnoses, types of surgical procedures, and mortality rates observed within both the study and control groups. The liver and spleen were the most frequently operated organs in both groups, and no statistically significant difference was found in this regard (p=0.393). In the study group, the most prevalent diagnoses included liver laceration in 19 patients (7.4%), multiple small and large intestine injuries in 18 patients (7.0%), and spleen laceration in 10 patients (3.9%). Conversely, the control group exhibited liver laceration in 30 patients (11.7%), stab wounds in 16 patients (6.3%), and combined liver and spleen lacerations in 13 patients (5.1%) as the most common diagnoses. However, these observed differences between the study and control groups were not statistically significant (p=0.357).

In the control group, 62 patients (30.5%) underwent surgery, while 46 patients (22.7%) in the study group required surgical intervention. The most common type of operation performed was multiple organ repair, involving hemostasis, resection, and primary repair, which was conducted in 26 patients (12.8%) in the control group and 17 patients (8.4%) in the study group. Significantly different surgical decisions (p=0.006) and types of surgery (p=0.032) were observed between the study and control groups. Among the patients, 2 individuals (1.0%) in the study group and 4 individuals (2.0%) in the control group experienced mortality. However, no significant difference in mortality rates was observed between the two groups (p=0.632).

Discussion

The coronavirus disease (COVID-19) has significantly impacted the management of both emergency and elective surgeries, primarily due

Table I. Comparison of demographic characteristics and trauma types of patient groups.

	Control group (n: 115)	Study group (n: 88)	p
Gender Total (n, %)	115 (56.7%)	88 (43.3%)	0.109
Female	18 (15.7%)	10 (11.4%)	
Male	97 (84.3%)	78 (88.6%)	
Age (year) (Mean ± Std)	38.5 ± 16.1 (IQR: 22, 18-90)	35.7 ± 13.2 (IQR: 20, 19-76)	0.518
Trauma type (n)			0.032*
Out-vehicle traffic accident	14 (12.2%)	9 (10.2%)	
In-vehicle traffic accident	20 (17.4%)	17 (19.3%)	
Firearm injury	13 (11.3%)	15 (17.0%)	
Sharps injury	39 (33.9%)	28 (31.8%)	
Beaten	1 (0.8%)	1 (1,1%)	
Work accident	4 (3.5%)	1 (1.1%)	
Motorcycle accident	9 (7.8%)	5 (5.7%)	
Falling from high	15 (12.2%)	12 (12.5%)	

*p-value below 0.05 were considered statistically significant. In instances where the traumatized individual was situated within a vehicle during the accident, the incident was categorized as an "in-vehicle traffic accident", whereas if the occurrence transpired outside the vehicle, it was classified as an "out of vehicle traffic accident".

Table II. Comparison of patient groups in terms of type of operated organ, diagnosis, type of operation performed and mortality development status.

	Control group (n: 115)	Study group (n: 88)	*p*
Operated organ (n, %)			
Adrenal glands	3 (2.6%)	1 (1.1%)	
Kidney	5 (4.3%)	1 (1.1%)	
Spleen	32 (27.8%)	19 (21.6%)	
Diaphragm	7 (6.1%)	8 (9.1%)	
Small intestine	18 (15.6%)	14 (15.9%)	
Large bowel	11 (9.6%)	14 (15.9%)	
Liver	31 (26.9%)	32 (36.4%)	
Stomach	6 (5.2%)	4 (4.5%)	
Pancreas	0 (0.0%)	1 (1.1%)	
Gall bladder	0 (0.0%)	2 (2.2%)	
Bladder	2 (1.7%)	(0.0%)	
Uterus	1 (0.9%)	(0.0%)	
Diagnosis (n, %)			0.357
Liver laceration	30 (26.0%)	19 (21.6%)	
Spleen laceration	12 (10.4%)	10 (11.4%)	
Gastric perforation + liver laceration + pancreas injury	5 (4.3%)	7 (8%)	
Liver laceration + spleen laceration	13 (5.1%)	4 (1.6%)	
Liver laceration + multiple injuries and fractures	12 (10.4%)	4 (4.5%)	
Spleen laceration + diaphragmatic injury	3 (2.6%)	6 (6.8%)	
Liver laceration + right adrenal hematoma	2 (1.7%)	2 (2.2%)	
Liver laceration + intestinal injury	8 (7.0%)	3 (3.4%)	
Stomach Perforation + Diaphragm injury	4 (3.5%)	3 (3.4%)	
Ileum perforation	7 (6.1%)	5 (5.7%)	
jejunal injury	5 (4.3%)	6 (6.8%)	
Multiple small and large intestine injury	12 (10.4%)	18 (20.6%)	
Other organ injuries	6 (5.2%)	8 (9.1%)	
Operation decision (n, %)			0.006
Yes	62 (53.9%)	46 (52.3%)	
No	53 (46.1%)	42 (47.7%)	
Operation type (n, %)			0.032*
Non-operative follow-up	53 (46.1%)	42 (47.7%)	
Non-diagnostic laparotomy	8 (7.0%)	8 (9.1%)	
Multiple organ repair	26 (22.6%)	17 (19.3%)	
Hemostasis	6 (5.2%)	11 (12.5%)	
Resection	12 (10.4%)	5 (5.7%)	
Splenectomy	10 (8.7%)	5 (5.7%)	
Mortality (n)			0.632
Yes	4 (3.5%)	111 (96.5%)	
No	2 (2.3%)	86 (97.7%)	

**p*-value below 0.05 were considered statistically significant. Non-diagnostic laparotomy: Situations where the indication for the operation cannot be confirmed in the perioperative examination.

to its highly contagious nature and the scarcity of personal protective equipment. The declaration of COVID-19 as a pandemic by the World Health Organization in over 160 countries has further underscored its profound effects on surgical practices. In response to this global health crisis, health systems worldwide have undergone substantial reorganization to effectively manage the demands imposed by the COVID-19 pandemic while ensuring the uninterrupted provision of primary healthcare services[5,13]. In order to address the complexities engendered by acute surgical emergencies amidst the pandemic, the American College of Surgeons (ACS) has promulgated comprehensive guidelines. These guidelines advocate for the prioritization of safe and non-surgical interventions whenever feasible for patients confirmed to have COVID-19 or those harboring clinical suspicion of the disease. In situations where surgical intervention becomes imperative for patients with established or suspected COVID-19 positivity, the guidelines ac-

centuate the imperative utilization of appropriate protective equipment and the strict implementation of precautionary measures to safeguard the healthcare team[14].

Amidst the course of the COVID-19 pandemic, a noticeable reduction of 13.3% in patient volume was observed within the study group in contrast to the control group. An analysis of the enrolled patients exhibited congruence in terms of age and gender distribution between the two temporal periods. Intriguingly, Göksoy et al[15] reported a more pronounced 25% decline in admissions to the emergency department among patients necessitating immediate surgical assessment during the COVID-19 pandemic. Correspondingly, Tebala et al[16] documented a comparatively moderate alteration in the spectrum of treatment approaches, whether medical or surgical, throughout the pandemic. Furthermore, Rausei et al[17] conducted an inquiry into emergency surgical practices and operative procedures during the COVID-19 pandemic, revealing a conspicuous reduction in both emergent surgical interventions and procedures.

We posit that the reduction in the influx of trauma cases to the emergency department during the pandemic phase can be attributed to the imposition of curfews. Incidents such as in-vehicle or out-of-vehicle traffic accidents feature prominently as primary trauma causes. It is our conjecture that the decline in traffic accidents due to curfew measures has correspondingly led to a reduction in the tally of trauma patients. Furthermore, the curtailment of nocturnal activities and social interactions during the pandemic has ostensibly contributed to a decrease in the incidence rates of stab injuries.

Among the findings of our study, the control group exhibited a higher prevalence of stab wounds in 39 (19.2%) patients, in-vehicle traffic accidents in 20 (9.9%) patients, and out-of-vehicle traffic accidents in 14 (6.9%) patients as the most common types of traumas. In contrast, the study group displayed a higher proportion of sharp object injuries in 28 (13.8%) patients, in-vehicle traffic accidents in 17 (8.4%) patients, and gunshot injuries in 15 (7.4%) patients. Notably, these observed differences between the two groups were found to be statistically significant (p=0.032).

Liver laceration emerged as the most prevalent diagnosis in 19 (7.4%) patients within the study group, while liver laceration was observed in 30 (11.7%) patients within the control group. The mortality rate was 2 (1.0%) patients in the study group and 4 (2.0%) patients in the control group. No statistically significant difference was found in terms of mortality (p=0.632) or patient diagnoses (p=0.357) between the COVID-19 pandemic period and the control period. These findings are consistent with previous literature. Krutsri et al[7] conducted a comparative study on patients who underwent emergency surgery during the COVID-19 pandemic and found no statistically significant difference in terms of morbidity and mortality. Similarly, Cano-Valderrama et al[8] conducted a clinical study comparing emergency surgery cases between the COVID-19 period and the control period and observed similar mortality rates. However, they did note an increase in morbidity during the COVID-19 period, although this increase was not found to be significant in multivariate analysis. At the beginning of the pandemic period, occupancy rates increased due to the lack of medical consensus on meeting the patient burden in health institutions and the effectiveness of antiviral treatments. However, afterward, operative results similar to the non-pandemic period were achieved with the rapid adaptation of healthcare professionals all over the world to the pandemic and COVID-19 diagnosis-treatment processes.

Limitations

This study has several limitations that should be considered. Firstly, it was conducted in a single center and focused on a 1-year period following the first reported COVID-19 case in Turkey. While it provides insights into the overall situation during the pandemic, more extensive and prolonged investigations would yield more robust and comprehensive findings regarding the subject matter. Additionally, to enhance the generalizability of the results, this research would benefit from additional support from multicenter studies involving larger cohorts of patients.

Conclusions

The findings of this study demonstrate a notable decrease in hospital admissions and surgical procedures among trauma patients during the COVID-19 pandemic. The impact of the pandemic on the management of individuals requiring urgent surgical intervention has been evident, as reflected by the lower rate of surgical procedures observed in the study group. However, despite the

preference for non-operative medical approaches in trauma cases, the demand for emergency surgical intervention persists in high-risk patients facing life-threatening conditions such as hemodynamic deterioration and shock.

Conflict of Interest
The authors declare that they have no conflict of interests.

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Authors' Contribution
Conception and design: Demir HB, Kircicegi S; acquisition of data: Demir HB, Kircicegi S; analysis and interpretation of data: Demir HB, Kircicegi S; drafting of article: Demir HB, Okut G; supervision: Okut G; language correction: Okut G, validation and final approval: all authors.

Informed Consent
All patients provided written informed consent.

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Ethics Approval
This retrospective, single-center study was carried out after obtaining approval from the Ethics Committee of Ege University School of Medicine (decision No. 2022/22-9.1T/11).

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