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The Impact of COVID-19 on Surgical Emergencies: Systematic Review/Meta-Analysis

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Abstract

Background: The COVID-19 pandemic, which originated in Wuhan, China, has caused widespread human distress, economic instability, and health system disruptions worldwide and is responsible for the 2019–20 pandemic. SARS-CoV-2 affects the respiratory tract, organs and systems, causing symptoms ranging from asymptomatic to severe illness.

Aim of Study: To evaluate the impact of COVID-19 on surgical emergencies(admissions) and surgical outcomes (mortality rates, post-operative complications, ICU admissions and length of stay).

Material and Methods: A literature search was conducted between March 2020 and August 2022 and yielded 512 articles after ranking articles by authors and year of publication. For further steps of data collection, analysis and reporting, only articles that met the inclusion criteria were included (18 articles in total).

Results: The results showed that the COVID-19 pandemic resulted in a significant increase in the complication rate among the pandemic group in comparison with the pre-pandemic group (RR 1.60, 95% CI 1.39–1.85), including a surge in mortality rate (RR 1.513, 95% CI: 1.137–2.014), and a decline by almost (22.8%) in admission number to the ED among the pandemic group. However, it has no influence on the following surgical patient outcomes: LOS in the hospital or ICU admission. Furthermore, a subgroup analysis among patients infected with COVID-19 vs. COVID-negative patients also shows an increase in mortality rate (RR 3.895, 95% CI 1.490–10.183) and a higher median length of stay during hospitalization.

Conclusion: The COVID-19 pandemic has had a significant impact on surgical outcomes. This unfavorable effect could play a crucial role in improving the proper implementation of strategies and safety precautions during a pandemic, which could contribute to a better diagnosis in these patients.

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Key Words: *COVID-19 – Emergency surgery – Surgical outcomes.*

Introduction

THROUGHOUT history, there have been numerous outbreaks and global health crises around the world, impacting the lives of thousands to millions. Despite advancements in research and medicine, we continue to face new pathogens that globally threaten people's lives, economic stability, and healthcare systems. The new coronavirus-related disease emerged from Wuhan, Hubei Province, China and was declared in December 2019. Initially labeled as the 2019 novel coronavirus (2019-nCoV), it was officially named later as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on February 11 by the WHO **[1,2]**.

On March 11, 2020, COVID-19 was declared as a pandemic by the WHO Subsequently, the COVID-19 cases number has surged significantly **[3]**. By September 2022, the cumulative global count of COVID-19 cases has surpassed 600 million, with over 6 million reported deaths **[4]**.

The pandemic has massively risked both global health, as well as healthcare professionals. In response to the COVID-19 pandemic, elective interventions have been postponed worldwide to make empty beds in hospitals and ICU accessible for COVID-19 infected patients. Nevertheless, it is impossible to postpone emergency patients and interventions **[2]**.

Early in the epidemic, a Wuhan article reviewed the outcome of patients who mistakenly underwent

elective surgery during the virus incubation period. Their findings indicated that surgery might progress the COVID-19 infection, resulting in a higher rate of hospitalizations to intensive care units and a 20.5% mortality rate **[5]**. Moreover, a published study reported that hospitalized patients requiring ICU admission are calculated at around 25% **[6]**.

Asymptomatic carriers of SARS-CoV-2 could potentially spread the virus during the incubation period, making it extremely difficult to prevent COVID-19 infection and resulting in unexpected clinical presentations and prognosis during surgeries **[7]**. Additionally, SARS-CoV-2 infection increases the risk of surgical death, necessitating the development of strategies to reduce it at all healthcare levels. Surgery may also increase stress by promoting pathways that enhance the pro-inflammatory state, highlighting the importance of addressing known surgical risk factors in decision-making processes during COVID-19 pandemic **[8]**.

This analysis examines the global response to the changes in surgical practice linked to the COVID-19 pandemic to assess surgical emergencies and outcomes, provide important data to help with emergency medical care management, policy improvements and lessons for potential future pandemics.

Aim of work:

Perform a systematic review/meta-analysis to identify the impact of COVID-19 on surgical emergencies (admissions) and surgical outcomes (postoperative complications, mortality rates, ICU admissions and length of stay during hospitalization).

Patients and Methods

Criteria for considering studies for this meta-analysis:

Types of studies: This review was restricted to retrospective cohort studies conducted between March 2020 and August 2022, which evaluated the impact of COVID-19 pandemic in surgical emergencies in adult human individuals.

Types of outcome measures:

At least one of these outcomes was taken into consideration:

- Impact of COVID-19 on surgical emergencies (admissions).
- Impact of COVID-19 on surgical outcomes (postoperative complications, mortality rates, ICU admissions and length of stay during hospitalization).

Inclusion criteria: Studies conducted on both gender: male and female.

Exclusion criteria: Narrative, opinion review, case reports and studies carried out on animals.

Search strategy for identification of studies:

A comprehensive search of electronic databases such as PubMed (https://pubmed.ncbi.nlm.nih.gov/), ScienceDirect (www.sciencedirect.com), ISI Web of Knowledge (http://www.isiwebofknowledge.com), and CENTRAL (Cochrane Central Register of Controlled Trials) will be used to identify published studies and abstracts concerning the impact of COVID-19 on surgical emergencies. Using a combination of the following keywords: “COVID-19” “Emergency surgery” “Emergency general surgery” “Surgical Outcomes” “Morbidity and Mortality”.

Locating and selecting studies:

Abstracts were identified using the above search strategy and examined, and articles that appeared to meet the inclusion criteria were retrieved in full. The study included data on a minimum of one outcome measure.

The literature was reviewed between March 2020 and August 2022 and yielded 512 articles after ranking articles by authors and year of publication. For further steps of data collection, analysis and reporting, only articles that met the inclusion criteria were included (18 articles in total) and the process was presented in a PRISMA flow chart, according to the PRISMA statement. The available studies were all published in English; none were available in Italian, French, or Spanish.

Data extraction:

A copy of each identified article was acquired, and relevant information was extracted in a standardized sheet prepared by Microsoft excel for a quantitative analysis. From full-text papers, we retrieved the following research data: First author name, year of publication, study design, sample size, inclusion criteria, study location, age, gender, description of study group and control groups and outcomes.

Statistical considerations:

A risk estimate and its 95% confidence interval were extracted from each study’s data. We determined unadjusted values from the article’s published data if a risk estimate and related 95% CI were not provided. Statistical heterogeneity was assessed using:

Testing for Heterogeneity:

1- *Cochran Q chi square test:*

- (p-value <0.1) denoted heterogeneity among the studies.

2- I-squared (I^2) index:

- 0% to 40%: Might not be important.
- 30% to 60%: May represent moderate heterogeneity.
- 50% to 90%: May represent substantial heterogeneity.
- 75% to 100%: Considerable heterogeneity.

By calculating the inverse variance of the effect measure for each study and using a logarithmic scale, pooled estimates of relative risks were obtained. This method for pooling results assumed that the study populations being compared were homogenous, and therefore consistent with a fixed effect analysis.

A violation of this test indicated that there were discrepancies between the pooled studies. We conducted a random effect analysis since there is significant heterogeneity in the effect measure between the compared studies. Thus, the interstudy variation was explained by the random effect analysis.

All statistical analyses for study pooling have been conducted by the Medcalc software version 22.019.

Results

In four databases, we identified 512 articles; 236 duplicates were removed. Out of the remaining 246 abstracts, we excluded 216 after screening. Thus, 30 full-text studies were assessed for eligibility and 12 were excluded. Finally, 18 studies were included for further qualitative and quantitative analyses (Fig. 1).

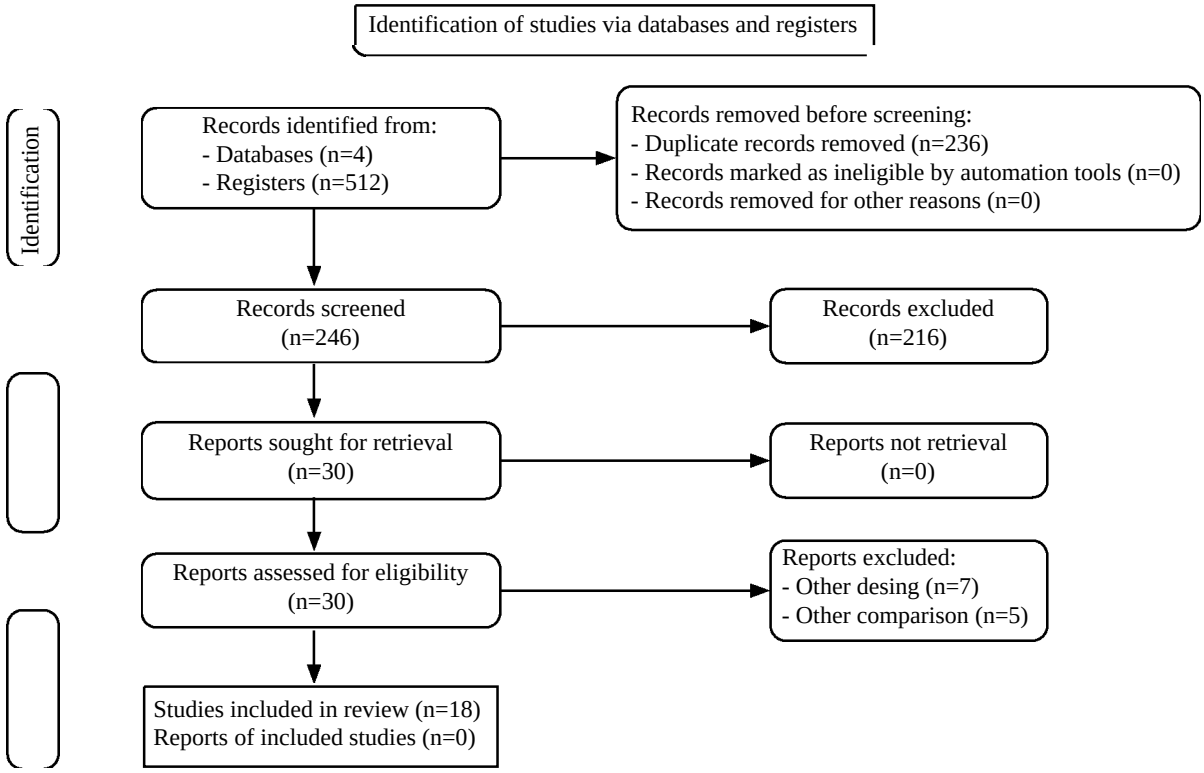

Fig. (1): PRISMA flow diagram with study selection (PRISMA; Preferred Reporting Items for Systematic Reviews and Meta-Analyses).

Characteristics of the included studies:

Eighteen retrospective studies were included, with 82658 of the total number of cases in the pre-pandemic period and 64403 of the total number of cases in the COVID-19 pandemic period as shown in (Table 1).

Table (1): Characteristics of the included studies evaluating the impact of the COVID-19 pandemic on surgical emergencies.

	Authors	Publication Year	Type of study	Study population	Participants (Pandemic / Pre-Pandemic)	Participants (Pandemic)	Control (Pre-pandemic)	Outcomes
1	İlhan et al. [9]	2022	RCS	Adult Patients in ED	592 / 1505	1 and 30 Apr 2020	Same dates in 2019	- Admission Rate - LOS - ICU Admission
2	Turan et al. [10]	2022	RCS	Adult Patients in ED	41 / 24	11 Mar 2020 to 25 Jan 2021	11 Mar 2019 to 25 Jan 2020	- LOS - Complications - Mortality - ICU Admission
3	Frankcombe et al. [11]	2022	RCS	Adult Patients in ED	723 / 833	1 Mar 2021 to 31 Mar 2022	Same dates in 2019–2020	- Admission Rate - LOS - Complications - ICU Admission
4	Khalaf et al. [12]	2022	RCS	Adult Patients in ED	180 / 590	2020 and 2021	2019	- Admission Rate - Complications - Mortality
5	Çelik et al. [13]	2022	RCS	Adult Patients in ED	369 / 392	11 Mar to 11 Sept 2020	Same dates in 2019	- Admission Rate - LOS
6	Dong et al. [14]	2021	RCS	Adult Patients in ED	1376 / 1668	Jan to May 2020	2019	- Admission Rate - LOS - Mortality
7	Hickland et al. [15]	2021	RCS	Adult Patients in ED	118 / 221	29 Mar to 25 Apr 2020	31 Mar to 27 Apr 2019	- Admission Rate - LOS - Mortality
8	Sá et al. [16]	2021	RCS	Adult Patients in ED	457 / 643	1 Mar to 2 May 2020	Same dates in 2019	- Admission Rate - Mortality
9	Colmenare et al. [17]	2021	RCS	Adult Patients in ED	59 / 45	11 Mar to 8 June 2020	Same dates in 2019	- LOS - Complications
10	Surek et al. [18]	2021	RCS	Adult Patients in ED	103 / 252	14 Mar to 15 May 2020	Same dates in 2019	- Admission Rate - Complications - Mortality
11	Ciarleglio et al. [19]	2021	RCS	Adult Patients in ED	109 / 137	Mar to May 2020	Same dates in 2019	- Admission Rate - LOS - Complications - Mortality - ICU Admission
12	Lazzati et al. [20]	2021	RCS	Adult Patients in ED	57589 / 72819	17 Mar to 11 May 2020	Same dates in 2019	- Admission Rate - Mortality
13	Pikoulis et al. [21]	2021	RCS	Adult Patients in ED	1819 / 2839	1 Mar to 15 Dec 2020	Same dates in 2019	- Admission Rate - LOS - Mortality - ICU Admission
14	Tarim et al. [2]	2021	RCS	Adult Patients in ED	132 / 195	15 Mar to 15 May 2020	Same dates in 2019	- Admission Rate - LOS - Complications - Mortality
15	Karlafti et al. [22]	2021	RCS	Adult Patients in ED	223 / 456	Mar 2020 to Feb 2021	Same dates in 2019	- Admission Rate - LOS - Mortality - ICU Admission
16	Yeşiltaş. [23]	2021	RCS	Adult Patients in ED	77 / 100	Mar to July 2020	Same dates in 2019	- Admission Rate - LOS
17	D'Urbano et al. [24]	2020	RCS	Adult Patients in ED	27 / 46	9 Mar to 9 Apr 2020	Same dates in 2019	- Admission Rate - LOS - Complications - Mortality
18	Cano-Valderrama et al. [25]	2020	RCS	Adult Patients in ED	117 / 285	16 Mar to 26 Apr 2020	11 Mar to 21 Apr 2020	- Admission Rate - LOS - Complication - Mortality - ICU Admission

RCS: Retrospective Cohort Studies.

LOS: Length of Stay.

ICU: Imtensive Care Unit.

ED : Emergency Department.

Outcomes:

Complications:

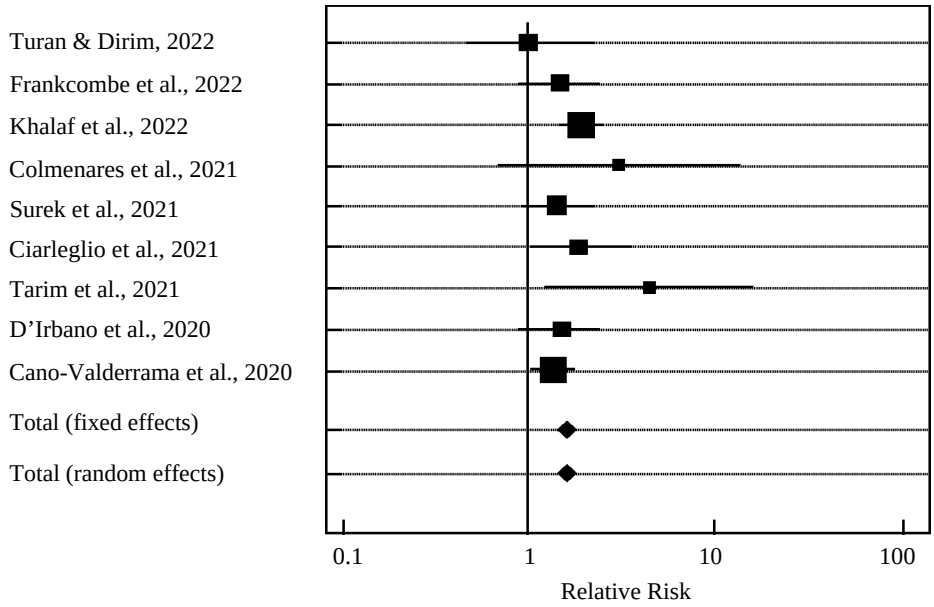

Fig. (2): Forest plot for the impact of COVID-19 in surgical emergencies on complications in patients.

The meta-analytical result of the nine retrospective studies shows a significant difference between the pandemic and pre-pandemic groups (RR 1.60, 95% CI 1.39-1.85).

Table (2): Meta-analysis on the impact of COVID-19 pandemic in surgical emergencies on complications in patients.

Study	Relative Risk	95% CI		Weight (%)	*p*-value
		Lower limit	Upper limit	Fixed	
Turan and Dirim, 2022	1.003	0.458	2.199	3.32	–
Frankcombe et al. 2022	1.462	0.883	2.421	8.03	–
Khalaf et al. 2022	1.930	1.484	2.510	29.56	–
Colmenares et al. 2021	3.051	0.681	13.675	0.91	–
Surek et al. 2021	1.422	0.919	2.201	10.71	–
Ciarleglio et al. 2021	1.843	1.005	3.380	5.55	–
Tarim et al. 2021	4.432	1.223	16.065	1.23	–
D'Urbano et al. 2020	1.503	0.906	2.494	7.96	–
Cano-Valderrama et al. 2020	1.353	1.054	1.737	32.73	–
Fixed Effect Model	1.607	1.390	1.859	100.00	<0.001
Random Effect Model	1.580	1.348	1.851	100.00	<0.001
Heterogeneity Test I^2: 9.66% *p*-value: 0.3547					

95% CI: 95% confidence interval.
I^2: Observed variance for heterogeneity.

There is no significant heterogeneity among the studies (Heterogeneity Test I^2: 9.66%, *p*-value: 0.3547). The meta-analytical result of the nine retrospective studies shows a significant difference between the pandemic and pre-pandemic groups (RR 1.60, 95% CI 1.39-1.85).

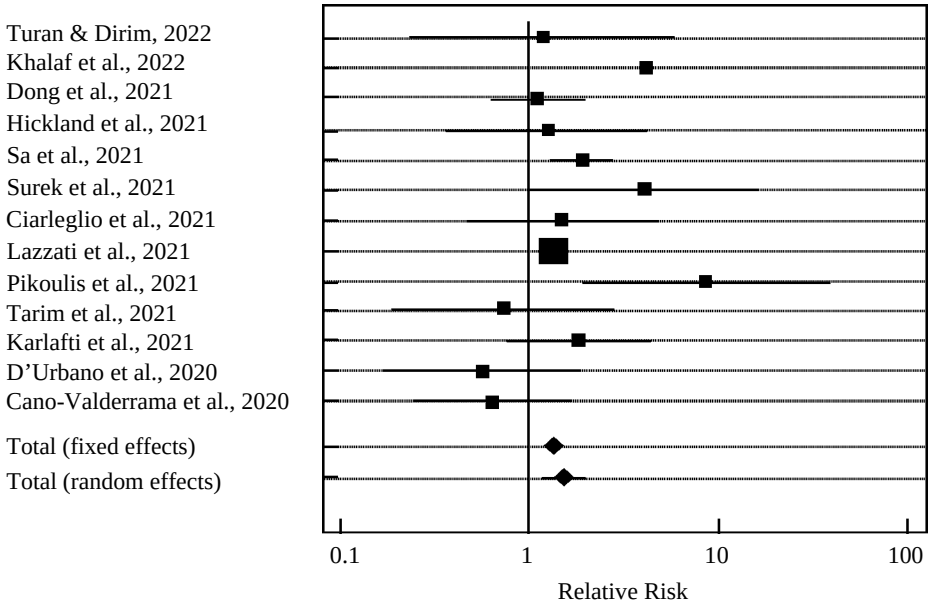

Fig. (3): Forest plot for the impact of COVID-19 in surgical emergencies on mortality in patients.

Mortality:

The meta-analysis of all included studies shows a significant difference in mortality between the pandemic and pre-pandemic groups (RR 1.513, 95% CI: 1.137-2.014).

Table (3): Meta-analysis on the impact of COVID-19 pandemic in surgical emergencies on mortality in patients.

Study	Relative Risk	95% CI		Weight (%) Random	*p*-value
		Lower limit	Upper limit		
Turan and Dirim. 2022	1.171	0.231	5.921	2.76	–
Khalaf et al. 2022	4.214	1.592	11.157	6.38	–
Dong et al. 2021	1.114	0.627	1.977	12.35	–
Hickland et al. 2021	1.249	0.359	4.337	4.34	–
Sá et al. 2021	1.925	1.290	2.874	16.57	–
Surek et al. 2021	4.078	0.993	16.751	3.51	–
Ciarleglio et al. 2021	1.508	0.473	4.811	4.87	–
Lazzati et al. 2021	1.342	1.233	1.460	24.08	–
Pikoulis et al. 2021	8.584	1.905	38.684	3.14	–
Tarim et al. 2021	0.739	0.188	2.902	3.70	–
Karlafti et al. 2021	1.840	0.759	4.465	7.31	–
D'Urbano et al. 2020	0.568	0.168	1.918	4.50	–
Cano-Valderrama et al. 2020	0.641	0.245	1.676	6.50	–
Fixed Effect Model	1.368	1.263	1.480	100.00	<0.001
Random Effect Model	1.513	1.137	2.014	100.00	0.004
Heterogeneity Test I^2: 46.24% *p*-value: 0.0341					

95% CI: 95% confidence interval.
I^2: Observed variance for heterogeneity.

There is significant heterogeneity among the studies (Heterogeneity Test I^2: 46.24%, *p*-value: 0.0341). The meta-analysis of all included studies shows a significant difference in mortality between the pandemic and pre-pandemic groups (RR 1.513, 95% CI: 1.137-2.014).

Mortality:

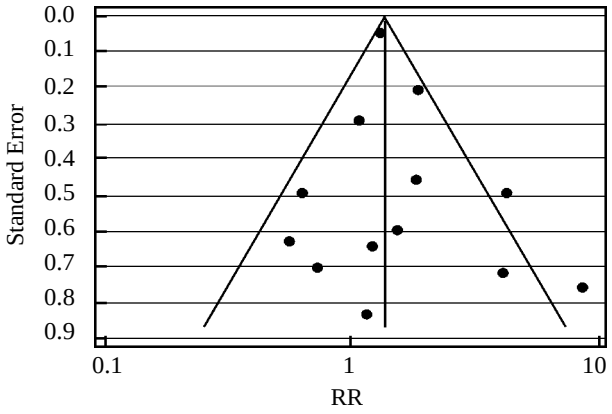

Fig. (4) Funnel plot for the impact of COVID-19 in surgical emergencies on mortality in patients.

ICU Admission:

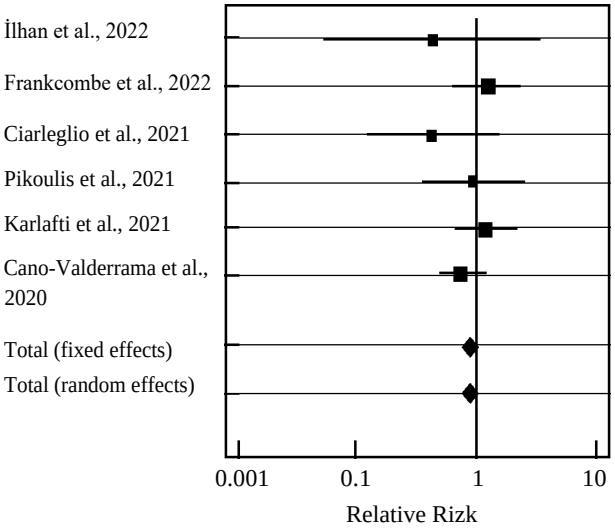

Fig. (5): Forest plot for the impact of COVID-19 in surgical emergencies on ICU admissions in patients.

Table (4): Meta-analysis on the impact of COVID-19 pandemic in surgical emergencies on ICU admission in patients.

Study	Relative Risk	95% CI		Weight (%) Fixed	*p*-value
		Lower limit	Upper limit		
İlhan et al., 2022	0.424	0.0511	3.512	1.93	–
Frankcombe et al., 2022	1.229	0.612	2.468	17.74	–
Ciarleglio et al., 2021	0.419	0.116	1.510	5.25	–
Pikoulis et al., 2021	0.936	0.341	2.572	8.45	–
Karlafti et al., 2021	1.168	0.646	2.114	24.53	–
Cano-Valderrama et al., 2020	0.750	0.477	1.179	42.11	–
Total (fixed effects)	0.885	0.661	1.184	100.00	0.411
Total (random effects)	0.892	0.665	1.196	100.00	0.445
Heterogeneity Test I^2: 0.00% *p*-value: 0.5498					

95% CI: 95% confidence interval.
I^2: Observed variance for heterogeneity.

The meta-analytical result of the six retrospective studies were insignificant between the pandemic and pre-pandemic groups (RR 0.885, 95% CI 0.661-1.184).

There is no significant heterogeneity among the studies (Heterogeneity Test I^2: 0.00%, *p*-value: 0.5498). The meta-analytical results of the six retrospective studies were insignificant between the pandemic and pre-pandemic groups (RR 0.885, 95% CI 0.661-1.184).

Length of stay during hospitalization:

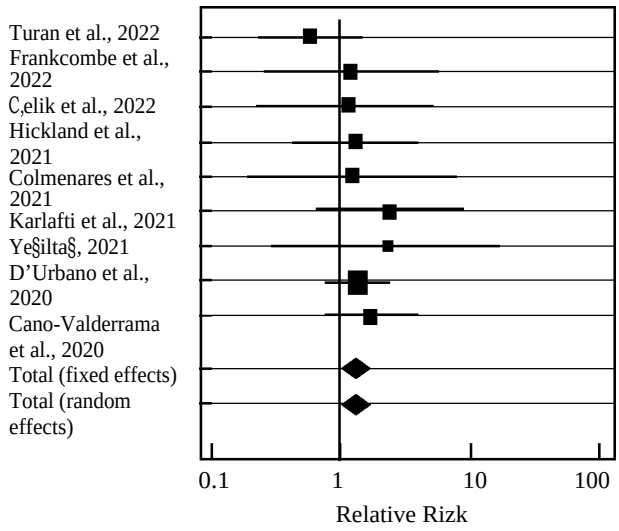

Fig. (6): Forest plot for the impact of COVID-19 in surgical emergencies on ICU admissions in patients.

The meta-analytical results of the nine retrospective studies were insignificant between the pandemic and pre-pandemic groups (RR 1.292, 95% CI 0.914-1.827).

Table (5): Meta-analysis on the impact of COVID-19 pandemic in surgical emergencies on the length of stay during hospitalization.

Study	Relative Risk	95% CI		Weight (%) Fixed	*p*-value
		Lower limit	Upper limit		
Turan et al., 2022	0.576	0.225	1.477	13.33	–
Frankcombe et al., 2022	1.152	0.239	5.544	4.79	–
Ç,elik et al., 2022	1.062	0.216	5.230	4.65	–
Hickland et al., 2021	1.303	0.415	4.087	9.05	–
Colmenares et al., 2021	1.208	0.187	7.786	3.41	–
Karlafti et al., 2021	2.352	0.622	8.895	6.68	–
Ye§ilta§, 2021	2.221	0.293	16.868	2.88	–
D'Urbano et al., 2020	1.332	0.767	2.314	38.80	–
Cano-Valderrama et al., 2020	1.697	0.726	3.966	16.41	–
Fixed effect model	1.292	0.914	1.827	100.00	0.147
Random effect model	1.277	0.905	1.801	100.00	0.163
Heterogeneity Test I^2: 0.00% *p*-value: 0.8221					

95% CI: 95% confidence interval.
I^2: Observed variance for heterogeneity.

There is no heterogeneity among the studies (Heterogeneity Test I^2: 0.00%, *p*-value: 0.8221). The meta-analytical results of the nine retrospective studies were insignificant between the pandemic and pre-pandemic groups (RR 1.292, 95% CI 0.914-1.827).

Subgroup Analysis Among Pandemic Group:

Mortality among COVID-19 (+VE) vs. COVID-19 (–VE) in patients in the pandemic group.

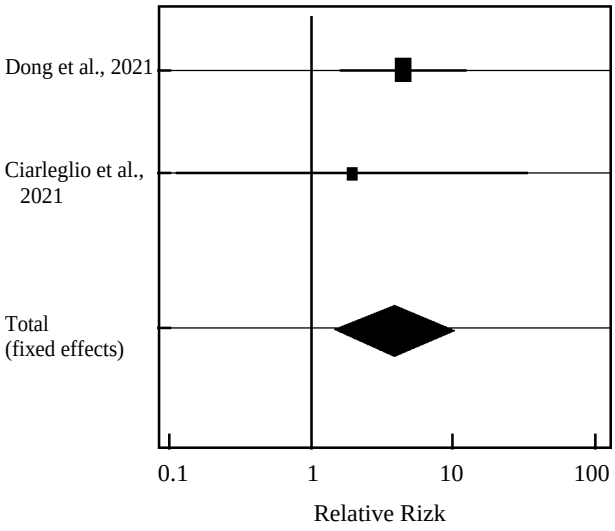

Fig. (7): Forest plot for the mortality rate in COVID-19 (+VE) vs. COVID-19 (–VE) patients.

The meta-analytical result of those two studies shows a significant effect on the mortality rate in COVID-19 (+VE) patients compared to COVID-19 (–VE) patients (RR 3.895, 95%CI 1.490-10.183).

Table (6): Meta-analysis for the mortality rate among COVID-19 (+VE) vs. COVID-19 (-VE) in patients in the pandemic group.

Study	Relative Risk	95% CI		Weight (%)	*p*-value
		Lower limit	Upper limit	Fixed	
Dong et al., 2021	4.428	1.589	12.342	88.51	–
Ciarleglio et al., 2021	1.952	0.114	33.582	11.49	–
Fixed Effect Model	3.895	1.490	10.183	100.00	0.006

95% CI: 95% confidence interval.

The meta-analytical result of those two studies shows a significant effect on the mortality rate in COVID-19 (+VE) patients compared to COVID-19 (–VE) patients (RR 3.895, 95% CI 1.490-10.183).

Impact of COVID-19 (+VE) patients on the length of stay during hospitalization vs. COVID-19 (–VE) patients in the pandemic group.

Dong CT et al., [14] stated that the median duration of LOS increased significantly in COVID-19 infected patients in comparison with COVID-negative (Days: 6.0 vs. 3.0, $p<0.001$). Similar to Ciarleglio FA et al., [19] that also demonstrated that COVID-positive patients had a higher median LOS (Days: 9 vs. 4, $p=0.11$), although these discrepancies did not reach statistical significance (Table 7).

Table (7): Impact of COVID-19 (+VE) patients on the length of stay during hospitalization vs. COVID-19 (-VE) patients in the pandemic group.

Study	Median duration of LOS COVID19 (+VE) vs COVID19 (-VE)	*p*-value
Dong et al., 2021	6.0 vs 3.0	0.001
Ciarleglio et al., 2021	9.0 vs 4.0	0.11

LOS: Length of Stay.

Table (8): Studies showing reduction rate of admission to the ED during COVID-19 pandemic period vs. pre-pandemic period.

Study	Pandemic	Pre-Pandemic	Reduction Rate (%)
İlhan et al. 2022	592	1505	60.7%
Frankcombe et al. 2022	723	833	13.2%
Khalaf et al. 2022	180	590	69.5%
Çelik et al. 2022	369	392	5.9%
Dong et al. 2021	1376	1668	17.5%
Hickland et al. 2021	118	221	46.6%
Sá et al. 2021	457	643	28.9%
Surek et al. 2021	103	252	59.1%
Ciarleglio et al. 2021	109	137	20.4%
Lazzati et al. 2021	57589	72819	20.9%
Pikoulis et al. 2021	1819	2839	35.9%
Tarim et al. 2021	132	195	32.3%
Karlafti et al. 2021	223	456	51.1%
Yeşiltaş. 2021	77	100	23%
D'Urbano et al. 2020	27	46	41.3%
Cano-Valderrama et al. 2020	117	285	58.9%
Total	64111	83050	22.8%

Pooling of sixteen of the included studies revealed that the admission rate decreased by about (22.8%) during the pandemic period when compared to the pre-pandemic period.

Discussion

This meta-analysis reviewed the published studies on the impact of COVID-19 on surgical emergencies and surgical outcomes. After a comprehensive search, eighteen retrospective studies were identified. The current meta-analysis involved 147,061 patients: 82658 in the pre-pandemic period and 64403 in the COVID-19 pandemic period.

Pooled results that evaluated the impact of COVID-19 pandemic in surgical emergencies on complications in patients:

According to nine pooled studies that assessed the effect of the COVID-19 pandemic on surgical emergency outcomes, there was a statistically significant rise in the rate of complications among the pandemic group vs. pre-pandemic group. This result coincides a retrospective cohort study that reported a statistically significant result during the pandemic period; the patients who developed complications were more than those in the control period (18.9% vs. 10.1%) (p=0.001) **[26]**. Furthermore, according to Fernández-Martínez et al., **[27]** there were twice as many patients experiencing postoperative complications in the pandemic group compared to the pre-pandemic group (35% vs. 14.8%) (p=<0.001).

However, in contrast, Fonseca Mk et al., and Hanger et al., **[28,29]** found that the complications rate was non-significant different between both groups; that is, there was no increase in complications. As well as the pooled effect sizes of another eight studies reported on the overall incidence of postoperative complications, there was no significant discrepancies between the COVID-19 pandemic group and the control group (OR: 0.90, 95% CI: 0.80–1.01, p=0.07) **[30].**

There was no interstudy variation, according to the results of the heterogeneity test between the pooled studies.

Pooled results that evaluated the impact of COVID-19 pandemic in surgical emergencies on mortality in patients:

Thirteen retrospective studies pooled together, and their meta-analytical results evaluated the impact of the COVID-19 pandemic in surgical emergencies show a significant increase in the mortality rate in the pandemic group compared to the pre-pandemic group. This result aligns with a retrospective cohort study that shows a higher death rate in the pandemic group relative to the control group. (21.7% vs. 15.3%) (p=0.039) **[26].** Moreover, a multi-center retrospective analysis conducted throughout the United Kingdom revealed that the pandemic's death rate was substantially higher (7.4% vs. 3.7%, p=<0.001) **[31].**

However, eight additional studies with pooled effect sizes did not reveal a statistically significant difference in mortality between the two groups. (OR: 1.27, 95% CI: 0.92-1.75). They concluded that the COVID-19 pandemic had not worsened surgical results. As a result, do not suggest deferring elective surgery during the pandemic **[30]**. In another study, a retrospective observational study reported that there is no difference in mortality in the pandemic group (4.8%) vs. the pre-pandemic group (6.1%) **[32].**

The pooled studies' heterogeneity test revealed a significant difference, indicating differences between studies. By pooling these heterogeneous studies, additional useful information was obtained.

Different study participants, outcomes, study designs, and potential bias risks could all be the cause of the variation in these studies' results.

Subgroup analysis among pandemic group: Pooled results on mortality among COVID-19 (+VE) vs. COVID-19 (-VE) in patients in the pandemic group: Two studies by Dong CT et al., and Ciarleglio FA et al., **[14,19]** show a statistically significant increase in the mortality rate in COVID-19 infected patients compared to COVID-19 negative patients. This result coincides with a meta-analysis that shows that concurrent COVID-19 infection elevates the risk of post-operative mortality, (Odds ratio: 7.9, 95% CI: 3.2–19.4) in COVID-19 (+VE) patients. This meta-analysis pooled eight studies, with a total of 1103 patients involved **[8].**

Furthermore, another meta-analysis conducted globally reviewed twenty-one studies that involved 2756 participants and reported a pooled prevalence of postoperative mortality of 20% (95% CI: 15–26) among COVID-19 infected surgical patients. Thus, it was concluded that more investigation is necessary to ensure that the surgical indications and perioperative surgical safety measures are appropriate for this susceptible group of patients, given the surprisingly high mortality rate of patients reported in the global literature **[33].**

The risk of surgical death increases with a concurrent SARS-CoV-2 infection. The severity of this risk demands the development of methods to reduce it at all healthcare levels. The potential cause for the markedly elevated mortality risk that was seen after surgery is the detrimental impact of the virus on the cardiovascular and respiratory systems. Pulmonary injury is hypothesized to be induced by the host's aggressive immunological response "cy-

tokine storm" combined with microvascular pulmonary thrombosis. Acute heart damage, myocarditis, thromboembolic illness, and disseminated intravascular coagulation can all result from this inflammatory response. In addition to putting more stress on the heart and lungs, surgery may promote these pathways by enhancing the pro-inflammatory state [8]. Therefore, COVID-19 conceals the significance of well-known surgical risk factors that are typically considered when making surgical decisions. These findings validate the recommendation to delay surgery in COVID-19 patients whenever feasible [34].

Pooled results that evaluated the impact of COVID-19 pandemic in surgical emergencies on ICU admission in patients:

Six pooled studies evaluated the need for ICU admission and demonstrated that, in comparison to the pre-pandemic period, the pandemic period did not result in a rise in the need for ICU admissions. This result is similar to a retrospective cohort study that reported that there is no difference in ICU admission during the pandemic compared to the prepandemic period (23% vs. 23%, p=0.99) [35]. Additionally, Ferahman et al., [36] also found no significant difference in intensive care units demand rates between both groups (34.3% vs. 37%, p=0.822).

Pooled results that evaluated the impact of COVID-19 pandemic in surgical emergencies on length of stay during hospitalization in patients:

The meta-analytical results of the nine retrospective studies were insignificant between the pandemic and pre-pandemic groups; this conclusion corresponds with a recently published retrospective analysis that reported no differences between the pandemic period and the control period with a mean of (6.3±9.4 vs. 6.6±8.2) and a median length of stay of 4 days throughout both periods [37]. Similar results were also reported in another retrospective cohort that mentioned the same mean length of stay in the pandemic versus the pre-pandemic group (7.7±10.0 vs. 7.8±10.5) (p=0.66) [38].

Subgroup analysis among pandemic group: Pooled results on LOS during hospitalization among COVID-19 (+VE) vs. COVID-19 (-VE) patients in the pandemic group: The impact of positive COVID-19 patients on the length of stay during hospitalization in surgical emergencies was assessed in two retrospective studies. Dong CT et al., and Ciarleglio FA et al., [14,19] found that median duration of days in hospital was higher in positive infected patients in comparison with COVID-19 negative patients. This is corresponding to a recent study that reported that during the pandemic, COVID-positive patients stayed in the hospital for significantly more time than COVID-negative patients (20.5 vs. 7.7) (p=<0.01) [39]. Including Bozada-GutiérrezKatya, [40] reported that symptomatic COVID-19 patients who required emergency surgery had increased ICU hospitalizations and extended LOS as compared with asymptomatic patients.

Regarding pooled results that evaluated the frequency of admission rate to ED; sixteen studies evaluated the frequency of admission rate to ED: - A pooling of sixteen of the included studies revealed that the admission rate decreased by about (22.8 %) during the pandemic period when compared to the pre-pandemic period. Reschen et al., [41] reported that the daily emergency department attendance experienced a decline of (37%). The general decrease in cases indicates the potential for decreasing unnecessary visits to the emergency department for individuals with minor illnesses in the future. However, it also raises concerns about the potential risks of delayed or overlooked medical attention that might worsen the surgical outcomes.

Conclusion:

COVID-19 pandemic caused a significant impact on surgical outcomes in terms of complication, mortality and led to a temporary reduction in the flow of patients to the emergency room. This unfavorable effect could play a role in the improvement of proper implementation of strategies and safety precautions during a pandemic that could contribute to a better diagnosis & prognosis in these patients.

References

1- CHAMS N., CHAMS S., BADRAN R., SHAMS A., ARAJI A., RAAD M., MUKHOPADHYAY S., STROBERG E., DUVAL E.J., BARTON L.M. and HAJJ HUSSEIN I.: COVID-19: A Multidisciplinary Review. Frontiers in public health, 8: 383, 2020.

2- TARıM İ.A., DEREBEY M., ÖZBALCı G.S., ÖZŞAY O., YÜKSEK M.A., BÜYÜKAKıNCAK S., BIRCAN R., GÜNGÖR B. and BAŞOĞLU M.: The impact of the COVID-19 pandemic on emergency general surgery: A retrospective study. Sao Paulo Medical Journal, 139 (1): 53-57, 2021.

3- HAGEMAN J.R.: The coronavirus disease 2019 (COVID-19): Pediatric Annals, 49 (3): e99-e100, 2020.

4- World Health Organization: WHO Coronavirus Disease (COVID-19) Dashboard With Vaccination Data | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data. In World Health Organization (pp. 1-5), 2021.

5- CHONG S.Y., HUNG R., GWOZDZ A., IRWIN S., EASTBURY J., CROSS T., AHMED K., TAYLOR C., GOLDENBERG S., SANDERSON J. and OLSBURGH J.: 30-Day postoperative COVID-19 outcomes in 398 patients from regional hospitals utilising a designated COVID-19

minimal surgical site pathway. Annals of the Royal College of Surgeons of England, 103 (6): 395-403, 2021.

6- KRAFT M., PELLINO G., JOFRA M., SORRIBAS M., SOLÍS-PEÑA A., BIONDO S. and ESPÍN-BASANY E.: Incidence, features, outcome and impact on health system of de-novo abdominal surgical diseases in patients admitted with COVID-19. The Surgeon, 19 (3): e53-e58, 2021.

7- LEI S., JIANG F., SU W., CHANG C., CHEN J., MEI W., ZHAN L., JIA Y., ZHANG L., LIU D., XIA Z.Y. and XIA Z.: Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. E Clinical Medicine, 21: 100331, 2020.

8- BROWN W.A., MOORE E.M. and WATTERS D.: Mortality of patients with COVID-19 who undergo an elective or emergency surgical procedure: A systematic review and meta-analysis. ANZ Journal of Surgery, 91 (1-2): 33-41, 2020.

9- İLHAN B., BERIKOL G.B., AYDıN H., ERDUHAN M.A. and DOĞAN H.: COVID-19 outbreak impact on emergency trauma visits and trauma surgery in a level 3 trauma center. Irish Journal of Medical Science (1971 -), 191 (5): 2319-2324, 2021.

10- TURAN Ü. and DIRIM A.B.: The effects of COVID-19 pandemic on emergency anterior abdominal wall hernia surgery: is it safe to postpone elective hernia surgery in the pandemic? European Journal of Trauma and Emergency Surgery, 48 (2): 833-839, 2021.

11- FRANKCOMBE D., GAURI N., SATCHITHANANDHA V., LIANG Y., BAK S., ŠURI T., LOXLEY D., MERRETT N. and KAUSHAL D.: Management of acute appendicitis during the COVID-19 pandemic: A retrospective cohort study. BMC Surgery, 22 (1), 2022.

12- KHALAF A.M., EL-SHIMY G. and OSMAN E.A.: Effects of COVID-19 pandemic on general surgical emergencies priorities. Al-Azhar International Medical Journal (Print), 3(1): 99-106, 2022.

13- ÇELIK S.U.: Impact of the COVID-19 pandemic on emergency general surgery outcomes: A single-center retrospective cohort study. Turkish Journal of Trauma and Emergency Surgery, 2021.

14- DONG C., LIVERIS A., LEWIS E.R., MASCHARAK S., CHAO E., REDDY S.H., TEPERMAN S., MCNELIS J. and STONE M.E.: Do surgical emergencies stay at home? Observations from the first United States Coronavirus epicenter. Journal of Trauma and Acute Care Surgery, 91 (1): 241-246, 2021.

15- HICKLAND P., CLEMENTS J., CONVIE L., MCKAY D. and MCELVANNA K.: Adapting an emergency general surgery service in response to the COVID-19 pandemic. Annals of the Royal College of Surgeons of England, 103 (7): 487-492, 2021.

16- SÁ A.F., LOURENÇO S.F., DA SILVA TEIXEIRA R., BARROS F., COSTA A.C.M.T. and LEMOS P.C.: Urgent/emergency surgery during COVID-19 state of emergency in Portugal: A retrospective and observational study. Brazilian Journal of Anesthesiology (English Edition), 71 (2): 123-128, 2021.

17- COLMENARES Y.T.C., DE CASTILLA D.C.R., BARRIONUEVO L.A.G., VALENCIA M.R.L., DORIA P.M., NOLE V.M., ESCALANTE F.P., SÁENZ C.A. and BORDA-LUQUE G.: Emergency abdominal laparoscopic surgery during the coronavirus Disease 2019 pandemic: experience in a private center in Peru. Journal of Laparoendoscopic and Advanced Surgical Techniques, 31 (3): 261-265, 2021.

18- SÜREK A., FERAHMAN S., GEMICI E., DURAL A.C., DÖNMEZ T. and KARABULUT M.: Effects of COVID-19 pandemic on general surgical emergencies: Are some emergencies really urgent? Level 1 trauma center experience. European Journal of Trauma and Emergency Surgery, 47 (3): 647-652, 2020.

19- CIARLEGLIO F.A., RIGONI M., MEREU L., CAI T., CARRARA A., MALOSSINI G., TATEO S., TIRONE G., JOHANSEN T.E.B., BENETOLLO P., FERRO A., GUARRERA G.M., GRATTAROLA M., NOLLO G. and BROLESE A.: The negative effects of COVID-19 and national lockdown on emergency surgery morbidity due to delayed access. World Journal of Emergency Surgery, 16 (1), 2021.

20- LAZZATI A., ROUSSEAU M., BARTIER S., DABI Y., CHALLINE A., HADDAD B., HERTA N., SOUIED E.H., ORTALA M., EPAUD S., MASSON M., SALAÜN-PENQUER N., COSTE A. and JUNG C.: Impact of COVID-19 on surgical emergencies: nationwide analysis. BJS Open, 5 (3), 2021.

21- PIKOULIS E., KOLIAKOS N., PAPACONSTANTINOU D., παραράς N., PIKOULIS A., FOTIOS-CHRISTOS S., NASTOS C., BAGIAS G., BOUTATI E., COCCOLINI F. and CATENA F.: The effect of the COVID pandemic lockdown measures on surgical emergencies: experience and lessons learned from a Greek tertiary hospital. World Journal of Emergency Surgery, 16 (1), 2021.

22- KARLAFTI E., BENIOUDAKIS E.S., PARAMYTHIOTIS D., SAPALIDIS K., KAIAFA G., DIDANGELOS T., MICHALOPOULOS A., Κεσίσογλου I. and SAVOPOULOS C.: Does the COVID-19 Pandemic Affect Morbidity and Mortality Rates of Emergency General Surgery? A Retrospective Study from a Single-Center Tertiary Greek Hospital. Medicina-lithuania, 57 (11): 1185, 2021.

23- YEŞILTAŞ M.: The effect of the Covid-19 outbreak on the management of acute appendicitis: A retrospective comparative cohort study. Journal of Surgery and Medicine, 5 (9): 907-911, 2021.

24- D'URBANO F., FABBRI N., RADICA M.K., ROSSIN E. and CARCOFORO P.: Emergency surgery in COVID-19 outbreak: Has anything changed? Single center experience. World Journal of Clinical Cases, 8 (17): 3691-3696, 2020.

25- CANO-VALDERRAMA Ó., MORALES X., FERRIGNI C., MARTÍN-ANTONA E., TURRADO V., GARCÍA A., CUÑARRO-LÓPEZ Y., ZARAIN-OBRADOR L., PÓVEDA M.D., BALIBREA J.M. and TORRES A.: Acute Care Surgery during the COVID-19 pandemic in Spain: Changes in volume, causes and complications. A multicentre retrospective cohort study. International Journal of Surgery, 80, 157-161, 2020.

26- ALELYANI R.H., ALGHAMDI A.H., MAHROUS S.M., ALAMRI B.M., ALHINIAH M.H., ABDUH M.S. and

ALDAQAL S.M.: Impact of COVID-19 pandemic lockdown on the prognosis, morbidity, and mortality of patients undergoing elective and emergency abdominal surgery: A retrospective cohort study in a tertiary Center, Saudi Arabia. International Journal of Environmental Research and Public Health, 19 (23): 15660, 2022.

27- FERNÁNDEZ-MARTÍNEZ M.E., ROMÁN L.M., LUZ F.M., CRISTINA R., PÉREZ-DÍAZ D. and TURÉGANO-FUENTES F.: Overall management of emergency general surgery patients during the surge of the COVID-19 pandemic: an analysis of procedures and outcomes from a teaching hospital at the worst hit area in Spain. European Journal of Trauma and Emergency Surgery, 47 (3): 693-702, 2021.

28- FONSECA M.K., TRINDADE E.N., FILHO O.P.C., NÁCUL M.P. and SEABRA A.P.: Impact of COVID-19 Outbreak on the Emergency Presentation of Acute Appendicitis. The American Surgeon, 86 (11): 1508-1512, 2020.

29- HANGER J., BUSH A., LUNT A., ADAMS M., KEATLEY B., MUNRO A., JARALLA N. and CHRISTOPOULOS P.: The early changes in emergency general surgery following implementation of UK COVID-19 Policy: A retrospective cohort study. Cureus, 2021.

30- TANG G., PI F., TAO J. and WEI Z.: Impact of the COVID-19 pandemic on surgical outcomes in patients undergoing colorectal cancer surgery: A retrospective study and meta-analysis of data from 11,082 participants. Frontiers in Public Health, 10, 2022.

31- IMAM M., YIU A.C.F., ELGEBALY A., SOBTI A., FIELD R.E., JAFFRY Z., GHAITH H.S., CONSIGLIERE P., NARVANI A., HASSAN R. and ABDALLA H.: The impact of COVID-19 pandemic on the mortality and morbidity of patients undergoing trauma surgery: A report from the UK Corona TRAUMA Surge (UKCoTS) study. International Orthopaedics, 47 (6): 1397-1405, 2023.

32- CABALLERO-MILÁN M., COLOMINA M., MARIN-CARCEY L.A., VIGUERA-FERNANDEZ L., BAYONA-DOMENGE R., GARCÍA-BALLESTER S., LÓPEZ-FARRE A., RUIZ-BUERA L., SANZ-ITURBE M., ÁLVAREZ-VILLEGAS D., JENSSEN-PAZ E.C., PUIG G.B., ARCOS-TERRONES A., BELMONTE-CUENCA C., PERELADA-ALONSO E., BLASCO-BLASCO F. and SABATÉ A.: Impact of the SARS-CoV-2 (COVID19) pandemic on the morbidity and mortality of high risk patients undergoing surgery: A non-inferiority retrospective observational study. BMC Anesthesiology, 21 (1), 2021.

33- ABATE S.M., MANTEFARDO B. and BASU B.: Postoperative mortality among surgical patients with COVID-19: A systematic review and meta-analysis. Patient Safety in Surgery, 14 (1), 2020.

34- DOGLIETTO F., VEZZOLI M., GHEZA F., LUSSARDI G.L., DOMENICUCCI M., VECCHIARELLI L., ZANIN L., SARACENO G., SIGNORINI L., PANCIANI P.P., CASTELLI F., MAROLDI R., RASULO F., BENVENUTI M.R., PORTOLANI N., BONARDELLI S., MILANO G., CASIRAGHI A., CALZA S. and FONTANELLA M.M.: Factors associated with surgical mortality and complications among patients with and without coronavirus disease 2019 (COVID-19) in Italy. JAMA Surgery, 155 (8): 691, 2020b.

35- LUND S., MACARTHUR T.A., FISCHMANN M.M., MAROUN J.W., DANG J., MARKOS J., ZIELINSKI M.D. and STEPHENS D.: Impact of COVID-19 governmental restrictions on emergency general surgery operative volume and severity. The American Surgeon, 000313482110111, 2021.

36- FERAHMAN S., DÖNMEZ T., SÜREK A., AYDıN H., GÜMÜŞOĞLU A.Y. and KARABULUT M.: Effects of COVID-19 outbreak on emergency surgeries for occlusive colorectal cancers. Turkish Journal of Colorectal Disease, 30 (4): 237-245, 2020.

37- SIEGEL R., HOHENSTEIN S., ANDERS S., STRIK M.W., KUHLEN R. and BOLLMANN A.: Access to Surgery and Quality of Care for Acute Cholecystitis During the COVID-19 Pandemic in 2020 and 2021 — an Analysis of 12,545 Patients from a German-Wide Hospital Network. Journal of Gastrointestinal Surgery, 26 (7): 1462-1471, 2022.

38- TEBALA G.D., MILANI M.S., BIGNELL M., BOND-SMITH G., LEWIS, C.A., CIROCCHI R., DI SAVERIO S., CATENA F., SCATIZZI M., MARINI P., LO DICO R., STRACQUALURSI A., RUSSO G., D'ERRICO S., CIANCI P., RESTINI E., SCIALANDRONE G., GUERCIONI G., MARTINEZ G. and SLACK Z.: Emergency surgery admissions and the COVID-19 pandemic: did the first wave really change our practice? Results of an ACOI/WSES international retrospective cohort audit on 6263 patients. World Journal of Emergency Surgery, 17 (1), 2022.

39- MONTAUBAN P., BALAKUMAR C., RAIT J., ZARSADIAS P., SHAHZAD F., OGBUAGU N., IQBAL S., CHOWDHURY A., PANGENI A., SHAH A. and IMTIAZ M.: Impact of the COVID-19 pandemic on the management and outcomes of emergency surgical patients: A retrospective cohort study. Journal of Perioperative Practice, 33 (1-2): 37-47, 2022.

40- BOZADA-GUTIÉRREZKATYA: Postoperative complications and predictors of mortality in patients with COVID-19. Cirugía Y Cirujanos, 2023.

41- RESCHEN M., BOWEN J.M., NOVAK A., GILES M.F., SINGH S., LASSERSON D. and O'CALLAGHAN C.A.: Impact of the COVID-19 pandemic on emergency department attendances and acute medical admissions. BMC Emergency Medicine, 21 (1), 2021.

تأثير كوفيد-١٩ على حالات الطوارئ الجراحية : مراجعة منهجية / تحليل تجميعى

الخلفية: تسببت جائحة كوفيد-١٩، التى نشأت فى مدينة ووهان الصينية، فى ضائقة إنسانية واسعة النطاق، وعدم استقرار اقتصادى، واضطرابات فى النظام الصحى فى جميع أنحاء العالم، وهى مسؤولة عن جائحة ٢٠١٩-٢٠٢٠. يؤثر SARS-CoV2 على الجهاز التنفسى والأعضاء والأنظمة، مما يسبب أعراضاً تتراوح من المرض بدون أعراض إلى المرض الشديد.

هدف الدراسة: تقييم تأثير كوفيد-١٩ على حالات الطوارئ الجراحية (القبول) والنتائج الجراحية (معدلات الوفيات، ومضاعفات ما بعد الجراحة، والقبول فى وحدة العناية المركزة ومدة الإقامة).

المواد والطرق: تمت مراجعة الأبحاث بين مارس ٢٠٢٠ وأغسطس ٢٠٢٢ وأسفر البحث عن ٥١٢ مقالًا بعد تصنيف المقالات حسب المؤلفين وسنة النشر. تم تضمين المقالات التى استوفت معايير الاشتمال فقط (١٨ مقالة فى المجموع) لمزيد من الخطوات لجمع البيانات وتحليلها وإعداد التقارير.

النتائج: أظهرت النتائج أن جائحة كوفيد-١٩ أدت إلى زيادة كبيرة فى معدل المضاعفات بين مجموعة الجائحة مقارنة بمجموعة ما قبل الجائحة، بما فى ذلك ارتفاع معدل الوفيات، وانخفاض بنسبة (٢٢,٨٪) تقريبًا فى عدد القبول فى قسم الطوارئ بين مجموعة الجائحة. ومع ذلك، لم تأثر على بعض النتائج الجراحية التالية للمريض: مدة الإقامة فى المستشفى أو دخول وحدة العناية المركزة. علاوة على ذلك، يُظهر أيضًا تحليل المجموعة الفرعية بين المرضى المصابين بكوفيد-١٩ مقابل المرضى الغير مصابين زيادة فى معدل الوفيات ومتوسط طول أعلى للإقامة أثناء العلاج فى المستشفى.

الاستنتاج: كان لوباء كوفيد-١٩ تأثير كبير على النتائج الجراحية. يمكن أن يلعب هذا التأثير السلبى دورًا حاسمًا وتطبيق من الاستراتيجيات واحتياطات السالمة أثناء الوباء التى يمكن أن تساهم فى تحسين التشخيص والنتائج فى هؤلاء المرضى.