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Repercussions of COVID-19-related National Lockdown on Emergency Surgery Department: A Longitudinal Cohort Monocentric Study

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Abstract

BACKGROUND: COVID-19 lockdown restrictions in conjunction with the pervasive hospital fear endured by the vast majority of the population played a fundamental role in discouraging access to emergency departments (EDs). We aimed at investigating whether and how the COVID-19 outbreak limited access to ED and affected urgent surgical activities during and immediately after the 2-month pandemic-related national lockdown.

METHODS: Data regarding patients who accessed to the surgical ED were retrospectively collected. Analysed time-periods included: 'Pre-COVID-19 Era', 'COVID-19 Era' considered as the period of full national lockdown and 'Post-COVID-19 Era' after easing of lockdown measures. Consecutive emergency surgical procedures and ED admissions before, during and after COVID-19-lockdown were retrieved and analysed.

RESULTS: There was a significant decrease in overall ED admissions and in all-specialty surgical consultations (P<0.01) throughout the outbreak. Once national lockdown was eased, we recorded a subsequent rebound 5-fold rise of emergency surgical procedures compared to COVID-19 group (P=0.011). Time-to-surgery was significantly greater in 'COVID-19 era' and 'post-COVID-19 era' compared to 'pre-COVID-19' group (22.56±4.78, 75.99±15.89 and 16.73 ±1.76 hours, respectively) (P<0.01). A raised incidence of postoperative complications emerged in the 'COVID-19 era' group (37.5%) compared to pre and post-COVID groups (9.1% and 12.5%, respectively; P<0.001). Mortality rate in the 'COVID-19 era' was 31.3% and 7.5% in 'post-COVID-19' group (<0.0001).

CONCLUSIONS: This study demonstrates the major reduction of emergency surgical procedures and overall ED admissions caused by COVID-19 pandemic. The raised rate of postoperative complications and mortality might be likely due to the superior severity of surgical conditions observed in the 'COVID-19 era' subjects together with a probable deferred pursuit of medical attention.

Key words: COVID-19 pandemic, lockdown, SARS-CoV-2, emergency surgery

Running title: Repercussions of COVID-19-related National Lockdown on Emergency Surgery Department

Introduction

On March 11th 2020, the WHO characterized the CoronaVirus Disease (COVID-19) outbreak as an actual pandemic [1-2]. Italy was certainly the first European country dealing with the sudden dramatic outbreak of COVID-19 on a large-scale [3]. Indeed, COVID-19 promptly spread throughout the Italian peninsula by the end of February 2020, threatening the already delicate balance of the National Healthcare System, risking its complete debacle. This healthcare crisis urged the need for extraordinary and unprecedented nationwide measures [4-5]. On March 9th 2020 the Italian Government enforced lockdown restrictions including social distancing, school closures and temporary discontinuation of non-essential businesses, all aiming at preventing a healthcare service overload by limiting or diminishing the prospect of a far-reaching viral transmission [6-7].

All medical subspecialties experienced a variation in activities according to Government national measures, with elective surgery being the most affected. In most hospitals, non-urgent or non-oncological procedures were cancelled to facilitate reorganisation of infrastructures and reallocation of healthcare personnel to the COVID-19 emergency wards [8]. Modifications in hospital practice and repurposing of resources were put to test in our country over the past few months, proving to be effective and allowing to reach and hopefully overcome this pandemic.

The aforementioned wide-ranging restrictions combined with the pervasive hospital fear experienced by the large majority of patients, played a fundamental role in discouraging access to emergency departments all over the country, especially for those perceived as minor conditions. As a result, many hospitals registered a substantial drop in emergency consultations [9]. The pandemic was instrumental in showing the previous misuse of emergency services by the population. Nevertheless, emergency cases persist to exist, despite the presence of a potentially life-threatening viral outbreak.

The aim of this study was to investigate whether and by what means the COVID-19 outbreak limited access to the emergency department (ED) and affected urgent surgical activities during and

immediately after the 2-month national pandemic-related lockdown, additionally sharing what adaptations were necessary and those changes made to our everyday surgical practice.

Materials and Methods

Study design

The Information System records of a Level 2 Accident and Emergency Department at the Sapienza University Hospital in Rome, Italy were retrieved. The ED of our hospital is organized in two separate pathways, namely a Medical and Surgical pathway, to which the patient is assigned during initial triage. Data regarding all patients who had access to the Surgical ED were retrospectively collected. The examined time periods included a 'Pre-COVID-19 Era' (i.e. control period) from March 9th 2019 to May 3rd 2019; a 'COVID-19 Era' (i.e. study period) considered to be the period of time of full national lockdown measures in our country (i.e. from March 9th 2020 to May 3rd 2020) and a 'Post-COVID-19 Era' intended as the period after easing of lockdown measures (i.e. May 4th 2020 to June 30th 2020). Same months of the year were chosen to compare the control and study periods in the attempt of seeking homogeneity based on the year lapse.

All records of consecutive emergency surgical procedures performed before, during and after the COVID-19 outbreak and related national lockdown in the aforesaid time-periods were collected and divided into 3 groups according to the period of admission. Medical records were analysed retrospectively for clinical parameters including: age, gender, comorbidities, pharmacological therapy, instrumental diagnostic exams executed on admission, diagnosis, type of surgical procedure performed, time to surgery (i.e. time elapsed between triage and surgery), postoperative complications, and mortality. Comorbidities were classified according to the Charlson Comorbidity Index (CCI) [10]. All surgical procedures performed in adult patients aged 18 years or older, during both eras and pertaining to the emergency general surgical field were included. Re-operations and

trauma surgery were excluded from the present study. All patients requiring emergency surgery during the 'COVID-19 era' and 'Post-COVID-19 era' routinely underwent a preoperative nasopharyngeal swab to rule out SARS-CoV-2 infection.

Furthermore, the total number of admitted patients to our surgical ED in all eras, regardless of the presenting complaint, were also recorded and subdivided in different surgical specialty categories (i.e. general surgery, urology, orthopedics, maxillofacial, ear, nose & throat, neurosurgery, cardiac surgery, thoracic surgery and vascular surgery). In this group, prognosis was divided based on the level of care assigned after diagnosis in: hospital admission, discharge, refusal of hospital admission, outpatient treatment and transfer to other hospitals.

Hospital reorganisation due to COVID-19 emergency

As the largest hospital in Rome, Italy, Sapienza University Hospital had to adapt to the COVID-19 emergency crisis in order to accommodate contagious patients, as the patient overflow would rapidly saturate hospital bed capacity in dedicated wards (namely, Infectious Diseases and Intensive Care Unit wards), causing major congestion and risking to further fuel the epidemic.

This hospital, soon after national lockdown, was repurposed as a 'COVID hospital'. This caused the diversion of trauma patients, who were transferred directly into other nearby 'non-COVID hospitals', while the rest of emergency surgical activity was preserved. In fact, trauma cases were considered as an exclusion criterion as it would inevitably represent a major bias to this study, as no trauma surgery was performed throughout the present outbreak.

In order to manage such a pandemic, a pre-triage was arranged outside the hospital ED, in a temporary facility, for initial screening. Patients followed a dedicated pathway that was separated from all other pathologies. Several wards were gathered together into a single one so as to re-adapt hospital infrastructures and generate new spaces for COVID patients, creating 4 Infectious Diseases wards, thereby increasing bed capacity by 59.7%. Also Intensive Care Units (ICUs) had to adjust, increasing

their capacity by 43.8%, reaching a total of 32 ICU COVID-dedicated beds. Additionally, 2 operating theatres were redeployed to serve as ICU wards. Finally, the Emergency Surgery ward decreased its number of beds by 23.8%, due to the decreased access of emergency surgical patients to the ED, thus allowing reallocation of supernumerary healthcare personnel in COVID wards.

Statistical analysis

Data are expressed as mean±SE for continuous variables and as relative frequencies for dichotomous variables. To compare the 3 different set of data the Levene's test for the homogeneity of variance, together with a t test was used. A P-value ≤ 0.05 was considered statistically significant. Linear regression analyses were performed and results are presented as beta coefficients with 95% CI.

The hypotheses for Levene's test are:

H0: $\sigma 12 - \sigma 22 = 0$ ("the population variances of group 1 and 2 or group 2 and 3 are equal")

H1: $\sigma 12 - \sigma 22 \neq 0$ ("the population variances of group 1 and 2 or group 2 and 3 are not equal")

Therefore, Levene's test provides a correct significance value when variance is or is not homogenous between two groups.

Quantitative variables were compared among groups using a one-way analysis of variance (ANOVA). Fisher's exact test was used to determine if there were non-random associations among categorical variables.

Point-biserial correlation was used to assess correlations between dichotomous variables and continuous variables. Cramer's V was used to examine the association between categorical variables.

A multinomial Logit model where the dependent variable was the discrete group variable was created. In particular, we were interested in characterizing the probability of belonging to each different group. The model provided also information about the relative importance of the explanatory variables (CCI and age).

The Kruskal Wallis test was used with mortality as an independent variable with 3 levels and ordinal dependent variables.

A stepwise factorial logistic regression was used with correlated categorical independent variables but a dichotomous dependent variable (mortality).

First, a linear model was run on the response as a function of the predictors to ensure that there were no multicollinearity issues; only predictors with variance inflation factors (VIF)<2 were included in this model.

Statistical analyses were performed with SPSS (v.26.0; SPSS Inc., Chicago, IL, USA).

Results

Table 1 illustrates the total number of admitted patients to the surgical ED in the 3 study groups, subdivided in different surgical specialty categories. There was a significant decrease in overall ED admissions and a substantial reduction in all specialty surgical consultations (P=0.008), with the exception of thoracic surgery (P=0.196) in the COVID-19 group compared to the pre-COVID-19 group. Similarly, once national lockdown was eased, we recorded a subsequent substantial increase in total ED admissions in the post-COVID-19 group (P=0.011).

Continuous and dichotomic variables for all study groups of patients undergoing emergency surgical procedures are reported in Table 2 as mean±SE or frequencies as percentage, respectively.

A total of 184 patients underwent emergency surgical treatment and included in the present study. Eighty-eight adult patients (55% men), mean age 58.15±2.49 years were operated during the 'pre-COVID-19 era', 16 patients (12% men), mean age 60.69±5.01 years, during the 'COVID-19 era' and finally, 80 patients (61% men), mean age 52.15±2.27 years underwent emergency surgery during the 'post-COVID-19 era'.

Only 1 patient during the 'post-COVID-19 era' tested positive to SARS-CoV-2 on preoperative nasopharyngeal swabs.

In the 'pre-COVID-19 era', the average time from hospital admission to operation (i.e. time to surgery) was 16.73±1.76 hours 95% CI [0.440, 0.832], while in the 'COVID-19 era' the average time was significantly greater: 22.56±4.78 hours 95% CI [-0.360, 3.735] (P=0.017). Interestingly, time to surgery was even greater in the 'post-COVID-19 era' compared to both study periods (75.99±15.89 hours; P=0.001) and likely attributable to the 5-fold increase in the total number of patients compared to the COVID-19 group who were required to undergo a mandatory nasopharyngeal swab prior to surgery, hence substantially extending preoperative waiting times. The time to intervention was, thus, affected by the presence of COVID-19 (Pearson correlation coefficient R=0.151, P= 0.040).

Postoperative complications were experienced by 9.1% of patients in 'pre-COVID-19 era', 37.5% of patients in the 'COVID-19 era' (P=0.002) and 12.5% in the 'post-COVID-19 era' (P=0.019). No patients died in the 'pre-COVID-19 era', while 31.3% of patients died postoperatively in the 'COVID-19 era' (P<0.0001) and 7.5% in the 'post-COVID-19' group (<0.0001). Deaths in the 'COVID-19 era' included 2 (12.5%) patients with small bowel ischemia, 2 (12.5%) patients presenting with ruptured abdominal aortic aneurysm (AAA) and 1 (6.25%) patient affected by perforated diverticulitis with feculent peritonitis. Mortality in the 'post-COVID-19 era' was due to ruptured AAA in 1 patient (1.25%), bowel obstruction in 2 patients (2.5%), aorto-duodenal fistula in 1 patient (1.25%), large bowel perforation in 1 patient (1.25%) and perforated and bleeding duodenal peptic ulcer in 1 patient (1.25%). A stepwise factorial logistic regression (β-coefficient=0.87, P<0.0001, AIC=366.05, BIC=953.38, Nagelkerke=1.000, McFadden=0.999) was used to find the best predictors of mortality in the observation periods and found that the complication variable was the only one to predict mortality 100% correctly assigning the subjects in the right categories.

The most commonly performed surgical procedures in the 'pre-COVID-19 era' were appendicectomy and gastrointestinal or colorectal resections (17% and 18.2%, respectively). In the 'COVID-19 era'

instead, the most frequent procedures included gastrointestinal or colorectal resections, abscess drainage and adhesiolysis (25%, 18.8% and 18.8%, respectively). Appendicectomy, gastrointestinal or colorectal resections and cholecystectomy were the most frequently executed operations in the 'post-COVID-19 era' (23.8%, 21.3% and 17.5%, respectively) (Figure 1). Remarkably, no minor operations, such as inguinal/crural hernia repair, were performed in the COVID-19 era group.

The CCI score was calculated for all groups. In the 'pre-COVID-19' group the total mean CCI was 4.16±0.97 while in the 'COVID-19' group it was 3.94±1.46 (p=0.202), suggesting a similar proportion of comorbidities in the patients included in both study periods. On the contrary, the 'post-COVID-19' group displayed a significantly lower CCI score compared to the 'COVID-19' group (1.81±0.25; P=0.021). Age was similar between groups (Table 2). A multinomial logistic regression (Cox and Snell pseudo r^2=0.986, Nagelkerke r^2=0.999, AIC and BIC 4400.96 and 11448.99, respectively, indicating good model fit) showed that each group was very well predicted by age and CCI using presence of diabetes, hypertension, chronic renal failure, heart failure and HIV as covariates.

Discussion

This study demonstrates the major reduction of emergency surgical procedures and overall admissions to the ED caused by the COVID-19 pandemic. The pervasive hospital fear withstood by most patients during the peak of this pandemic seems to be mainly responsible for such a significant reduction. Furthermore, the need of minimizing exposure of patients and healthcare providers to perioperative SARS-CoV-2 infection, also played a crucial role in delaying or postponing certain types of urgent or emergent surgical operations which could be managed conservatively or electively, when feasible and safe for the patient. In fact, we witnessed a 5-fold increase in the number of surgical procedures performed once the pandemic-related lockdown measures were eased, almost reaching pre-pandemic levels. We noted how the total time elapsed between triage and surgery was

significantly greater in the 'COVID-19 era' (i.e. study period) compared to the 'pre-COVID-19 era' (i.e. control period) (22.56±11.20 versus 16.73±1.76 hours, P=0.017). The substantial increase in such a parameter might be likely due to the requirement imposed by institutional guidelines of performing nasopharyngeal swabs to all patients prior to having access to operating theatres. Interestingly, time to surgery was even greater in the 'post-COVID-19 era' compared to both study periods (75.99±15.89 hours; P=0.001) and likely attributable to the 80% rise in the total number of operated patients compared to the COVID-19 group, who were also required to undergo a mandatory nasopharyngeal swab prior to surgery, hence further prolonging preoperative waiting times. The time to intervention was, thus, inevitably affected by the presence of COVID-19 (Pearson correlation coefficient R=0.151, P=0.040).

Unfortunately, the availability of appropriate personal protective equipment (PPE), such as FFP2/FFP3 masks, were widely lacking albeit necessary during surgery and waiting for their procurement prior to surgery partially contributed to additionally lengthening time elapsed before surgical intervention.

The total number of comorbidities at baseline and the quantification of disease burden as evaluated by the CCI score was similar between the 'pre-COVID-19' and 'COVID-19' groups (P=0.202). Nonetheless, a greater incidence of postoperative complications (9.1% versus 37.5%, respectively; P=0.002) and mortality (0% versus 31.3%, respectively; P<0.0001) occurred in the 'COVID-19 era' group. On the contrary, postoperative complications were similar between the pre and post-COVID eras (9.1% and 12.5%, respectively; P= 0.478), while significantly lower in the post-COVID compared to the COVID group (P=0.019). We observed a superior severity of presenting surgical conditions in the 'COVID-19 era' subjects (namely, bowel ischemia in 12.5%, AAA rupture in 12.5% and perforated diverticulitis with feculent peritonitis in 6.25%). Also a delayed presentation of patients to the ED was noted, as subjects referred that the onset of symptoms started several hours or days before seeking medical attention. The combination of more severe conditions with the deferred

presentation may presumably be linked to the greater rate of postoperative complications and deaths in the 'COVID-19 era'.

Several commentaries, editorials, letters, expert opinions and predictive statistical models have been published since the beginning of this healthcare crisis and have mostly focused on sharing advice or viewpoints on how to confront such a large-scale challenge, providing mere speculations on emergency surgery availability and usage [11-15]. To the best of our knowledge, this is the first study describing the changes endured during the COVID-19 pandemic, based on actual comprehensive clinical data reporting with regards to ED access and related surgical activities and outcomes.

Patients affected by various medical conditions, including malignancies, cardiovascular disease and other chronic disorders, were amongst those who suffered the most as a collateral effect of the current healthcare crisis. In the attempt of containing the viral outbreak and managing critically ill COVID-19 patients, the necessity of hospital rearrangements inevitably caused a shortage of services pertaining to non-emergent pathologies [14, 16-17].

Although the ED still continued to function on a regular basis with preserved available personnel, a reduced patient inflow was registered and possibly caused by the pandemic-related panic perceived by most patients of a possible in-hospital infection. Additionally, awareness of the limited resources accessible (especially for subjects requiring postoperative ICU observation) and the risk of hospital capacity saturation with consequent system failure, pressured surgeons to discriminate between pathologies requiring urgent surgical attention from those amenable of non-operative management.

The Italian COVID-19 experience preceded by several weeks that of numerous other countries worldwide. In consideration of this, we believe that sharing such experience, which somehow anticipated that of many other countries and bestowing the changes implemented in hospital infrastructure reorganization, optimization of resources and emergency surgical practice is essential in order to successfully overcome such a far-reaching pandemic.

Emergency surgeons must necessarily take into account the risk of intra-hospital viral transmission, additionally to the limited access to operating theatres due to their frequent conversion into ICUs, when giving indication to surgical procedures that might be responsive to non-operative management.

In fact, conservative treatment could be a valid option in certain types of conditions and should be considered on a case-by-case basis. When choosing to undertake this therapeutic approach, however, a close clinical and radiological surveillance is mandatory, switching to surgical treatment in those cases with a worsening of clinical signs or symptoms. Whenever an emergency surgical procedure is needed, the surgeon must be responsible of supervising the application of safety measures, involving the smallest number of healthcare staff with adequate PPE protection. Although no definitive evidence is available with regards to the risk of aerosol virus dissemination, when employing laparoscopy, smoke filtering and limiting gas leakage is recommended [13, 18]. Routine testing to all patients having access to the operating theatre, regardless of symptoms, is crucial. Finally, coordination between anaesthesiologists and emergency surgeons is always advisable so as to optimizing the usage of limited existing resources, contemporaneously aiming at containing the rise of viral exposure among patients and personnel.

Conclusions

The extensive pandemic-associated decrease of patients gaining access to the ED during the peak of this outbreak could result in substantially delaying time-sensitive emergency procedures, which might eventually lead to worsened prognoses and preventable deaths.

Once the COVID-19 outbreak will be surpassed and ordinary life measures and hospital activity will be resumed, the healthcare system might face with a rebound increase of patients accessing the ED, possibly causing further lengthening of delays in diagnosis and treatment of urgent pathologies. The final outcome might encompass a deterioration in public health and productivity leading to a soaring

economic and healthcare encumbrance. Estimating the possible post-pandemic cumulative effect this might cause once the pandemic has been surpassed, is critical in order to better define how to restructure EDs in the near future.

	Group 1 Pre-COVID-19 Era (09/03/2019-03/05/2019)	Total % Variation Rate (group 1 vs. group 2)	Group 2 COVID-19 Era (09/03/2020-03/05/2020)	Total % Variation Rate (group 2 vs. group 3)	Group 3 Post-COVID-19 Era (04/05/2020-30/06/2020)
Overall access to ED	1603	-88.2	189	+78.7	889
		Surgical specialty			
General surgery	476	-83.4	79	+75.9	328
Urology	154	-79.9	31	+70.8	106
Orthopaedics	814	-92.9	58	+83.9	361
Maxillofacial surgery	40	-95.0	2	+81.8	11
Ear, nose & throat	27	-74.1	7	+84.4	45
Neurosurgery	52	-94.2	3	+70.0	10
Cardiac surgery	4	-75.0	1	0.0	1
Thoracic surgery	2	+150.0	5	+78.3	23
Vascular surgery	34	-91.2	3	+25.0	4
		Assigned level of care			
Hospital Admission	422	-78.9	89	+68.1	279
Discharge	568	-94.5	31	+85.5	214
Hospital admission Refusal	340	-87.9	41	+78.9	194
Outpatient treatment	234	-88.9	26	+86.3	190
Transfer to other hospital	39	-94.9	2	+80.0	10
		P value (group 1 vs. group 2) = 0.008		P value (group 2 vs. group 3)= 0.011	

Table 1. Total number of admitted patients to the surgical Emergency Department (ED) in the pre-COVID-19 (group 1), COVID-19 (group 2) and post-COVID-19 (group 3) eras, subdivided in different surgical specialty categories. Prognosis is divided based on the level of care assigned after diagnosis (i.e. hospital admission, discharge, refusal of hospital admission, outpatient treatment, transfer to other hospitals).

	Group 1 Pre-COVID-19 Era (09/03/2019-03/05/2019) (n=88)	P-value (group 1 vs. group 2)	Group 2 COVID-19 Era (09/03/2020-03/05/2020) (n=16)	P-value group 2 vs. group 3)	Group 3 Post-COVID-19 Era (04/05/2020-30/06/2020) (n=80)
Gender, male/female (n)	33/55	0.341	12/4	0.906	49/31
Age, years (mean±SE)	58.15±2.49	0.772	60.69±5.01	0.462	52.15±2.27
Surgical Outcomes					
Time to surgery, hours, (mean±SE)	16.73±1.76	0.017	22.56±11.20	0.001	75.99±15.89
Postoperative complications (%)	9.1	0.002	37.5	0.019	12.5
Mortality (%)	0.0	<0.0001	31.3	<0.0001	7.5
Comorbidities					
CCI (mean±SE)	4.16±0.97	0.202	3.94±1.46	0.021	1.81±0.25
Hypertension (%)	40.9	0.001	25	1.000	27.5
Diabetes (%)	22.7	0.001	6.3	0.091	5.0
BPH (%)	12.5	0.001	0.0	0.014	3.8
Cardiomyopathy (%)	14.8	0.470	6.3	0.085	7.5
Neurological disorders (%)	6.8	0.023	0.0	0.019	6.3
CKD (%)	4.5	0.018	12.5	0.011	3.8
Abdominal aortic aneurysm (%)	0.0	<0.0001	6.3	0.005	0.0
HIV (%)	0.0	<0.0001	6.3	0.005	0.0
Hematological disorders (%)	0.0	<0.0001	12.5	0.034	2.5
Respiratory disorders (%)	0.0	<0.0001	12.5	<0.0001	7.5
Previous surgeries (%)	0.0	<0.0001	12.5	0.043	35.0
Pharmacological Therapy					
Antihypertensives (%)	38.6	0.532	43.8	0.757	28.8
Anticoagulants (%)	20.9	0.495	25	1.000	16.3
Antidiabetics (%)	10.7	0.002	0.0	0.083	5.0
PPI (%)	16.9	0.370	12.5	0.376	12.5
Antidepressants (%)	0.0	<0.0001	12.5	0.015	7.5
Steroids (%)	0.0	<0.0001	6.3	0.839	2.5
Uricosurics (%)	0.0	<0.0001	12.5	<0.0001	0.0
Statins (%)	0.0	<0.0001	6.3	0.315	6.3
Erythropoietin (%)	0.0	<0.0001	6.3	0.235	1.3
Antiretrovirals (%)	0.0	<0.0001	6.3	0.005	0.0
Diagnostic Investigations					
Chest X-Ray (%)	83	0.027	68.8	0.019	61.3
Abdomnial X-Ray (%)	29.5	0.027	25	0.015	33.8
Rectoscopy (%)	18.2	<0.0001	0.0	0.038	3.8
Abdominal US%)	65.9	0.908	33.3	0.021	32.5
Abdominal CT Scan (%)	28.4	0.664	68.8	0.261	46.3
Head CT Scan (%)	1.1	0.392	0.0	1.000	1.3
Scrotal US (%)	6.8	0.868	6.3	0.553	3.8
MRCP (%)	1.1	0.392	0.0	1.000	0.0
Chest CT Scan (%)	0.0	<0.0001	18.8	0.290	15.0
CT Angiography (%)	2.3	0.090	6.3	0.001	0.0
Nasopharyngeal swab (%)	N/A	N/A	100	1.000	100

Table 2. Demographic data, surgical outcomes, CCI score, comorbidities, pharmacologic therapy, diagnostic investigations in the pre-COVID-19 (group 1), COVID-19 (group 2) and post-COVID-19 (group 3) eras. Data are shown as mean±SE or percentage of subjects.

(BPH: benign prostatic hyperplasia; CCI: Charlson comorbidity index; CKD: chronic kidney disease; CT: computed tomography; HIV: human immunodeficiency virus; MRCP: magnetic resonance cholangiopancreatography; PPI: proton pump inhibitor; US: ultrasound; SE: standard error; N/A: not applicable).

Figure legend

Figure 1. Percentage of different emergency surgical procedures performed in pre-COVID-19, COVID-19 and post-COVID-19 eras

(AAA: abdominal aortic aneurysm; CEA: carotid endarterectomy; EPSiT: endoscopic pilonidal sinus treatment).

List of abbreviations

SARS-CoV-2 – Severe Acute Respiratory Syndrome CoronaVirus-2

WHO – World Health Organization

COVID-19 – CoronaVirus Disease

ED – Emergency Department

CCI – Charlson Comorbidity Index

ICU – Intensive Care Units

SE – Standard Error

CI – Confidence Interval

VIF – Variance Inflation Factors

PPE – Personal Protective Equipment

AAA – Abdominal Aortic Aneurysm

Declarations

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Authors' contributions

LCG, GC and AM, FLT designed the study and contributed to the manuscript writing, LCG, IL, PF, AI, MC, MA, MCT contributed to the data collection and interpretation of the results. All authors provided critical feedback and helped shape the research, analysis and manuscript.

All authors have approved the final version of the article.

Institutional Review Board (IRB) Statement

IRB and ethical approval were waived for this study, due to the retrospective nature of the study. All procedures performed involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent statement

Informed consent was obtained from all individual participants involved in the study.

Data availability statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy issues. All data generated or analysed during this study are included in this published article.

Conflicts of interest

The authors have no commercial associations that might be a conflict of interest in relation to this article.

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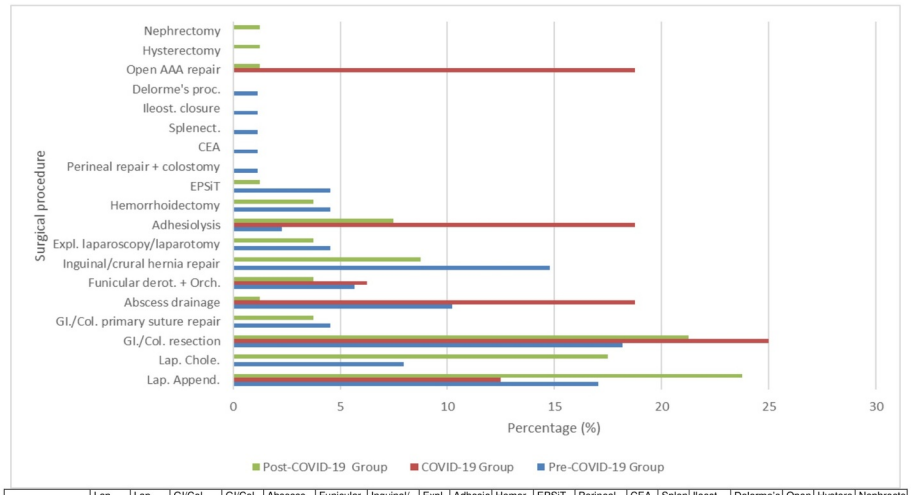

	Lap. Append	Lap. Chole.	GI/Col. Resection	GI/Col. Primary suture repair	Abscess Drainage	Funicular Derot. + Orch.	Inguinal/ Crural hernia repair	Expl. Lap.	Adhesiolysis	Hemorrhoidectomy	EPSiT	Perineal repair + colostomy	CEA	Splenectomy	Ileost. closure	Delorme's procedure	Open AAA repair	Hysterectomy	Nephrectomy
Pre-COVID-19 Group (n)	17.0% (15)	8.0% (7)	18.2% (16)	4.5% (4)	10.2% (9)	5.7% (5)	14.8% (13)	4.5 % (4)	2.3% (2)	4.5% (4)	4.5% (4)	4.5% (4)	1.1% (1)	1.1% (1)	1.1% (1)	1.1% (1)	0.0% (0)	0.0% (0)	0.0% (0)
COVID-19 Group (n)	12.5% (2)	0.0% (0)	25.0% (4)	0.0% (0)	18.8% (3)	6.3% (1)	0.0% (0)	0.0 % (0)	18.8% (3)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	18.8 % (3)	0.0% (0)	0.0% (0)
Post-COVID-19 Group (n)	23.8% (19)	17.5% (14)	21.3% (17)	3.8% (3)	1.3% (1)	3.8% (3)	8.8% (7)	3.8 % (3)	7.5% (6)	3.8% (3)	1.3% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	1.3% (1)	1.3% (1)	1.3% (1)