




## Impact of COVID-19 on Emergency General Surgery

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### Abstract

**Introduction:** There are limited data on emergency surgical practices during the COVID-19 era. To compare the outcomes of emergency surgery before and during COVID-19.

**Methods:** This was a retrospective study of emergency admissions to one general surgery department during November 2019, which is likely to represent our normal working pattern, and April 2020, which was the peak of the COVID-19 crisis in our population. Data of each of these two months were collected separately. The patients' demographic features, type of procedures, blood test results, procedure approach (open; laparoscopic), morbidities and mortality were recorded. Statistical analysis was performed using descriptive statistics, the Chi-squared test, and the Z-test. P-values <0.05 marked significance with a confidence interval of 95%. Both groups underwent emergency surgery admissions and/or operations. The primary endpoints were COVID-19 diagnosis rates together with the number and types of surgical admissions and procedures. The secondary endpoints were complications, mortality, laparoscopic and open approaches, C-reactive protein (CRP) levels and white blood cell counts, length of stay, age, and gender.

**Results:** A total of 332 patients were admitted; 146 patients during April 2020 and 177 during November 2019. There were 147 males and 176 females. The mean age was 51 years in the November group and 49 years in the April group. There were 146 procedures performed in November, while 117 operations were conducted in April. Length of stay was 5.87 and 5.43 for November and April patients, respectively. There were 7 patients who tested positive for COVID-19, and 3 mortalities occurred in each group. The CRP level and prevalence of acute cholecystitis, abscess, and diverticulitis were significantly different between the two groups (P<0.05). Meaningful differences were also found in the total number of operations, postoperative complications, and mortality (P<0.05).

**Conclusion:** Postoperative complications, mortality, and acute cholecystitis occurred at significantly higher rates while abscess and diverticulitis were significantly less prevalent in the COVID-19 era.

**Keywords:** COVID-19, emergency surgery, complications

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## Introduction

COVID-19 is associated with significant impacts on elective and emergency surgery (1-4). As expected, there has been a significant drop in the number of emergency operations compared with the pre-COVID-19 era (4). This drop is explained by fear from visiting hospitals to avoid the infection but also could be due to disturbances to local health systems and referral pathways, alternative managements, and limited access to services (5). This may result in complicated cases of the common surgical admissions like acute appendicitis, bowel obstruction, diverticulitis and abscess formation (6). If the patients develop COVID-19 infection, the additional physiological burden increases the likelihood of a poor outcome. The cytokine storm syndrome associated with COVID-19 is likely to progress to organ failure and mortality (7, 8). This study aimed to compare the trends and outcomes of emergency surgery admissions and operations before and during the COVID-19 era.

## Methods

### Study Design

A retrospective observational study was conducted at our university hospital. The study population was comprised of 332 patients admitted consecutively during November 2019 and April 2020. Both adults and children were included. The patients had been followed-up in the surgical assessment unit and clinics. The methodology was in line with the STROBE statement (<https://www.strobe-statement>

org/). Three (0.9%) patients were lost to follow up. The patients' demographic features, the type and number of procedures, the complications, length of stay, mortality, inflammatory markers, and the number of COVID-19 positive surgical patients were reported (Tables 1-3). Ethical approval was not needed for this retrospective study.

### Data Sources/Measurement

The source of the data was the details pertaining to the patients' diagnosis, operations, follow-ups, complications, and the outcomes. The data were stored on a hospital computer with encrypted passwords. Only the clinical and research team had access to the data.

### Bias & Study Size

There was no selection bias as all consecutive patients were included. All postoperative complications had been attended to as emergency conditions by the on-call team ahead of referral to the related surgical team for management. The study size (332 patients) was larger compared with previous studies (5).

### Statistical Methods

Socscistatistics software was used to determine statistically significant differences between the two groups (<https://www.socscistatistics.com/tests/>). P-values <0.05 were taken to mark significance with a confidence interval of 95%.

### Follow-up and Missing Data

There was no missing data. All patients had attended

**Table 1:** Demographics, inflammatory markers, COVID-19 status, and mortality

Characteristics	November 2019		April 2020		P value
		SD		SD	
Male	072		75		0.241
Female	105		71		0.295
Age (mean)	51	21.87	49	23.42	0.505
Length of stay	5.87	6.64	5.43	5.82	0.986
Mean White cell count	10.85	4.16	12.8	4.83	0.395
Mean CRP	66.64	82.85	100.47	78.89	0.002
Covid-19 +ve	0		7		0.003
Mortality	3		3		0.851

**Table 2:** Procedure type

Characteristics	Nov. 2019 No(%)	April 2020 No(%)	P value
Laparotomy	3(3)	5(8)	0.149
EUA & Drainage of abscess	38(39)	20(31)	0.040
Laparoscopic appendicectomy	35(36)	27(42)	0.432
Laparotomy /adhesiolysis	6(6)	5(8)	0.472
Laparoscopic adhesiolysis	2(2)	0(0)	0.102
Laparoscopic cholecystectomy	2(12)	1(1.5)	0.348
Colonic stent	0(0)	1(01.5)	0.131
Meckel's diverticulectomy	2(2)	0(0)	0.102
Other operations	9(9)	5(8)	0.248
Total	97	64	0.05

**Table 3:** Diagnosis

Characteristics	November 2019	April 20202	P value
Acute cholecystitis	16	26	0.041
Appendicitis	31	29	0.654
Abscess	33	14	0.046
Bowel obstruction	13	16	0.302
Diverticulitis	13	03	0.037
Bowel perforation	03	05	0.331
GI Bleeding	08	04	0.416
Pancreatitis	06	09	0.260
Cancer	04	01	0.254
Bariatric emergencies	01	03	0.064
Non-specific pain	21	10	0.165
Others	28	26	0.687
Total	177	146	0.158

**Table 4:**Clavien-Dindo classification of the complications

Grade		No(%) November 2019 177 patients	No(%) April 2020 146 patients	P value
Grade I	Deviation from the normal postoperative course. drugs as antiemetics, antipyretics, analgesics, diuretics and electrolytes and physiotherapy	5(29)	8(26)	0.787
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.	4(24)	11(35)	0.395
Grade III	Requiring surgical, endoscopic or radiological intervention			
IIIa	Under LA			
IIIb	Under GA	3(18) 0	6(19) 0	0.888
Grade IV	Life-threatening complication requiring IC/ICU-management			
IVa	Single organ dysfunction (including dialysis)	2(11)	3(10)	0.818
IVb	Multiorgan dysfunction	0	0	
Grade V	Death of a patient	3(18)	3(10)	0.00001
Total		17(100)	31(100)	0.0035

the follow-up clinic in 6 weeks after their operations during November 2019 and the surgical assessment unit/ambulatory unit in April 2020. Patients who developed complications either referred to their GPs or presented to the A&E department.

## Results

### Descriptive Results

There were 72 male and 105 female admissions during November 2019, while 75 male and 71 female admissions occurred in April 2020 (P-values of 0.241 and 0.295, respectively).

The mean age was 51 and 49 in the November and April groups, respectively (P=0.505). There was a significant increase in postoperative complications in April 2020 compared with November 2019 (17 (9.6%) versus 31 (21.2%), respectively; P=0.00001). More acute gallbladder disease admissions were reported in April (26 versus 16; P=0.041), while more diverticulitis and abscesses prevailed in November (P-values of 0.037 and 0.46, respectively). There was no significant difference in acute appendicitis cases (31 versus 29; P=0.654). Bariatric emergencies showed a trend of increment during the COVID-19 era

but did not reach statistical significance (P=0.064). Examination under anesthesia (EUA) & abscess drainage was reported in 38 patients (26%) of cases during November 2019 vs. 20 operations in April 2020 (P=0.040). The total number of emergency surgery was significantly lower (34% reduction) during COVID-19 era (97 vs. 64 procedures; P=0.05).

The commonest surgical operation during November was EUA & drainage of abscess while laparoscopic appendectomy was the commonest procedure during April 2020. The November admission length of stay was 5.87 (SD: 6.64) days compared with 5.43 (SD: 5.82) days in the April group. There was no statistical difference in use of the laparoscopic approach (39 vs. 29; P=0.363).

The level of the inflammatory marker, C-reactive protein (CRP), was significantly higher during the COVID-19 era (66.64 (SD: 82.85) vs. 100.47 (SD: 78.89) mg/L; P=0.002), while there was no significant difference in the white blood cell count (10.85 (SD: 4.16) vs. 12.8 (SD: 4.83) x 10<sup>9</sup>/L; P=0.395). There were seven COVID-19 patients in the April 2020 group including one mortality (P=0.003).

There was a significant difference in mortality between the November 2019 and April 2020 groups

(3 (1.6%) vs. 3 (2.05%), respectively;  $P=0.00001$ ). There was a significant difference in complications between November 2019 (17; 9.6%) and April 2020 (31; 21%). Apart from mortality, there were no significant differences in the Clavien-Dindo Grades I-IV (Table 4).

## Discussion

The most important findings of this study are a significant reduction in the emergency surgical procedures, increased postoperative complications, a significant difference in mortality, increased admissions for acute cholecystitis, reduction in the abscess and diverticulitis presentations, and increased CRP levels during the COVID-19 era compared with pre-COVID-19 conditions. There was a 34% reduction in surgical operations compared to the pre-COVID-19 period. Studies had shown a reduction in emergency surgery workload due to variety of reasons including the fear of catching the infection in hospitals (4, 5, 9). Not only general surgical procedures but also acute gastrointestinal bleeding rates showed reductions of up to 55% during the COVID-19 crisis (10). There were significantly more postoperative complications in the COVID-19 era relative to November 2019 (21.3% vs. 6.85%;  $P=0.0002$ ).

All the surgical procedures were performed by consultant surgeons during April 2020 to reduce the operative time and provide the best possible experience with reduced complications. This affected the higher surgical training program at our hospital.

One of the possible explanations for the increased complications during COVID-19 era is late presentations and increased complexity of the cases. Limited access to the services because of shut down of GP surgeries is another possible factor. Delayed presentations might be reflected by a significant increase in the CRP level during the COVID-19 period, which indicated a greater degree of inflammation. There were increased admissions for acute cholecystitis and abscess cases but significantly less diverticulitis cases in the COVID-19 era (April 2020).

It is the cancelling of elective procedures that had increased the waiting time for laparoscopic cholecystectomy, meaning that more patients were readmitted with recurrent attacks of cholecystitis. The increase in abscess cases can be explained by the fear of infection and limited access to early diagnosis and treatment. Some of these abscesses could have been prevented if the preceding cellulitis was treated at an early stage with antibiotics. There was no apparent reason why diverticulitis admissions were dramatically reduced apart from fear of infection, which is especially applicable to mild cases that can be settled without intervention and or intravenous antibiotics treatment. There was a trend toward increased bariatric emergencies admission during

COVID-19; however, this did not reach statistical significance ( $P=0.64$ ).

Surgery in COVID-19 patients is associated with increased risks (2, 6, 9, 11-13). There is an ongoing debate of laparoscopy vs. laparotomy for an acute abdomen given the risk of aerosol-generating procedures (4, 9, 14-17).

Our emergency laparoscopic workload did not show any significant difference between the two periods of the total number of operations. We used full personal protection equipment (PPE) during April 2020 period for both suspected and confirmed COVID-19 patients. At the beginning of the COVID-19 crisis, which hit our health service like a storm as it did everywhere in the world, we adjusted the service in the department. Large numbers of surgical staff were redeployed to the medical wards and intensive therapy units (ITUs) as elective surgical services had contracted. The remaining surgical personnel were allocated to the emergency surgical services and the urgently needed virtual clinics. There was a huge challenge to arrange the services within a very short period. We divided theatres and beds to COVID-19 and non-COVID-19 areas, which were geographically separated. A reorganization of the hospital's complex structure was immediately required to contain the spread of the infection (18, 19).

Symptomatic assessment for patients attending emergency surgical care has always been the cornerstone of our assessment; however, testing at the beginning of the COVID-19 crisis was not readily available and we relied on the computerized tomography (CT) scan of the chest as the criteria to classify emergency patients into the COVID-19 or non-COVID-19 areas (theatres and wards). In selected patients, CT scan of the chest was performed; for all intra-abdominal problems, the lower basis of the chest would be included.

We kept our surgical ambulatory and assessment unit open at all times. This was vital to the service as all admissions were through the unit and also it became the site for post-operative follow-up and provided hot clinics. Despite all our changes and precautions, three consultant surgeons and five junior staff became infected with COVID-19 during April 2020. It was unknown where and how they got the infection. Fortunately, they all recovered.

Our mortality rate was significantly higher during the COVID-19 month ( $P=0.0001$ ). Overall, 14% (1 of 7 patients) of COVID-19 positive patients had died after surgery due to severe adult respiratory distress syndrome (ARDS). A previous report showed a high 30-day mortality of COVID-19 patients (23.8%; 268 of 1128 patients) (20).

Limitations: This study suffers from limitations of possible bias of assessing the outcomes despite the fact that the data were departmental data.

The other limitation was the study period of one month (April), and more representation could have been depicted by comparing a pair of three-month

periods. The study reflects a one-month cross-sectional period at the peak of COVID-19 crisis in our region. Therefore, the pattern of workload and acute surgical admission outside the April period may show a different trend.

The report also had a limitation of the possibility of late complications development outside the study follow-up of six weeks.

## Conclusion

There was a significant reduction in the emergency surgical procedures, increased postoperative complications and mortality, increased admissions for acute cholecystitis, reduced abscess and

diverticulitis presentations, and increased CRP levels during the COVID-19 era relative to a month representative of the pre-COVID-19 conditions. These results suggest later presentation of patients during the current COVID-19 pandemic.

## Author Contributions

Mr. SE and Mr. AH had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. AH, SE, RH, SS, OM, AG, and HS equally contributed to the study.

**Conflicts of interests:** None declared.

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