Outcome of general surgical emergent and urgent elective procedures in coronavirus disease 2019-infected patients in Ain Shams University, El-Obour Hospital

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Background

The worldwide pandemic of severe acute respiratory syndrome coronavirus 2 has been associated with 273 million registered coronavirus disease 2019 (COVID-19) cases. COVID-19 infection has been proved in 340 000 Egyptians as registered by the Ministry of Health. Surgery in COVID-19-infected patients has special risks and considerations. This study discusses the outcome of emergency and urgent surgery in COVID-19-infected patients.

Aim

To assess morbidity and mortality rates among COVID-19-positive acute surgical patients in Ain Shams El-Obour Hospital and to compare our results with the literature and evaluate the effect of COVID-19 as a risk factor in comparison with other well-known risk factors.

Patients and methods

Emergency and urgent operative interventions were performed for 103 patients with the preoperative diagnosis of COVID-19 infection. They were transferred to Ain Shams El-Obour Hospital, which was assigned to management of COVID-19-infected patients. All patients were assessed regarding comorbidities, surgical condition, surgical intervention, postoperative complications, and postoperative mortality.

Results

Postoperative mortality was 27.2%. Postoperative pulmonary complications were most common (14%). Sepsis either related to pneumonia or other source of sepsis occurred in 12% of cases and thromboembolic events were recorded in 6.8% of cases.

Conclusion

COVID-19 infection is associated with increased postoperative mortality. Mortality was related to increased age, severity of the surgical condition, CO-RADS score, and anesthesia type. It is advised to postpone unnecessary surgical intervention in patients with COVID-19 infection owing to high incidence of perioperative complications. However, it was noticed that unnecessary delay may worsen the outcome. Continuous evaluation of the surgical condition as well as the pulmonary and general condition is key to achieving the best outcome in COVID-19-infected patients.

Keywords:
complications, coronavirus disease 2019, surgery, thromboembolic

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has spread worldwide to most countries. WHO declared coronavirus disease 2019 (COVID-19) a pandemic on March 11, 2020 [1]. As of December 19, 2021, SARS-CoV-2 has caused more than 273 million registered cases and more than 5.3 million deaths according to the WHO [2]. WHO reported major disruptions in health care systems globally [3].

COVID-19 had affected Egypt strongly. WHO has recorded 382 194 cases and 21 639 deaths in Egypt from COVID-19 infection till December 29, 2021. This number is suspected to be underestimated owing to shortage of diagnostic tools and financial and economic burdens [2].

Patients undergoing surgery are a vulnerable group at risk of SARS-CoV-2 exposure in hospital and might be particularly susceptible to subsequent pulmonary

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complications, owing to the pro-inflammatory cytokine and immunosuppressive responses to surgery and mechanical ventilation [4,5].

Evidence of the safety of performing surgery in SARS-CoV-2-exposed hospitals is needed. Before the SARS-CoV-2 pandemic started, high-quality, multinational observational studies had reported overall baseline rates of postoperative pulmonary complications (up to 10%) and subsequent mortality (up to 3%) after surgery [6,7].

The COVID-19 pandemic caused a decreased global capacity for elective procedures with an estimated number of 2.4 million cases canceled weekly [8]. Continuation of both surgical emergencies and urgent elective procedures was needed. COVID-19-infected surgical patients had 30-day postoperative mortality rate of 24.4% and pulmonary complication rate of 51% [4]. A 24% mortality rate in SARS-CoV-2-positive patients was considered high compared with pre-pandemic era, with similarly high rates in both emergency and elective operations [8].

Our study is one of a few performed in a COVID-19 isolation university hospital. Ain Shams EL-Obour Hospital (ASOH) was the first designated isolation university in Egypt. Patients received the same management protocol for COVID-19. Operations were performed by the same surgical team.

The accuracy of PCR test in the postoperative period remains unknown. Notably, accuracy of different tests was assessed in recent series of 1000 cases in China, where chest computed tomography (CT) scan had a sensitivity of 98% compared with a PCR sensitivity of only 71% [9].

According to Center of Diseases Control and Prevention recommendations in January 2022, people who are symptomatic for COVID-19 or who are in close contact to someone with COVID-19 should undergo testing for COVID-19. PCR testing is the gold standard for diagnosis of SARS-CoV-2, but its sensitivity is not satisfactory. The diagnosis of COVID-19 should be based on clinical data, CT imaging criteria, epidemiological history, and tests to support the diagnosis of the disease and/or its complications. New diagnostic methods with higher sensitivity and specificity, as well as faster results, are necessary to be discovered [10,11].

Despite our study being conducted in a developing country, our center is one of few fully funded centers among the university and government health care system.

The primary end point was to assess the morbidity and mortality rates among COVID-19-positive acute care surgical patients in ASOH.

The secondary end point was to evaluate our results in light of the literature regarding COVID-19-positive acute surgical patients and compare the effect of COVID-19 only with other well-known risk factors.

Patients and methods

Patients

This single center, observational, retrospective cohort study was performed in ASOH. The hospital is dedicated for isolation of COVID-19-infected patients.

This research was performed at the Department of General Surgery, Ain Shams University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants.

We retrospectively reviewed and collected data from patients who were transferred to ASOH from the first of July 2020 to June 30, 2021 during the COVID-19 pandemic lockdown.

Patients eligible for inclusion in the study were patients who underwent surgical intervention with regional or general anesthesia and had either a SARS-CoV-2-positive RT-PCR test (nasopharyngeal or throat swab) or a strong clinical suspicion combined with a CT of the chest defined as suspected for SARS-CoV-2 infection within 30 days before surgery.

COVID-19-positive patients who did not undergo surgical intervention were excluded from the study. Surgical cases that underwent conservative management or deferred definitive management were also excluded. Additionally, we excluded patients with incomplete postoperative follow-up data.

Methods

All patients who presented to the Emergency Department (ED) of Ain Shams University Hospitals underwent screening chest CT scan without contrast with susceptibility classification for COVID as CO-RADS 1, 2, 3, 4, and 5. Thereafter, the patients underwent chest consultation to assess COVID-19 infection status and their need for transferal to the isolation hospital. This took place under supervision of an infection control specialist. PCR testing then was done in ASOH after patients' admission, either preoperatively or after surgical intervention. On January 2021, PCR test was introduced to the ED of Ain Shams University Hospitals, and it was mandated for the patients to be PCR positive for COVID-19 infection to be transferred to ASOH.

All PCR-positive patients were transferred to ASOH. PCR-negative patients were assessed by a chest physician who revised their clinical picture and chest CT scan and decided their COVID-19 status. Confirmed COVID-19-infected patients were transferred either to ASOH or Ain Shams Field Hospital. Acute surgical patients were transferred only to ASOH.

Transfer time was the time from presentation of the patient to the ED in Ain Shams University hospitals till OR introduction in ASOH. According to Ain Shams University regulations of transferal, the time of transferal should not exceed 12 h.

Infection control measures mandated limitation of the number of surgeons, assistants, and scrub nurses in the operating theater. All surgeons, assistants, coworkers, and nurses were asked to wear personal protective equipment, which included N95 mask over an ordinary surgical mask, disposable protective suit, face shield, and disposable footwear. The scrubbed personnel wore additional disposable gowns and double gloves. To reduce the operative time, the most senior on-call surgeon, who was always one of a selected group of lecturers in surgery, performed the procedure assisted by one resident and a scrub nurse. Additional assistance was called upon when needed. Operating room equipment, such as monitors, computers, and equipment containers, were covered by a plastic wrap.

Closing of theater doors was always carried out, and the door was opened only in limited conditions to limit spread of infection. After finishing operative intervention completely, the staff, residents, anesthesiologists, and nurses could leave the operative theater.

Any unnecessary equipment was removed, and required instruments for surgery were promptly prepared inside the room. The surgeon was required to use only the equipment prepared in the room to minimize the number of times the theater door was opened after the patient had entered.

The need to decontaminate reusable instruments favored the use of disposable equipment and items. Rapid sequence intubation was considered to avoid manual ventilation. Intubation while patients were awake was avoided when possible.

Patients were positioned and draped with a disposable sterile set for surgery. Suction of electrocautery-induced smoke was done immediately, even though there were no data to suggest spread of COVID-19 infection via body fluids. After surgery, disposable items were discarded as hazardous waste. They were placed in special bags, which were closed and sealed immediately and sent to the waste disposal unit.

Patients were transferred to a ward or the ICU via the shortest route. The operating theater and surrounding area through which patients were transferred was sanitized as soon as possible.

In the postoperative course, surgical patients underwent PCR swab test every other day until turning negative. Once being negative, test repetition on the next day was done. Two successive negative tests in stable patients indicated transferal of the patient to Demerdash hospital. All patients were followed up for 1 month postoperatively either by phone calls between surgical teams from different hospitals or by phone calls to discharged patients. PCR-negative patients with mild COVID-19 disease who underwent minor surgical procedures could be discharged directly with home isolation instructions.

For all surgical patients, we collected the following data: sex, age, comorbidities, American Society of Anesthesiologists (ASA) class as well as pathology and type of surgery, chest CT CO-RADS score, and PCR for COVID-19. Type and duration of anesthesia as well as operative time were recorded. Postoperative complications were recorded and subdivided into thrombotic, hemorrhagic, pulmonary, cardiac, surgical, and septic. The length of hospital stay, reoperation, and 30-day mortality were reported.

Results

This study included 103 patients who underwent surgical intervention in ASOH from the first of July 2020 to the end of June 2021. Table 1 summarizes the demographic data of the patients. Middle to elder age groups were the most susceptible for intervention which also reflected the age susceptibility to the infection. Male COVID-19-positive patients were slightly more than females (59 vs. 41%).

Regarding preoperative comorbidities, the most common comorbidity was diabetes mellitus (43.7%), ischemic heart disease (15.5%), morbid obesity (8.7%), chronic liver disease (7.8%), and end-stage renal disease (6.8%).

PCR positive patients were 74 patients, whereas 29 patients were diagnosed with a combination of clinical manifestations and CT findings of SARS-CoV-2 infection, despite being PCR negative.

Table 1 Preoperative demographic data

Variables	Value [*n* (%)]
Age (mean±SD)	48.68±16.77
Sex	
Male	61 (59.2)
Female	42 (40.8)
Morbid obesity	9 (8.7)
DM	45 (43.7)
ESRD	7 (6.8)
CLD	8 (7.8)
IHD	16 (15.5)
PCR	
Positive	75 (72.8)
Negative	28 (27.2)
Chest CT	
CO-RADS 1-2	24 (23.3)
CO-RADS 3	36 (35)
CO-RADS 4-5	43 (41.7)
Transfer time	11.83±2.73

CLD, chronic liver disease; CT, computed tomography; DM, diabetes mellitus; ESRD, end-stage renal disease; IHD, ischemic heart disease.

Table 2 Surgical diagnosis of the study patients

Pathology	*n* (%)
Diabetic foot infection	26 (25.2)
Limb ischemia	8 (7.8)
Large subcutaneous abscess	10 (9.7)
Fournier gangrene	2 (1.9)
Obstructive jaundice with failed ERCP and PTC	2 (1.9)
Palliative feeding jejunostomy	2 (1.9)
Peritonitis (MVO)	5 (4.9)
Peritonitis (blunt abdominal trauma)	2 (1.9)
Peritonitis (perforated duodenal ulcer)	3 (2.9)
TB peritonitis (intestinal perforation)	1 (0.97)
Peritonitis (appendicitis)	13 (12.6)
Retroperitoneal bleeding	13 (12.6)
Intestinal obstruction (obstructed hernia)	5 (4.9)
Intestinal obstruction (malignant intestinal obstruction)	4 (3.9)
Intestinal obstruction (adhesive intestinal obstruction)	2 (1.9)
Intestinal obstruction (fecal impaction)	2 (1.9)
Intestinal obstruction (gall stone ileus)	1 (0.97)
Intestinal obstruction (sigmoid volvulus)	1 (0.97)
Intestinal obstruction (bezoar)	1 (0.97)

ERCP, endoscopic retrograde cholangiopancreatography; MVO, mesenteric venous occlusion; PTC, percutaneous transhepatic cholangiography).

The most common preoperative diagnosis was diabetic foot infection, seen in 26 (25.2%) cases. Acute lower limb ischemia was present in eight (7.8%) patients. Spontaneous retroperitoneal bleeding (SRB) was not uncommon (12.6%). Mesenteric vascular occlusion was found in approximately five (4.9%) cases. A total of 13 (12.6%) patients presented with acute appendicitis, whereas 11 (10.7%) cases presented with peritonitis secondary to other causes. Intestinal obstruction was the indication of surgery in 13 (12.6%) patients. The diagnosis is summarized in Table 2.

Table 3 Operative data and hospital stay

Variables	Value [*n* (%)]
Anesthesia type	
Spinal	42 (40.8)
General	61 (59.2)
ASA score	
ASA 2	48 (46.6)
ASA 3	43 (41.7)
ASA 4	12 (11.7)
ICU admission	
Yes	57 (55.3)
Reoperation	
Yes	15 (14.6)
Hospital stay in days (mean±SD)	3.97±2.32

ASA, American Society of Anesthesiologists.

ICU stay was indicated in 57 (55.3%) patients. It was based on the patient's condition as decided by anesthesia and chest staff. It was related to the COVID-19 respiratory condition, ASA score, and complexity of the surgical intervention (Table 3).

Reoperation was performed in 15 (14.6%) patients. It was in the form of removal of packing for previous packs in patients with SRB, further debridement or higher amputations in diabetic foot infection, or lower limb amputation in ischemic patients after failure of limb salvage measures.

Patients with diabetic foot infection underwent 13 debridement sessions and 22 amputations. Incision and drainage of abscesses were carried out in 10 cases. Of 13 patients with spontaneous retroperitoneal bleeding, two patients underwent packing only as they died on the second day postoperatively. The other 11 patients underwent depacking when they became stable (3–7 days postoperatively). Debridement was performed 13 times for 12 patients; one patient underwent a second debridement. Of the 13 appendectomy cases, seven cases underwent open appendectomy through McBurney's incision, whereas six cases presented with peritonitis necessitating exploratory laparotomy. Furthermore, exploratory laparotomy was performed for 19 cases for various indications. The operations performed are detailed in Table 4.

The most common postoperative complications were respiratory complications as sequalae of COVID-19 infection (25.3%). Thromboembolic complications were diagnosed in seven (6.3%) patients. They presented in the form of cerebral stroke and myocardial infarctions.

The overall mortality was 27.2%, including both hospital and postdischarge mortality (Table 5).

Table 4 Operative interventions

Operation	*n* (%)
Amputation	22 (22.14)
Debridement	13 (12.6)
Incision and drainage	10 (9.7)
Exploration and packing/depacking for SRB	11 (10.7)
Exploration packing only SRB	2 (1.9)
Appendectomy	7 (6.8)
Exploration appendectomy	6 (5.8)
Hernia reduction and repair	4 (3.9)
Hernia repair with resection and anastomosis	2 (1.9)
Exploration with colectomy and colostomy	4 (3.9)
Exploration with adhesiolysis	2 (1.9)
Exploration with resection and ileostomy	7 (6.8)
Exploration with resection anastomosis	2 (1.9)
Exploration with splenectomy	1 (0.97)
Exploration and repair with omental patch	3 (2.9)
CBD exploration	2 (1.9)
Feeding jejunostomy for advanced malignancy	2 (1.9)
Fecal disimpaction	2 (1.9)
Palliative gastrojejunostomy	1 (0.97)

CBD, common bile duct; SRB, spontaneous retroperitoneal bleeding.

Table 5 Postoperative complications

Complications	Number of affected patients [*n* (%)]
Pulmonary complications	26 (25.3)
Thrombotic complications	7 (6.8)
Wound infection	5 (4.9)
Hospital mortality	25 (24.3)
After discharge mortality	3 (2.9)
Overall mortality	28 (27.2)

Table 6 Postoperative complications according to the Clavien-Dindo classification

Clavien-Dindo classification	Complication	*n* (%)
I		
II	Wound infection	4 (3.9)
III	Wound infection underwent debridement	3 (2.9)
	Burst abdomen	
	Further debridement in diabetic foot patient	
IV	Thromboembolic complications and pulmonary complications	33 (32.1)
V	Mortality	28 (27.2)

According to Table 6, complications were further classified following Clavien-Dindo, which revealed that pulmonary and thromboembolic complications required ICU admission (class IV).

As demonstrated in Table 7, mortality was significantly related to age, uncontrolled diabetes mellitus, chronic liver disease, ischemic heart disease, ASA scoring system, and CO-RADS CT chest classification. Elderly patients had worse CT criteria and increased preoperative comorbidities with subsequently increased mortality. This was independent from the surgical insult which had additional comorbidity according to the severity of surgical condition.

Mortality was significantly related to general anesthesia (Table 8), pulmonary complications, and sepsis. Pulmonary complications included pulmonary fibrosis, pneumonia, and pulmonary embolism; all led to respiratory failure. On the contrary, there was no statistical correlation between thrombotic complications and mortality.

Reoperation was statistically significantly correlated with mortality. Reoperations were performed for depacking for SRB, higher amputation for diabetic foot, or ischemic limb patients with devitalized or infected stumps.

Table 9 shows that the most significant operation associated with mortality was amputation, but the highest rate of mortality occurred in patients with mesenteric vascular occlusion and SRB operations and explorations related to obstructed cancer colon or feeding jejunostomy; feeding tubes were indicated in cases of prolonged intubation.

Discussion

Our study was conducted on general surgery COVID-19-infected patients admitted to ASOH between first of July 2020 and end of June 2022 with the aim of finding out the mortality and morbidities associated with the surgical intervention in COVID-19-infected patients. COVID-19 infection was confirmed by the pulmonology staff. They based their diagnosis on chest CT scan combined with clinical manifestations or on PCR test. It is noteworthy that the COVIDSURG Collaborative study found that postoperative COVID-19 infection was higher than preoperative infection [8]. They reported SARS-CoV-2 infection preoperatively in 294 (26.1%) of 1128 patients and postoperatively in 806 (72%). We excluded patients with postoperative diagnosis of COVID-19 infection from our study, as they were not referred to ASOH except after surgery.

The transferal protocol was designed to be rapid for best management of patients and protection for health care individuals. Tartaglia *et al.* [12] reported 40% decrease in emergency operation rate in their center compared with the same period in non-COVID era. Using a simple cost-effective method for peritonitis assessment called mean Mannheim Peritonitis Index Score, they found an association between delay and complication rates. In another study, Rashdan *et al.*

Table 7 Correlation between mortality and preoperative data

Variable	Mortality [*n* (%)]		*P* value	Sig.
	Yes (28)	No (75)		
Age	53.86±12.27	46.75±17.85	0.025	S
Transfer time	11.6±2.03	11.1±2.32	0.318	NS
MO (9)	1 (11.1)	8 (88.9)	0.257	NS
DM (45)	8 (17.8)	37 (82.2)	0.059	NS
Renal disease (7)	4 (57.1)	3 (42.9)	0.065	NS
CLD (8)	6 (75)	2 (25)	0.002	HS
IHD (16)	9 (56.3)	7 (43.8)	0.004	HS
Comorbid patients (58)	17 (29.3)	41 (70.7)	0.582	NS
ASA score				
ASA 2 (48)	10 (20.8)	38 (79.2)	0.005	HS
ASA 3 (43)	10 (23.3)	33 (76.7)		
ASA 4 (12)	8 (66.7)	4 (33.3)		
CT chest				
CO-RADS 1-2 (24)	4 (16.7)	20 (83.3)	0.018	S
CO-RADS 3 (36)	6 (16.7)	30 (83.3)		
CO-RADS 4-5(43)	18 (41.9)	25 (58.1)		

ASA, American Society of Anesthesiologists; CLD, chronic liver disease; CT, computed tomography; DM, diabetes mellitus; IHD, ischemic heart disease; Sig, statistical significance.

Table 8 Correlation between mortality and operative and postoperative data

Variable	Mortality [*n* (%)]		Test value	*P* value	Sig
	Yes (28)	No (75)			
Anesthesia type					
Spinal (42)	5 (11.9)	37 (88.1)	8.365*	0.004	HS
General (61)	23 (37.7)	38 (62.3)			
Reoperation (15)	8 (53.3)	7 (46.7)	6.065*	0.014	HS
Pulmonary complications (26)	17 (65.3)	9 (34.7)	16.023*	<0.001	HS
Thromboembolic complications (7)	4 (57.1)	3 (42.9)	2.856*	0.091	NS

*χ^2 test.

Table 9 Correlation between mortality and operations

Variables	Mortality [*n* (%)]		Test value	*P* value	Sig
	Yes (28)	No (75)			
Amputation (22)	4 (18.2)	18 (81.8)	38.289*	<0.001	HS
Debridement (13)	1 (8.3)	12 (91.7)			
Incision and drainage (10)	0	10 (100)			
Exploration with packing/depacking (11)	7 (63.6)	4 (36.4)			
Exploration with packing only (2)	2 (100)	0			
Appendectomy (7)	0	7 (100)			
Exploration with appendectomy (6)	1 (16.7)	5 (83.3)			
Hernia with reduction and repair (4)	1 (25)	3 (75)			
Hernia repair with resection and anastomosis (2)	0	2 (100)			
Exploration colectomy and colostomy (4)	3 (75)	1 (25)			
Exploration adhesiolysis (2)	0	2 (100)			
Exploration, resection and ileostomy (7)	5 (71.4)	2 (28.6)			
Exploration, resection anastomosis (2)	0	2 (100)			
Exploration splenectomy (1)	0	1 (100)			
Exploration and repair with omental patch (3)	1 (33.3)	2 (66.7)			
CBD exploration (2)	1 (50)	1 (50)			
Feeding jejunostomy for advanced malignancy (2)	2 (100)	0			
Fecal disimpaction (2)	0	2 (100)			
Palliative gastrojejunostomy (1)	0	1 (100)			

CBD, common bile duct.
*Fisher exact test.

[13] demonstrated 28% reduction in admission rates for emergent surgical conditions, that is, prolonged preadmission symptom time and prolonged ICU admission. In our study, we could not analyze the delay in presentation as it was difficult to measure, though the effect on prognosis was noticeable.

Diabetic foot infections were common. This could be related to patients' age and the prolonged preadmission symptom time described by Rashdan *et al*. [13] COVID-19-related thrombogenesis might be a cofactor added to diabetic microangiopathy. Acute and critical lower limb ischemia was diagnosed in eight (7.8%) patients. The possible relation between worsening of lower limb ischemia and COVID-19 infection could not be ruled out. Farouk and Gad [14] found that diabetes mellitus was not significant either for ICU admission or mortality; ischemic heart disease was the most determinant for ICU and mortality in their study.

SRB was not unusual as an emergency presentation in COVID-19-infected patients and represented ~12% of patients. SRB was obviously due to large doses of anticoagulation. Later the anticoagulation protocol was changed to a prophylactic regimen with subsequent decrease in the overall incidence of SRB. In the last 4 months, only one case of SRB was reported. In a previous study, we detailed the SRB cases and their management and outcome [15].

Our study reported a mortality rate of 27.2%. This was nearly similar to the outcome reported in COVIDSURG Collaborative study which reported 27% mortality among 1142 patients. It is considered one of largest global studies. Similar results were reported by Colosimo and colleagues. They reported a 26.8% perioperative mortality during first wave of COVID-19 in the USA in 155 hospitals. However, our mortality rate was higher than the mortality rate of 19% reported by Doglietto and colleagues and only a 16.6% 30-day mortality rate by Jonker and colleagues; on the contrary, Farouk and Gad [14] reported 40% mortality in emergency surgical patients; they performed their study in a tertiary care hospital managing both COVID and non-COVID patients, and their study discussed both emergency and elective cases [8,16–18].

The perioperative mortality in non-COVID-infected patients in the same period was 2.4% in the study by Jonker *et al.* [16] and 4% in the study by Doglietto *et al.* [17]. In these studies, a significant difference was noticed between perioperative mortality in COVID-19-infected patients and non-COVID-19-infected patients. We did not study the outcome of surgery in non-COVID-19-infected patients as our hospital was an isolation hospital receiving only COVID-19-infected patients.

In the postoperative period, PCR test was performed regularly for all of the patients. When a patient turns PCR negative, the stable patient was transferred to Demerdash hospital for postoperative management. The post-transferal mortality was 2.9%. There may be other unreported mortalities as deaths at home were not reported to our hospital. In addition, COVID-19-negative patients were followed up in other hospitals or health care facilities.

We reported a significantly higher mortality rate in elderly patients with higher ASA scoring and CO-RADS scoring of 3 or more who underwent surgical intervention under general anesthesia. Additionally, in our study, general anesthesia was a significantly factor for predisposition to mortality. This was mostly owing to expected ventilator dependency, which was one of cumulative risks in the model proposed by Doglietto *et al.* [17]. However, the study by Doglietto *et al.* [17] found that the type of anesthesia was not related to postoperative mortality. The absence of a relationship between anesthesia type and mortality was also found in the COVIDSURG Collaborative study [8].

The most common complication in our study was severe pulmonary complications (25.3%), and it was highly significant for mortality. Similarly, Farouk and Gad reported a 26% pulmonary complication rate. This rate is less than that reported by Doglietto and colleagues and the COVIDSURG Collaborative study of 34 and 50%, respectively. The high rates in the previous studies may be owing to inclusion of mild pulmonary complications and early detection of COVID-19 cases with a mild disease [8,17].

The underlying pathophysiologic mechanisms of the increased mortality rate of SARS-CoV-2-positive patients undergoing surgery may include pulmonary complications of COVID-19, mechanical ventilation, and anesthesia itself. The tissue damage caused by the operation may provoke a pro-inflammatory cytokine and immunosuppressive response, potentially worsening the presentation of a preoperative or postoperative SARS-CoV-2 infection [19,20]. Surgery-related thromboembolic and pulmonary complications in addition to the underlying effects of the SARS-CoV-2 infection may further increase the risk of thrombotic effects in the pulmonary circulation, respiratory insufficiency, respiratory distress syndrome, and eventually death [21,22].

Thromboembolic events occurred in seven (6.8%) patients in our study, with 57% mortality. This incidence was much higher than thromboembolic complications in non- COVID-19-infected patients. The same results were observed by Jonker *et al.* [16], although they did not mention the resultant mortality rate. They observed thromboembolism in 0.3% in non-COVID-19-infected patients. In other studies, thromboembolic complications were found in 10% of COVID-19-infected acute surgical patients in contrast to none in non-COVID-19-infected patients [17].

COVID-19-positive acute surgical patients had higher mortality than non-COVID-19-infected acute surgical patients. Consequently, a more conservative management may be prudent in COVID-19-infected patients [8,16]. On the contrary, a delay in surgical intervention in COVID-19-infected patients with acute surgical conditions may worsen the prognosis. Therefore, the surgical decision must be revised regularly considering the development of surgical, pulmonary, and general conditions of the patient.

Conclusion

COVID-19 infection was associated with an increased postoperative mortality rate in acute surgical cases. Postoperative morbidity and mortality were correlated with high CO-RADS scores, ASA score, and pulmonary complications. Despite our study being conducted in a developing country, our morbidity and mortality rates were nearly similar to the studies conducted in developed countries.

A more conservative management is advised in COVID-19-positive acute surgical patients. The decision and timing of surgery must take into consideration the CO-RADS status, chest condition, comorbidities, and ASA scoring of the patient. However, delay of surgical intervention may worsen the prognosis in certain cases. That is why, continuous evaluation of the patient's surgical and COVID-19-related condition is mandatory.

One of the limitations of our study is the fact that we did not have data on acute surgical non-COVID-19-infected patients as ASOH was an isolation hospital with only COVID-19-infected patients. Factors that could be applied for prediction of outcome in this cohort of patients need a multi-centric study with a larger number of cases.

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Conflicts of interest
There are no conflicts of interest.

References

1 WHO. WHO announces COVID-19 outbreak a pandemic. Available at: http://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/3/who-announces-covid-19-outbreak-a-pandemic. [Accessed December, 2020].

2 WHO. WHO announces COVID-19 outbreak a pandemic October 2021.

3 Joob B, Wiwanitkit V. Acute care surgery and post-operative COVID-19 care: a comment. ANZ J Surg 2020; 90:1214.

4 Besnier E, Tuech JJ, Schwarz L. We asked the experts: COVID-19 outbreak: is there still a place for scheduled surgery? 'Reflection from pathophysiological data'. World J Surg 2020; 44:1695–1698.

5 Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, *et al*. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020; 395:497–506.

6 Kirmeier E, Eriksson LI, Lewald H, Jonsson Fagerlund M, Hoeft A, Hollmann M, *et al*. Post-anaesthesia pulmonary complications after use of muscle relaxants (POPULAR): a multicentre, prospective observational study. Lancet Respir Med 2019;7:129–140.

7 Neto AS, da Costa L, Hemmes S, Canet J, Hedenstierna G, Jaber S, Hiesmayr M, *et al*. The LAS VEGAS risk score for prediction of postoperative pulmonary complications: an observational study. Eur J Anaesthesiol 2018; 35: 691–701.

8 COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans [e-pub ahead of print] *Br J Surg.* 2020 9. COVID Surg Collaborative Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. Lancet 2020; 396:27–38.

9 Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, Tao Q, Sun Z, Xia L. Correlation of chest CT and RT-PCR testing for coronavirus disease 2019 (COVID-19) in China: a report of 1014 cases. Radiology 2020; 296:E32–E40.

10 Goudouris ES. Laboratory diagnosis of COVID-19. J Pediatr (Rio J) 2021; 97:7–12.

11 CDC. CDC guidelines: COVID-19 testing: what you need to know, January 2022.

12 Tartaglia N, Pavone G, Lizzi V, Vovola F, Tricarico F, Pacilli M, Ambrosi A. How emergency surgery has changed during the COVID-19 pandemic: A cohort study. Ann Med Surg (London) 2020; 60:686–689.

13 Rashdan M, Al-Taher R, Al-Qaisi M, Khrais I, Salameh M, Obaidat I, *et al*. The impact of the Covid-19 pandemic on emergency surgery in a tertiary hospital in Jordan. A cross sectional study. Ann Med Surg (Lond) 2021; 66:102339.

14 Farouk N, Gad ZD. Impact of Covid 19 pandemic on surgical outcomes, a single center experience. Med J Cairo Univ 2021; 89:825–832.

15 Abdelrahman M, Gouda M, Rayan M, Fouly M. Spontaneous retro peritoneal bleeding with COVID 19: management modalities and mortality predictors. Ain Shams J Surg 2021; 14:57–65.

16 Jonker P, van der Plas WY, Steinkamp PJ, Poelstra R, Emous M, van der Meij W, *et al*. Perioperative SARS-CoV-2 infections increase mortality, pulmonary complications, and thromboembolic events: a Dutch, multicenter, matched-cohort clinical study. Surgery 2021; 169:264–274.

17 Doglietto F, Vezzoli M, Gheza F, Lussardi GL, Domenicucci M, Vecchiarelli L, *et al*. Factors associated with surgical mortality and complications among patients with and without coronavirus disease 2019 (COVID-19) in Italy. JAMA Surg 2020; 155:691–702.

18 Colosimo C, Bhuller S, Cornett B, Dziadkowiec O, Yon JR, Weaver J, Stahel PF. Perioperative mortality in SARS-CoV-2-positive surgical patients during the first wave of the novel coronavirus pandemic. Br J Surg 2021; 108:201–e202.

19 Lei S, Jiang F, Su W. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. EClin Med 2020; 0:100331.

20 Helmy SAK, Wahby MA, El-Nawaway M. The effect of anaesthesia and surgery on plasma cytokine production. Anaesthesia 1999; 54:733–738.

21 Myles PS, Maswime S. Mitigating the risks of surgery during the COVID-19 pandemic. Lancet 2020; 396:2–3.

22 Assareh H, Chen J, Ou L, Hillman K, Flabouris A. Incidences and variations of hospital acquired venous thromboembolism in Australian hospitals: a population-based study. BMC Health Serv Res 2016; 16:511.