Observational Study

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Obstructive jaundice treatment during the COVID-19 pandemic: retrospective cohort study at a single tertiary care center in Serbia

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Abstract

Objective: We aimed to compare mortality and complication rates in patients treated for obstructive jaundice before and during the COVID-19 pandemic in a tertiary care center in Serbia.

Methods: We conducted a retrospective cohort study among a first group of patients treated between 1 January 2017 and 1 January 2019. The second group was treated between 1 March 2020 and 1 March 2022.

Results: The first group comprised 35 patients, and the second group (in which all patients were SARS-CoV-2 positive) included 18 patients; 37 and 16 patients were treated for malignant and benign diseases, respectively. The groups did not differ significantly regarding the diagnoses and treatment received. The second group showed significantly higher aspartate aminotransferase levels and lower white blood cell, C-reactive protein, and interleukin 6 levels. Mortality and complication rates did not differ significantly between groups. All deceased patients in the second group had significant radiologic findings associated with COVID-19 pneumonia.

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Conclusions: COVID-19 infection is a risk factor in treating obstructive jaundice. This study illustrates the potential influence of COVID-19 on mortality after obstructive jaundice treatment. COVID-19 pneumonia may be a significant risk factor for mortality in patients treated for obstructive jaundice.

Keywords
COVID-19 pandemic, obstructive jaundice, surgery, retrospective study, mortality, risk factor

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Introduction

The COVID-19 pandemic has tested the resilience of health care systems worldwide, with elective surgical procedures being limited or suspended during the first waves of the pandemic.[1–3] A large body of research has been focused on mortality related to COVID-19, the influence of the pandemic on the surgical treatment of various benign and malignant diseases,[4–7] as well as the nosocomial spread of COVID-19.[5] Infection with the causative agent of COVID-19, namely, SARS-CoV-2, is considered a significant health risk in the perioperative period, with both short and long-term consequences such as chronic pulmonary dysfunction, myocarditis, renal impairment, thrombotic events, and chronic fatigue.[4,6] Surgery within 7 weeks after COVID-19 infection has been associated with increased morbidity and mortality.[6]

Surgery appears to exacerbate the disease course of COVID-19 infection through the stress response to injury, the need for mechanical ventilation,[8] and susceptibility to other infections,[9] especially in patients harboring SARS-CoV-2 preoperatively.[10] Furthermore, the COVID-19 era has created a differential diagnostic challenge for all physicians treating postoperative pulmonary complications.[11]

Malignancies (cholangiocarcinoma, periampullary and pancreatic cancers) and chronic pancreatitis have become increasingly prevalent as causes of obstructive jaundice.[12] Obstructive jaundice is a potentially life-threatening complication of gallstone disease (choledocholithiasis), together with biliary pancreatitis and acute cholangitis.[3] Rates of perioperative morbidity in patients with obstructive jaundice range from 20% to 30%.[12]

The aim of the present study was to compare the mortality and complication rate of patients undergoing treatment for obstructive jaundice before and during the COVID-19 pandemic in a tertiary care center in Serbia.

Methods

In this retrospective cohort study, we used the medical records of patients treated in a single tertiary care center. The first group comprised patients treated for obstructive jaundice before the COVID-19 pandemic (1 January 2017 to 1 January 2019) for comparison with the COVID-19 pandemic period in the study. The second patient group was treated during the COVID-19 pandemic (1 March 2020 to 1 March 2022). Patients from both periods were consecutively included in the study.

This study was approved by the Ethics Committee of the University Hospital Medical Center Bezanijska kosa in Belgrade, Serbia (approved 10 January 2023; approval number 53/1). All patients with a diagnosis of obstructive jaundice

treated during the aforementioned periods were included in the study. Patients with other non-obstructive causes of jaundice (hepatitis, congenital causes such as Gilbert syndrome) as well as those with obstructive jaundice who declined hospital treatment were not included in the study. All patient details were de-identified. Signed consent was not obtained from individual patients because the study was based on anonymized medical records. The reporting of this study conforms to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[13]

The diagnostic protocol included physical and laboratory examinations as well as radiologic findings (abdominal and endoscopic ultrasound, computed tomography [CT), and magnetic resonance imaging). Additionally, for patients in the second group, COVID-19 testing was routinely performed on admission using nasal swab samples and polymerase chain reaction (PCR). Furthermore, the possible existence of pneumonia was evaluated with a chest CT scan the day before treatment initiation. The CT findings were classified into the following categories: early, progressive, peak, and late-stage COVID-19 pneumonia.[14] The history of COVID-19 vaccination was also recorded for patients in the second group. Residents of Serbia, where the study was conducted, could choose between four vaccines: Pfizer, Sinopharm (BBIBP-CorV), Sputnik V (Gam-COVID-Vac), and AstraZeneca vaccines.

According to the indication, surgical procedures included laparoscopic or open cholecystectomy, T-tube drainage (or laparoscopic/open cholecystectomy and T-tube drainage combined), biliodigestive bypass (hepaticojejunostomy), cephalic pancreaticoduodenectomy (Whipple procedure), and total pancreatectomy. Interventional radiologic procedures included percutaneous transhepatic biliary drainage (PTBD) or endoscopic retrograde cholangiopancreatography (ERCP) with common bile duct (CBD) stenting. No patients received chemotherapy, targeted therapy, or any other specific therapeutic regimen prior to treatment for obstructive jaundice.

The following parameters were analyzed before treatment: demographic data (sex and age), the cause of obstructive jaundice, laboratory parameters (using peripheral venous blood drawn on the morning of the procedure or treatment initiation at 6 a.m., as a single reading), and comorbidities. The following laboratory parameters were evaluated: total and direct bilirubin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase, serum albumin, hemoglobin, C-reactive protein (CRP), D-dimer, and interleukin-6 (IL-6) levels as well as total white blood cell (WBC), lymphocyte, and platelet counts. Because the second group underwent chest CT just prior to blood analysis, the laboratory findings corresponded to the COVID-19 radiologic stage. Finally, the treatment approach and type, postoperative complications (according to the Clavien–Dindo [CD] scale), and mortality rate were analyzed in both groups.

Statistical analysis

Statistical analysis was performed using descriptive and analytical statistics. Categorical variables were compared using the chi-squared test. The normality of distribution was assessed using the Kolmogorov–Smirnov test. Continuous variables not normally distributed were compared using the Mann–Whitney U test; continuous variables with a normal distribution were analyzed using the Student *t*-test. We used IBM SPSS version 22.0 (IBM Corp., Armonk, NY, USA) in the analyses. A p value <0.05 was considered statistically significant.

Results

Fifty-three patients were included in this study. The first group (treated before the pandemic, SARS-CoV-2 negative) comprised 35 patients (66%), and the second group (treated during the pandemic) included 18 patients (34%). All patients in the second group were positive for SARS-CoV-2 infection, according to PCR testing before the initiation of treatment for obstructive jaundice.

The average age of the total sample was 71.07 ± 10.70 years. The age of patients who were negative and positive for SARS-CoV-2 did not differ significantly: 72.23 ± 10.25 versus 68.83 ± 11.48 years. The same conclusion was reached after analyzing the sex structure of the two groups: the SARS-CoV-2-positive group comprised 61% male and 39% female patients, and the group negative for SARS-CoV-2 included 51% male and 49% female patients. The sex ratio in the total sample was 1:2.

In the SARS-CoV-2-positive group, five patients (27.8% of that group) were in the peak stage of COVID-19 pneumonia, and the same number of patients exhibited the progressive stage. The remaining patients ($n = 8$, 44.4%) did not show any signs of pneumonia on chest CT. Three patients from the second group had received two doses of Sinopharm vaccine; the second dose was administered 2 months, 3 months, and 1 year prior to treatment for obstructive jaundice in these patients. An additional two patients from the same group received only one dose of Sputnik V vaccine, at 1 month and 3 months prior to treatment.

In the total sample, most patients underwent treatment for malignant disease (37 patients, 69.8%), with 16 patients (30.2%) having benign conditions. There was no difference in the distribution of benign versus malignant disease between patients who were positive and negative for SARS-CoV-2. The same conclusion was reached when comparing the incidence of specific diagnoses between the groups. There was also no significant difference in the frequency of therapeutic approaches between patients who were SARS-CoV-2 positive and negative. In the total sample, most patients received surgical treatment (Table 1).

Table 2 lists the comorbidities in the two groups. Most patients in both groups had arterial hypertension and diabetes. The difference between groups regarding comorbidities was not statistically significant. Table 3 presents the laboratory findings before treatment. SARS-CoV-2-positive patients had significantly higher AST levels ($p = 0.018$). SARS-CoV-2-negative patients showed significantly higher levels of CRP ($p = 0.009$) and IL-6 ($p = 0.035$), as well as a significantly higher WBC count ($p = 0.017$), as compared with SARS-CoV-2-positive patients. Table 4 shows the analysis results for the two outcomes examined in this study, the postoperative complication rate and mortality rate. There was no intergroup difference related to either of these factors.

Three patients in the SARS-CoV-2-negative group who died (two female and one male patient, average age 73 years) all had malignant disease: two patients had metastatic pancreatic cancer and one patient had unresectable Klatskin tumor. These three patients received palliative surgery, conservative treatment, and PTBD, respectively. However, all deceased patients in the SARS-CoV-2-positive group (four male and one female patient) had pancreatic cancer; PTBD was performed in three patients and surgery in two. Three patients who were SARS-CoV-2 positive had progressive bilateral changes associated with COVID-19 pneumonia on chest CT. Of these, one patient received one vaccine dose 1 month prior to treatment. The other two patients exhibited bilateral lung consolidation (peak stage); of these, one

Table 1. Causes and treatment of obstructive jaundice among patients who were positive and negative for SARS-CoV-2.

Diagnoses	Group		Total
	SARS-CoV-2 negative, n (%)	SARS-CoV-2 positive, n (%)	
Benign			
Choledocholithiasis	4 (7.5%)	3 (5.7%)	7 (13.2%)
Calculous cholecystitis (Mirizzi syndrome type I)	7 (13.2%)	0 (0%)	7 (13.2%)
Pancreatitis	1 (1.9%)	0 (0%)	1 (1.9%)
Papillary stenosis	1 (1.9%)	0 (0%)	1 (1.9%)
Malignant			
Pancreatic carcinoma	12 (22.6%)	11 (20.8%)	23 (43.4%)
Klatskin tumor (hilar cholangiocarcinoma)	4 (7.5%)	4 (7.5%)	8 (15,1%)
Gallbladder carcinoma	5 (9.4%)	0 (0%)	5 (9.4%)
Common bile duct cholangiocarcinoma	1 (1.9%)	0 (0%)	1 (1.9%)
Total	35 (66%)	18 (34%)	53 (100%)
Treatment types			
Surgery	21 (39.6%)	7 (13.2%)	28 (52.8%)
PTBD	7 (13.2%)	8 (15.1%)	15 (28.3%)
Conservative treatment	7 (13.2%)	2 (3.8%)	9 (17%)
ERCP with CBD stenting	0 (0%)	1 (1.9%)	1 (1.9%)
Total	35 (66%)	18 (34%)	53 (100%)

PTBD, percutaneous transhepatic biliary drainage; ERCP, endoscopic retrograde cholangiopancreatography; CBD, common bile duct.

Table 2. Comorbidities in both patient groups.

Comorbidities	Group, n (%)	
	SARS-CoV-2 negative	SARS-CoV-2 positive
Arterial hypertension	21 (60%)	7 (38.9%)
Diabetes	6 (17.1%)	5 (27.8%)
Asthma/chronic obstructive pulmonary disease	5 (14.3%)	0 (0%)
Cardiomyopathy	0 (0%)	2 (11.1%)
Atrial fibrillation	2 (5.7%)	0 (0%)
Renal insufficiency	0 (0%)	2 (11.1%)
Mitral valve insufficiency	1 (2.8%)	0 (0%)
Polycythemia vera	1 (2.8%)	0 (0%)
Liver cirrhosis	1 (2.8%)	0 (0%)
Hypothyroidism	1 (2.8%)	0 (0%)
Neurological deficit (post-stroke)	1 (2.8%)	0 (0%)
Neurological deficit (after brain tumor surgery)	1 (2.8%)	0 (0%)
Benign prostatic hyperplasia	1 (2.8%)	0 (0%)
Deep venous thrombosis	1 (2.8%)	0 (0%)
Glaucoma	1 (2.8%)	0 (0%)

Table 3. Laboratory findings in patients testing positive and negative for SARS-CoV-2.

Laboratory findings	Reference range	Result (total sample)	Group		p
			SARS-CoV-2 negative	SARS-CoV-2 positive	
Total bilirubin (μmol/L)	<21.0	266.1 ± 207.7 (21.1–930.0)	261.2 ± 232 (21.1–930.0)	275.6 ± 155.5 (76.0–482.0)	0.357
Direct bilirubin (μmol/L)	<6.0	166.6 ± 138.4 (9.5–675.0)	164.3 ± 155.4 (9.5–675.0)	171.1 ± 101.2 (48.0–313.0)	0.367
Aspartate aminotransferase (IU/L)	<40	162.8 ± 123.4 (19.0–588.0)	137.3 ± 120.5 (19.0–588.0)	212.4 ± 116.8 (56.0–389.0)	0.018*
Alanine aminotransferase (IU/L)	<41	188.3 ± 147 (19.0–763.0)	165.6 ± 152 (19.0–763.0)	232.4 ± 129.4 (31.0–439.0)	0.060
Alkaline phosphatase (IU/L)	<129	410.2 ± 300.4 (85.0–1811.0)	416.9 ± 329.5 (85.0–1811.0)	397.1 ± 242.2 (106.0–886.0)	0.910
Albumin (g/L)	35–52	34.2 ± 5.2 (22–49)	33.7 ± 4.2 (26–43)	35.3 ± 6.8 (22–49)	0.347
Hemoglobin (g/L)	130–170	118.8 ± 15.6 (69–149)	120.3 ± 12.1 (101–149)	116.0 ± 20.9 (69–147)	0.345
Total leukocyte count (10^9/L)	4.0–10.0	8.6 ± 4.1 (3.06–22.70)	9.4 ± 4.1 (5.03–22.70)	6.9 ± 3.5 (3.06–14.50)	0.017*
Lymphocyte count (10^9/L)	1.0–4.0	1.1 ± 0.6 (0.18–2.89)	1.1 ± 0.5 (0.31–2.89)	1 ± 0.7 (0.18–2.30)	0.208
Platelet count (10^9/L)	150–450	274.1 ± 96.8 (64.0–553.0)	275.6 ± 98.5 (64.0–553.0)	271.3 ± 96.1 (100.0–437.0)	0.925
C-reactive protein (mg/L)	<5.0	52.2 ± 62.9 (2.9–302.0)	63.4 ± 70.8 (4.5–302.0)	31 ± 37.6 (2.9–128.0)	0.009*
D-dimer (ng/mL)	<500	2265.6 ± 2204 (150.0–8456.0)	2124.3 ± 1836.5 (386.0–8456.0)	2406.8 ± 2566.3 (150.0–7964.0)	0.486
Interleukin-6 (pg/mL)	<7.0	32.6 ± 25.1 (1.2–98.6)	36.7 ± 19.1 (13.0–75.0)	24.2 ± 36.7 (1.2–98.6)	0.035*

Note: Values are mean ± standard deviation or (min-max range).

*Statistically significant difference with Student *t*-test or Mann–Whitney U test, as appropriate.

Table 4. Postoperative complication rate and mortality rate.

Outcome	Group, n (%)		Total	p*
	SARS-CoV-2 negative	SARS-CoV-2 positive		
Mortality	3 (5.7%)	5 (9.4%)	8 (15.1%)	0.064
Postoperative complications	3 (5.6%)	2 (3.8%)	5 (9.4%)	0.765

*Chi-square test.

patient received one dose of vaccine 3 months prior to treatment. Respiratory failure was determined to be the cause of death in all five patients who were positive for SARS-CoV-2 infection. The average age of deceased SARS-CoV-2-positive patients was 79.6 years.

Postoperative complications in the SARS-CoV-2-negative group included pulmonary thromboembolism (CD grade IV), subdural hematoma (occurring after the patient experienced a fall, treated conservatively; CD grade II), and hepatorenal syndrome (CD grade IV). The two patients with postoperative complications in the SARS-CoV-2-positive group both had grade A pancreatic fistula (CD grade I); both had no signs of pneumonia on pre-treatment chest CT and no history of COVID-19 vaccination. Owing to the small number of deceased patients as well as patients with postoperative complications, statistical analysis of the relationship between CT stage or history of COVID-19 vaccination and mortality and morbidity could not be performed.

Statistical follow-up analyses could not be conducted in most treated patients owing to their dispersion to primary and secondary care centers across the country, according to their residence, and subsequent loss of contact with the institution where this study was performed.

Discussion

The present study included patients with various causes of obstructive jaundice who were treated before and during the COVID-19 pandemic in a single tertiary care center in Serbia. The two groups of patients (SARS-CoV-2 positive versus SARS-CoV-2 negative) were similar regarding sex and age distribution, comorbidities, diagnoses, and the treatment received. The most common cause of obstructive jaundice was pancreatic cancer, in both groups and the total sample. SARS-CoV-2-positive patients expressed lower inflammatory parameters (WBC count, CRP, and IL-6 levels) as well as higher AST levels than the SARS-CoV-2-negative group. A small study from Wuhan, China (30 patients who underwent emergency surgery between 15 January and 15 March 2020) found lower pre- and postoperative lymphocyte counts as well as higher AST and ALT levels in patients with COVID-19 infection, as compared with COVID-19-negative patients.[2] Despite that study not including any patients with jaundice, the noted difference in AST levels between patients who were COVID-19 positive and negative is similar to the results of the present study. The difference in liver function tests as well as lower WBC counts may be attributable to COVID-19 infection itself. However, higher CRP and IL-6 levels in the first group may be owing to a greater number of patients with gallstone disease and subsequent inflammatory conditions, such as cholecystitis or choledocholithiasis associated with cholangitis.

In 2020, the Society of Surgical Oncology recommended surgical treatment

for aggressive hepato-pancreato-biliary malignancies, as indicated.[15] Delaying surgery for 7 weeks after SARS-CoV-2 infection has been suggested to avoid postoperative complications related to COVID-19. However, the risk of disease progression shifts this paradigm in a risk–benefit manner.[6] In 2022, Sandblom et al. published a study comparing patients undergoing surgery for gallstone disease during 2015–2020 and patients who underwent surgery between April 2020 and March 2021 (78,211 procedures). Those authors found a moderate increase in the rate of procedures performed owing to obstructive jaundice, acute cholecystitis, or biliary pancreatitis during the pandemic (56.2% of all surgeries during the pandemic versus 47.9% in the pre-pandemic period), probably owing to the increase in gallstone-related complications. During the pandemic period included within that previous study, 2080 surgeries were performed for obstructive jaundice, in contrast to the mean annual number of similar surgeries before the pandemic, which was 1522. There was no increase in ERCP cases performed for CBD stones during the pandemic.[3] The present study focused on patients with obstructive jaundice whose total bilirubin levels (mean value 266.1 μmol/L) indicated accelerated treatment. The time-sensitive nature of treating patients with jaundice (via surgery or endoscopic treatment) creates a specific situation that can be considered semi-urgent owing to the multisystem consequences of obstructive jaundice.[12] A study by Düzenli and Köseoğlu dealing with the effects of enhanced personal protective equipment showed that the number of ERCP procedures remained unchanged during the pandemic, highlighting how biliary tree disease represents a medical emergency requiring prompt treatment. Nearly 90% of patients in that study had benign obstruction caused by gallstones.[16] A similar conclusion was reached by Tag-Adeen et al. in which most patients also had gallstone disease.[17] A study by Barabino et al. among patients with acute cholecystitis during the initial phase of the COVID-19 pandemic in Italy shed new light on the role of percutaneous cholecystostomy in the COVID-19 era.[18] A web-based survey conducted between 30 March and 5 April 2020 among 36 hepato-pancreato-biliary surgeons from 14 countries revealed a drastic decrease in the cholecystectomy rate for cholelithiasis.[1] This delay in treatment for gallstone disease naturally increases the backlog of patients requiring surgery, as well as the risk for gallstone disease complications including obstructive jaundice caused by choledocholithiasis. Layton et al. showed that ERCP procedures in their 2020 cohort had a significantly longer average duration than procedures in the 2019 cohort (40.3 versus 30 minutes), suggesting greater disease severity owing to delayed treatment.[19] In our study, most patients from the first group underwent appropriate surgery, although there was a slight shift toward PTBD in the second group. Moreover, the number of patients treated for obstructive jaundice was reduced by nearly half during the COVID-19 pandemic, probably owing to patients' general hesitation to seek treatment during the pandemic.

We found no significant difference regarding the postoperative complication rate and mortality rate between patients who were SARS-CoV-2 positive and negative. However, a difference was noted regarding the intragroup mortality rates, with 27.8% mortality in the SARS-CoV-2-positive group versus 8.6% in the negative group. It could be that having COVID-19 pneumonia during the time of treatment significantly aggravated the condition of patients in the second group, based on pre-treatment radiologic findings of deceased patients who were SARS-CoV-2 positive. Regarding postoperative

complications, a 2020 recommendation from the COVIDSurg Collaborative states that all patients with fever of unknown origin or respiratory symptoms should be isolated and chest CT performed or COVID-19 laboratory testing considered.[5] Doglietto et al. stated that a high index of suspicion can lead to early diagnosis of mild interstitial pneumonia in the postoperative period through prompt COVID-19 testing upon occurrence of any signs suggestive of the disease.[10] In our study, however, all patients in the second group underwent routine PCR testing on admission. Because they all tested positive for SARS-CoV-2 infection, a chest CT was performed before the initiation of treatment for obstructive jaundice.

A study among 7402 patients with cancer, among whom 11.5% had hepato-pancreato-biliary cancer, showed a significantly greater mortality rate during the pandemic (2% versus the pre-pandemic 0.7%). Furthermore, COVID-19-related pulmonary complications had higher odds of death than pulmonary complications without SARS-CoV-2 infection.[20] Lei et al. published a study conducted among 34 patients who received elective surgery between 1 January and 5 February 2020 and who had direct exposure to Wuhan City before surgery. The study showed that patients with COVID-19 pneumonia during the postoperative period were more likely to be admitted to the intensive care unit if they were older and had more comorbidities, owing to the development of respiratory distress syndrome, shock, secondary infection, or acute cardiac injury.[21]

Most patients included in studies regarding the influence of COVID-19 on postoperative complications and the mortality rate underwent urgent or emergency surgery.[2,4,9,10,22] Doglietto et al. published a study in 2020 on patients undergoing surgery between 23 February and 1 April 2020 in Brescia, Italy who had positive COVID-19 test results (either before or within 1 week after surgery). COVID-19-positive patients had significantly higher preoperative CRP, D-dimer, and fibrinogen levels than matched patients without COVID-19. Pulmonary and thrombotic complications were more common in the COVID-19 group, and their 30-day mortality rate was also significantly higher compared with COVID-19-negative patients (with an odds ratio of 9.5). Approximately 90% of both COVID-19 and non-COVID-19 patients underwent urgent surgery.[10] A similar conclusion was reached in a Dutch study where a matched analysis showed a 30-day mortality rate of 12.2% in the COVID-19-positive group of surgical patients, compared with 4.6% in the COVID-19-negative group. COVID-19 positive patients had pulmonary and thromboembolic complications significantly more often than patients without COVID-19.[8]

The results of the multicenter COVIDSurg study (1 January to 30 June 2020) among 1581 patients in the United States who underwent surgery with perioperative SARS-CoV-2 infection (confirmed within a week before or 30 days after surgery) showed that 22.8% of patients had pneumonia and 15.3% had acute respiratory distress syndrome (ARDS). Patients with pulmonary complications had a 30-day mortality rate of 24.4% whereas the overall 30-day mortality rate was 11%. Factors significantly associated with postoperative mortality were age $\geq$70 years, male sex, American Society of Anesthesiologists (ASA) grades 3–5, malignant indication for surgery, emergency surgery, postoperative WBC count $\geq$11.000/μL, respiratory comorbidity, and increased cardiac risk. Nearly 80% of all procedures were performed in an emergent fashion, usually for benign indications (72.9%). The authors stated that the mortality and pulmonary complication rates were higher than the

rates reported before the pandemic.[4] An earlier report from the COVIDSurg Collaborative (January to March 2020; 1128 patients from 24 countries) showed a higher mortality rate (32.8%) and a higher rate of pulmonary complications (51.2%) for the period during the pandemic. The 30-day mortality rate in patients with pulmonary complications was 38%. Risk factors associated with 30-day mortality in adjusted analysis were male sex, age $\geq$70 years, ASA grades 3–5, malignant disease, emergency versus elective surgery, and major versus minor surgery.[22] The conclusions of both these studies recommend postponing elective surgery and adopting non-operative management when clinically reasonable, particularly in men aged 70 years and older.[4,22] The COVIDSurg study also used the period from 1 February 2020 to 31 July 2020 to develop a model to predict mortality risk in patients with perioperative SARS-CoV-2 infection. The final model comprised four features: age, ASA score, Revised Cardiac Risk Index score, and preoperative respiratory support, with an area under the receiver operating characteristic curve of 0.73.[23]

Knisely et al. researched perioperative morbidity and mortality among patients with COVID-19 undergoing urgent or emergent surgery between 17 March and 15 April 2020 in New York City. Thirty-six patients (7.7% from the total sample of 468) were COVID-19 positive, and approximately half of them were asymptomatic. In total, 58.3% of patients with COVID-19 had postoperative complications, significantly more often than COVID-19-negative patients at 5.6%. Complications included cardiac arrest, shock, respiratory failure, pneumonia, acute kidney injury, and ARDS. In a matched analysis, the mortality rate in patients who were COVID-19 positive and negative was 17.7% versus 5.7%.[9]

In conclusion, our study showed that SARS-CoV-2-positive patients who underwent treatment for obstructive jaundice and had significant radiologic findings associated with COVID-19 pneumonia may have had an increased mortality risk. Therefore, patients with a suspected lower respiratory tract infection, such as COVID-19 pneumonia, may benefit from a thorough diagnostic workup including chest CT before treatment initiation. Whereas other similar studies have dealt with specific diseases such as gallstone disease or malignancy, this study encompassed multiple underlying causes of obstructive jaundice as well as various treatment modalities. Our study may inspire future research on the influence of viral respiratory infections, including COVID-19, on the early post-treatment outcomes of patients with obstructive jaundice.

Regarding the finding of no significant difference in the mortality rate, this should be understood in consideration of the small number of patients analyzed, which is a limitation of this study. Future studies should include more patients with obstructive jaundice to further elucidate the influence of COVID-19 pneumonia (occurring synchronously with a surgical/interventional radiologic procedure) on post-treatment mortality and complication rates. Additionally, multicenter studies including other tertiary care centers treating obstructive jaundice should be conducted. Further treatment analyses should also be performed using larger samples, such as comparing the types of surgery or percutaneous/endoscopic procedures received. In addition, the influence of other clinical and pathological factors (tumor histology and molecular or immunohistochemical markers, clinical stage of disease) should be assessed among a larger number of patients with obstructive jaundice.

Author contributions

BT – conception, design, supervision, materials, data collection and processing, analysis and interpretation, writing, critical review; BV – conception,

analysis and interpretation, literature review, writing, critical review; DZ – design, supervision, literature review, writing, critical review; BC – design, analysis and interpretation, literature review, writing; IN – materials, data collection and processing, literature review, writing; AS – design, analysis and interpretation, literature review, writing; DM – design, analysis and interpretation, literature review, writing; ST – analysis and interpretation, literature review, writing. critical review; RL – conception, analysis and interpretation, literature review, writing, critical review; VM – conception, design, supervision, data collection and processing, analysis and interpretation, writing, critical review.

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