An Evaluation of the Impact of COVID-19 on Cardiovascular Surgery

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ABSTRACT

Introduction: We aimed to describe the impact of COVID-19 among the patients who had cardiac surgery, with particular emphasis on pulmonary complications and 30-day mortality.

Patients and Methods: From March 2020 to June 2021, a total of 2267 patients underwent cardiovascular surgery at Koşuyolu High Specialization Training and Research Hospital.. Patients who tested SARS-CoV-2-positive by PCR perioperatively (seven days before or 30 days after surgery), despite testing negative at admission, were included. The primary endpoint of the study was 30-day mortality following surgery. The secondary endpoint was the development of pulmonary complications including acute respiratory distress syndrome (ARDS) or respiratory failure, which were defined according to the Berlin definition, and the need for mechanical ventilation for >48 h after the operation or the need for re-intubation after extubation.

Results: Eleven patients out of 2267 (0.48%) had a positive PCR test for COVID-19. In the postoperative period, seven patients were diagnosed with COVID-19 in the clinical wards, of whom three patients were re-admitted to the ICU. Nine patients had radiological pulmonary involvement. Five patients (45.5%) developed ARDS within four to seven days after a positive PCR test. Eight patients (72.7%) developed respiratory failure and required re-intubation, of whom two could not be extubated. Five patients (45.5%) died within 30 days, and seven (63.6) died during their hospital stay.

Conclusion: COVID-19 has a severe negative impact on the postoperative course of cardiac surgery patients in terms of cardiovascular outcomes, pulmonary complications, and mortality. Given the dramatic impact of COVID-19 infection on postoperative outcomes, it appears that deferring cardiovascular surgeries may be more suitable if COVID-19 positivity is detected.

Key Words: COVID-19; cardiac surgery; acute respiratory distress syndrome

COVID-19'un Kalp Damar Cerrahisi Üzerindeki Etkisinin Değerlendirilmesi

ÖZET

Giriş: Kalp cerrahisi geçiren hastalarda Koronavirüs Hastalığı (COVID-19) etkisini, özellikle pulmoner komplikasyonlar ve 30 günlük mortaliteye vurgu yaparak tanımlamayı amaçladık.

Hastalar ve Yöntem: Mart 2020-Haziran 2021 tarihleri arasında Koşuyolu Yüksek İhtisas Eğitim ve Araştırma Hastanesinde toplam 2267 hastaya kalp ve damar cerrahisi uygulandı. Başvuru sırasında PCR testi negatif olmasına rağmen, operasyon öncesi ve sonrasında (ameliyattan yedi gün önce veya 30 gün sonra) PCR testi yapılan ve SARS-CoV-2 tespit edilen hastalar çalışmaya dahil edildi. Çalışmanın birincil sonlanım noktası, ameliyattan sonraki 30 günlük mortalite olarak belirlendi. İkincil sonlanım noktası ise, Berlin kriterlerine göre tanımlanan akut respiratuar distres sendromu (ARDS) veya solunum yetmezliği gibi pulmoner komplikasyonların gelişmesi ve ameliyattan sonra >48 saat mekanik ventilasyon ihtiyacının olması veya ekstübasyondan sonra yeniden entübasyondu.

Bulgular: 2267 hastanın 11'inde COVID-19 PCR pozitifliği (%0.48) tespit edildi. Ameliyat olduktan sonra servise çıkarılan yedi hastaya COVID-19 teşhisi kondu ve bunlardan üçü yoğun bakım ünitesine yeniden yatırıldı. Dokuz hastada radyolojik akciğer tutulumu vardı. Beş hastada (%45.5) pozitif bir PCR testinden sonra dörtle yedi gün içinde ARDS gelişti. Sekiz hastada (%72.7) solunum yetmezliği gelişti ve mekanik ventlasyon ihtiyacı oldu. Bu hastalardan ikisi mekanik ventilatörden ayrılamadı. Beş hasta (%45.5) 30 gün içinde, yedi hastaysa (%63.6) hastanede kaldıkları süre içinde kaybedildi.

Sonuç: COVID-19'un kardiyovasküler sonuçlar, pulmoner komplikasyonlar ve mortalite açısından kalp ameliyatı geçiren hastaların ameliyat sonrası seyri üzerinde olumsuz etkisi bulunduğu saptanmıştır. COVID-19 pozitifliğinin tespit edilmesi durumunda, COVID-19 enfeksiyonunun postoperatif sonuçlar üzerindeki dramatik etkisi de göz önüne alındığında, kardiyovasküler ameliyatların ertelenmesinin daha uygun olabileceği görülmektedir.

Anahtar Kelimeler: COVID-19; kalp cerrahisi; akut respiratuar distres sendromu

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has had drastic effects on healthcare systems globally. This virus not only causes infection but also substantially complicates the usual course of treatment in many aspects; elective surgeries have been postponed or canceled, patients with chronic diseases have been deprived of hospital visits and controls, and available intensive care unit (ICU) resources have been extensively allocated to COVID-19 patients, etc. Studies have shown that mortality is increased in the presence of cardiovascular diseases such as hypertension, coronary artery disease, and diabetes[1,2]. One typical example of COVID-19-associated disruptions has been in the field of elective cardiac surgeries, which involve the use of a wide range of hospital resources including personnel, equipment, hospital beds, protective equipment, and laboratory tasks[3].

Despite a considerable length of time spanned after the onset of the pandemic, data are limited about the impact of COVID-19 on the postoperative course of patients undergoing cardiovascular surgeries. This study aimed to evaluate the impact of COVID-19 on patients after cardiac surgery, with particular emphasis on pulmonary complications and 30-day mortality.

PATIENTS and METHODS

From March 2020 to June 2021, a total of 2267 patients underwent cardiovascular surgery at Koşuyolu High Specialization Training and Research Hospital, a 465-bed tertiary referral center in İstanbul, Türkiye, with three intensive care units (ICU) (adult cardiovascular surgical ICU, pediatric cardiovascular surgical ICU, coronary ICU) as well as cardiovascular surgery clinics (one for pediatric cardiovascular surgery), gastroenterology surgery clinic, transplantation clinic, and cardiology clinics. Since the onset of the pandemic, all patients admitted to the hospital have been tested for COVID-19. If the PCR test was positive, elective surgeries were postponed. Urgent/emergency surgeries were performed taking protective measures. PCR-positive patients were isolated in a specialized area for COVID-19 and were closely followed by the infection control committee. Hospitalized PCR-negative patients were also supervised for isolation and COVID-19 symptoms.

All patients were screened for COVID-19 at admission and/or in the postoperative period by reverse transcriptase–polymerase chain reaction assay (PCR) of nasopharyngeal swabs. Inclusion criteria were PCR-confirmed COVID-19 infections detected within seven days before or 30 days after surgery irrespective of age. In the presence of multiple cardiac operations during the same hospitalization period, the one closest to the time of a positive PCR test was taken into consideration for analysis.

The primary endpoint of the study was 30-day mortality following surgery. The secondary endpoint was the development of pulmonary complications including acute respiratory distress syndrome (ARDS) or respiratory failure, which were defined according to the Berlin definition and the need for mechanical ventilation for >48 h after the operation or the need for re-intubation after extubation, respectively[4,5]. The study was approved by the institutional review board of the Koşuyolu High Specialization Training and Research Hospital (2021/12/534).

Statistical Analysis

Data were analyzed using SPSS Statistics 20. The normal distribution of continuous variables was checked by Kolmogorov-Smirnov test. Normally and non-normally distributed variables were reported as mean ± standard deviation and median (Interquartile range) respectively.

RESULTS

During the study period, PCR-confirmed COVID-19 was detected in 11 patients. The median age was 58 years (IQR 42-66), and four patients were female (Table 1). Two patients were pediatric cases aged one and 12 years. Comorbidities included diabetes mellitus (n= 5), hypertension (n= 4) and chronic obstructive pulmonary disease (n= 2) (Table 2).

All patients contracted COVID-19 during the hospitalization period. PCR testing was performed because of fever (n= 5), sudden-onset dyspnea (n= 3), contact history with a COVID-19-positive family member or COVID-positive patients (n= 2), and preoperative screening (n= 2). COVID-19 diagnoses were made on pre-operative day one in two patients and from one to 20 days (median six days) postoperatively in nine patients (Table 2). Surgical procedures included isolated coronary artery bypass grafting surgery (n= 5), coronary artery bypass grafting and carotid endarterectomy[1], mitral valve replacement (n= 1), thoracic endovascular aortic repair, and ascending aorta stent-grafting (n= 1), tetralogy of Fallot repair (n= 1), atrial septal defect repair (n= 1) and sternal wound reconstruction (n= 1) (Table 1). One patient required re-operation due to bleeding. All patients underwent on-pump cardiac surgery and received routine postoperative care and monitoring in the adult or pediatric cardiothoracic ICU. The median intubation time postoperatively was 14 hours (IQR 7.5-21.5).

The median length of hospital stay was 21 days (IQR 14-32), and the median preoperative hospital stay was five days (IQR 1-14) (Table 2).

Table 1. Demographics and surgical outcomes of patients diagnosed with COVID-19

Patients no	Gender	Age (years)	Date of a negative PCR test	Date of a positive PCR test	Type of surgery	Day of ARDS after operation	Respiratory failure	Day of fatal outcome after operation
1	Male	65	Preoperative 6	Preoperative 1	CABG carotid endarterectomy	Postoperative 5	Re-intubation	Day 9
2	Female	67	Preoperative 2 Preoperative 4	Postoperative 20	MVR	Postoperative 24	Re-intubation	Day 28
3	Female	56	Preoperative 7	Postoperative 7	CABG	None	None	Survived
4	Male	68	Preoperative 1	Postoperative 6	CABG	None	None	Survived
5	Female	1	Preoperative 7	Postoperative 4	TOF repair	None	Re-intubation	Survived
6	Male	50	Preoperative 1	Postoperative 2	AASG TEVAR	None	No extubation	Day 4
7	Male	12	Preoperative 2	Postoperative 1	ASD Repair	None	None	Survived
8	Male	66	Preoperative 11	Preoperative 1	AASG+ TEVAR	None	Re-entubation	Day 20
9	Male	64	Preoperative 6	Postoperative 1	CABG	None	No extubation	Day 8
10	Female	58	Postoperative 1, 2, 3, 4	Postoperative 15	CABG	Postop 22	Re-entubation	Day 32
11	Male	42	Preoperative 3	Postoperative 5	CABG	Postoperative 12	Re-entubation	Day 188

CABG: Coronary artery bypass grafts, COVID-19: Coronavirus 2019, MVR: Mitral valve replacement, TOF: Tetralogy of fallot, AASG: Ascending aorta stent-grafting, TEVAR: Thoracic endovascular aortic repair, ASD: Atrial septal defect, SWR: Sternal wound reconstruction.

In the postoperative period, seven patients were diagnosed with COVID-19 in the clinical wards, of whom three patients were re-admitted to the ICU. Eight adult patients received favipiravir therapy, one patient received favipiravir and hydroxychloroquine, whereas pediatric patients received no therapy for COVID-19. All but two patients had radiological pulmonary involvement. Five patients (45.5%) developed ARDS within four to seven days after a positive PCR test. A lung-protective strategy was applied to all ARDS patients. One patient (Patient 11) required extracorporeal life support seven days after the operation. Eight patients (72.7%) developed respiratory failure and required re-intubation, of whom two could not be extubated. The 30-day mortality rate was 45.5%, the in-hospital mortality rate was 63.6% (Table 2).

DISCUSSION

We identified 11 patients who were found to contract COVID-19 during hospitalization for cardiovascular surgery from March 2020 to June 2021. Nine of these patients contracted COVID-19 after a median of six days (range 1-20) postoperatively. During the study period, 2267 patients underwent cardiovascular surgery at our hospital, which is a dedicated referral center for cardiovascular diseases and surgery. After the first reported case of COVID-19 by the Turkish authorities on March 11, 2020, elective surgeries were cancelled or postponed till June 1, 2020, at our center. After this date, the limitation for elective surgeries was abolished, with the requirement of an admission PCR-test and/or CT scanning. Given these circumstances, the incidence of COVID-19 was 0.5%, which is remarkably lower than the reported rates ranging from 3.5% to 7.7% in the literature[6-8]. Of note, the time interval for analysis was remarkably longer in our study (16 months) compared with reported intervals of three to four months[6,8,9].

Data on patients undergoing cardiovascular surgery are limited with respect to COVID-19- associated mortality, with only one comprehensive international, multicenter study reporting a 30-day mortality rate of 34% among 50 patients undergoing cardiac surgery during the pandemic[9]. Two other multicenter studies from Italy and UK reported in-hospital mortality rates of 20.8 and 24.5%, respectively, among COVID-19 patients undergoing cardiovascular surgery[6,8]. In our study, 30-day mortality was 45.5%. This high mortality rate may be associated with the small sample size and the severity of COVID-19 infection.

The postoperative course of cardiovascular surgery in patients with COVID-19 is more frequently complicated by pulmonary complications than in those undergoing other surgeries[7-9]. This may be due to the fact that cardiovascular surgeries pose additional risks for pulmonary complications, with the longer operation time, use of cardiopulmonary bypass, and the

Table 2. Preoperative and postoperative data of COVID-19-positive patients undergoing cardiovascular surgical procedures

Timing of COVID-19 diagnosis	
Preoperative, n (%)	2 (18.2%)
Postoperative, n (%)	9 (81.8%)
Age (years)	58 (IQR 42-66)
Gender (male/female)	7/4
Comorbidities	
Diabetes mellitus, n (%)	5 (45.5%)
Hypertension, n (%)	4 (36.4%)
Chronic obstructive pulmonary disease	2 (18.2%)
Surgical procedures, n (%)	
Isolated CABG	5 (45.5)
Congenital heart surgery	2 (18.2%)
CABG + Carotid endarterectomy	1 (9.1%)
AASG + TEVAR	1 (9.1%)
Valve surgery	1 (9.1%)
Sternal wound reconstruction	1 (9.1%)
CPB time (min)	127 (±41.9)
Operation time (min)	288 (± 67) (180-430)
ICU admission or readmission, n (%)	7 (63.6%)
Reoperation, n (%)	1 (9.1%)
Left ventricular ejection fraction %,	56 (± 11.3)
Laboratory findings	
White blood cell count, $\times 10^9$/L	11506 (±5322)
Lymphocyte count, $\times 10^9$/L	1306 (±1257)
Neutrophil count	9472 (±5066)
Hemoglobin, mg/dL	9.7 (±1.9)
C-reactive protein, mg/L	90 (±53)
Interleukin-6	146 (±84)
Complications	
Respiratory failure, n (%)	8 (72.7%)
Acute respiratory distress syndrome, n (%)	5 (45.5%)
30-day mortality, n (%)	6 (54.5%)
In-hospital mortality, n (%)	7 (63.6%)

Data are presented as mean ± SD or median (interquartile range) or n (%).
CABG: Coronary artery bypass grafts, AASG: Ascending aorta stent-grafting, TEVAR: Thoracic endovascular aortic repair, CPB: Cardiopulmonary bypass, ICU: Intensive care unit, IQR: Interquartile range.

need for blood transfusions being the leading risk factors[8-10]. In our study, eight patients developed respiratory failure and required re-intubation, two of whom could not be extubated. The incidence of pulmonary complications was 72.7%, which was considerably lower than 94% reported by a previous study[9].

Limitations

Being an observational study, its retrospective and single-center design are the main limitations of the present study. In addition, there were some inconsistencies with the guideline concerning PCR testing of the patients for COVID-19[9-11]. Although all patients were tested for COVID-19 at admission, not all patients underwent PCR testing 48 hours before their operations.

CONCLUSION

Our findings demonstrate that COVID-19 has a severe negative impact on the postoperative course of cardiac surgery patients in terms of cardiovascular outcomes, pulmonary complications, and mortality. Therefore, we must ensure timely PCR testing before cardiovascular surgical procedures. Given the dramatic impact of COVID-19 infection on postoperative outcomes, it appears that deferring cardiovascular surgeries may be more suitable if COVID-19 positivity is detected.

Ethics Committee Approval: The approval for this study was obtained from Kartal Koşuyolu High Specialization Training and Research Hospital Ethics Committee (Decision no: 2021/12/534, Date: 21.09.2021).

Informed Consent: This is retrospective study, we could not obtain written informed consent from the participants.

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