



Original study

How does preoperative SARS-CoV-2 time affect outcome parameters in open heart surgery?

Açık kalp cerrahisinde ameliyat öncesi SARS-CoV-2 süresi sonuç parametrelerini nasıl etkiler?

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ABSTRACT

In the present study, the purpose was to compare the outcome parameters before open heart surgery according to the time of Covid-19 infection in patients who had Covid-19. The primary outcome was 28-day mortality, secondary outcomes were length of stay in the Intensive Care Unit, length of hospital stay, and postoperative complications.

Patients, who were over the age of 18, who underwent open heart surgery between July 2021 and August 2022 in Izmir Katip Çelebi University Atatürk Training and Research Hospital Cardiovascular Surgery Clinic, were evaluated retrospectively. Those who had Covid-19 infection that was confirmed with the positivity of Polymerase Chain Reaction (PCR) before the surgery were included in the study. The patients were divided into 3 groups as those who underwent open heart surgery in the first 7 weeks following Covid-19, between 7-24 weeks and following 24 weeks. Patients who did not have preoperative Covid-19, those who underwent beating heart surgery, and patients who had postoperative Covid-19 were excluded from the study.

A total of 89 patients were evaluated. The mean age was 59.44±12.2 (23-81) years and 73% (n=58) patients were male. PCR positive-time to surgery was 33.72±25.86 (median 26.43) weeks. No difference was detected in terms of mortality and postoperative complications (bleeding, infection, acute neurological event, revision surgery, blood transfusion) among patients who underwent open heart surgery in the first 7 weeks, between 7-24 weeks and following 24 weeks following the Covid-19 infection. No difference was detected between the groups in terms of duration of anesthesia, duration of surgery, duration of cardiopulmonary bypass, and cross-clamping. It was found that extubation times, hospital stays, and length of stays on mechanical ventilator were higher in patients who underwent open heart surgery 7 to 24 weeks following Covid-19 infection (p= 0.02, p=0.05, p= 0.009).

Although it was reported in the literature that surgery 7 weeks following Covid-19 infection is safe in terms of survival and morbidity, it was found in the present study that the duration of extubation, mechanical ventilation and hospital stays were prolonged in patients who were operated at a later period (up to the 24th week). We think that there is a need for further randomized controlled studies to evaluate the late effects of Covid-19 infection in open heart surgery.

Keywords: Open heart surgery; post COVID-19; timing of operation

ÖZET

Bu çalışmada amaç, Covid-19 geçiren hastalarda açık kalp ameliyatı öncesi sonuç parametrelerinin Covid-19 enfeksiyon zamanına göre karşılaştırılmasıdır. Birincil sonuç 28 günlük mortalite, ikincil sonuçlar ise Yoğun Bakım Ünitesinde kalış süresi, hastanede kalış süresi ve postoperatif komplikasyonlardır.

İzmir Katip Çelebi Üniversitesi Atatürk Eğitim ve Araştırma Hastanesi Kalp ve Damar Cerrahisi Kliniği'nde Temmuz 2021-Ağustos 2022 tarihleri arasında açık kalp ameliyatı geçiren 18 yaş üstü hastalar retrospektif olarak değerlendirildi. Ameliyat öncesi Polimeraz Zincir Reaksiyonu (PCR) pozitifliği ile teyit edilen Covid-19 enfeksiyonu olanlar çalışmaya dahil edildi. Hastalar Covid-19 sonrası ilk 7 hafta, 7-24 hafta arası ve 24 hafta sonrası açık kalp ameliyatı olanlar olarak 3 gruba ayrıldı. Ameliyat öncesi Covid-19 olmayan hastalar, atan kalp ameliyatı olanlar ve ameliyat sonrası Covid-19 geçiren hastalar çalışma dışı bırakıldı.

Toplam 89 hasta değerlendirildi. Ortalama yaş $59,44 \pm 12,2$ (23-81) idi ve hastaların %73'ü (n=58) erkekti. Ameliyat için PCR pozitif süresi $33,72 \pm 25,86$ (medyan 26,43) haftaydı. Açık kalp cerrahisi uygulanan hastalarda ilk 7 hafta, 7-24. haftalar ve takip eden 24. haftalarda mortalite ve postoperatif komplikasyonlar (kanama, enfeksiyon, akut nörolojik olay, revizyon cerrahisi, kan transfüzyonu) açısından fark saptanmadı. Covid-19 enfeksiyonu. Anestezi süresi, cerrahi süresi, kardiyopulmoner bypass süresi ve kros klemp süresi açısından gruplar arasında fark saptanmadı. Covid-19 enfeksiyonundan 7 ila 24 hafta sonra açık kalp ameliyatı geçiren hastalarda ekstübasyon süreleri, hastanede kalış süreleri ve mekanik ventilatörde kalış sürelerinin daha yüksek olduğu saptandı ($p=0,02$, $p=0,05$, $p=0,009$).

Literatürde Covid-19 enfeksiyonundan 7 hafta sonra cerrahinin sağkalım ve morbidite açısından güvenli olduğu bildirilse de bu çalışmada opere olan hastalarda ekstübasyon, mekanik ventilasyon ve hastanede kalış sürelerinin uzadığı (24. haftaya kadar) saptanmıştır. Açık kalp cerrahisinde Covid-19 enfeksiyonunun geç dönem etkilerini değerlendirmek için daha fazla randomize kontrollü çalışmalara ihtiyaç olduğunu düşünüyoruz.

Anahtar kelimeler: Açık kalp cerrahisi; post COVID-19; ameliyat zamanı

INTRODUCTION

COVID-19 caused a pandemic that led to an extremely widespread health crisis worldwide. Cardiac surgeries were also affected all over the world and open heart surgery applications had to be postponed in this process [1, 2]. COVID-19 is associated with poor survival in patients undergoing cardiac surgery, and available evidence suggests that patients with preoperative and perioperative SARS-CoV-2 infection have dramatically worsened postoperative outcomes [3, 4].

Today, clinicians are faced with patients who have had COVID-19 in operating rooms and the difficulties of when to be operated. According to the COVID Surg Collaborative data, a worldwide collaborative effort to investigate the surgical effects of the COVID-19 pandemic, elective surgery in the first 7 weeks from PCR positivity to surgery was associated with increased post-operative survival and complications [5].

The situation is even more difficult for most patients who must undergo open heart surgeries since the timing of surgery is time-sensitive and there is an increased risk of morbidity and mortality in the event that operations are postponed. Most recommendations are based on expert opinions because of the limited evidence in the literature on the ideal timing for cardiac surgery [6]. Also, there is a limited number of studies that compare the clinical outcomes of post-COVID-19 patients who undergo open heart surgery following the infection.

In the present study, the purpose was to compare the outcome parameters according to the time of preoperative COVID-19 infection in patients who had COVID-19 before open heart surgery. The

primary outcome was 28-day mortality, secondary outcomes were length of stay in the Intensive Care Unit, length of hospital stay, and postoperative complications.

MATERIAL and METHOD

Patients who were over the age of 18 who underwent open heart surgery between July 2021 and August 2022 in Izmir Katip Çelebi University Atatürk Training and Research Hospital Cardiovascular Surgery Clinic were evaluated retrospectively. Those who had COVID-19 infection that was confirmed with the positivity of Polymerase Chain Reaction (PCR) before surgery were included in the study. The patients were divided into 3 groups as those who underwent open heart surgery in the first 7 weeks, between 7-24 weeks, and following 24 weeks following COVID-19 infection. Patients who did not have preoperative COVID-19, those who had beating heart surgery and patients who had postoperative COVID-19 were excluded from the study.

The demographic data of patients, European System for Cardiac Operative Risk Evaluation 2 (Euroscore 2), American Society of Anesthesiologist (ASA) classification, concomitant diseases, type of operation [Coronary Artery Bypass Graft Surgery (CABG), Aortic Valve Replacement (AVR), Mitral Valve Replacement (MVR), AVR and MVR, Valve + CABG, aneurysm, dissection] hemogram, biochemistry, coagulation parameters, transthoracic echocardiography findings, duration of anesthesia, duration of surgery, time of cross clamp, use of blood and blood products, amounts of bleeding, extubation times, re-intubation, mechanical ventilation duration, length of stay in the Intensive Care Unit and hospital,

amounts of post-operative drainage, 28-day mortality, causes of mortality, and postoperative complications were recorded. The study protocol was approved by the institutional Ethics Committee (Number 0131 / 23.03.2023).

RESULTS

A total of 101 patients who had COVID-19 infection that was confirmed with PCR positivity before surgery were evaluated in the study. Eight patients were excluded because off-pump surgery was performed, and 4 patients were excluded because they had postoperative COVID-19 infection and a total of 89 patients were analyzed. The mean age was 59.44±12.2 (23-81) years and 73% (n=58) patients were male. The PCR positive-time to surgery was

33.72±25.86 weeks (median 26.43 weeks). The comparison of the demographic characteristics and comorbidities of the patients is given in (Table 1). The type of surgery was elective (83.1%) and emergency (16.9%.) and no statistically significant differences were detected between the three groups in terms of types of surgery (Table 2). The comparison of the intraoperative data of the patients is given in Table 3. It was found that the duration of extubation, length of hospital stays and length of stay on mechanical ventilator were high in patients who underwent open heart surgery between 7 and 24 weeks following COVID-19 infection (p= 0.02, p=0.05, p= 0.009, respectively) (Table 4). When all three groups were compared, no statistically significant differences were detected in terms of mortality and postoperative complications (Table 4).

Table 1: The comparison of the demographic characteristics and comorbidities of the patients

		0-7 weeks		7-24 weeks		Over 24 weeks		p-value
Age		57,5 [12]		62 [17,5]		62 [18,5]		0,424
Gender	Male	14	(100)	15	(60)	36	(72)	0,013
ASA score	ASA III	2	(14,3)	12	(48)	22	(44)	0,000
	ASA IV	3	(21,4)	9	(36)	27	(54)	
	ASA V	9	(64,3)	4	(16)	1	(2)	
Euroscore		4,08 [4,68]		3,2 [5,41]		1,61 [2,02]		0,006
EF (%)		55 [11,25]		55 [10]		60 [10]		0,482
BMI (kg/m²)		25,5 [4,5]		26 [4]		28 [4]		0,015
HT		8	(57,1)	17	(68)	32	(64)	0,795
DM		1	(7,1)	3	(12)	12	(24)	0,296
COPD		1	(7,1)	7	(28)	3	(6)	0,026
CAD		9	(64,3)	17	(68)	38	(76)	0,607
CKD		2	(14,3)	4	(16)	3	(6)	0,255
Preoperative Peripheral Thrombosis		1	(7,1)	5	(20)	5	(10)	0,442

*p<0.05 was considered statistically significant. Values are expressed as frequency (%) and median [IQR].
 **AF: atrial fibrillation, ASA: American Society of Anaesthesiologists, BMI: Body mass index, CAD: Coronary Artery Disease, CKD: Chronic Kidney Disease, COPD: Chronic obstructive pulmonary disease, DM: Diabetes mellitus, EF: ejection fraction, HT: Hypertension

Table 2: The comparison of the surgery types of the patients

		0-7 weeks		7-24 weeks		Over 24 weeks		p-value
Type of Surgery	Urgent	10	(71,4)	4	(16)	1	(2)	0,000
	Elective	4	(28,6)	21	(84)	49	(98)	
Type of Surgery								
CABG		10	(71,4)	14	(56)	34	(68)	0,533
If CABG, the number of the vessels		3 [3]		2 [2,5]		2 [3]		0,500
AVR		-	-	5	(20)	6	(12)	0,189
MVR		2	(14,3)	2	(8)	5	(10)	0,784
AVR+MVR		-	-	-	-	1	(2)	1,000
Valve+CABG		-	-	3	(12)	1	(2)	0,182
Aortic Aneurysm		-	-	3	(12)	5	(10)	0,601

Aortic Dissection	2	(14,3)	1	(4)	-	-	0,024
Tricuspid Annuloplasty	-	-	-	-	1	(2)	1,000
AF Ablation	-	-	-	-	2	(4)	0,678
PFO Closure	1	(7,1)	-	-	1	(2)	0,366

*p<0.05 was considered statistically significant. Values are expressed as frequency (%) and median [IQR].
 ** AF: Atrial fibrillation, AVR: Aortic valve replacement, CABG: Coronary Artery Bypass Graft, PFO: Patent foramen ovale, MVR: Mitral valve replacement

Table 3: The comparison of the intraoperative data of the patients

	0-7 weeks	7-24 weeks	Over 24 weeks	p-value
Anesthesia Time [min]	232,5 [106,25]	265 [85]	240 [52,5]	0,276
Surgery Time [min]	212,5 [95]	245 [90]	220 [48,75]	0,314
Pump Time [min]	76,5 [36,25]	95 [48]	80 [37,25]	0,361
Cross Clamp Time [min]	42,5 [29]	64 [41,5]	43,5 [32]	0,305
Peroperative Total Bleeding [ml]	400 [225]	500 [325]	400 [300]	0,380
Peroperative PRBC	1 [0]	1 [1]	1 [0,5]	0,143
Peroperative FFP	1 [0,25]	1 [1]	1 [1]	0,718

*p<0.05 was considered statistically significant. Values are expressed as frequency (%) and median [IQR].
 **FFP: Fresh-Frozen Plasma PRBC: Packed Red Blood Cells

Table 4: The Comparison of the Postoperative Data and Mortality Rates of the Patients

		0-7 weeks		7-24 weeks		Over 24 weeks		p-value
Revision Surgery								
Revision Surgery Type	Bleeding	1	(100)	3	(60)	6	(75)	0,467
	Open Sternum	-	-	2	(40)	-	-	
	Debridement	-	-	-	-	2	(25)	
Peripheral Thrombosis	-	-	1	(4)	-	-	0,434	
Bleeding	1	(7,1)	4	(16)	10	(20)	0,579	
Acute Neurological Event	-	-	-	-	5	(10)	0,217	
Pneumonia	2	(14,3)	3	(12)	3	(6)	0,398	
Postoperative PRBC	1 [0,5]		1 [0]		1 [1]		0,353	
Postoperative FFP	1,5 [1,25]		1,5 [1]		2 [1]		0,728	
Postop. Extubation Time [min]	540 [495]		630 [420]		540 [180]		0,020	
Failed Extubation	3	(21,4)	3	(12)	2	(4)	0,078	
Prolonged Weaning	7	(50)	19	(76)	28	(56)	0,166	
MV Duration [min]	540 [495]		600 [270]		540 [180]		0,050	
Length of Stay in ICU [days]	3,5 [2]		4 [3]		3 [1]		0,079	
Length of Stay in Hospital [days]	12,5 [6,75]		18 [10,5]		13,5 [10]		0,009	
Mortality	1	(7,1)	2	(8)	2	(4)	0,553	
Cause of Deficiency	Pneumonia	1	(100)	-	-	-	-	0,605
	Septic shock	-	-	1	(50)	-	-	
	MODS	-	-	1	(50)	2	(100)	

*p<0.05 was considered statistically significant. Values are expressed as frequency (%) and median [IQR].
 **FFP: Fresh-Frozen Plasma ICU: Intensive care unit, MODS: Multiple organ dysfunction syndrome, MV: Mechanical Ventilation, PRBC: Packed Red Blood Cells

DISCUSSION

Studies conducted in the early stages of the pandemic show that peri-operative SARS-CoV-2 infection is associated with clinically increased mortality and morbidity rates [7, 8]. Nowadays when the pandemic is left behind, studies to determine the optimal time between SARS-CoV-2 infection and surgery in terms of postoperative complications and mortality have come to the forefront.

According to the results of a prospective cohort study, it was reported that the mortality rate was found to be high in elective surgeries that were performed within 0-2 weeks following COVID-19 infection and patients who underwent surgery 7 weeks or more following infection had a similar survival rate to patients who did not have COVID-19. In the present study, patients who had traumas, malignancy surgeries and obstetric surgeries were evaluated [5]. In thoracic surgery, Recommendations of the European Association of Cardiothoracic Anesthesiology and Intensive Care (EACTAIC) was used, which states the timing of surgical procedures following SARS-CoV-2 infection and recommends deferring surgical procedures for at least seven weeks following SARS-CoV-2 infection whenever possible. However, it was emphasized that the urgency of the COVID-19 operation and the comorbidities of the patients and post COVID-19 sequelae should also be taken into consideration [9]. Recommendations for the cardiac surgery population are limited, as most of the literature data indicate only a small percentage of open heart surgery patients [6].

According to the current the American Society of Anesthesiologists and Anesthesia Patient Safety Foundation Joint Statement Guide, it is recommended that a multidisciplinary team discuss the risks and benefits of elective surgery to be performed in the first 7 weeks following infection in a patient with COVID-19 infection to reduce postoperative complications and improve surgical outcomes [10].

A total of 71.4% of the patients who underwent surgery within 7 weeks of COVID-19 infection were operated with an emergency indication in the present study. When the groups were compared according to the operation types and timing, no differences were detected in terms of operation types, emergency and elective surgeries, and they had a similar distribution ratio. The PCR-positive-median time to surgery was 26.43 weeks in the present study. We think that our findings reflect the late effects of the pandemic.

In a comprehensive and retrospective study conducted by Deng et al. in the early period of the pandemic, patients were divided into groups as those who were operated in the first 4 weeks following the infection, those who were operated between 4-8 weeks, and those who were operated following 8 weeks following their diagnosis, and it was reported that the surgery performed within 4-8 weeks was associated

with an increased risk of postoperative pneumonia and respiratory failure. In this study, the sample group included all types of surgery [11].

When complications such as bleeding, pneumonia, acute neurological event, revision surgery, and blood transfusion were compared in the present study, the rate of postoperative pneumonia was found to be the highest in the group operated in the first 7 weeks following COVID-19 infection (14.3%), but there was no significant difference between the groups.

According to the results obtained in the present study, when the patients who underwent open heart surgery between 7 and 24 weeks following COVID-19 infection and those who were operated 7 weeks before and after 24 weeks were compared, it was found that the duration of extubation, length of hospital stay, and length of stay on mechanical ventilator were high in the patients who underwent open heart surgery between 7 and 24 weeks following COVID-19 infection. According to our findings, we think that patients with preoperative COVID-19 must be evaluated clinically in the first 24 weeks following open heart surgery.

It is reported in the literature that the long period between SARS-CoV-2 infection and surgery reduces postoperative mortality [12]. In the present study, however, we did not find a significant difference in terms of mortality according to the time of COVID-19 infection. Although this finding is not compatible with the literature data, it may have occurred because of the small number of our patients.

It was reported that perioperative mortality occurs largely because of pulmonary and thromboembolic and septic complications in patients with COVID-19 [13-15]. In the present study, the causes of mortality were ARDS, sepsis and multiorgan failure, and no deaths were detected because of thromboembolic events, and no differences were detected between the groups in terms of mortality causes.

Limitations

The present study was planned in the single-center and retrospective design, and we think that it must be supported by multicenter and prospective studies. The patient sample number was small. The study did not have a control group.

Conclusion

Although it was reported in the literature that surgery 7 weeks following COVID-19 infection is safe in terms of survival and morbidity, in the present study, it was found that the duration of extubation, mechanical ventilation and hospital stays were prolonged in patients who were operated at a later period (up to the 24th week), but no differences were detected in terms of mortality. We think that there is a need for further randomized controlled studies to

evaluate the late effects of COVID-19 infection in open heart surgery.

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