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Reorganizing as a COVID-Free Heart Center: Does It Really Matter for the Primary Percutaneous Coronary Intervention Endpoints During the COVID-19 Pandemic?

Covid'siz Bir Kalp Merkezi Olarak Yeniden Yapılanma: COVID-19 Pandemisi Primer Perkütan Koroner Girişimin Sonlanim Noktalari Için Gerçekten Önemli Mi?

Serhan Ozyildirim

Istanbul University, Cerrahpasa Institute of Cardiology, Department of Cardiology, Istanbul, Turkey

Abstract

Aim: Investigating the effects of the extraordinary environment produced by the COVID-19 pandemic on the angiographic endpoints of the primary percutaneous intervention is the main objective of the present study.

Material and Method: Data regarding the organizational arrangements as defining COVID-free heart centers during the first waves is scarce. 88 STEMI patients admitted between March 11, 2020, and June 11, 2020 (Group1) as well as the 79 Patients admitted in the same period of 2019 (group 2) were investigated. Two of the patients with positive COVID-PCR test results were transported to other centers. Analysis of the data from these admissions resulted in the enrollment of 70 patients for group 1 and 55 Patients for group 2. None of these cases had hospital acquired SARS CoV-2 infection during the follow-up. Therefore, no COVID-related morbidity or mortality was observed in this vulnerable group.

Results: When we analyzed the 88 primary percutaneous coronary intervention procedures of the non-COVID STEMI patients of the lockdown period and compared the 70 of them with the 50 STEMI patients of the previous year, the results were not that encouraging. Even our hospital was declared as a COVID-free cardiovascular center, there was a significant delay in the symptom-to-door time (SDT) during the pandemic (4.8 vs. 2.5 hours, respectively; P<0.001). Door-to-balloon time (DBT) for the lockdown period was not different than the prepandemic era. The main difference regarding the angiographic endpoints was in corrected TIMI frame counts (cTFC) which was significantly higher during the pandemic (32.9 vs. 27.3) (P<0.001). Furthermore, a powerful positive correlation between SDT and TFC was represented (R=0.731, p<0.001). Hospitalization duration was shortened during the pandemic (2.3 days in pandemic and 3.4 days in 2019, P<0.001). None of the patients had hospital-acquired infection and related morbidity. However, in-hospital mortality was significantly higher than the previous year's (11.4% vs. 1.8% respectively, P=0.039). TFC was found to be an independent predictor of in-hospital cardiac events (OR: 1.17, 95% CI: 1.05-1.31, P< 0.01).

Conclusion: These results suggest that, when we exclude morbidity and mortality resulting from hospital-acquired infection, reorganizing as a COVID-free cardiac center doesn't have satisfactory favorable impact on the adverse cardiovascular outcome during the pandemic, unless the public is well informed.

Keywords: COVID-19; percutaneous coronary intervention; STEMI

Öz

Amaç: COVID-19 pandemisinin oluşturduğu olağanüstü ortamın primer perkütan girişimin anjiyografik son noktalarına etkisinin araştırılması planlandı.

Gereç ve Yöntem: Pandemi döneminde COVID'siz kalp merkezlerini tanımlayan organizasyonel düzenlemelere ilişkin veriler azdır. 11 Mart 2020-11 Haziran 2020 tarihleri arasında başvuran 88 STEMI hastası (Grup 1) ve 2019 yılının aynı döneminde başvuran 79 hasta (Grup 2) incelendi. COVID-PCR testi pozitif çıkan hastalardan ikisi başka merkezlere sevk edildi. Ardından elde edilen verilerin analizi, grup 1'e 70 hastanın ve grup 2'ye 55 hastanın kaydıyla sonuçlandı. Bu vakaların hiçbirinde takip sırasında hastaneden edinilmiş SARS CoV-2 enfeksiyonu yoktu. Bu nedenle, bu hassas grupta COVID ile ilgili herhangi bir morbidite veya mortalite gözlenmedi.

Bulgular: Sokağa çıkma yasağı döneminde COVID olmayan STEMI hastalarının 88 birincil perkütan koroner girişim prosedürünü analiz ettiğimizde ve bunların 70'ini önceki yılın 50 STEMI hastasıyla karşılaştırdığımızda sonuçlar o kadar da iç açıcı değildi. Hastanemiz COVID'siz bir kardiyovasküler merkez olarak ilan edilse bile, pandemi sırasında semptomlardan kapıya kadar geçen sürede (SDT) önemli bir gecikme oldu (sırasıyla 4,8 - 2,5 saat; P<0,001). Karantina döneminde kapıdan balona geçen süre (DBT), pandemi öncesi dönemden farklı değildi. Anjiyografik sonlanım noktalarına ilişkin temel fark, pandemi sırasında önemli ölçüde daha yüksek olan düzeltilmiş TIMI frame count (cTFC) olmuştur (32,9 - 27,3, P<0,001). Ayrıca, SDT ile TFC arasında güçlü bir pozitif korelasyon gösterildi (R=0.731, p<0.001). Pandemi sırasında hastanede kalış süresi kısaldı (pandemide 2,3 gün ve 2019'da 3,4 gün, P<0,001). Hastaların hiçbirinde hastane kaynaklı enfeksiyon ve buna bağlı morbidite yoktu. Ancak, hastane içi ölüm oranı bir önceki yıla göre önemli ölçüde yüksekti (sırasıyla %11,4'e karşı %1,8, P=0,039). TFC'nin hastane içi kardiyak olayların bağımsız bir belirleyicisi olduğu bulundu (OR: 1.17, %95 GA: 1.05-1.31, P< 0.01).

Sonuçlar: Bu sonuçlar, hastane kaynaklı enfeksiyondan kaynaklanan morbidite ve mortaliteyi hariç tuttuğumuzda, COVID'siz bir kalp merkezi olarak yeniden yapılanmanın, halk iyi bilgilendirilmedikçe, pandemi sırasında olumsuz kardiyovasküler sonuç üzerinde tatmin edici olumlu bir etkiye sahip olmadığını göstermektedir.

Anahtar Kelimeler: COVID-19; perkütan koroner girişim; STEMI

Corresponding *(İletişim)*: Serhan Ozyildirim, Istanbul University, Cerrahpasa Institute of Cardiology, Department of Cardiology, Istanbul, Turkey
E-mail *(E-posta)*: serhanozyildirim@gmail.com
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INTRODUCTION

The coronavirus disease 2019 (COVID-19) has caused repeated waves of outbreaks across the globe since early 2020.[1,2] Following the detection of highly transmissible variants of the virus s Omicron causing superspreading events recently, it has been proposed that COVID-19 vaccines may be less effective against the new variant(s) and there may be a rise in morbidity and mortality again, resulting in a huge extra burden that threatens to overwhelm the health services.[3] New measures in the management of cardiovascular diseases during such extraordinary public health problems may be necessary again in the future.[4] Multiple studies have shown that many patients suffering myocardial infarction did not receive proper medical care during the first wave of the pandemic.[1] Approximately 30% reduction in emergency ambulance calls for chest pain and a significant delay in primary percutaneous coronary intervention (PPCI) during ST segment elevation myocardial infarction (STEMI) was reported owing to prolonged symptom onset to door time (SDT) and door to balloon time (DBT). These unfavorable effects of the pandemic gave rise to an increase in both in-hospital and long-term mortality of STEMI.[2,5-7] In addition to the admission delay, screening and infection control procedures, lack of rapid testing for COVID-19, scarcity of protective equipment for hospital staff and organizational delay further exacerbated the delay for revascularization, resulting in a negative impact on patient prognosis as an increase in in-hospital mortality.[8] It was suggested that reorganization of some cardiovascular centers as COVID-free centers may help to overcome these issues.[9] Being reorganized as a COVID-free tertiary cardiovascular center during the first wave and thereafter, we aimed to present our primary PCI experience.

Revascularization during acute myocardial infarction restores blood flow in the target vessel resulting in epicardial reperfusion which is not equal to myocardial perfusion. Latter is shown to be adversely affected from both symptom onset to balloon time (SBT) and DBT.[4] Therefore, any delay before or after the hospital admission harms the myocardial reperfusion. SBT itself is an independent predictor of microvascular reperfusion failure.[10]

The TIMI frame count (TFC), is a method defined by Gibson CM et al to objectively evaluate an index of coronary flow as a continuous quantitative variable by counting the number of cineframes needed for contrast medium to reach a standard distal coronary landmark in the infarct-related artery. TFC facilitates comparisons of angiographic end points and also provides information about microvascular perfusion.[11] In this study, we aimed to explore the angiographic endpoints of the interventions for ST-Segment Elevation Myocardial Infarction (STEMI) during the outbreak period by using TIMI frame count as a standardized method.

MATERIAL AND METHOD

Our center, a cardiology center with a 24-hour primary PCI facility, was determined and organized as a COVID-free center during the pandemic. COVID patients were not treated in our center. Patients with COVID, or suspicion of it, were not brought to our center. Moreover, all patients were checked with COVID-PCR test soon after hospitalization and the patient was transported to other hospitals if the result was positive. Therefore, study population was selected from COVID-free patients who were admitted to our hospital during the outbreak. This study was approved by the local ethical committee and the study was conducted in accordance with the Helsinki Declaration. The study was carried out with the permission of İstanbul Üniversitesi Cerrahpaşa Faculty of Medicine Clinical Researches Ethics Committee (Date: 18.03.2021, Decision No: 55570).

Study Design and patient selection

The study was planned as a retrospective analysis of inpatient data by surveying the emergency admissions that were diagnosed and internalized with acute coronary syndrome in the periods of the COVID-19 outbreak and the same period of the previous year. All subjects had ischemic symptoms and elevated cardiac troponin-T levels with ST-segment elevation on ECG. Each patient with ongoing acute STEMI underwent emergency primary PCI, regardless of the symptom onset or admission time. Inclusion and exclusion criteria are presented within the consort flow diagram. (**Figure 1**) Only the patients with type 1 myocardial infarction according to the fourth universal definition of myocardial infarction by using hs-cTnT (Elecsys; Roche Diagnostics) were included in both groups. 88 STEMI patients admitted between March 11, 2020, and June 11, 2020 (Group1) as well as the 79 Patients admitted in the same period of 2019 (group 2) were investigated. Two of the patients with positive COVID-PCR test results were transported to other centers. These and other 5 patients with COVID-infection history were excluded. Analysis of the data from these admissions resulted in the enrollment of 70 patients for group 1 and 55 Patients for group 2.

Acute coronary syndrome cases from March-June period of 2020 vs 2019 assessed for eligibility	
ACS 2020 n:273	ACS 2019 n:358
NSTEMI and MI other than type I STEMI (including vasospastic etiology); excluded n : 183 vs. n: 277	
Myocarditis; excluded n: 2 vs. n:2	
Type I STEMI cases	
n: 88	**n: 79**
Cases with insufficient data or missing values of potential confounders ;excluded n:9 vs. n:19	
n: 79	n:60
Active COVID infection (n:2) and COVID history (n:5); excluded n:7 vs. n:0	
n: 72	N: 60
Cardiogenic shock; excluded n:1 vs n:2	
n:71	n:58
Coronary artery abnormalities; excluded n:1 vs n:3	
n:70 (enrolled as group 1)	**n:55 (enrolled as group2)**

Figure 1. Study Flow Chart.
Abbreviations: STEMI: ST-segment-elevation myocardial infarction, NSTEMI: Non-ST-segment-elevation myocardial infarction

Data collection

Demographic characteristics of the patients were obtained from the medical record database of the hospital electronic system and symptom onset to admission time besides the first ECG recordings were received from patient files. Angiographic image recordings were reviewed and coronary flow was quantified by two experienced interventional cardiologists and controversial recordings were evaluated by a third senior interventional cardiologist. Three consecutive frames from the same phase of the cardiac cycle in the optimal projection that identified the stenosis in its greatest severity were selected for quantitative angiographic measurement. TFC was determined as the number of cineframes necessary for contrast to first reach a standard distal coronary landmark at a cinefilming rate of 30 frames per second. To objectively evaluate an index of coronary flow as a continuous quantitative variable, the number of cineframes required for contrast to first reach standardized distal coronary landmarks in the infarct-related artery (the TIMI frame count) was measured with a frame counter. The first frame used for TIMI frame counting was the first frame in which dye fully entered the artery. If the LAD was sub-selectively engaged and the LCx was the culprit vessel, the TIMI frame count began when dye first touched both borders at the origin of the LCx. The same rule was true for sub-selective engagement of the circumflex artery. In order to get the corrected TFC results, LAD counts were divided by 1.7 due to the longer length of LAD than RCA and LCx (11). In this sense, patients with coronary artery abnormalities were also excluded (Figure 1). Before the correction, normal TFC for LAD, LCx and RCA were regarded as 36±2.3, 22.2±3.8 and 21.7±2.8 respectively.

Statistical Analysis

Statistical analysis was performed by using SPSS for windows version 21 (Chicago, Illinois). Kolmogorov-Smirnov test was used to determine the distribution of continuous variables. Continuous variables with normal distribution were presented as mean±standard deviation by using Student's t-test. Non-normal distribution of independent samples was tested with Mann-Whitney U-test. Categorical data were tested with Pearson's chi-square test or Fisher's exact test and expressed as numbers and frequencies. Pearson correlation coefficient was used for the correlations between the continuous variables. Factors related to TFC were analyzed with binary logistic regression analysis. $P<0.05$ is accepted for statistical significance.

RESULTS

Baseline characteristics

Mean age of all study population was 58.8±10.3 and 21% of the subjects were female. Both COVID-19 period group and the control group were similar in terms of risk factors as smoking, diabetes, hypertension and hyperlipidemia. Baseline characteristics were depicted in **Table 1**. The blood test analyses of both groups also displayed no statistical difference except the admission troponin-T levels which was significantly higher in the patients of the COVID-19 period with 0.5±1.5 and 0.7±1.5 for the control and COVID-period groups respectively with a cut-off value of 0.014 (P <0.001) (**Table 1**).

Outcome measures

One of the main differences between two groups was obtained in the analysis of symptom-to-door time (SDT) defined as the length of the time period between the chest pain onset and emergency room admission. There was a significant delay in the presentations of the patients with myocardial infarction during the COVID-19 period when compared to the previous year (4.8±1.7 hours vs 2.5±1.4 hours, respectively; P<0.001). However, after hospital arrival, DBT was similar for both groups. (58.8±14 minutes vs. 62.1±12 minutes, P=0.09) (**Table 1**).

Table 1. Baseline Demographic Characteristics of Study Groups

	All Population (n:176)	Grup1 (n:70)	Grup 2 (n:55)	P value
Age (years)	58.8±10.3	57.6±11.5	60.3±8.5	0.161
Female (%)	21 (16.8%)	11 (15.7%)	10 (18.2%)	0.714
Smoker (%)	87 (69.6%)	48 (68.6%)	39 (70.9%)	0.778
DM (%)	63 (50.4%)	43 (61.4%)	20 (36.4%)	0.005
HT (%)	42 (33.6%)	25 (35.7%)	17 (30.9%)	0.572
HL (%)	54 (43.2%)	34 (48.6%)	20 (36.4%)	0.171
Anterior MI (%)	56 (44.8%)	27 (38.6%)	29 (52.7%)	0.114
SVD (%)	53 (42.4%)	28 (40.0%)	25 (45.5%)	0.306
LAD (%)	57%45.6%)	28 (40.0%)	29 (52.7%)	0.366
No-reflow (%)	15 (12.0%)	10 (14.3%)	5 (9.1%)	0.420
Hospitalization (days)	2.8±1.9	2.3±1.9	3.4±1.8	<0.001
Stent diameter	2.8±0.2	2.8±0.3	2.9±0.3	0.843
Stent length	24.9±7.6	24.8±7.3	25.1±8.1	0.911
SDT (hours)	3.8±1.9	4.8±1.7	2.5±1.4	<0.001
DBT (minutes)	60.6±13	62.1±12	58.8±14	0.09
TFC	30.5±8.2	32.9±7.4	27.3±8.3	<0.001
LVEF	42.8±8.1	42.2±8.2	43.6±7.9	0.342
First TnT	0.6±1.5	0.7±1.5	0.5±1.5	<0.001
In-hospital mortality (%)	9 (7.2%)	8 (11.4%)	1 (1.8%)	0.039
BUN	16.6±7.5	16.7±7.4	16.5±9.4	0.060
Creatinin	0.9±.4	0.9±0.2	1.0±0.6	0.990
GFR	91.3±25.2	90.2±24.0	92.8±26.7	0.570
Total cholesterol	177.4±51.5	181.6±52.8	172.1±49.7	0.309
LDL cholesterol	115.0±46.5	123.2±50.2	104.5±34.5	0.062
Triglyceride	166.4±119.4	164.4±82.2	168.8±155.2	0.341
WBC	11881.6±4594	11975.7±4729	11761.8±4458	0.877
Hemoglobin	14.5±1.6	14.6±1.3	14.4±1.9	0.519
Platelet	246±64	246±64	247±63	0.957
MPV	8.7±0.9	8.7±0.9	8.6±0.8	0.666

Values are expressed as mean±standard deviation (SD) or as median for continuous variables, or n (%) for categorical variables.
Abbreviations: BMI, body mass index; BUN, Blood urea nitrogen; CAG, coronary angiography; CABG, coronary artery bypass grafting; DBT, door-to-balloon time; DM, diabetes mellitus; GFR, glomerular filtration rate; HT, hypertension; HL, hyperlipidemia; LAD, left anterior descending artery (as the target vessel); LVEF, left ventricular ejection fraction; MI, myocardial infarction; MPV, mean platelet volume; PCI, percutaneous coronary intervention; SDT, symptom-to-door time; SVD, single vessel disease; TFC, TIMI frame count; TnT, Troponin T; WBC, white blood cell count.

Evaluation of the coronary angiogram and intervention recordings revealed 45.6% LAD target lesion without considerable difference between two groups. Contrary to the lesion location, the difference between the cTFC of the groups was significant (27.3±8.3 and 32.9±7.4 for control and COVID-19 period groups respectively; P<0.001). Frequency of no-reflow as angiographic end-point was approximate for both groups (9.1% vs 14.3% with a P value of 0.420) as well as the implanted stent size.

Length of hospital stay was 2.3±1.9 days for the patients who had myocardial infarction during the pandemic and this was significantly shorter than the 3.4±1.8 day hospitalization of the patients from the previous year (P<0.001). Contrary to the shorter length of hospitalization, in-hospital mortality of the COVID19 period patients was significantly higher than the patients of the control group (11.4% vs 1.8% respectively, P=0.039). The echocardiographic evaluation before discharge revealed no significant difference between both groups in terms of LVEF (43.6±7.9 vs 42.2±8.2, respectively; P= 0.342).

Among the variables of interest, correlation analysis displayed powerful positive correlation between the admission time and TFC with an R value of 0.731(P<0.001) and weaker positive correlation with initial troponin and DBT (R=0.201, P=0.025 and R=0.202, P=0.024 respectively) (**Table 2**).

Table 2: Spearman Correlation analysis of NT-proBNP and BDNF levels

	TFC	
	R (x2)	**P value**
SDT	731	<0,001
TnT	201	0,025
DBT	202	0,024

Abbreviations: DBT, door-to-balloon time; R: correlation coefficient; SDT, Symptom-to-door time; TnT, (Initial) troponin T level; TFC, TIMI frame count.

In order to determine the predictors of in-hospital cardiac event, defined as combined in hospital mortality and no-reflow phenomenon as an angiographic end point, DBT, SDT, TFC, LVEF and DM were analyzed by binary logistic regression. TFC was found to be the independent predictor of in-hospital cardiac events (OR: 1.17, 95% CI: 1.05-1.31, P< 0.01) (**Table 3**).

Table 3: Predictors of mortality and noreflow using binary logistic regression

	Event		
	OR	**%95 CI**	**P-value**
DBT	1,18	0,78-1,78	0,41
SDT	1,02	0,96-1,07	0,42
TFC	1,17	1,05-1,31	< 0,01
LVEF	0,99	0,92-1,06	0,85
DM	1,71	0,47-6,23	0,41

Abbreviations: DBT, door-to-balloon time; DM, diabetes mellitus; LVEF, ejection fraction; OR, Odds Ratio , Nagelkerke R2: 0.41; SDT, Symptom-to-door time; TFC, TIMI frame count

DISCUSSION

The main consequences of the present study can be summarized as:

No hospital acquired COVID infection was observed in our center. Hospital-acquired COVID infection may lead to increased mortality in patients with acute coronary syndrome (12). A prominent decrease ranging between 18 to 80% in the admissions with ST segment elevation myocardial infarction (STEMI) was reported all over the world during the pandemic (13). Fear of contagion was an important factor, and it wasn't such an unfounded fear. It was estimated that more than 11.3% of hospitalized patients with COVID-19 acquired the infection from hospitals during the outbreak and this proportion increased to more than 15% by the middle of May, 2020, months after the peak of admissions. During the same period of COVID, none of the 273 acute coronary syndrome patients, hospitalized and treated at our center, had hospital acquired COVID infection which might have been fatal in this vulnerable population. These data reveal the importance of COVID-free centers in reducing morbidity and mortality due to in-hospital transmission in a vulnerable patient group such as acute coronary syndrome.

We tried to explore the angiographic end points of the interventions for STEMI of the outbreak period by using TIMI frame count as a standardized method. Patients with Myocardial infarction arrived later to the emergency department of our center during the COVID-19 pandemic.

This result was in accordance with the results of the previous reports from all over the world suggesting a resistance of patients against utilizing health care system facilities globally. [1] COVID-19 pandemic resulted in increased morbidity and mortality of noninfectious medical emergencies which was related to an approximately 50% decline in emergency department admissions of patients including myocardial infarction cases. There was a dramatic increase in out of hospital cardiac arrests (OHCA) in March 2020 when compared to February 2020, proposing that patients had a tendency to wait too long to seek cardiac care. More than 20 % reduction in STEMI hospital admissions were reported in Europe during the lockdown period of the pandemic.[12-14] However, contrary to our results, time from symptom onset to admission in patients with STEMI was the same as before during the outbreak, and the interventional treatment of both STEMI and NSTEMI was also not affected in France. [14] De Rosa S et al presented from Italy that both patient- and system-related declared delays were substantially increased during the COVID-19 outbreak. In their multicenter nationwide study, time from symptom onset to coronary angiography for the patients with acute myocardial infarction was increased by 39.2% in 2020 compared with the previous year while the time from first medical contact to coronary revascularization was increased by 31.5%. They speculated that the possible reasons behind the delay might have been linked to both the fear of the virus contagion and also the occupation of the medical system with COVID-19 cases which might explain why the reduction in hospitalizations for STEMI (26.5%) was prominently less than with NSTEMI (65.1%). [15] SDT was longer for the STEMI patients in our study. The occupation of the EMS with COVID patients which could cause a system related delay that might share the responsibility for the pre-hospital delay in our study however, this subject is multifactorial. Our center is located in the city center of Istanbul and the heavy traffic in Istanbul is a time consuming factor which may prolong SDT. However, the lock down period decreased the load of traffic in Istanbul impressively which eased the reach of the patients to our hospital. Moreover, our organization for 7/24 PCI did not change during the outbreak. Therefore, it was expected for a patient with STEMI to get the same or even faster interventional treatment after his or her call for EMS during the pandemic when compared to the period without the pandemic, but our results were contrary to this expectation. TURKMI-2 registry presented that there were no significant delays between the pre-pandemic and pandemic periods in terms of the EMS patient transport durations for STEMI patients after first contact with the patient.[9] Therefore we speculate the main reason of the delay as the fear of the contagion. A reflection of the admission delay, as expected, was the significantly higher troponin levels of this group in our study which was another clue about the meaningfulness of the aforementioned delay. Our results about the pre-hospital delay were also compatible with the previous results from our country. Karagoz A et al presented a significant pre-hospital delay in both self and ambulance transported patients in Istanbul Turkey which was also concordant with another, nationwide study that compared 1113 patients from 48 centers in Turkey who had myocardial infarction during COVID pandemic with 1872 patients from pre-pandemic period.[9,16]

The TFC of the patients with STEMI during the COVID pandemic was significantly higher than the patients of the previous year

Since our hospital was selected as a COVID free cardiology center, all of our patients were proven to be COVID negative and seasonal variations were excluded. The period between symptom onset and target vessel revascularization during STEMI is important for angiographic results. Lee CH et al found that DBT >90 minutes, compared with ≤90 minutes, was independently associated with increased cTFC (>28) owing to possible microvascular obstruction. STEMI patients with DBT >90 minutes also had higher 30-day mortality.[17] Our DBT was around 60 minutes without any significant change during COVID pandemic. Therefore, we supposed that the reason behind the increased TFC was probably the pre-hospital delay.

The data about the factors affecting coronary flow by using TFC as a measure of angiographic end point after primary PCI is scarce. Most of the studies are about no-reflow phenomenon which can be regarded as the end of deteriorated coronary flow spectrum. Age, STEMI, delayed presentation (longer SDT) and cardiogenic shock on admission as clinical predictors and complex, bifurcation or longer coronary lesion, need for a glycoprotein IIb/IIIa inhibitor during PCI, pre-procedural TIMI flow grade 0, plaque features (burden, necrotic core size, and cap thickness on IVU-S) as the angiographic predictors of no-reflow were defined by the previous studies.[18-20]

Failure to achieve normal coronary flow after PPCI was shown to be associated with some other factors as systolic blood pressure on admission, total stent length, and baseline TIMI flow.[13] Interestingly, smoking and previous PCI had paradoxical preventive effect from no-reflow. The reason for the former is not known however the latter is thought to be related to antiplatelet use.[4]

We didn't evaluate all angiographic predictors of no-reflow since their relationship with cTFC was not clear from the previous studies. However, we recorded and analyzed the stent sizes which were similar for both groups. Our groups were identical in terms of smoking habit however their previous medications as well as GPIIb-IIIa inhibitor use were not evaluated. In previous studies, failure to restore normal coronary flow was presented to result in worse short-term clinical outcomes during PPCI.[13] Patients with AMI who developed no-reflow had greater mortality, both in the catheterization laboratory and during the overall hospitalization. The largest study with 182,467 STEMI patients demonstrated 2.7% no-reflow ratio.[20] In our study no-reflow percentage among STEMI patients was higher than this study by Robert WH et al, like the other previous smaller scale studies concluding the incidence of no-reflow during PCI as 11% to 41% of patients.[20] However, the relationship between SDT and no-reflow couldn't reach statistical significance, although it was higher for the patients suffered myocardial infarction during the pandemic of COVID-19 (9.1% vs 14.3%, P=0.420). This result was interpreted as being related to relatively small sample size of our study.

Gibson et al presented in the TIMI studies that the corrected TIMI frame count was an independent predictor of in-hospital mortality in patients with myocardial infarction.[21] Compatible with this result, our study revealed a statistically significant increase in the in-hospital mortality of myocardial infarction patients of the pandemic period when compared to the previous year (11.4% vs 1.8% respectively, P=0.039) although mean hospital stay was significantly shorter during the pandemic (2.3±1.9 vs 3.4±1.8 days respectively, P<0.001). The shorter stay of the patients was mainly attributed to four factors: The first one was the effort of the hospital management to keep the beds as unoccupied as possible which was a part of the nationwide precautions, the second was the fear of the hospital staff from possible contagion of any patient; the third factor was the willingness of the patients to leave the hospital as soon as possible when they feel good enough to go home and fourth was the shortage at the hospital staff due to rearrangement for the first COVID-19 wave precautions . We contemplate that it would be reasonable to study the long term mortality of these somehow prematurely discharged patients of COVID-19 period since the difference in between may go even wider gradually after the discharge.

Limitations

Small sample size and retrospective design were two main limitations of our study. We needed to combine mortality and no-reflow data to define the event rate. And another limitation was related to previous medication analyses including antiplatelets which might have an effect on coronary flow.

CONCLUSION

This study shows that COVID-free centers may be useful to prevent hospital acquired infections in vulnerable patient groups with cardiovascular diseases. However, delayed SDT in STEMI patients during the pandemic was also relevant for our COVID-free tertiary cardiology center where the risk of contagion was very low. Correlated with this pre-hospital delay, cTFC was longer which was found to be an independent predictor of in-hospital events. Effect of COVID-19 pandemic on human life has gone beyond the disease's morbidity or mortality potential. The fear was sometimes more devastating than the danger itself. In such occasions, more effort and organizational arrangements may be required to ensure that informing does not turn into intimidation which may negatively affect cardiovascular disease management. Further studies are needed to demonstrate the necessity of COVID-free centers to reduce the secondary unfavorable effects of this and other disasters on cardiovascular morbidity and mortality.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of İstanbul Üniversitesi Cerrahpaşa Faculty of Medicine Clinical Researches Ethics Committee (Date: 18.03.2021, Decision No: 55570).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

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