Outcomes of Primary Percutaneous Coronary Intervention in Post COVID-19 Patientspresenting with ST Segment Elevation Myocardial Infarction

Hany M. Fakhry*, Nadeem M. Elmasry, Ali A. El-Abd, Haitham G. Helmy
Department of Cardiology, Faculty of Medicine, Ain Shams University, Egypt
***Corresponding author:** Hany Mohammed Fakhry Mahmoud, **Mobile:** (+20) 01002554916, **E-mail:** drhanyfakhry@gmail.com

ABSTRACT

Background: COVID-19 can cause a wide range of thrombotic diseases, including acute coronary syndromes (ACS). While these thrombotic diseases occur during acute infection, evidence on the long-term thrombotic consequences of COVID-19 remain unknown.

Objective: The aim of the current study was to establish the particular coronary angiographic findings, as well as the procedural and clinical effectiveness of revascularization in post COVID-19 patients presenting with STEMI.

Patients and methods: A total 100 patients presented to Ain Shams University Hospitals with ST Segment Elevation Myocardial Infarction (STEMI) managed by primary percutaneous coronary intervention (PCI). Participants were divided into two groups: Group (A) included 50 patients who developed COVID-19 infection in the previous 6 months, and Group (B) included 50 patients who deny COVID-19 infection in the previous 6 months. Group (A) was divided into two subgroups: the Early Post-COVID subgroup, which included 16 patients who developed STEMI within 8 weeks of infection, and the Late Post-COVID subgroup, which included 34 patients who developed STEMI >8-24 weeks after infection. **Results:** The Early Post-COVID subgroup had a statistically significant high thrombus load on angiography, with 81.3% versus 48% in the control group. This resulted in a statistically significant increase in the utilization of pre-dilatation (56.2% versus 24%) and thrombus aspiration (43.8% versus 4%) in the Early Post- COVID grouping (P-values 0.015 and 0.001, respectively). Coronary no-reflow was a substantially more common in the Early post-COVID subgroup (62.5%) than in the control group (22%). This translated into a higher Major Adverse Cardiovascular Events (MACE) among Early Post-COVID patients, at 31.3% versus 6% in the control group.

Conclusion: The thrombogenic impact of COVID-19 on STEMI outcomes continues even after infection clearance being greatest during the first 8 weeks following infection and thereafter diminishes. It has an impact on the angiographic, procedural, and overall clinical success of in-hospital revascularization.

Keywords: COVID-19, STEMI, Primary PCI, Thrombosis.

INTRODUCTION

While COVID-19 infection can be catastrophic, even fatal, in its acute form, the virus's long-term implications remain a hazy and uncharted topic of study. The majority of what is known regarding post-COVID manifestations consists mostly of respiratory symptoms such as increasing shortness of breath and anosmia, referred to as the Post COVID Syndrome [(1)].

Extensive study has been conducted on the cardiovascular implications of COVID-19 infection. Two recent investigations indicate the presence of myocardial harm in COVID-19 deaths and survivors 2 to 3 months after infection resolution [(2,3)].

Several studies have linked active COVID-19 infection to a higher thrombus burden, more complications, and lower angiographic success in patients presenting with STEMI while the infection is active, necessitating the use of higher doses of Unfractionated Heparin, Glycoprotein IIb/IIIa inhibitors, and thrombus aspiration [(4,5)]. However, evidence on the long-term effects of COVID-19 is limited in this area. Patients are apparently sensitive to venous thromboembolic events during COVID-19 infection and, to a lesser extent, 4 to 6 months after infection [(6)]; our investigation investigates if the same holds true for acute coronary syndromes.

Proving the presence of an elevated thrombus load in post COVID patients can pave the path for future research into the prevention and treatment of STEMI in this group of patients.

The aim of the current study was to look at the particular coronary angiographic findings, as well as the procedural and clinical effectiveness of revascularization in post COVID-19 patients who presented with STEMI.

PATIENTS AND METHODS

A case-control study was conducted on 100 STEMI patients admitted to Ain Shams University Hospital from January 2022 to June 2022. Participants were divided into two groups: Group (A) included patients who had recently developed COVID-19 infection in the previous 6 months as determined by RT-PCR or CT chest (CORADS-4 or more), and Group (B) "control group" included patients who had not recently demonstrated such infection as confirmed by negative COVID-19 antibody test.

This pilot randomized controlled trial goal was to assess the outcomes of PCI in these patients. The post-COVID group was split into two groups: Early post-COVID group (within 8 weeks of infection) and Late post-COVID group (>8-24 weeks after infection), in order to further question the idea that the thrombogenic impact of COVID-19 diminishes with passage of time.

The exclusion criteria were that patients who did not for any reason perform primary PCI for any reason.

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Age, gender, BMI, and risk factors for atherosclerotic cardiovascular disease (smoking, diabetes, hypertension, dyslipidemia, and renal impairment) were all taken into account when obtaining everyone's medical history. The technique of diagnosis, prior COVID-19 infection within the last six months, the kind of the vaccine, the Pain to Door (PTD) and Door to Balloon (DTB) intervals, and any prior COVID-19 vaccinations within the last six months.

Comprehensive examination included cardiac and chest auscultation, Killip class, and vital signs. Investigations included a 12-lead surface ECG performed both before and after coronary angiography, serum creatinine at admission and 48 hours after coronary angiography to identify Contrast Induced Nephropathy (CIN) [(7)], serial troponin and creatine kinase, COVID IgG and IgM from control group candidates, and echocardiography with emphasis on ejection fraction using Simpson's method and left ventricular dimensions [(8)].

1. Coronary angiography:

Detailed analysis of angiography and intervention including:

- ***Culprit vessel and the site of occlusion*** [(9)]
- ***Thrombus grade:***
  - Grade 0 indicates the lack of a thrombus; Grade 1 indicates a potential thrombus; Grade 2 indicates a small thrombus, with the largest dimension equal to or less than half the vessel diameter; Grade 3 indicates a moderate thrombus, with the largest dimension greater than half but less than twice the vessel diameter; Grade 4 indicates a large thrombus, with the largest dimension equal to or greater than twice the vessel diameter; and Grade 5 indicates total occlusion [(10)].

- ***TIMI flow (Thrombolysis In Myocardial Infarction):***
  - TIMI 0 indicates no ante-grade flow beyond occlusion, TIMI 1 indicates mild ante-grade flow beyond occlusion, TIMI 2 indicates full filling of the distal arterial bed, and TIMI 3 indicates normal flow [(11)].

- ***Myocardial Blush Grade:***
  - No myocardial blush (MBG 0), minimal myocardial blush (MBG 1), moderate myocardial blush but less than that obtained during angiography of a contralateral or ipsilateral non-infarct- related coronary artery (MBG 3), and normal myocardial blush (MBG 3)[(12)]

- ***Coronary no reflow (CNR)*** is identified right away following PCI when post-procedural angiographic TIMI flow is less than 3, or if TIMI flow is 3 and MBG is zero or one, or when ST resolution is less than 70% within 60 to 90 minutes of the operation. [(13)].

- ***Intracoronary medicine, pre-dilatation, and post-stent dilatation, use of thrombus aspiration.***
  - Each patient got a loading dose of 300 mg aspirin and either 180 mg or 600 mg of ticagrelor, depending on whether ticagrelor was appropriate or accessible. In each patient, the last three factors that determine effective care were evaluated: (i) Angiographic success: TIMI flow and Myocardial Blush Grade (MBG) post-PCI. (ii) Procedural success: Angiographic success without in-hospital MACE. (iii) Clinical success: Procedural success with resolution of chest pain, Resolution of ST-segment segment elevation.

Ethical Consideration:

This study was ethically approved by the Institutional Review Board of the Faculty of Medicine, Ain Shams University. Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical Analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (SPSS, version 22, SPSS Inc., Chicago, Illinois, USA). Qualitative data were defined as numbers and percentages. Chi-Square test and Fisher's exact test were used for comparison between categorical variables as appropriate. Quantitative data were tested for normality by Shapiro-Wilk test. The range (minimum and maximum), mean, standard deviation, median, and interquartile range were used to characterize quantitative statistics (IQR). Normal distribution of variables was described as mean and standard deviation (SD), and independent sample t-test/Mann-Whitney U test was used for comparison between groups. P value ≤ 0.05 was considered to be statistically significant.

RESULTS

There was no statistically significant difference regarding age, sex and BMI with (P values 0.108, 0.817 and 0.081, respectively) (**Table 1**).

Table (1): Comparison between groups A and B regarding demographic data.

Variable		Post COVID group (A) No. = 50	Control group (B) No. = 50	Test value	P-value	Sig.
Age years	**Mean ± SD**	55.62 ± 8.95	58.36 ± 7.9	-1.622•	0.108	NS
	Range	30 – 73	44 – 72			
Gender	**Female**	13 (26%)	12 (24%)	0.053*	0.817	NS
	Male	37 (74%)	38 (76%)			
BMI	**Mean ± SD**	25.42 ± 3.74	24.10 ± 3.74	1.763•	0.081	NS
	Range	18 – 31	18 – 31			

**:Chi-square test; •: Independent t-test.*

Regarding the prevalence of diabetes, there was a statistically significant difference (68% of patients in group A versus 88% of patients in group B, with a p-value of 0.016). With a p-value of 0.009, there was a statistically significant difference in the prevalence of hypertension between groups A and B (66% of patients in group A versus 88% of patients in group B). Meanwhile smoking, dyslipidemia and the presence of a prior MI were not significantly different between groups A and B (P values 0.542, 0.834, and 0.068, respectively) (**Table 2**).

Table (2): Comparison between groups A and B regarding risk factors.

Variable		Post COVID group (A)		Control group (B)		Test value*	P-value	Sig.
		No.	%	No.	%			
DM	**No**	16	32%	6	12%	5.828	0.016	**S**
	Yes	34	68%	44	88%			
HTN	**No**	17	34%	6	12%	6.832	0.009	**HS**
	Yes	33	66%	44	88%			
Smoker	**No**	19	38%	22	44%	0.372	0.542	NS
	Yes	31	62%	28	56%			
Dyslipidemia	**No**	33	66%	32	64%	0.044	0.834	NS
	Yes	17	34%	18	36%			
Previous MI	**No**	33	66%	41	82%	3.326	0.068	NS
	Yes	17	34%	9	18%			

**:Chi-square test*

There was no statistically significant difference regarding vaccination against COVID-19 withp-value 0.826. The median period between COVID infection and occurrence of STEMI was 11 weeks in the post COVID group. 32% of the cases group developed STEMI within 8 weeksof infection (Early post-COVID) while 68% developed STEMI within >8-24 weeks after their infection (Late post-COVID) (**Table 3**).

Table (3): Comparison between groups A and B regarding COVID-19 status.

Variable		Post COVID group (A) No. = 50	Control group (B) No. = 50	Test value*	P-value	Sig.
Post COVID	**No**	0 (0.0%)	50 (100%)	100	0.000	**HS**
	Yes	50 (100%)	0 (0.0%)			
COVID Dx	**Yes**	50 (100%)	0 (0.0%)	100	0.000	**HS**
	PCR	17 (34%)	0 (0.0%)			
	CT	15 (30%)	0 (0.0%)			
	Both	18 (36%)	0 (0.0%)			
COVID Vaccine	**No**	15 (30%)	14 (28%)	0.049	0.826	NS
	Yes	35 (70%)	36 (72%)			
COVID to STEMI (wks)	**Median (IQR)**	11 (7 – 16)	--	--	--	--
	Range	1 – 22	--			
Recent COVID		16 (32%)	--	--	--	--
Late post COVID		34 (68%)	--			

**:Chi-square test*

There was no statistically significant difference regarding the **pain to door interval**, **door to balloon interval**, **type of STEMI**, **Killip class** and the type of **P2Y12 inhibitor** used as loading (P values 0.714, 0.515, 0.444, 0.863 and 0.817, respectively (**Table 4**).

Table (4): Comparison between groups A and B regarding presentation to ER.

Variable		Post COVID group (A) No. = 50	Control group (B) No. = 50	Test value	P-value	Sig.
Pain to door (hrs)	**Median (IQR)**	10.5 (5 – 13)	9 (8 – 12)	-0.367‡	0.714	NS
	Range	2 – 36	2 – 32			
Door to balloon (mins)	**Mean ± SD**	30.70 ± 6.12	31.50 ± 6.12	-0.654•	0.515	NS
	Range	20 – 40	21 – 40			
STEMI type	**Anterior**	35 (70%)	31 (62%)	1.625*	0.444	NS
	Inferior	7 (14%)	12 (24%)			
	Lateral	8 (16%)	7 (14%)			
Killip class	**Killip class I**	43 (86%)	44 (88%)	0.745*	0.863	NS
	Killip class II	2 (4%)	3 (6%)			
	Killip class III	2 (4%)	1 (2%)			
	Killip class IV	3 (6%)	2 (4%)			
P2Y12 loading	**Ticagrelor**	37 (74%)	38 (76%)	0.053*	0.817	NS
	Clopidogrel	13 (26%)	12 (24%)			

**:Chi-square test; •: Independent t-test; ‡: Mann Whitney test*

There was no statistically significant difference regarding the **culprit**, the **level of occlusion**, the **thrombus burden**, the use of **pre** and **post stent dilatation** and the **number of stents** deployed (P values 0.220, 0.911, 0.523, 0.069, 0.648, 0.538 and 0.508, respectively). While there was statistically significant difference found between groups A and B regarding the use of **thrombus aspiration**, where **18%** of the Post COVID group required such technique as compared to only 4%of the Control group, with P-value 0.025 (**Table 5**).

Table (5): Comparison between groups A and B regarding coronary angiography.

Variable		Post COVID group (A)		Control group (B)		Test value*	P-value	Sig.
		No.	%	No.	%			
Culprit	**LAD**	33	66%	31	62%	8.253	0.220	NS
	RCA	4	8%	10	20%			
	LCX	6	12%	8	16%			
	Ramus	2	4%	0	0.0%			
	OM	2	4%	1	2%			
	D+OM	2	4%	0	0.0%			
	LM+LAD	1	2%	0	0.0%			
Level of occlusion	**Proximal**	33	66%	31	62%	0.188	0.911	NS
	Mid	15	30%	17	34%			
	Distal	2	4%	2	4%			
Modified Thrombusgrade	**Grade 2**	1	2%	3	6%	2.241	0.523	NS
	Grade 3	18	36%	23	44%			
	Grade 4	18	36%	16	34%			
	Grade 5	13	26%	8	16%			
Thrombus burden	**Low (0-3)**	17	34%	26	52%	3.304	0.069	NS
	Heavy (4-5)	33	66%	24	48%			
Pre-dilatation	**No**	36	72%	38	76%	0.207	0.648	NS
	Yes	14	28%	12	24%			
Thrombus aspiration	**No**	41	82%	48	96%	5.005	0.025	S
	Yes	9	18%	2	4%			
No. of stents	**0**	2	4%	0	0.0%	2.323	0.508	NS
	1	27	54%	28	56%			
	2	18	36%	20	40%			
	3	3	6%	2	4%			
Post stent dilatation	**No**	45	90%	43	86%	0.379	0.538	NS
	Yes	5	10%	7	14%			

**:Chi-square test*

There was highly statistically significant difference regarding the thrombus burden, where 81.3% of the Early post COVID group were found to have a high thrombus burden vs. 48% in the control group, at P-value 0.019. The need to use pre-dilatation was significantly higher in the Early post COVID group, with 56.2% requiring pre-dilatation vs. only 24% of the control group, at P-value 0.015. The need to use thrombus aspiration was significantly higher in the early post COVID group, with 43.8% requiring this technique as compared to only 4% of the control group, at P-value <0.001. While there was no statistically significant difference regarding the culprit vessel and the use of post-stent dilatation, at P-values 0.073 and 0.408, respectively **(Table 6).**

Table (6): Comparison between Early post COVID and Control groups regarding coronary angiography.

Variable		Early Post COVID		Control group		Test value*	P-value	Sig.
		No.	%	No.	%			
Culprit	LAD	14	87.6%	31	62%	8.536	0.073	NS
	RCA	1	6.2%	10	20%			
	LCX	0	0.0%	8	16%			
	Ramus	0	0.0%	0	0.0%			
	OM	0	0.0%	1	2%			
	D+OM	1	6.2%	0	0.0%			
	LM+LAD	0	0.0%	0	0.0%			
Thrombus burden	Low (0-3)	3	18.7%	26	52%	5.440	0.019	HS
	Heavy (4-5)	13	81.3%	24	48%			
Pre-dilatation	No	7	43.8%	38	76%	5.811	0.015	HS
	Yes	9	56.2%	12	24%			
Thrombus aspiration	No	9	56.2%	48	96%	16.262	<0.001	HS
	Yes	7	43.8%	2	4%			
Post stent dilatation	No	15	93.7%	43	86%	0.683	0.408	NS
	Yes	1	6.3%	7	14%			

**:Chi-square test*

There was no statistically significant difference regarding the occurrence of no reflow, myocardialblush grade or in-hospital MACE, with P-values 0.361, 0.140 and 0.182, respectively (**Table 7**).

Table (7): Comparison between groups A and B regarding angiographic success.

Variable		Post COVID group		Control group		Test value*	P-value	Sig.
		No.	%	No.	%			
No reflow	No	35	70%	39	78%	0.831	0.361	NS
	Yes	15	30%	11	22%			
TIMI Pre	TIMI 0	8	16%	11	22%	1.727	0.631	NS
	TIMI 1	17	34%	17	34%			
	TIMI 2	11	22%	13	26%			
	TIMI 3	14	28%	9	18%			
TIMI post	TIMI 0	1	2%	0	0.0%	3.487	0.322	NS
	TIMI 1	3	6%	2	4%			
	TIMI 2	9	20%	5	10%			
	TIMI 3	37	72%	43	86%			
MBG	Grades 0-1	6	12%	2	4%	2.173	0.140	NS
	Grades 2-3	44	88%	48	96%			
In hospital MACE	No	43	86%	47	94%	1.778	0.182	NS
	Yes	7	14%	3	6%			

**:Chi-square test*

There was no statistically significant regarding the TIMI flow pre intervention with P-values = 0.923. While there was a very statistically significant difference between the two groups in terms of the likelihood of no reflow (62.5% of the Early post COVID group versus 22% of the control group) at P-value 0.002, there was no such difference in terms of the occurrence of reflow. At a P-value of 0.001, the early post COVID group's Myocardial Blush Grade (MBG) was considerably lower than that of the Control group, with 37% of participants reaching MBG 0 or 1. At 31.3% versus 6% in the Control group, In-hospital Major Adverse Cardiovascular Events were substantially more common in the Early Post COVID group, with a P-value of 0.007 (**Table 8**).

Table (8): Comparison between Early post COVID group and Control group regarding angiographic success.

Variable		Early Post COVID		Control group		Test value*	P-Value	Sig.
		No.	%	No.	%			
No reflow	No	6	37.5%	39	78%	9.164	0.002	HS
	Yes	10	62.5%	11	22%			
TIMI flow Pre	TIMI 0	3	18.7%	11	22%	1.957	0.923	NS
	TIMI 1	6	37.5%	17	34%			
	TIMI 2	3	18.8%	13	26%			
	TIMI 3	4	25%	9	18%			
MBG	Grades 0-1	6	37%	2	4%	12.770	<0.001	HS
	Grades 2-3	10	63%	48	96%			
In-hospital MACE	No	11	68.7%	47	94%	7.255	0.007	HS
	Yes	5	31.3%	3	6%			

*:*Chi-square test*

Regarding the continuation of chest discomfort following PCI, there was no statistically significant difference (P-value 0.118). While there was a statistically significant difference in the resolution of ST segment elevation in ECG >70% post PCI, 74% of the Post COVID group met that goal as opposed to 90% of the Control group, at P-value 0.037 (**Table 9**).

Table (9): Comparison between groups A and B regarding clinical and procedural success.

Variable		Post COVID group		Control group		Test value*	P-value	Sig.
		No.	%	No.	%			
Cheast pain post PCI	No	38	76%	44	88%	2.439	0.118	NS
	Yes	12	24%	6	12%			
STE resolution >70%	No	13	26%	5	10%	4.336	0.037	S
	Yes	37	74%	45	90%			

*:*Chi-square test*

There was statistically significant difference regarding the persistence of chest pain post PCI, where 50% of the Early post COVID patients had persistent chest pain versus 12% of the control group, at P-value <0.001. The resolution of ST elevation post PCI was significantly lower in the Early post COVID group, occurring in only 37.5% of patients compared to 90% of the Control group, at P-value <0.001 (**Table 10**).

Table (10): Comparison between Early post CVID and Control groups regarding clinical and procedural success.

Variable		Early Post COVID		Control group		Test value*	P-value	Sig.
		No.	%	No.	%			
CP post PCI	No	8	50%	44	88%	10.473	<0.001	HS
	Yes	8	50%	6	12%			
STE resolution >70%	No	10	62.5%	5	10%	19.023	<0.001	HS
	Yes	6	37.5%	45	90%			

*:*Chi-square test*

Ejection fraction, LV internal diameter in diastole, and that in systole following PCI did not change statistically significantly (P-values 0.084, 0.393, and 0.473, respectively) (**Table 11**).

Table (11): Comparison between groups A and B regarding Echo findings.

Variable		Post COVID group	Control group	Test value•	P-value	Sig.
		No. = 50	No. = 50			
Echo Ejection fraction (percentage)	Mean ± SD	40.77 ± 7.23	43.48 ± 8.2	-1.743	0.084	NS
	Range	28 – 56	29 – 58			
LVIDd (mm)	Mean ± SD	57.61 ± 3.91	58.18 ± 2.55	-0.857	0.393	NS
	Range	49 – 69	53 – 65			
LVIDs (mm)	Mean ± SD	44.57 ± 4.60	43.94 ± 4.11	0.721	0.473	NS
	Range	34 – 54	37 – 54			

•*: Independent t-test*

The LV internal diameter in diastole was not significantly different after PCI, with a P-value of 0.466. The early post-COVID group's Ejection fraction was significantly different from the Control group's, with a mean of 36% compared to 43.48%, with a P-value of 0.001. LV internal dimensions in systole after PCI also showed a very significant difference between the two groups, with a mean of 47 mm in the Early post COVID group against 43.94 mm in the Control group, at P-value 0.007 (**Table 12**).

Table (12): Comparison between Early post COVID and Control groups regarding Echo findings.

Variable		Early post COVID No. = 50	Control group No. = 50	Test value•	P-value	Sig.
Echo EF (percentage)	**Mean ± SD**	36 ± 5.51	43.48 ± 8.2	-3.56	<0.001	HS
	Range	28 - 47	29 – 58			
LVIDd (mm)	**Mean ± SD**	58 ± 3.92	58.18 ± 2.55	0.083	0.466	NS
	Range	52 - 62	53 – 65			
LVIDs (mm)	**Mean ± SD**	47 ± 4.34	43.94 ± 4.11	2.506	0.007	HS
	Range	39 - 53	37 – 54			

•*: Independent t-test*

DISCUSSION

Numerous studies have been conducted in the literature on the COVID-19 disease pandemic, including both the short-term effects and the long-term ones. In fact, those with COVID-19 had a higher risk of incident cardiovascular illness overall, including cerebrovascular disorders, dysrhythmias, ischemic heart disease, pericarditis, myocarditis, heart failure, and thromboembolic disease, even in the first 30 days after infection. Acute coronary syndrome, myocardial infarction, ischemic cardiomyopathy, and angina have all been described as arterial thrombotic repercussions of the disease and are pertinent to our investigation [(14)].

The nature of thrombotic events during COVID-19 infection has also been described in other studies as having higher thrombus burden, more complications, and lower angiographic success, necessitating the use of higher doses of unfractionated heparin, Glycoprotein IIb/IIIa inhibitors, and thrombus aspiration [(4,5)]. However, there is a shortage of information regarding COVID-19's long-term arterial thrombotic impact. Patients are reportedly prone to venous thromboembolic events both during COVID-19 infection and to a lesser extent the 4 to 6 months after infection [(6)].

Our two groups, the Post COVID group (A) and the Control group (B), were comparable in age, with the bulk of our patients being in their mid-fifties (the mean ages of groups (A) and (B) were 55.6 and 58.3 respectively). Since the average age of the first myocardial infarction was 65.6 years for males and 72.0 years for women, the American Heart Association's demographic, description in 2019, our study shows that we are younger overall [(15)]. Such age disparity may be caused by racial, ethnic, and environmental variances between the two nations.

About two thirds of our research population in both groups, or the bulk of our patients, were men. Given that males are three times more likely than women to get STEMI, this demographic distribution was consistent with the known influence of gender on arterial thrombosis [(16)].

Other risk variables, such as smoking, BMI, dyslipidemia, and prior MI history, were equally prevalent in both groups. Contrarily, there were considerably more people with diabetes and hypertension in the control group than in the post-COVID group (88% of the control group had diabetes and 88% had hypertension, compared to 68% and 66% of the post-COVID group, respectively). **Choudry *et al.*** [(4)] examined 115 patients who presented with STEMI while having an ongoing COVID-19 infection in an observational research that was published in the Journal of the American College of Cardiology in 2020.

In Choudry study, diabetes and hypertension were more common in the active COVID-19 group than in the Control group (46.2% of the COVID group had diabetes and 71.8% had hypertension, compared to 26.3% and 42.1%, respectively, in the Control group). It is important to highlight that previous studies had not demonstrated how diabetes and hypertension alter the thrombus load in patients who suffer STEMI [(17)].

The criteria used to classify research participants into the Post-COVID or Control groups rely on demonstrating the presence of a prior COVID infection within the preceding six months. The Post COVID group included patients who reported an infection supported by a positive RT-PCR test or a CT chest revealing CORADS-4 or higher. Of them, 34% had PCR-only diagnoses, 30% had CT-only diagnoses, and 36% had PCR-and-CT diagnoses.

The median time between the diagnosis of COVID-19 and the onset of STEMI was 11 weeks. The post-COVID group was further split into the Early Post-COVID group (STEMI developed within 8 weeks of infection and comprising 32% of group (A) patients) and the Late Post-COVID group (STEMI developed >8-24 weeks post infection and comprising 68% of group (A) patients) for descriptive purposes and to accurately determine the length of time in which the thrombotic effect of COVID-19 infection persists. Sub-group analysis was then performed on these two groups.

In light of the numerous case reports of thrombosis that have been linked to COVID-19 vaccinations that have been reported in the years after their discovery [(18)], it was essential to randomize and account for variations in the vaccination status of our two groups. There was no statistically significant difference in that regard because 72% of the Control group and 70% of our Post-COVID patients had both received at least one dose of a COVID-19 vaccination.

The median time from pain to door in groups (A) and (B) was 10.5 hours and 9 hours, respectively (B). Since the pain-to-door time is regarded as one of the most significant indicators of thrombus load on angiography and the incidence of no reflow, this similarity was crucial for the correctness of our results [(17)]. The same for our door to balloon time at a medium of 30.7 minutes in group A and 31.5 mins in group B. we consider the effect of both factors to be distributed equally

Choudry determined a four-hour median time between the beginning of chest pain and reperfusion. This was much less time than our previously described pain-to-door period, which might be explained by London's more sophisticated and integrated emergency transit services. His median door-to-balloon was about 50 minutes in both groups, which is a little bit longer than ours 30 minutes in both group.

The majority of our patients' [66% in group (A) and 62% in group (B)] deaths were caused by LAD blockage. According to the most recent ESC guidelines, the majority [74% of group (A) and 76% of group (B)] used ticagrelor as a P2Y12 loading rather than clopidogrel and were Killip class I [86% of group (A) and 88% of group (B)] [(14)]. Randomization was sufficient because there was little variance between the two groups in terms of these factors.

The difference in the thrombotic load discovered during coronary angiography was rather small. Although there was a larger thrombus load in the Post-COVID group (66% of patients had a thrombus grade of 4 or more compared to 48% in the Control group), this was not statistically significant (P-value 0.523). Furthermore, there was no statistically significant difference in the need for pre- or post-dilatation. Only the utilization of thrombus aspiration demonstrated a significant difference in the post-COVID group 18% versus 4% in the control group.

Unfortunately, this variation in the use of thrombus aspiration has some drawbacks. This method is not widely available throughout all of our institutes, and as a result, the instructions for its use are not consistently adhered to, leading to an erratic rather than a systematic pattern for utilization.

The active COVID-19 patients in Choudry's observational trial had a considerably greater risk of multivessel thrombosis, stent thrombosis, and higher modified thrombus grade, which led to a higher usage of glycoprotein IIb/IIIa inhibitors and thrombus aspiration. Higher heparin dosages were also used to achieve produce therapeutic activated clotting times [(5)].

Our concern is how long this elevated thrombotic condition lasts after the virus has cleared up. According to a subgroup analysis of the participants in our study, patients who experienced a STEMI in the early post-COVID period (defined in our study as occurring within 8 weeks of COVID diagnosis) had a statistically significant higher thrombus burden (81.3%) than the control group (P-value 0.019). Pre-dilatation and thrombus aspiration rates increased as a consequence, both statistically significant (P values 0.015 and 0.001, respectively) in the Early Post-COVID group.

Despite the fact that both groups' baseline TIMI flow grades were identical, there was a significant thrombogenic difference; this result is congruent with what Choudry discovered in his study.

Similarly, there was no detectable difference in the occurrence of no reflow, Myocardial Blush Grade (MBG), or in-hospital Major Adverse Cardiovascular Events between the Control group and the whole Post COVID-19 trial group (MACE, defined in our study as a composite of nonfatal stroke, nonfatal re-infarction, and cardiovascular death).

Again, subgroup analysis produced more useful data: Coronary no re-flow (CNR; defined as TIMI flow <3, or TIMI flow 3 and MBG 0 or 1, or ST resolution <70% within 60-90 min of the operation) was a significantly more common occurrence following PCI in the Early post-COVID group (62.5%) compared to the Control group (22%).

In the Early Post COVID group, 37% of patients did not achieve an MBG of 2 or above, compared to 4% in the control group. This was consistent with Choudry's findings, which revealed that only 6% of his Control group and 46% of his active COVID-19 patients had MBGs less than two following PCI [(4)].

In-hospital MACE occurred in 5 (31.3%) patients of our Early Post COVID patients (2 fatalities, 1 cerebrovascular stroke, and 2 re-infarctions). Compared to 6% of control group, the in-hospital death rate was numerically greater among COVID-19 STEMI patients in Choudry's trial, although this did not achieve statistical significance (17.9% versus 6.5%, P=0.10).

Clinically, patients in the early post-COVID group were less likely to recover following PCI; 50% of them reported persistent chest discomfort, and 62.5% did not achieve 70% clearance of ST segment elevation compared to 12% and 10% of the control group, respectively. This was consistent with the angiographic findings; greater no-reflow and a lower MBG were correlated with ST elevation and prolonged discomfort.

An essential method for identifying the cardiovascular consequences of COVID-19 infection is echocardiography. The European Association of Cardiovascular Imaging (EACVI) [(19)], in a prospective worldwide online survey, gathered information on the echocardiography of patients with suspected or confirmed COVID-19. 667 subjects overall (55%) had an abnormal echocardiography. In 479 (39%) and 397 (33%) patients, left and right ventricular anomalies were noted with report of new myocardial infarction in 36(3%), myocarditis in 35(3%), Takotsubo cardiomyopathy in 19(2%).

In our investigation, it became clear that individuals who experienced STEMI within 8 weeks

after infection had more severe myocardial damage as a result of the condition. In comparison to the Control group, this patient group's mean Ejection Fraction was 36% versus 43.48% of control group, with a P-value of 0.001 between the two groups. The Left Ventricular Internal Dimensions in Systole (LVIDs), which averaged 47mm against 43.94mm and had a P-value of 0.007, were likewise impacted. However, both groups had identical Left Ventricular Internal Dimensions in Diastole.

Since there was no statistically significant difference in the culprit between the two groups, and since the LAD was the most frequently affected vessel in both the early post-COVID and the Control groups, the difference in ejection fraction and systolic functions cannot be attributed to different culprit involvement.

CONCLUSION

COVID-19's thrombogenic effect on STEMI outcomes persist after the infection but progressively fades with time. It has an impact on the clinical success overall, the procedural success, and the angiographic success of revascularization throughout the hospital stay. The first eight weeks following infection are when this impact is at its peak, but it then starts to fade.

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