Original Article

Very Early Discharge of Patients with ST-Segment-Elevation Myocardial Infarction after Primary Percutaneous Coronary Intervention

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Abstract

Background: *The discharge of uncomplicated patients with ST-segment-elevation myocardial infarction (STEMI) within 48 to 72 hours has been proven safe and feasible. The safety and feasibility of the very early discharge (≤48 h) of such patients, especially during the COVID-19 pandemic with limited bed availability and infection risk, have yet to be evaluated.*

Methods: *In this cohort study on 108 patients with STEMI who presented to Farshchian Heart Center between February and May 2020, 30 patients received fibrinolysis and 78 were scheduled for emergent coronary angiography. One patient had no coronary obstruction, 3 underwent emergent surgery, and 3 had high-risk features mandating a prolonged stay. The remaining patients were assigned to either Group A (≤48 h) or Group B (>48 h) regarding hospital discharge. Demographic, angiographic, procedural, and outcome data were compared between the 2 groups.*

Results: *Group A consisted of 51 patients, including 7 women (13.7%), at a mean age of 62.74±12.35 years, and Group B comprised 20 patients, including 4 women (20.0%), at a mean age of 65.20±12.82 years. The mean hospital length of stay was 38.02±9.15 hours in Group A and 88.20±23.31 hours in Group B (P<0.001). The mean stent diameter was smaller in Group B (3.19±0.34 mm vs 2.96±0.29 mm; P=0.008). Demographic, angiographic, procedural, and outcome data, including the rates of in-hospital, 1-week, and 1-month mortality, were similar between the 2 groups.*

Conclusion: *This study shows that a hospital discharge in less than 48 hours in low-risk patients with STEMI is safe and feasible. The potential advantages of this approach in the COVID-19 pandemic should be balanced against its risks.*

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Introduction

Acute ST-segment-elevation myocardial infarction (STEMI) is one of the major causes of mortality and morbidity in the globe and comprises a large proportion of emergency referrals and coronary care unit admissions.[1] Timely and correct treatment of acute STEMI will significantly reduce mortality and its complications. Over time, significant improvements have been made in the treatment of acute myocardial infarction (AMI), significantly reducing mortality and morbidity.

Historically, the initial treatment of patients with AMI has been hospitalization and complete bed rest to watch incident complications. Electrical monitoring of the heart for the timely diagnosis and treatment of lethal cardiac arrhythmias has led to a reduction in mortality. Thrombolytic therapy was another breakthrough in the treatment of MI that led to a further mortality reduction.[2] With the advent of primary percutaneous coronary intervention (PCI), as the current standard treatment of MI, mortality, complications, and hospital stay in these patients have been significantly decreased.[3] Various studies have shown that patients with AMI who have undergone uncomplicated primary PCI can be discharged in a short time.[4-6] The use of the radial artery approach for angiography and angioplasty allows the early ambulation of these patients and perhaps shortens the length of hospitalization. Some studies have shown the safety of an earlier discharge in selected low-risk patients with AMI who have fulfilled specific risk scores and have undergone uncomplicated primary angioplasty.[7, 8] The latest STEMI guideline states that patients who have undergone uncomplicated primary PCI can be transferred to the general ward within 24 to 48 hours and that discharging these patients should be considered within 48 to 72 hours provided that there is a precise follow-up and cardiac rehabilitation program.[3]

The recent viral pandemic caused by severe acute respiratory system coronavirus 2 (SARS-CoV-2) has caused a daunting challenge in the hospital presentation, diagnosis, and management of patients with AMI. Preliminary analyses have revealed a significant fall in the number of patients with STEMI presenting to hospitals and a simultaneous drop in the activation rate of catheterization units for STEMI treatment in North America and Europe since the beginning of the COVID-19 pandemic.[9] The potential causes of such a decrease could be a combination of concerns about acquiring COVID-19 in the hospital, the avoidance of medical care due to social distancing, STEMI misdiagnosis, and the increased use of pharmacological reperfusion. Another challenge is to adopt the best STEMI treatment strategy during the COVID-9 pandemic. Currently, the best treatment for STEMI is still primary PCI at capable centers when it can be provided in a suitable period, with an expert team outfitted with personnel protection equipment (PPE) in a dedicated catheterization room.[10]

In the recent pandemic, a sizable percentage of general and special hospital beds are designated for COVID-19 patients, resulting in a decrease in the availability of beds. On the other hand, hospitalized patients with cardiovascular disease are at risk of developing severe and critical COVID-19.[11] Therefore, it seems logical to adopt an effective treatment method that, while safe, has the shortest possible duration of hospital stay. To date, no study has been published regarding how to shorten hospital stay in patients with AMI during the COVID-19 period. The safety of the earlier discharge (<72 h) of patients with STEMI after uncomplicated primary PCI has been shown in small studies.[4] In the present study, we evaluated the outcome of a very early hospital discharge (≤48 h) in selected low-risk patients with STEMI who underwent uncomplicated primary PCI with an organized follow-up program during the COVID-19 pandemic.

Methods

This prospective cohort study enrolled patients admitted to Farshchian Heart Center, Hamadan, Iran, with a STEMI diagnosis between February 27 and May 27, 2020. (The first confirmed case of COVID-19 was registered on February 19, 2020, in Iran.)

Out of 108 patients hospitalized with a diagnosis of STEMI, 30 patients underwent thrombolytic therapy due to the unavailability of catheterization laboratories and shortages of PPE at the time of admission, and the remaining 78 underwent emergent selective coronary angiography. Out of the 78 patients, 1 patient had no obvious obstructive coronary artery disease, and 3 patients received consultations for emergent coronary artery bypass graft surgery (CABG) due to unsuitable coronary anatomy. Primary PCI was done in the remaining 74. Any patients with probable complications, including stent thrombosis, decompensated heart failure, mechanical complications, cardiac tamponade, vascular access complications, acute kidney injury, electrical instability, and conduction disturbances requiring pacemaker implantation and, thus, prolonged hospitalization, were excluded from this study. Three patients were excluded due to the abovementioned complications. At the discretion of the treating physicians, the 71 uncomplicated cases were assigned to 2 groups based on the duration of hospitalization: Group A (a very early discharge: ≤48 h) and Group B (a routine discharge: > 48 h) (Figure 1). The endpoints were all-cause mortality, major adverse cardiovascular events (MACE), including recurrent MI and target vessel revascularization, and rehospitalization due to cardiac problems other than non-culprit vessel revascularization during 1 month of the index hospitalization. Demographic data, infarcted areas, culprit vessels, numbers of involved coronary arteries, the left ventricular ejection fraction (LVEF), arterial access sites,

hospital lengths of stay, and P2Y12 inhibitors (clopidogrel or ticagrelor) were compared between the 2 groups. The patients were followed up by telephone at 24 hours, at 1 week, and scheduled office visits at 30 days after discharge.

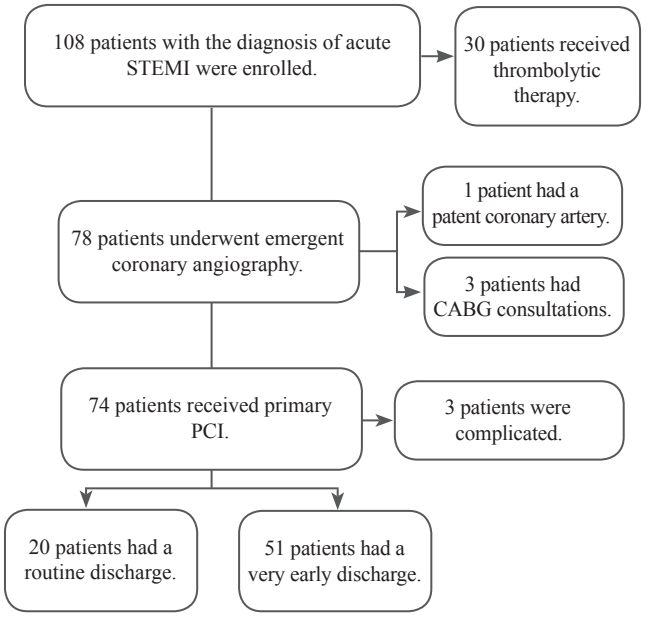

Figure 1. The image illustrates the flowchart of patient enrolment in the study. PCI, Percutaneous coronary intervention; CABG, Coronary artery bypass graft surgery

The recorded data were analyzed with the SPSS software, version 24, via descriptive statistics methods if the criteria of parametric tests from the Fisher exact test and the independent t-test samples were established. Otherwise, their nonparametric equivalents were used. Differences between the groups were considered significant if the P value was 0.05 or less.

This study was approved by the institutional ethics committee (ethics code: IR.UMSHA.REC.1399.227), and written informed consent was taken from all the participants.

Results

The study population was divided into 2 groups: 51 patients were assigned to Group A (a very early discharge: ≤48 h) and 20 patients to Group B (a routine discharge: >48 h). There were no statistically significant differences between the 2 groups in baseline characteristics, including age, sex, and risk factors (viz, diabetes mellitus, hypertension, dyslipidemia, and cigarette smoking). Both groups were similar in terms of cardiac arrest at presentation, the mean systolic and diastolic blood pressures, history of PCI, and history of CABG. Twenty-eight patients (54.9%) in Group A and 12 patients (60.0%) in Group B received ticagrelor as the second antiplatelet agent, and the rest received clopidogrel (P=0.793) (Table 1).

The pattern of coronary artery involvement, consisting of the vessel score (P=0.650), the culprit vessel (P=0.469), and the initial thrombolysis in myocardial infarction flow grade (P=0.860), following angiography was similar between the 2 groups. The radial approach was used in 92.2% of the Group A patients and 90.0% of the Group B patients (P=1.000). Glycoprotein IIb/IIIa inhibitor, eptifibatide, was administered during angioplasty in 7 patients (13.7%) in Group A and 1 patient (5.0%) in Group B (P=0.427). There were no statistically significant differences concerning the mean total stent length (P=0.293), the mean number of deployed stents (P=0.953), and the drug-eluting stent deployment ratio (P=1.000) between the studied groups; however, the mean stent diameter was statistically different (P=0.008) (Table 2).

There was no statistically significant difference between

Table 1. Baseline characteristics, risk factor profile, revascularization history, blood pressure, and type of P2Y12 inhibitor drug in the 2 study groups

	Group A (≤48 h) (n=51)	Group B (>48 h) (n=20)	P
Mean age (y)	62.74±12.35	65.20±12.82	0.459
Female	7 (13.7)	4 (20.0)	0.491
Diabetes mellitus	11 (21.6)	6 (30.0)	0.540
Hypertension	11 (21.6)	6 (30.0)	0.540
Dyslipidemia	8 (15.7)	6 (30.0)	0.196
Cardiac arrest at presentation	4 (7.8)	2 (10.0)	1.000
History of CABG	1 (2.0)	0	1.000
History of PCI	3 (5.9)	0	0.554
Cigarette smoking	23 (45.1)	4 (20.0)	0.061
Mean SBP (mmHg) at presentation	132.64±25.91	139.22±25.56	0.794
Mean DBP (mmHg) at presentation	79.83±20.82	91.55±17.24	0.394
Platelet P2Y12 Inhibitor			
Clopidogrel	23 (45.1)	8 (40.0)	0.793
Ticagrelor			

Group A, Very early discharge ≤48 h; Group B, Routine discharge>48 h
CABG, Coronary artery bypass graft surgery; PCI, Percutaneous coronary intervention; SBP, Systolic blood pressure; DBP, Diastolic blood pressure

Table 2. Baseline angiography and angioplasty data in the 2 study groups

	Group A (≤48 h)(n=51)	Group B (>48 h)(n=20)	P
Vessel Score			0.650
1VD	18 (38.3)	7 (36.8)	
2VD	17 (36.2)	9 (47.4)	
3VD	12 (25.5)	3(15.8)	
Arterial Access			1.000
Right radial	47 (92.2)	18 (90.0)	
Right femoral	4 (7.8)	2 (10.0)	
Culprit Vessel			0.469
LAD	20 (39.2)	10 (50.0)	
LCX and OM	11 (21.6)	6 (30.0)	
RCA and PLB	19 (37.3)	4 (20.0)	
SVG	1 (2.0)	0	
Initial TIMI Culprit			0.860
0	34 (73.9)	17 (85.0)	
1	1 (2.2)	0	
2	6 (13.0)	2 (10.0)	
3	5 (10.9)	1 (5.0)	
Glycoprotein IIb/IIIa Inhibitor			
Eptifibatide	7 (13.7)	1 (5.0)	0.427
DES	51 (100.0)	20 (100.0)	1.000
Mean stent diameter (mm)	3.19 ±0.34	2.96±0.29	0.008
Mean stent length (mm)	28.50±9.25	30.45±5.77	0.293
Number of stents used	1.15±0.41	1.15±0.48	0.953

Group A, Very early discharge: ≤48 h; Group B, Routine discharge: >48 h
1VD, Single-vessel coronary artery disease; 2VD, Two-vessel coronary artery disease; 3VD, Three-vessel coronary artery disease; LAD, Left anterior descending; LCX, Left circumflex; RCA, Right coronary artery; DES, Drug-eluting stent; OM, Obtuse marginal; PLB, Posterolateral branch; SVG, Saphenous vein graft; TIMI, Thrombolysis in myocardial infarction

Table 3. In-hospital, 1-week, and 1-month outcome data in the 2 study groups

	Group A (≤48 h)	Group B (>48 h)	P
ST-segment resolution			0.317
<30%	0	1 (5.0%)	
30%–70%	6 (11.8%)	1 (5.0%)	
>70%	45 (88.2%)	18 (90.0%)	
In-hospital mortality	0	0	1.000
1-week mortality	0	0	1.000
1-month mortality	0	0	1.000
Total length of hospital stay (h)	38.02±9.15	88.20±23.31	<0.001
LVEF	40.51±7.82	39.03±11.52	0.594
Max CKMB (IU/L)	138.80±116.49	98.94±70.26	0.103
1-month MACE	0	0	1.000

Group A, Very early discharge: ≤48 h; Group B, Routine discharge: >48 h
LVEF, Left ventricular ejection fraction; MACE, Major adverse cardiovascular events; CKMB, Creatine kinase myocardial isoform

the groups in ST-segment resolution following the revascularization of the infarct-related artery (P=0.317). The mean LVEF after primary PCI was 40.51%±7.82% in Group A and 39.03%±11.52% in Group B (P=0.594). The maximum rate of creatine kinase MB rise during hospitalization was not different between the 2 groups (P=0.103). The mean length of hospital stay was 38.02±9.15 hours in Group A and 88.20±23.31 hours in Group B (P<0.001). The rates of in-hospital, 1-week, and 1-month mortality, as well as the rate of 1-month MACE, were 0 in both groups (P=1.000) (Table 3).

Discussion

Recent advances in the care and management of patients with STEMI have shortened the length of hospital stay among uncomplicated cases. The earlier discharge of patients with MI can reduce hospitalization costs, hospital bed occupancy during the COVID-19 pandemic, and contact

with COVID-19 infected patients during hospitalization. Furthermore, during the COVID-19 pandemic, a shorter hospital stay is associated with a lower likelihood of patients' exposure to SARS-CoV-2 in hospitals where infected patients are admitted.

We designed the present study to evaluate the safety and consequences of a very early discharge compared with a routine discharge of patients who were admitted to Farshchian Heart Center, Hamadan, Iran, between February 27 and May 27, 2020, with the diagnosis of STEMI and underwent primary PCI without any complications.

In this regard, discrepant results have been reported. A recently published study evaluated the safety and feasibility of a very early discharge for selected low-risk patients with STEMI after successful uncomplicated primary PCI.[12] Our study revealed no differences in the 30-day mortality and MACE rates between the routine discharge group and the very early discharge group, which may be due to case selection.

A single-center prospective observational registry of all patients with acute coronary syndromes, including patients with STEMI and those with NSTEMI who underwent selective coronary angiography and/or primary PCI, showed that radial access was associated with a better outcome in this group of patients.[13] Radial access is our default; accordingly, the vascular access complication rate, which may be a probable reason to postpone discharge, was very low in the studied groups and allowed us to discharge the patients as soon as possible.

A systematic review and a meta-analysis of 12 randomized controlled trials on the safety of the early discharge of patients with coronary artery disease, including patients with STEMI, showed that an early discharge after PCI was associated with an increased risk of readmission in the STEMI group.[5] It should be noted that their definition of an early discharge in the STEMI group was a hospital discharge between 48 and 72 hours after the intervention. In our study, we evaluated possible differences vis-à-vis consequences between a very early discharge and an early discharge and found no difference in this regard.

A study conducted in the Czech Republic found that the early discharge (within 48–72 h) of low-risk patients with STEMI treated successfully with primary PCI was safe and feasible.[14] The fact that our case group patients were discharged safely in less than 48 hours highlights the unique design of our study.

Another salient point in the management of patients with STEMI during the COVID-19 pandemic is the time it takes to serve patients. A research letter published in *Circulation* showed numerically longer median times in all components during this period compared with historical data from the prior year.[15] It seems that a few factors affected these times, with the most significant ones being related to patients' requests for help and the availability of PPE for catheterization laboratory personnel in this era. Fortunately, the electrocardiogram-verification STEMI-to-device time in the studied groups was within the standard range, but information regarding the time to request help was unavailable.

A recent study showed that droplet exposure during face-to-face contact was the most prevalent route of SARS-CoV-2 transmission.[16] Every effort to decrease contact time diminishes the transmission rate. One of our objectives in the current investigation was to determine the rate of decrease in SARS-CoV-2 infection in the case group by comparison with the control group; nonetheless, the difference was not considerable.

The strength of our study is that it shows the feasibility and safety of the very early discharge of selected low-risk patients with STEMI during the COVID-19 pandemic, which likely lessens contact between patients with STEMI and those with SARS-CoV-2 during the hospitalization period. However, the main limitations of the present investigation were a lack of randomization and a small study population. If proven safe in larger randomized control studies, our results could be generalized to patients with STEMI even after the COVID-19 pandemic to shorten the length of hospital stay and lessen its economic burden on healthcare systems.

Conclusion

Hospital discharge in selected low-risk patients with STEMI in less than 48 hours could be safe and feasible. The potential benefits of such an approach would be the higher availability of hospital beds and the less exposure of patients with STEMI to COVID-19 infection during this pandemic. Further investigations with larger study populations are recommended to generalize our results in selected low-risk patients with STEMI undergoing uncomplicated primary PCI after the subsidence of the pandemic.

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References

1. Moran AE, Tzong KY, Forouzanfar MH, Rothy GA, Mensah GA, Ezzati M, Murray CJ, Naghavi M. Variations in ischemic heart

disease burden by age, country, and income: the Global Burden of Diseases, Injuries, and Risk Factors 2010 study. Glob Heart 2014;9:91-99.
2. Sarmento-Leite R, Krepsky AM, Gottschall CA. Acute myocardial infarction. One century of history. Arq Bras Cardiol 2001;77:593-610.
3. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, Caforio ALP, Crea F, Goudevenos JA, Halvorsen S, Hindricks G, Kastrati A, Lenzen MJ, Prescott E, Roffi M, Valgimigli M, Varenhorst C, Vranckx P, Widimský P; ESC Scientific Document Group. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 2018;39:119-177.
4. Jirmár R, Widimský P, Capek J, Hlinomaz O, Groch L. Next day discharge after successful primary angioplasty for acute ST elevation myocardial infarction. An open randomized study "Prague-5". Int Heart J 2008;49:653-659.
5. Abdelnoor M, Andersen JG, Arnesen H, Johansen O. Early discharge compared with ordinary discharge after percutaneous coronary intervention - a systematic review and meta-analysis of safety and cost. Vasc Health Risk Manag 2017;13:101-109.
6. Gong W, Li A, Ai H, Shi H, Wang X, Nie S. Safety of early discharge after primary angioplasty in low-risk patients with ST-segment elevation myocardial infarction: A meta-analysis of randomised controlled trials. Eur J Prev Cardiol 2018;25:807-815.
7. Marbach JA, Alhassani S, Chong AY, MacPhee E, Le May M. A Novel Protocol for Very Early Hospital Discharge after STEMI. Can J Cardiol 2020;36:1826-1829.
8. Tralhão A, Ferreira AM, Madeira S, Borges Santos M, Castro M, Rosário I, Trabulo M, Aguiar C, Ferreira J, Almeida MS, Mendes M. Applicability of the Zwolle risk score for safe early discharge after primary percutaneous coronary intervention in ST-segment elevation myocardial infarction. Rev Port Cardiol 2015;34:535-541.
9. Garcia S, Albaghdadi MS, Meraj PM, Schmidt C, Garberich R, Jaffer FA, Dixon S, Rade JJ, Tannenbaum M, Chambers J, Huang PP, Henry TD. Reduction in ST-Segment Elevation Cardiac Catheterization Laboratory Activations in the United States During COVID-19 Pandemic. J Am Coll Cardiol 2020;75:2871-2872.
10. Mahmud E, Dauerman HL, Welt FGP, Messenger JC, Rao SV, Grines C, Mattu A, Kirtane AJ, Jauhar R, Meraj P, Rokos IC, Rumsfeld JS, Henry TD. Management of Acute Myocardial Infarction During the COVID-19 Pandemic: A Position Statement From the Society for Cardiovascular Angiography and Interventions (SCAI), the American College of Cardiology (ACC), and the American College of Emergency Physicians (ACEP). J Am Coll Cardiol 2020;76:1375-1384.
11. Clerkin KJ, Fried JA, Raikhelkar J, Sayer G, Griffin JM, Masoumi A, Jain SS, Burkhoff D, Kumaraiah D, Rabbani L, Schwartz A, Uriel N. COVID-19 and Cardiovascular Disease. Circulation 2020;141:1648-1655.
12. Shah JA, Saghir T, Ahmed B, Ul Haq SA, Kumar R, Mengal MN, Zehra M, Raza SS, Karim M, Qamar N. Safety and Feasibility of Same Day Discharge Strategy for Primary Percutaneous Coronary Intervention. Glob Heart 2021;16:46.
13. Mehta SR, Jolly SS, Cairns J, Niemela K, Rao SV, Cheema AN, Steg PG, Cantor WJ, Džavík V, Budaj A, Rokoss M, Valentin V, Gao P, Yusuf S; RIVAL Investigators. Effects of radial versus femoral artery access in patients with acute coronary syndromes with or without ST-segment elevation. J Am Coll Cardiol 2012;60:2490-2499.
14. Novobilsky K, Stipal R, Cerny P, Horak I, Kaucak V, Mrozek J, Vaclavik J, Kryza R. Safety of early discharge in low risk patients after acute ST-segment elevation myocardial infarction, treated with primary percutaneous coronary intervention. Open label, randomized trial. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub 2019;163:61-66.
15. Wiersinga WJ, Rhodes A, Cheng AC, Peacock SJ, Prescott HC. Pathophysiology, Transmission, Diagnosis, and Treatment of Coronavirus Disease 2019 (COVID-19): A Review. JAMA 2020;324:782-793.
16. Tam CF, Cheung KS, Lam S, Wong A, Yung A, Sze M, Lam YM, Chan C, Tsang TC, Tsui M, Tse HF, Siu CW. Impact of Coronavirus Disease 2019 (COVID-19) Outbreak on ST-Segment-Elevation Myocardial Infarction Care in Hong Kong, China. Circ Cardiovasc Qual Outcomes 2020;13:e006631.