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.
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. 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. 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. Various studies have shown that patients with AMI who have undergone uncomplicated primary PCI can be discharged in a short time. 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. 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.

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. 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-19 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.

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. 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. 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. 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

| 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 | 132.6±25.91 | 139.2±25.56 | 0.794 |
| Mean DBP (mmHg) at presentation | 79.8±20.82 | 91.5±17.24 | 0.394 |
| Platelet P2Y12 Inhibitor |                  |            | 0.793 |
| Clopidogrel            | 23 (45.1)              | 8 (40.0)    | 0.793 |
| Ticagrelor             |                       |            | 0.793 |

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
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).

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           |                       |                        |    |
| 1VD                    | 18 (38.3)             | 7 (36.8)               | 0.650 |
| 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 |

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|

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. 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. 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. 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. 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. 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. 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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