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Early vs Late Discharge in Low-Risk ST-Elevation Myocardial Infarction Patients Treated With Percutaneous Coronary Intervention: A Systematic Review and Meta-Analysis

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Abstract

Background: For low-risk patients with ST-elevation myocardial infarction (STEMI) undergoing percutaneous coronary intervention (PCI) the recommended optimal discharge timing is inconsistent in guidelines. The European Society of Cardiology guidelines recommend early discharge within 48–72 h, while the American College of Cardiology guidelines do not recommend a specific discharge strategy. In this systematic review and meta-analysis we compared outcomes with early discharge (≤ 3 days) versus late discharge (>3 days).

Methods: Randomized controlled trials (RCTs) and observational studies were selected after searching MEDLINE and EMBASE database. Meta-analysis was stratified according to study design. Outcomes were reported as random effects risk ratios (RR) with 95% confidence intervals.

Results: Seven RCTs comprising 1780 patients and 4 observational studies comprising 39,288 patients were selected. The RCT-restricted analysis did not demonstrate significant differences in terms of all-cause mortality (RR, 0.97 [0.23–4.05]) and major adverse cardiac events (MACE) (RR, 0.84 [0.56–1.26]). Conversely, observational study restricted analysis showed that early vs

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Appendix A. Supplementary data

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late discharge strategy was associated with a reduction in all-cause mortality (RR, 0.40 [0.23–0.71]) and MACE (RR, 0.45 [0.26–0.78]). There were no significant differences in hospital readmissions between early vs late discharge in both RCT or observational study analyses.

Conclusions: Early discharge strategy in appropriately selected low-risk patients with STEMI undergoing PCI is safe and it has the potential to improve cost of care.

Keywords

ST-elevation myocardial infarction; Length of stay; Meta-analysis

1. Introduction

ST-elevation myocardial infarction (STEMI) accounts for approximately 33% of patients presenting with acute coronary syndrome [1]. The cornerstone of treatment in STEMI is primary percutaneous coronary intervention (PCI), which is ideally performed within 90 min of presentation, followed by inpatient monitoring for complications [2,3]. With improvements in antiplatelet therapy, drug-eluting stents, PCI equipment, a preference for radial access and improved door to balloon times, the mortality from STEMI has decreased considerably over the last three decades [3-7]. While these initiatives have improved the quality of care, the median cost of care for STEMI patients treated with PCI has increased from \$17,182 in 2001 to \$19,614 in 2011 and prolonged inpatient hospitalization constitutes the bulk of this cost [8].

Patients with STEMI are a heterogeneous group that yield a spectrum of adverse events with most of the complications occurring within the first 48–72 h of presentation [9]. Small randomized controlled trials (RCT) and observational studies have shown the safety and efficacy of early discharge within 72 h for low-risk patients with STEMI [10-15]. However, most of these studies were not adequately powered to detect a difference in mortality. As a result, the optimal timing of discharge in patients classified as low-risk with STEMI and treated with PCI is unclear and there is heterogeneity in professional society guideline recommendations. The American College of Cardiology (ACC) guidelines do not provide any recommendations regarding optimal discharge timing; whereas, the European Society of Cardiology guidelines recommend early discharge within 48–72 h for low-risk STEMI patients (Class IIa) [2,3]. There are limited number of randomized controlled trials (RCTs) on this topic; and the recommendation for early discharge is mainly supported by observational data, which has its limitation of residual bias. In this systematic review and meta-analysis, we pooled the data from RCTs and observational studies that compared early (< 3 days) versus late discharge (>3 days) and examined the association of discharge timing with mortality, readmissions and major adverse cardiac events (MACE) in low-risk patients with STEMI.

2. Methods

We followed Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (PRISMA) and Meta-analyses of Observational Studies in Epidemiology (MOSE) guidelines for observational studies in conducting this meta-analysis [16,17].

2.1. Search strategy

Two authors (Z.A, A.A) conducted independent searches in MEDLINE, EMBASE and major cardiology conference websites (European Society of Cardiology, American College of Cardiology, American Heart Association, Transcatheter Cardiovascular Therapeutics) from inception till September 09, 2019. The medical subject headings and keywords included “ST elevation myocardial infarction” combined with: “percutaneous coronary intervention” OR “PCI” “Primary percutaneous coronary intervention” OR “angioplasty” OR “PTCA” OR “revascularization” AND “patient discharge” OR “early discharge” OR “late discharge” OR “length of stay”. Titles and abstracts were screened and wherever necessary full manuscripts with references were reviewed to identify eligible studies.

2.2. Study eligibility

Studies were considered eligible if they met the inclusion criteria: (1) RCTs and observational studies of low-risk patients with STEMI treated with PCI, (2) reporting of at least one outcome of interest, and (3) outcomes were reported separately for early vs late discharge strategy. We excluded abstracts or if minority (<50%) had received PCI for STEMI. There was little variation in the definition of low-risk in the included studies and generally, it was defined as uneventful first 24 h of hospital stay, single epicardial culprit vessel, 2 coronary artery disease, Zwolle risk score 3, ejection fraction 40% and age < 75 years.

2.3. Data extraction

A data collection form was used to extract demographic and outcome data from eligible studies. Following information was collected: characteristics of trials and participants, raw events, sample sizes and follow up duration. Data was abstracted on intention to treat principle.

2.4. Outcomes

The early and late discharge strategies were defined as 3 days and >3 days respectively (Table 1). The outcomes of interest were all-cause mortality, major adverse cardiovascular events (MACE) and hospital readmissions.

2.5. Quality and risk of bias assessment

The quality and risk of bias assessment was done on the Newcastle-Ottawa Quality Assessment Scale for observational studies (Appendix Table 1), and the Cochrane risk of bias assessment tool for RCTs (Appendix Fig. 1) [18]. The whole process of study selection, data abstraction and risk of bias assessment was performed by two independent reviewers (Z.A, A.A) and any disagreements were resolved by discussion with the adjudicating author (M.A-F).

2.6. Statistical analysis

Meta-analysis was stratified according to study design into (1) RCTs and (2) observational studies. The estimates were pooled by the Mantel-Haenszel random effects model. Outcomes were reported as risk ratio (RR) with 95% confidence intervals (CIs). We used a

random effects model to account for any potential between-study variability. Heterogeneity was calculated using the Chi-square method and I^2 statistic above 75% was consistent with a high degree of heterogeneity. The 95% CI that did not cross 1 were considered statistically significant. Review Manager (Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) was used for data analysis.

3. Results

Of 720 records, 38 full text articles were reviewed after removal of duplicates and abstracts. Ultimately, 7 RCTs (1780 patients) and 4 observational studies (39,288 patients) met the inclusion criteria (Fig. 1) [10-15,19-23]. Study designs and the baseline characteristics of included patient populations are reported (Table 1 and Appendix Table 2). Overall, the included studies were of high quality. Sensitivity analysis was performed after removing one study at the time (Appendix Table 3).

3.1. Mortality

Six RCTs comprising 1724 patients reported the outcome of mortality stratified by early vs late discharge. There were zero events in both early discharge and late discharge arm of the 4 of the studies so it was not possible to pool their effects. A total of 4 events (0.46%) occurred among 871 patients in the early discharge arm versus 4 (0.47%) events among 853 patients in the late discharge arm. The pooled estimate showed that there was no statistically significant difference in mortality with early discharge compared with late discharge (RR = 0.97; 95% CI 0.23 to 4.05; $p = .97$) ($I^2 = 0\%$; $p = .47$) (Fig. 2). Three observational studies comprising 36,635 patients reported the outcome of mortality stratified by early discharge vs late discharge. A total of 94 events (0.86%) occurred among 10,907 patients in the early discharge arm versus 493 (1.9%) events among 25,728 patients in the late discharge arm. The pooled estimate showed early discharge was associated with a statistically significant reduction in all-cause mortality compared with late discharge however, there was moderate heterogeneity (RR = 0.40; 95% CI 0.23 to 0.71; $p = .002$) ($I^2 = 44\%$; $p = .17$) (Fig. 2).

3.2. Major adverse cardiac events

Two RCTs comprising 686 patients reported the outcome of MACE stratified by early discharge vs late discharge. A total of 37 events (10.7%) occurred among 344 patients in the early discharge arm versus 44 (12.9%) events among 342 patients in the late discharge arm. The pooled estimate showed that there was no statistically significant difference in MACE with early discharge compared with late discharge (RR = 0.84; 95% CI 0.56 to 1.26; $p = .40$) ($I^2 = 0\%$; $p = .42$) (Fig. 3). Three observational studies comprising 36,840 patients reported the outcome of mortality stratified by early discharge vs late discharge. A total of 371 events (3.3%) occurred among 11,102 patients in the early discharge arm versus 1094 (4.3%) events among 25,738 patients in the late discharge arm. The pooled estimate showed early discharge was associated with a statistically significant reduction in MACE compared with late discharge however this finding should be interpreted with caution due to high heterogeneity (RR = 0.45; 95% CI 0.26 to 0.78; $p = .004$) ($I^2 = 94\%$; $p < .00001$) (Fig. 3).

3.3. Readmissions

Six RCTs comprising 1565 patients reported the outcome of readmissions stratified by early discharge vs late discharge. There were zero events in one study so it was not possible to pool its effect. A total of 32 events (4%) occurred among 801 patients in the early discharge arm versus 41 (5.4%) events among 764 patients in the late discharge arm. The pooled estimate showed that there was no statistically significant difference in readmissions with early discharge compared with late discharge ($RR = 0.76$; 95% CI 0.48 to 1.20; $p = .23$) ($I^2 = 0\%$; $p = .64$) (Fig. 4). Two observational studies comprising 36,573 patients reported the outcome of readmissions stratified by early discharge vs late discharge. A total of 178 events (1.63%) occurred among 10,872 patients in the early discharge arm versus 360 (1.4%) events among 25,701 patients in the late discharge arm. The pooled estimate showed early discharge was not associated with readmissions compared with late discharge however, there was moderate heterogeneity ($RR = 0.89$; 95% CI 0.64 to 1.24; $p = .51$) ($I^2 = 59\%$; $p = .12$) (Fig. 4).

4. Discussion

4.1. Major findings

Our major finding is the safety of early discharge strategy in appropriately selected low risk patients with STEMI treated with PCI. The pooled estimate of RCTs showed that there was no statistically significant difference in mortality, MACE or readmissions with early discharge versus low discharge strategy. The pooled estimate of observational studies suggested no difference in hospital readmissions but a statistically significant reduction in mortality and MACE associated with early discharge strategy. Overall, these findings suggest that early discharge strategy does not result in increased mortality, MACE or readmissions in low-risk patients with STEMI undergoing PCI. While the observational data favored early discharge strategy for reduction in mortality [14,15] and MACE [13,14], these benefits were not supported by RCTs [11,12,20].

4.2. Justification of major findings

The most likely explanation for these results is the low event rates among the low-risk STEMI population considered for early discharge. The majority of complications in patients with STEMI such as arrhythmias, cardiogenic shock and bleeding or recurrent ischemic events occur during the first 24–72 h. A large study of 5745 STEMI patients treated with PCI showed that 90% of ventricular tachycardia or ventricular fibrillation occurred within 48 h of presentation [9]. An early discharge strategy allows for identification for these complications while still ensuring that patients without complications are discharged promptly. The more likely explanation for worse outcomes observed with late discharge strategy in observational studies is that the sicker patients required longer hospital stay and had worse mortality and MACE.

4.3. Comparison with published literature

A 2018 similar meta-analysis of 5 RCTs comprising 1575 patients by Gong et al. showed that early discharge strategy was associated with a shortened length of stay without any

significant difference in mortality or readmissions [24]. Our updated RCT restricted analysis included 7 RCTs with 1780 patients and showed similar findings which increases the sample size of prior meta-analysis and supports their findings. While the RCT restricted analysis has its strengths, a small sample size is a significant limitation. Due to paucity of RCTs on this subject and small sample size, we included 4 observational studies comprising 39,288 patients in our analysis. The inclusion of observational studies not only increased the sample size but also provided important real-world clinical data that improves the generalizability of our findings.

4.4. Significance and implications for clinical practice

Our findings show that only observational studies support the current European Society of Cardiology 2017 guidelines that recommend discharge within 48–72 h for low-risk STEMI patients (Grade IIa) [2]. While the American College of Cardiology 2013 STEMI guidelines do not provide any recommendations regarding timing of discharge, our study provides a helpful summary and highlights the limitations of the available evidence on this subject [3].

While demonstration of safety of early discharge strategy is the most important implication of our study, another important implication is the potential to reduce cost of care associated with prolonged hospitalization. The index hospitalization cost of care for STEMI is approximately \$19,000 and 20% of that cost is related to hospital length of stay [8,25]. Moreover, the Medicare reimbursements are inadequate for these hospitalizations and it creates a significant economic burden on hospitals and patients [26]. An early discharge strategy can reduce the cost of care substantially and allow triage of resources to better post discharge care and rehabilitation.

Multiple risk stratification scores have been developed to predict adverse events in patients with STEMI which are often used as a guide to decide the appropriate length of stay. The CADILLAC score can predict 30-day mortality based on variables like age > 65 years, Killip class 2/3, left ventricular ejection fraction <40%, anemia, renal insufficiency, triple vessel disease and post PCI thrombolysis in myocardial infarction (TIMI) flow grade. This metric classifies patients into low, intermediate and high-risk patients [27]. When the CADILLAC score was applied to retrospectively stratify STEMI patients undergoing PCI, the risk of MACE at day 3 or later was 0% in low-risk vs 11.4% in intermediate-high risk patients ($p = .0002$) [28]. Another metric, the Zwolle index utilizes multiple variables including Killip class and post-PCI TIMI flow to predict 30-day mortality and patients classified as low-risk have 0.1% mortality at 2 days [29]. In a retrospective study, the Zwolle index was applied to identify low-risk STEMI patients treated with PCI and it was found that 72% of low-risk patients were inappropriately hospitalized for >3 days [30]. Similarly, application of the Zwolle index prospectively to 549 STEMI patients showed that the in-hospital mortality for low-risk patients was only 0.4% vs 12.5% for high-risk patients ($p < .001$) and implementation of a fast track protocol to discharge these low-risk patients early resulted in significant reduction in cost expenditure [31].

Recent data have also hinted that practice is already changing towards early discharge strategy [9]. Insights from the National Inpatient Sample database (678,545 hospitalizations for PCI in STEMI patients) showed that mean length of stay was decreased from 3.3 days to

2.7 days and the proportion of STEMI hospitalizations with length of stay >3 days had decreased from 31.9% to 16.9% ($p < .001$ for all) from 2005 to 2014 [9]. Undoubtedly, early discharge strategy carries multiple advantages including cost-effectiveness, patient satisfaction and optimal resource utilization^{31–33}. However, the potential risks with early discharge include limited time to provide patient education, implement appropriate guideline directed medical therapy, arrange cardiac rehabilitation and schedule follow up appointments. The decision to determine optimal timing of discharge is complex and should be individualized as the risk scores may fail to account for certain patient factors like thrombocytopenia, anemia, renal failure, frailty, renal failure, intolerance to antiplatelet medications or ventricular ectopy beyond 48 h.

4.5. Limitations

The current study has various limitations. First, this is a study-level meta-analysis since we did not have access to patient-level data. Hence, the variations in patient demographics, comorbidities, medications, PCI techniques could not be accounted for in the pooled estimates. Secondly, the event rates in the included RCTs were low suggesting trials were underpowered to detect differences in endpoints. However, our analysis includes the best available evidence on this subject and in future larger trials can be conducted. Thirdly, the observational studies are confounded with biases such as attrition and selection biases, therefore we have conducted a stratified analysis based on study design. Fourth, some of the RCTs included in our analysis are old and do not reflect the substantial improvements in treatment of STEMI in the last few years. However, due to limited number of RCTs on this subject, we have not excluded the older RCTs to avoid compromising on our sample size and precision of estimates. Finally, RCTs included only low-risk patients with STEMI so current results are only reflective of low-risk patients which are different from most STEMI patients seen in clinical practice. Therefore, we advise careful patient selection when early discharge is considered.

5. Conclusion

In conclusion, this meta-analysis indicates that early discharge strategy in appropriately selected low-risk patients with STEMI undergoing PCI is safe and it has the potential to improve cost of care. The observational data favored early discharge strategy for reduction in mortality and cardiovascular events, while, RCTs showed no difference in mortality, MACE and readmissions between early vs late discharge. The decision regarding optimal timing of discharge should be tailored to the individual patient.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Fig. 1.
PRISMA diagram showing search strategy.

Fig. 2.

Forest plot showing outcome of mortality with early discharge vs late discharge.

Fig. 3.

Forest plot showing outcome of major adverse cardiac events with early discharge vs late discharge.

Fig. 4.

Forest plot showing outcome of readmissions with early discharge vs late discharge.

Table 1

Study design and characteristics of included studies.

Study	Sample	Inclusion criteria	Primary outcomes	Secondary outcome	Length of stay	Revascularization & antiplatelets	Follow up	Risk ratio for early vs late discharge		
								Mortality	Readmissions	MACE
Observational studies										
Swaminathan 2015	33,920 Short LOS (<i>n</i> = 9135) Medium LOS (<i>n</i> = 15,704) Long LOS (<i>n</i> = 9081)	65 age PPCI for STEMI 2004–2009 NCDR Database	30-day mortality or MACE defined as composite of mortality, MI readmissions, unplanned revascularizations	30-day all-cause mortality, readmissions for MI, unplanned revascularization, bleeding events	Very short 1–2 days Short 3 days Medium = 4–5 days Long 5 days	Femoral access 97.9% ED, 98% LD	1-year	ED 3 days Events = 82 Total = 9135 Risk Ratio ED = 82/9135 LD > 3 days Events = 475 Total = 24,785 Risk Ratio LD = 475/24785	ED 3 days Events = 91 Total = 9135 Risk Ratio for ED: 91/9135 LD > 3 days Events = 318 Total = 24,785 Risk Ratio LD: 318/24785	ED 3 days Events = 174 Total = 9135 Risk Ratio ED: 174/9135 LD > 3 days Events = 799 Total = 24,785 Risk Ratio LD: 799/24785
Karabulut 2011	267 D/C in 1-day (90) D/C in 2 days (94) D/C in 3-days (46) D/C in >3 days (37)	PPCI for STEMI	1-year mortality or revascularization of infarct related artery.	Defining an optimal LOS according to demographic and clinical characteristics	1-day 2-days 3-days >3-days	Tirofiban 45.2% ED, 73% LD	1-year	ED 3 days Events = 1 Total = 230 Risk Ratio ED = 1/230 LD > 3 days Events = 3 Total = 37 Risk Ratio LD = 3/37	ED 3 days Events = 37 Total = 230 Risk Ratio ED = 37/230 LD > 3 days Events = 11 Total = 37 Risk Ratio LD = 11/37	ED 3 days Events = 37 Total = 230 Risk Ratio ED = 37/230 LD > 3 days Events = 11 Total = 37 Risk Ratio LD = 11/37
Jones 2012	2779 D/C in 2-days (1117) D/C in 3-days (620) D/C in >3-days (916)	PPCI for STEMI	30-day readmissions	MACE defined as composite of death, recurrent MI, revascularization, stroke, target vessel revascularization	2-days 3-days >3-days	Radial access 42.5% ED, 31.2% LD GP IIb/IIIa 90% ED, 87.6% LD	2.8 years (IQR 1.3–4.4) (median)		ED 3 days Events = 87 Total = 1737 Risk Ratio ED: 87/1737 LD > 3 days Events = 42 Total = 916 Risk Ratio LD: 42/916	ED 3 days Events = 160 Total = 1737 Risk Ratio ED: 160/1737 LD > 3 days Events = 284 Total = 916 Risk Ratio LD: 284/916
Noman 2013	2448 ED (1542) LD (906)	PPCI for STEMI	Mortality at 1, 7 and 30 days			Radial access 72.6% ED, 64.1% LD Aspiration thrombectomy 45.7% ED, 39.3% LD GP IIb/IIIa inhibitors 83.3% ED, 79.4%	ED 584 days and 582 days in LD (mean)	ED Events = 11 Total = 1542 Risk Ratio ED: 11/1542 LD Events = 15 Total = 906		

Study	Sample	Inclusion criteria	Primary outcomes	Secondary outcome	Length of stay	Revascularization & antiplatelets	Follow up	Risk ratio for early vs late discharge		
								Mortality	Readmissions	MACE
Randomized controlled clinical trials										
Satlimisoglu 2016 (EDAP-PCI)	769 ED (370) LD (363)	PPCI for STEMI within 12 h of onset, Uneventful 24 h f/u. Single epicardial vessel to be treated	30-day mortality	Readmission at 30 days due to reinfarction, unstable angina, arrhythmia, CHF, revascularization, stroke, major bleeding. Functional status Health related QOL	ED < 48 h to 56 h.	Aspirin Clopidogrel	30-days	Risk Ratio LD: 15/906		
								ED < 48 h to 56 h. Events = 2 Total = 370 Risk Ratio ED = 14/370	ED < 48 h to 56 h. Events = 14 Total = 370 Risk Ratio ED = 14/370	
								LD > 48 h to 56 h. Events = 3 Total = 363 Risk Ratio LD = 3/363	LD > 48 h to 56 h. Events = 25 Total = 363 Risk Ratio LD = 25/363	
Melberg 2015	215 ED (107) LD (108)	STEMI within 2 days of admission with Zwolle risk score 3	30-day mortality	30-day readmissions Health related QOL	ED 3-days	DES 60% ED, 62% LD GP IIb/IIIa inhibitors 61.7% ED, 71.3% LD Aspiration thrombectomy 48.6% ED, 55.6% LD Radial access 50.5% ED, 66.7% LD	30-days	ED 3 days Events = 0 Total = 107 Risk Ratio ED = 0/107	ED 3 days Events = 4 Total = 107 Risk Ratio ED = 4/107	ED 3 days Events = 1 Total = 107 Risk Ratio for ED = 1/107
								LD > 3 days Events = 0 Total = 108 Risk Ratio LD = 0/108	LD > 3 days Events = 3, Total = 108 Risk Ratio LD = 3/108	LD > 3 days Events = 3 Total = 108 Risk Ratio for ED = 3/108
Azzalini 2015 (EDAMI)	100 ED (54) CDS (46)	PPCI for STEMI within 12 h of onset, Zwolle risk score 3, symptoms	Feasibility of ED vs LD Strategy		ED 3-days	BMS 42% DES 56% POBA 2% Aspirin 99% Clopidogrel 88% Prasugrel 11% Ticagrelor 1%	ED 3 days Events = 0 Total = 54 LD > 3 days Events = 0 Total = 46			
Kotowycz 2010 (SAFE-DEPART)	54 ED (27) LD (27)	PPCI or Rescue PCI for STEMI	Feasibility of ED vs LD Strategy		ED 2-3 days	Aspirin Clopidogrel			ED 3 days Events = 2 Total = 27 Risk Ratio ED = 2/27	ED 3 days Event = 1 Total = 27 Risk Ratio LD = 1/27

Study	Sample	Inclusion criteria	Primary outcomes	Secondary outcome	Length of stay	Revascularization & antiplatelets	Follow up	Risk ratio for early vs late discharge		
								Mortality	Readmissions	MACE
Jirmar 2008 (PRAGUE-5)	56 ED (37) LD (19)	PPCI for Uncomplicated STEMI-TIMI-3 flow with <20% residual stenosis Single vessel disease EF >40% Age < 75	Feasibility and Safety of ED vs LD Strategy	30-day Death Reinfarction Stroke Unstable Angina Rehospitalization Repeat target vessel revascularization Local groin complications EF	ED 1 day	Aspirin Clopidogrel	30-days		ED 1 day Events = 1 Total = 37 Risk Ratio ED = 1/37 LD > 1 day Events = 0 Total = 19 Risk Ratio LD = 0/19	
Grines 1998 (PAMI-II)	471 ED (237) LD (234)	PPCI for Low-risk STEMI Age 70 years LVEF >45% 2-Vessel disease Successful PPCI	Composite of death, reinfarction, unstable ischemia, stroke or CHF by 6-months	Death, reinfarction, unstable ischemia, stroke or CHF by 6-months	ED 3 days	Successful PTCA 96.1% TIMI Grade 3 flow 92.9% vessels	6-months	ED 3 days Events = 2 Total = 237 Risk Ratio ED = 2/237 LD > 3 days Events = 1 Total = 234 Risk Ratio LD = 1/234	ED 3 days Events = 10, Total = 237 Risk Ratio ED = 10/237 LD > 3 days Events = 9, Total = 234 Risk Ratio LD = 9/234	ED 3 days Events = 36 Total = 237 Risk Ratio ED = 36/237 LD > 3 days Events = 41 Total = 234 Risk Ratio LD = 41/234
Novobilsky 2018	151 ED (76) LD (75)	PPCI STEMI 12 h after onset Age 75 years EF >45% 2-Vessel disease Successful PPCI No arrhythmias or hemodynamic instability >2 h after PPCI	Composite of death, MI, UA, stroke, unplanned rehospitalization, repeat target vessel revascularization, stent thrombosis at 90-days post discharge.		ED 3 days	DES 84.2% ED, 93.3% LD GP IIb/IIIa inhibitors 14.5% ED, 16% LD Aspiration thrombectomy 46.1% ED, 46.7% LD Radial access 98.7% ED, 100% LD		ED 3 days Events = 0 Total = 76 Risk Ratio ED = 0/76 LD > 3 days Events = 0 Total = 75 Risk Ratio LD = 0/75	LD > 3 days Events = 5 Total = 76 Risk Ratio ED = 5/76 LD > 3 days Events = 6 Total = 75 Risk Ratio LD = 6/75	

APN: Advanced practice nurse, BMS: Bare Metal Stent, CDS: Conventional discharge strategy, CHF: Congestive heart failure, D/C: Discharge, DES: Drug Eluting Stent, ED: Early discharge, EF: Ejection fraction, F/u: Follow up, GP: Glycoprotein, IQR: Interquartile range, LD: Late discharge, LOS: Length of stay, MACE: Major adverse cardiovascular events, MI: Myocardial infarction, NCDR: National cardiovascular disease registry, PPCI: Primary percutaneous coronary intervention, POBA: Percutaneous Old Balloon Angioplasty, QOL: Quality of life, STEMI: ST-Elevation myocardial infarction.