JACC: CARDIOVASCULAR INTERVENTIONS
VOL. 8, NO. 15, 2015

ISSN 1936-8798/$36.00
PUBLISHED BY ELSEVIER INC.
http://dx.doi.org/10.1016/j.jcin.2015.08.030

CORONARY

The Association of Previous Revascularization With In-Hospital Outcomes in Acute Myocardial Infarction Patients

Results From the National Cardiovascular Data Registry

Luis Gruberg, MD,* Anne S. Hellkamp, MS,† Laine E. Thomas, PhD,† James A. de Lemos, MD,‡ Benjamin M. Scirica, MD,§ Anthony Hilliard, MD,‖ Jonathan R. Enriquez, MD,¶ Amr Mohsen, MD,# Tracy Y. Wang, MD, MHS, MSc†

ABSTRACT

OBJECTIVES The aim of this study was to compare outcomes of ST-segment elevation myocardial infarction (STEMI) patients with a history of coronary artery bypass graft surgery (CABG), previous percutaneous coronary intervention (PCI), or no previous revascularization undergoing primary PCI.

BACKGROUND Limited data exist regarding door-to-balloon times and clinical outcomes of STEMI patients with a history of CABG or PCI undergoing primary PCI.

METHODS We examined 15,628 STEMI patients who underwent primary PCI at 297 sites in the United States. We used multivariable logistic regression analyses to compare door-to-balloon time delays >90 min and in-hospital major adverse cardiovascular or cerebrovascular events (MACCE).

RESULTS Patients with previous CABG were significantly older and more likely to have multiple comorbidities ($p < 0.0001$). Previous CABG was associated with a lower likelihood of a door-to-balloon time ≤90 min compared with patients with no previous revascularization. However, no significant differences in door-to-balloon times were noted between patients with previous PCI and those without previous revascularization. The unadjusted MACCE risk was significantly higher in patients with a history of CABG compared with patients without previous revascularization (odds ratio: 1.68, 95% confidence interval: 1.23 to 2.31). However, after multivariable risk adjustment, there were no significant differences in MACCE risk between the 2 groups. No significant differences in in-hospital outcomes were seen in patients with a previous PCI and those without previous revascularization.

CONCLUSIONS In a large cohort of STEMI patients undergoing primary PCI, patients with previous CABG were more likely to have reperfusion delays, yet risk-adjusted, in-hospital outcomes were similar to those without previous revascularization. No significant differences in reperfusion timeliness and in-hospital outcomes were seen in patients with a history of PCI compared with patients without previous revascularization. (J Am Coll Cardiol Intv 2015;8:1954–62)

From the *Department of Medicine, Division of Cardiovascular Medicine, Stony Brook University Hospital, Stony Brook, New York; †Duke Clinical Research Institute, Durham, North Carolina; ‡Department of Medicine, Division of Cardiology, University of Texas Southwestern Medical Center, Dallas, Texas; §Cardiovascular Division, Brigham and Women's Hospital, Boston, Massachusetts; ‖Division of Cardiology, Department of Medicine, Loma Linda University, Loma Linda, California; ¶Division of Cardiology, Department of Medicine, University of Missouri-Kansas City, Kansas City, Missouri; and the #Department of Cardiovascular Medicine, William Beaumont Hospital, Royal Oak, Michigan. Dr. Gruberg has received honoraria for serving on the

Primary percutaneous coronary intervention (PCI) is currently a Class I indication and the default strategy for the management of patients with ST-segment elevation myocardial infarction (STEMI) if it can be performed in a timely manner (1-3). However, current guidelines for the management of STEMI patients make no reference to door-to-balloon time goals for patients who have had a previous surgical or percutaneous coronary revascularization procedure who may have more complex coronary anatomy or require additional diagnostic image acquisition to inform decision making (1). There are limited data comparing outcomes between patients with and without previous coronary revascularization. Previous reports have indicated that the prevalence of STEMI after previous coronary artery bypass graft surgery (CABG) ranges from 2% to 14% (4,5) and, although infrequent, is associated with worse clinical outcomes (6-9). Early studies performed with fibrinolytic therapy showed poor angiographic success and higher mortality rates in these patients (10,11). The advent of percutaneous transluminal coronary angioplasty did not seem to improve the outcomes of these patients (5,8,9,12). More recent studies using intracoronary stenting showed that patients with previous CABG had significantly higher mortality rates than those without previous revascularization, especially if the infarct-related lesion was located in a bypass graft (4,13-15). Conversely, a recent study of acute myocardial infarction (MI) patients undergoing PCI for a previously stented culprit lesion had significantly lower mortality rates compared with patients who had a PCI for a de novo culprit lesion (16). However, there is no contemporary study that directly compares in a single cohort the outcomes of primary PCI among STEMI patients with previous CABG, previous PCI, or no previous revascularization.

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By merging 2 datasets of the National Cardiovascular Data Registry, the CathPCI Registry and the Acute Coronary Treatment and Intervention Outcomes Network (ACTION) Registry and Get With the Guidelines, we were able to assess both interventional and in-hospital clinical outcomes on the basis of the patient's revascularization history and the culprit lesion treated. We sought to compare reperfusion timeliness and in-hospital outcomes after primary PCI among STEMI patients with a history of CABG, patients with a history of PCI, and those without previous revascularization.

ABBREVIATIONS AND ACRONYMS

CABG = coronary artery bypass graft surgery

CI = confidence interval

GWTG = Get With the Guidelines

MACCE = major adverse cardiovascular or cerebrovascular event(s)

MI = myocardial infarction

OR = odds ratio

PCI = percutaneous coronary intervention

STEMI = ST-segment elevation myocardial infarction

METHODS

STUDY POPULATION. The mission of the National Cardiovascular Data Registry, developed by the American College of Cardiology Foundation, is to improve the quality of cardiovascular patient care by measuring adherence to performance metrics, providing direct feedback to participating sites together with knowledge and tools to improve performance (17). The ACTION (Acute Coronary Treatment and Intervention Outcomes Network) Registry-GWTG (Get With the Guidelines) was designed to assess the characteristics, treatments, and outcomes of consecutive STEMI or non-STEMI patients. Participation in these registries is voluntary and subject to approval by the institutional review board of each institution. These data are collected as part of quality improvement programs in participating hospitals with defined data quality report specifications for data capture and transmission, as well as an auditing program; therefore, a waiver of informed consent was granted to all sites.

As described previously, the ACTION Registry-GWTG and CathPCI Registry datasets were linked to create a novel single file of patients with records in both registries (18). Data on patients' demographic characteristics, medical history, treatment modality, medications (at home, in-hospital, and at discharge) were obtained from the ACTION Registry-GWTG. Angiographic and procedural data and periprocedural outcomes were obtained from the CathPCI Registry. This merge resulted in a total of 24,214 matched STEMI patients with a record in both the ACTION Registry-GWTG and CathPCI Registry. We excluded patients who had cardiogenic shock or cardiac arrest on presentation (n = 2,103) as reperfusion decision making for these patients is likely different than that for other more hemodynamically stable STEMI

Speakers Bureau of AstraZeneca and Janssen. Dr. Wang has received research grants to the Duke Clinical Research Institute from AstraZeneca, Boston Scientific, Daiichi-Sankyo, Eli Lilly, Gilead Sciences, GlaxoSmithKline, and Regeneron Pharmaceuticals; and consulting fees or honoraria from AstraZeneca and Eli Lilly. Dr. Hilliard has received honoraria for serving on the Speakers Bureau of Abiomed. Dr. de Lemos has received honoraria from AstraZeneca; and consultant fees from the Sanofi and Daiichi-Sankyo. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received June 1, 2015; revised manuscript received July 21, 2015, accepted August 14, 2015.

patients. We then excluded 6,109 patients who underwent interhospital transfer for reperfusion because this introduces a delay to reperfusion. Due to U.S. privacy laws, we excluded 220 patients who were transferred out from the National Cardiovascular Data Registry hospital as post-transfer outcomes could not be ascertained. Finally, we excluded 19 patients who were missing information on previous CABG or previous PCI status. For patients with multiple MI admissions in National Cardiovascular Data Registry, we used the first MI admission to avoid double counting the patient. Our final study population included 15,628 STEMI patients treated at 297 U.S. hospitals between June 13, 2009 and September 28, 2011.

DATA COLLECTION AND DEFINITIONS. All patient clinical and angiographic characteristics, procedural details, length of hospital stay, and in-hospital outcomes are collected at each participating institution using standardized data elements and definitions and exported in a standard format to the American College of Cardiology (www.ncdr.com). The CathPCI Registry captures detailed angiographic information including lesion location, pre-procedural stenosis, and pre-procedural Thrombolysis In Myocardial Infarction flow grade. If no culprit lesion was designated for the STEMI patient, then the first lesion treated was considered the infarct-related artery. The CathPCI Registry also denotes whether the culprit lesion was located in a bypass graft or native coronary artery and whether in a previously treated versus de novo coronary location. The outcomes of interest in this study included door-to-balloon time, in-hospital mortality, in-hospital major adverse cardiac or cerebrovascular events (MACCE), defined as the composite of death, nonfatal MI, or stroke, and in-hospital major bleeding, defined as absolute hemoglobin drop (baseline to nadir) ≥4 g/dl, intracranial hemorrhage, retroperitoneal hemorrhage, use of red blood cell transfusion in patients with a baseline hemoglobin ≥9.0 g/dl, and use of red blood cell transfusion among patients with a baseline hemoglobin <9.0 g/dl and a witnessed bleeding event (19).

STATISTICAL ANALYSIS. We divided the study population into STEMI patients with a history of PCI, a history of CABG, and a history of no previous revascularization. Patients with previous CABG were further analyzed according to whether the PCI treated a graft or a native vessel. Similarly, patients with a history of PCI were analyzed on the basis of whether the lesion was in a previously stented location or in a de novo location. Categorical variables were compared between groups using the Pearson chi-square test. Continuous variables are presented as medians and compared between groups using the Kruskal-Wallis test.

Multivariable logistic regression models, which used generalized estimating equations to account for correlation within sites, were used to examine the association between each group and the outcomes of interest. Covariates used in each model were selected on the basis of a combination of previous risk models, clinical judgment, and significant differences observed in univariable comparisons between groups and included age, sex, race, insurance status, weight, presenting heart rate, presenting systolic blood pressure, hypertension, diabetes mellitus, peripheral arterial disease, smoking status, dyslipidemia, dialysis, chronic lung disease, atrial fibrillation/flutter, previous MI, previous heart failure, previous stroke, home use of a $P2Y_{12}$ receptor inhibitor, baseline hemoglobin, baseline creatinine, baseline troponin, culprit artery, pre-procedural Thrombolysis In Myocardial Infarction flow grade, previously stented lesion, lesion in a graft, lesion complexity, lesion length, the presence of thrombus, and a bifurcation lesion. All comparisons used patients without previous revascularization as the reference group. For a lesion in a graft, comparisons are made with a lesion in a native vessel.

RESULTS

Between June 2009 and September 2011, a total of 15,628 patients underwent primary PCI at 297 hospitals in the United States, of these, 969 (6%) had a history of CABG, 3,010 (19%) had a previous PCI, and the majority (n = 11,649 [75%]) had no history of coronary artery revascularization. As shown in Table 1, there were significant clinical differences among the groups. STEMI patients with a history of CABG were significantly older than patients with a previous PCI or those without previous revascularization (66 years vs. 60 years and 59 years, respectively; $p < 0.001$). Additionally, previous CABG patients had higher rates of hypertension, dyslipidemia, diabetes, peripheral vascular disease, chronic lung disease, cerebrovascular disease, and end-stage renal disease on dialysis compared with patients who had previous PCI or no previous revascularization ($p < 0.001$ for all). Regarding angiographic and procedural characteristics, there were also significant differences among the 3 groups, particularly between patients with a history of CABG and those patients with either a history of PCI or without previous PCI, as shown in Table 2 and Figure 1. In patients with previous PCI or without a history of coronary

revascularization, intervention for the right coronary artery was more frequent, whereas for patients with previous CABG, multivessel PCI, intervention for the right coronary artery, or a bypass graft was more frequently performed. PCI for a previously stented lesion was performed in 42.4% of previous PCI patients; PCI for a graft lesion was performed in 54.4% of previous CABG patients (Figure 1). The use of drug eluting stents was approximately 50% in this acute STEMI population; however this percentage was slightly higher (54%) in patients without previous revascularization (Table 2). In addition, a higher percentage of previous CABG patients had reduced left ventricular ejection fraction compared with the other 2 groups (Table 2).

REPERFUSION TIME AND PROCEDURAL SUCCESS. A lower percentage of patients with a history of CABG achieved a door-to-balloon time of ≤90 min compared with patients with a history of PCI and patients with no previous revascularization (76.4% vs. 88.5% vs. 88.0%) (Figure 2A). A door-to-balloon time of ≤90 min was achieved in 90.1% of patients with a history of PCI with the culprit lesion in a previous stent location and in 87.3% if the lesion was in a nonstented region (Figure 2B). Conversely, only 75.9% of patients with a history of CABG achieved an appropriate door-to-balloon time of ≤90 min when the culprit lesion was located in a CABG graft and in 77% in patients with a previous CABG when the lesion was located in a native vessel, which was significantly less than in patients without previous revascularization (Figure 2A). Overall procedural success was achieved in 93.8% of the total study population. However, in patients with a history of CABG, procedural success was achieved in only 88.3% of patients compared with 93.4% of patients with a history of PCI and 94.4% of patients without a history of revascularization ($p < 0.0001$).

IN-HOSPITAL OUTCOMES FOR PATIENTS WITH PREVIOUS CABG. As seen in Table 3 and Figure 3, patients with a history of CABG undergoing primary PCI had significantly higher unadjusted in-hospital mortality and MACCE risk than did patients without previous revascularization (odds ratio [OR]: 1.73, 95% confidence interval [CI]: 1.15 to 2.60, $p = 0.009$ and OR: 1.68, 95% CI: 1.23 to 2.31, $p = 0.001$, respectively). However, after multivariable adjustment, this difference was no longer present (OR: 1.03, 95% CI: 0.64 to 1.68, $p = 0.89$ and OR: 1.07, 95% CI: 0.77 to 1.49, $p = 0.69$, respectively) (Table 3). There was a trend for an increased mortality risk in the unadjusted and the adjusted model if the treated lesion was in a bypass graft versus a previous coronary artery bypass graft with the lesion in a native vessel (OR: 2.18, 95% CI: 0.95 to 4.98, $p = 0.07$ and OR: 2.20, 95% CI: 0.93 to 5.17, $p = 0.07$), but not if the lesion was in a native coronary artery compared with no previous revascularization (OR: 1.13, 95% CI: 0.55 to 2.33 and OR: 0.67, 95% CI: 0.31 to 1.48, $p = 0.32$, respectively). Unadjusted and adjusted MACCE risk was similar when

TABLE 1 Demographics and Baseline Clinical Characteristics

	Previous CABG (n = 969)	Previous PCI (n = 3,010)	No Previous Revascularization (n = 11,649)	p Value
Demographic characteristics				
Age, yrs	66	60	59	<0.001
Male	764 (78.8)	2,318 (77.0)	8,218 (70.6)	<0.001
Race				<0.001
White	871 (90.0)	2,570 (85.6)	9,815 (84.5)	
Black	50 (5.2)	290 (9.7)	1,054 (9.1)	
Hispanic	31 (3.2)	100 (3.3)	515 (4.4)	
Asian	10 (1.0)	30 (1.0)	186 (1.6)	
Others	6 (0.6)	11 (0.4)	41 (0.4)	
Medical history				
Current smoker	318 (32.8)	1,453 (48.3)	5,330 (45.8)	<0.0001
Hypertension	853 (88.0)	2,481 (82.5)	6,739 (57.9)	<0.0001
Dyslipidemia	845 (87.2)	2,509 (83.4)	5,465 (46.9)	<0.001
Diabetes mellitus	358 (37.0)	854 (28.4)	2,330 (20.0)	<0.001
Peripheral vascular disease	170 (17.6)	243 (8.1)	431 (3.7)	<0.001
Chronic lung disease	141 (14.6)	369 (12.3)	879 (7.6)	<0.001
Congestive heart failure	124 (12.8)	245 (8.2)	233 (2.0)	<0.001
Previous myocardial infarction	561 (58.0)	1,986 (66.0)	460 (4.0)	<0.0001
Previous cerebrovascular event	77 (8.0)	180 (6.0)	424 (3.6)	<0.0001
Chronic dialysis	15 (1.6)	33 (1.1)	71 (0.6)	0.0003

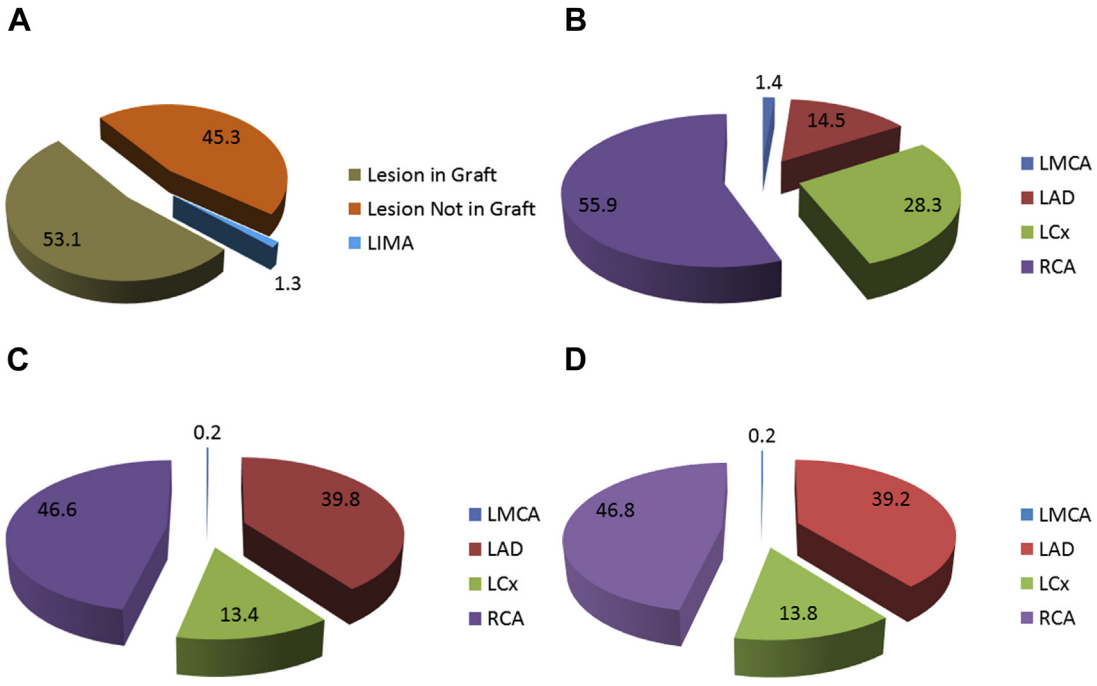
Values are n (%).
CABG = coronary artery bypass graft surgery; PCI = percutaneous coronary intervention.

TABLE 2 Angiographic and Procedural Characteristics

	Previous CABG (n = 969)	Previous PCI (n = 3,010)	No Previous Revascularization (n = 11,649)	p Value
Culprit artery				<0.0001
Left main	13 (1.4)	5 (0.2)	27 (0.2)	
Left anterior descending	139 (14.5)	1,195 (39.8)	4,555 (39.2)	
Left circumflex	271 (28.3)	403 (13.4)	1,597 (13.8)	
Right coronary	536 (55.9)	1,398 (46.6)	5,437 (46.8)	
Thrombus present	572 (59.2)	1,820 (60.5)	6,330 (54.4)	<0.0001
Previously stented lesion	151 (15.6)	1,274 (42.4)	N/A	<0.0001
Multivessel PCI	56 (5.8)	136 (4.5)	513 (4.4)	0.12
Drug-eluting stent	480 (49.5)	1,477 (49.1)	6,406 (55.0)	<0.0001
Bifurcation lesion	61 (6.3)	387 (12.9)	1,347 (11.6)	<0.0001
Lesion complexity: high/C	703 (72.9)	2,051 (68.3)	7,879 (67.7)	0.004
Ejection fraction				
>50%	407 (42)	1,372 (45.6)	6,430 (55.2)	<0.0001
<25%	62 (6.4)	121 (4.0)	268 (2.3)	<0.0001

Values are n (%).
N/A = not applicable; other abbreviations as in Table 1.

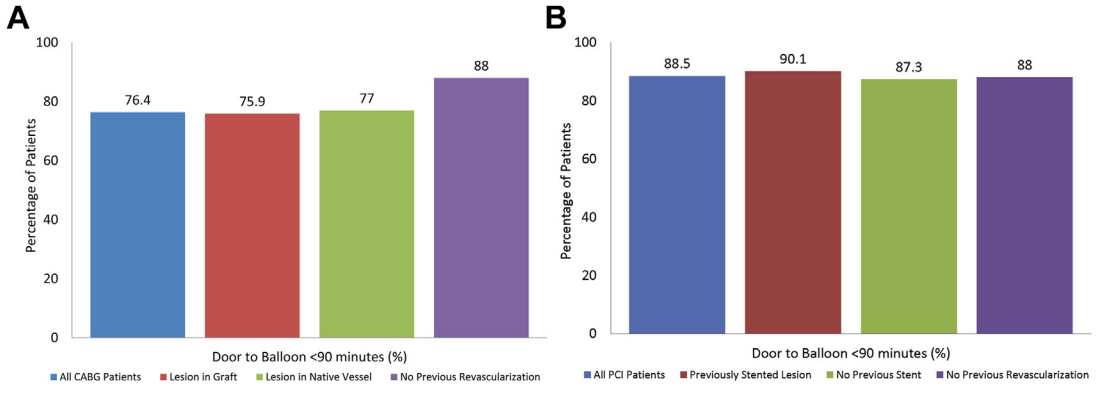
FIGURE 1 Target Vessel in Prior CABG and PCI Patients



(A) Percentage of patients with a lesion in a graft, internal mammary graft, or native vessel. **(B)** Target vessel in patients with a history of CABG. **(C)** Target vessel in patients with a history of PCI. **(D)** Target vessel in patients with no history of revascularization. LAD = left anterior descending artery; LCx = left circumflex artery; LMCA = left main coronary artery; PCI = percutaneous coronary intervention; RCA = right coronary artery.

comparing primary PCI in a lesion located in a bypass graft versus a native coronary artery and between primary PCI in a native vessel versus in patients with no previous revascularization (Table 3). Likewise, major bleeding risk was similar in the unadjusted and adjusted models for all patients with a history of CABG compared with patients with no previous revascularization (OR: 1.13, 95% CI: 0.92 to 1.38, p = 0.26 and OR: 0.91, 95% CI: 0.68 to 1.20, p = 0.49), regardless of lesion location. However, it is important

FIGURE 2 Percentage of Patients With Reperfusion Time <90 Minutes



(A) Percentage of patients with a history of CABG for whom a door-to-balloon time <90 min was achieved. **(B)** Percentage of patients with a history of PCI for whom a door-to-balloon time <90 min was achieved. Abbreviations as in Figure 2.

to note that this was an analysis of a smaller number of patients.

IN-HOSPITAL OUTCOMES FOR PATIENTS WITH A PREVIOUS PCI. When comparing patients with a history of PCI with patients with no previous revascularization, risk was similar in the unadjusted and adjusted model for mortality (OR: 1.23, 95% CI: 0.96 to 1.58, p = 0.10 and OR: 1.12, 95% CI: 0.76 to 1.63, p = 0.57, respectively), as were MACCE risk (OR: 1.10, 95% CI: 0.89 to 1.37, p = 0.38 and OR: 0.90, 95% CI: 0.68 to 1.18, p = 0.44, respectively) (Table 4). Mortality risk was similar in the unadjusted and adjusted models when patients underwent PCI of a previously stented lesion compared with patients who had a history of PCI, but the lesion was located in a different lesion (OR: 0.86, 95% CI: 0.55 to 1.35, p = 0.51 and OR: 0.77, 95% CI: 0.46 to 1.29, p = 0.32). However, there was a trend for a lower MACCE risk for patients undergoing primary PCI of a previously stented lesion, for both the unadjusted and adjusted models (OR: 0.76, 95% CI: 0.53 to 1.09, p = 0.13 and OR: 0.67, 95% CI: 0.45 to 1.00, p = 0.05, respectively). Patients with a history of PCI who had the infarct-related lesion in a new location (de novo lesion) had a trend toward a higher mortality and MACCE risk compared with patients without previous revascularization in the unadjusted model (OR: 1.31, 95% CI: 0.98 to 1.75, p = 0.07 and OR: 1.24, 95% CI: 0.97 to 1.58, p = 0.09) but not in the adjusted model (OR: 1.25, 95% CI: 0.82 to 1.91, p = 0.30 and OR: 1.06, 95% CI: 0.78 to 1.44, p = 0.70) (Table 4). Major bleeding risk was similar in the unadjusted and adjusted models for all patients with a history of PCI compared with patients with no previous revascularization in the unadjusted and adjusted models (OR: 0.88, 95% CI: 0.76 to 1.03, p = 0.11 and OR: 0.87, 95% CI: 0.71 to 1.05, p = 0.14), respectively. Bleeding rates were similar in patients with a lesion located in a previously stented lesion compared with patients who had a de novo lesion in the unadjusted and adjusted models (OR: 1.05, 95% CI: 0.81 to 1.36, p = 0.70 and OR: 0.98, 95 CI: 0.75 to 1.29, p = 0.90) and in patients undergoing primary PCI in a de novo lesion compared with patients without previous revascularization in the adjusted and unadjusted models (OR: 0.86, 95% CI: 0.71 to 1.05, p = 0.14 and OR: 0.87, 95% CI: 0.70 to 1.09, p = 0.23) (Table 4).

TABLE 3 In-Hospital Outcomes in Patients With Previous CABG

Outcome*	Previous CABG: All CABG Patients	Previous CABG: Lesion in Graft	Previous CABG: Lesion in Native Vessel	No Previous Revascularization
Mortality				
Event rate	3.3 (32/969)	4.3 (23/529)	2.0 (9/440)	1.8 (211/11,649)
Unadjusted model				
OR (95% CI)	1.73 (1.15–2.60)	2.18 (0.95–4.98)	1.13 (0.55–2.33)	Reference
p value	0.0089	0.065	0.74	
Adjusted model				
OR (95% CI)	1.03 (0.64–1.68)	2.20 (0.93–5.17)	0.67 (0.31–1.48)	Reference
p value	0.89	0.072	0.32	
MACCE				
Event rate	5.1 (49/963)	5.9 (31/526)	4.1 (18/437)	3.0 (354/11,625)
Unadjusted model				
OR (95% CI)	1.68 (1.23–2.31)	1.44 (0.78–2.67)	1.38 (0.83–2.29)	
p value	0.0013	0.24	0.21	
Adjusted model				
OR (95% CI)	1.07 (0.77–1.49)	1.35 (0.70–2.58)	0.91 (0.55–1.51)	
p value	0.69	0.37	0.71	
Major bleeding				
Event rate	9.6 (92/954)	9.8 (51/519)	9.4 (41/435)	8.5 (980/11,519)
Unadjusted model				
OR (95% CI)	1.13 (0.92–1.38)	1.03 (0.70–1.52)	1.11 (0.82–1.49)	
p value	0.26	0.88	0.50	
Adjusted model				
OR (95% CI)	0.91 (0.68–1.20)	1.11 (0.73–1.70)	0.86 (0.59–1.24)	
p value	0.49	0.62	0.41	

Values are % (n/N) unless otherwise specified. *Unadjusted and adjusted models for all CABG patients and a lesion in a native vessel are performed using patients without previous revascularization as the reference group. For a lesion in a graft, comparisons are made with a lesion in a native vessel.

CI = confidence interval; MACCE = major adverse cardiac or cerebrovascular event; OR = odds ratio; other abbreviations as in Table 1.

DISCUSSION

The major findings of our study in a contemporary, nationally representative database of 15,628 patients undergoing primary PCI for STEMI in the United States are the following; 1) patients with a history of CABG had longer delays to reperfusion than those without previous revascularization; 2) unadjusted in-hospital mortality and MACCE risk was significantly higher in patients with a history of CABG. However, after risk adjustment, there were no significant differences in in-hospital outcomes compared with patients without previous revascularization; 3) there was a trend toward higher in-hospital mortality risk in patients undergoing primary PCI in a lesion located in a CABG graft; 4) a higher percentage of patients with a history of PCI undergoing primary PCI in a previously stented lesion achieved a door-to balloon time of ≤90 min; and 5) There was a trend toward lower in-hospital mortality and MACCE risk in patients undergoing primary PCI in a previously stented lesion.

In this study, we sought to assess the outcomes of patients with a history of revascularization, either by CABG or PCI, and compare them with patients with no history of a revascularization procedure. No randomized trial or retrospective study has directly compared the outcomes of these 3 groups. As expected, these 3 groups of patients were

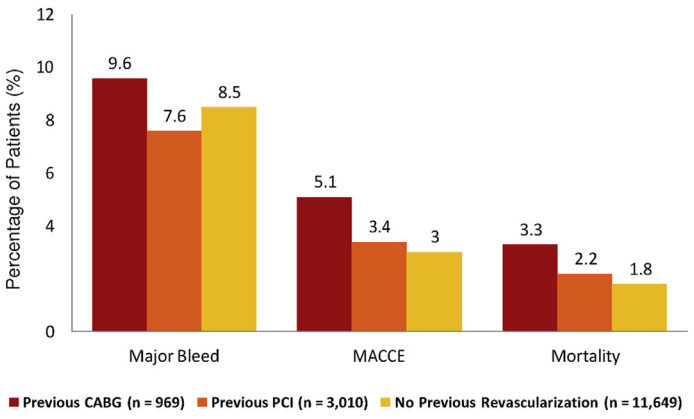
TABLE 4 In-Hospital Outcomes in Patients With Previous PCI

Outcome*	Previous PCI			No Previous Revascularization
	All PCI Patients	Previously Stented Lesion	Not Previously Stented Lesion	
Mortality				
Event rate	2.2 (67/3,010)	2.0 (26/1,274)	2.4 (41/1,736)	1.8 (211/11,649)
Unadjusted model				
OR (95% CI)	1.23 (0.96–1.58)	0.86 (0.55–1.35)	1.31 (0.98–1.75)	
p value	0.10	0.51	0.065	
Adjusted model				
OR (95% CI)	1.12 (0.76–1.63)	0.77 (0.46–1.29)	1.25 (0.82–1.91)	
p value	0.57	0.32	0.30	
MACCE				
Event rate	3.4 (101/3,005)	2.9 (37/1,271)	3.7 (64/1,734)	3.0 (354/11,625)
Unadjusted model				
OR (95% CI)	1.10 (0.89–1.37)	0.76 (0.53–1.09)	1.24 (0.97–1.58)	
p value	0.38	0.13	0.088	
Adjusted model				
OR (95% CI)	0.90 (0.68–1.18)	0.67 (0.45–1.00)	1.06 (0.78–1.44)	
p value	0.44	0.051	0.70	
Major bleeding				
Event rate	7.6 (225/2,975)	7.8 (98/1,258)	7.4 (127/1,717)	8.5 (980/11,519)
Unadjusted model				
OR (95% CI)	0.88 (0.76–1.03)	1.05 (0.81–1.36)	0.86 (0.71–1.05)	
p value	0.11	0.70	0.14	
Adjusted model				
OR (95% CI)	0.87 (0.71–1.05)	0.98 (0.75–1.29)	0.87 (0.70–1.09)	
p value	0.14	0.90	0.23	

Values are % (n/N) unless otherwise specified. *Unadjusted and adjusted models for all coronary artery bypass graft surgery patients and a lesion in a native vessel are performed using patients without previous revascularization as the reference group. For a lesion in a graft, comparisons are made with a lesion in a native vessel.

Abbreviations as in Tables 2 and 3.

FIGURE 3 In-Hospital Crude Mortality, MACCE, and Major Bleeding Rates



MACCE = major adverse cardiovascular or cerebrovascular event(s); other abbreviations as in Figure 1.

significantly different regarding baseline clinical, angiographic and procedural characteristics and therefore the need for adjustment for confounding variables. The present study shows that 24% of patients with a history of CABG did not achieve the 90-min door-to-balloon time standard set by the American College of Cardiology, the American Heart Association, and the Society for Cardiac Angiography and Interventions guidelines for the treatment of STEMI, particularly when the infarct-related artery was a bypass graft. Furthermore, in 12% of these patients, the operator was unable to successfully treat the lesion compared with 7% of patients with a history of PCI and 6% of revascularization-naïve patients. These reperfusion rates are very similar to the rates reported by O'Keefe et al. (20) in 1993, Stone et al. (15) in 2000, and Welsh et al. (4) in 2010 (4,15), and it would seem that success rates in the acute MI setting have not improved in the past 20 years despite technological and pharmacological advances in interventional cardiology. Hence, it is possible that patients with a history of CABG did not achieve fast and successful reperfusion due to the complexity of the infarct-related artery and/or lesion and the logistics associated with this patient population (1,20–22). Although in our study, the unadjusted in-hospital mortality and MACCE rates were significantly higher for patients with previous CABG, after multivariable adjustment, the risk of these adverse events was similar to that in STEMI patients without previous revascularization. However, the lack of long-term follow-up precludes us from observing longer term outcomes associated with these reperfusion challenges.

Although the efficacy of timely reperfusion in STEMI patients has been well established in previous clinical trials, the data for patients with a history of CABG are less conclusive; whereas some studies have shown that these patients have worse angiographic results and increased mortality rates, others have shown no difference in outcomes after multivariable logistic regression analysis correcting for baseline differences (4,14). In our study, we observed a strong trend for increased in-hospital mortality risk when the infarct-related lesion was in a bypass graft and a similar mortality risk when the infarct-related lesion was located in a native vessel versus in a patient without previous revascularization.

Among all patients with a history of PCI presenting with STEMI, the door-to-balloon time was similar compared with patients who had no history of revascularization. However, the door-to-balloon time was significantly shorter when the infarct-related

lesion was in a previously stented lesion, and there was a trend toward lower in-hospital MACCE risk in these patients in the adjusted model ($p = 0.05$). Overall procedural success, in-hospital mortality, and MACCE and major bleeding risk were similar in the adjusted and unadjusted models for all patients with a history of PCI compared with patients without previous revascularization. A recent publication by Chin et al. (16) that examined all acute MI patients (STEMI and non-STEMI) who underwent PCI in the CathPCI Registry showed that patients with a history of PCI had lower mortality rates compared with patients undergoing a first PCI, despite a higher risk profile. The results of our study focusing on STEMI patients only showed similar in-hospital mortality, MACCE, and bleeding rates in patients with a previous PCI and patients without previous revascularization.

STUDY LIMITATIONS. The major limitation of this study is the observational nature of the analysis, and, although the data are collected at all sites using standardized definitions, the events are not independently adjudicated. Despite the large number of patients in all 3 groups, there were substantial differences among the groups, and unmeasured confounders are not accounted for despite rigorous multivariable analysis. The lack of long-term follow-up constitutes an important limitation because outcomes may differ significantly among the 3 groups as time elapses.

CONCLUSIONS

Analysis of this large and contemporary cohort of patients showed that patients with a history of CABG undergoing primary PCI in the setting of acute STEMI are older, have multiple comorbidities, and are less likely to achieve successful reperfusion and a door-to-balloon time of ≤90 min compared with patients without previous revascularization. Conversely, patients with a history of PCI achieved similar reperfusion rates and door-to-balloon time of ≤90 min compared with patients without previous revascularization and even shorter door-to-balloon times when the infarct-related lesion was located in a previously stented lesion. After risk adjustment for multiple clinical, angiographic, and procedural differences between groups, there was no significant difference in in-hospital mortality, MACCE, and major bleeding among the 3 groups. Mechanisms to optimize door-to-balloon time and improve success of reperfusion in patients with previous CABG should be a priority for future research.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. Luis Gruberg, Division of Cardiovascular Medicine, Department of Medicine, Health Sciences Center, T16-080, Stony Brook, New York 11794-8160. E-mail: luis.gruberg@stonybrook.edu.

PERSPECTIVES

WHAT IS KNOWN? Prompt revascularization of the infarct-related artery is currently the default strategy in patients presenting with STEMI. Also, it should be performed in a timely manner, with a recommended door-to-balloon time of ≤90 min for patients undergoing PCI.

WHAT IS NEW? Patients with a history of CABG have more complex anatomy and more comorbidities and therefore have a more prolonged door-to-balloon time compared with patients with a history of PCI or those who never had a previous revascularization procedure. However, after risk adjustment for multiple clinical, angiographic, and procedural differences between the groups, patients with previous CABG had in-hospital outcomes similar to those of patients with a previous PCI and patients who never had a previous revascularization procedure. No significant differences in reperfusion timeliness or in-hospital outcomes were seen in patients with a history of PCI compared with patients without previous revascularization.

WHAT IS NEXT? These findings should be verified in other large databases. Every effort should be made to improve reperfusion timeliness in patients with a history of CABG.

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KEY WORDS coronary artery bypass graft, door-to-balloon, percutaneous coronary intervention, revascularization, STEMI