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6-Month Mortality and Cardiac Catheterization in Non-ST Elevation Myocardial Infarction Patients with Anemia

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Abstract

Background—It is unknown how anemia influences the invasive management of patients with non-ST-segment-elevation myocardial infarction (NSTEMI) and associated mortality. We investigated whether receipt of cardiac catheterization relates to 6-month death rates among patients with different severity of anemia.

Methods—We used data from the population-based Worcester Heart Attack Study, which included 2,634 patients hospitalized with confirmed NSTEMI, from 3 PCI-capable medical centers in the Worcester (MA) metropolitan area, during 5 biennial periods between 1997 and 2005. Severity of anemia was categorized using admission hematocrit levels: $\leq 30.0\%$ (moderate-to-severe anemia), 30.1–39.0% (mild anemia), and $>39.0\%$ (no anemia). Propensity matching and conditional logistic regression adjusting for hospital use of aspirin, heparin, and plavix compared 6-month post-admission all-cause mortality rates in relation to cardiac catheterization during NSTEMI hospitalization.

Results—Compared to patients without anemia, patients with anemia were less likely to undergo cardiac catheterization (adjusted odds ratio [AOR] 0.79 [95% confidence interval [CI]: 0.67–0.95] for mild anemia and 0.45 [95% CI: 0.42–0.49] for moderate-to-severe anemia). After propensity matching, cardiac catheterization was associated with lower 6-month death rates only in patients without anemia (AOR 0.26 [95% CI: 0.09–0.79]) but not in patients with mild anemia (AOR 0.55 [95% CI: 0.25–1.23]). The small number of patients rendered data inconclusive for patients with moderate-to-severe anemia.

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Conclusions—Anemia at the time of hospitalization for NSTEMI was associated with lower utilization of cardiac catheterization. However, cardiac catheterization use was associated with a decreased risk of dying at 6 months post hospital admission only in patients without anemia.

Keywords

anemia; acute myocardial infarction; cardiac catheterization

Introduction

Anemia on presentation is common in patients hospitalized with acute myocardial infarction (AMI), and this condition is associated with an increased risk for dying and the development of non-fatal adverse events^{1–4} Biologically, anemia has the potential to worsen the supply-demand mismatch in patients with underlying coronary artery disease.^{5, 6} Anemia may also serve as a marker of comorbid conditions, especially conditions that predispose to bleeding,^{1, 2} which may contribute to an increased risk of unfavorable outcomes.⁷ However, anemia has been shown to be an independent predictor of adverse events in patients with underlying coronary disease, irrespective of the use of blood transfusions and multivariate-risk adjustment for additional comorbidities.^{8, 9} It is also possible that AMI patients with anemia are managed differently than patients without anemia, which in turn may contribute to differences in prognosis. This is especially important in the invasive management of patients hospitalized with AMI, since balance has to be strived between performing invasive procedures in a population with a higher risk of adverse outcomes, such as those with anemia,^{9–13} versus the potential benefits associated with coronary revascularization.

Since there are limited data describing the relationship between anemia and the utilization of cardiac catheterization in patients with non-ST segment myocardial infarction (NSTEMI) and hospital outcomes, we examined the association between anemia at the time of admission for NSTEMI and cardiac catheterization use during hospitalization, and how the use of cardiac catheterization relates to 6-month death rates among patients with varying severity of anemia. Data from the population-based Worcester Heart Attack Study were utilized for purposes of this investigation.^{11–13}

METHODS

Study Population

The Worcester Heart Attack Study (WHAS) is a population-based clinical/epidemiologic investigation examining changing trends in the descriptive epidemiology of AMI in adult residents of the Worcester (MA) metropolitan area.^{14–16} Medical records of patients hospitalized for possible AMI at all 11 greater Worcester medical centers in 5 biennial periods between 1997 and 2005 were retrospectively reviewed. The presence of AMI was validated according to standardized criteria including the presence of at least 2 of the following 3 factors: presence of symptoms consistent with AMI, serial electrocardiographic changes during hospitalization, and increases in serum cardiac enzyme levels above the upper limit of normal at each participating hospital's laboratory.¹⁷

Consistent with ACC/AHA guidelines,^{18, 19} we considered NSTEMI to be present when there was absence of ST segment elevation ≥ 1 mm, or a new, or presumably new, pattern of left bundle branch block on the admission ECG. Of the 5,385 patients hospitalized with a validated AMI during the 5 study years between 1997 and 2005 (1997, 1999, 2001, 2003, and 2005), we restricted our study sample to those with NSTEMI ($n = 3,314$) so that patients would have similar patterns and indications for invasive disease management.

We excluded patients who had either a known terminal illness as recorded in the medical record by treating clinicians ($n = 23$), who died during the first 48 hours of hospitalization ($n = 100$), or who were discharged within 24 hours after hospital arrival ($n = 63$) because the treatment of these patients may not have been intended to prolong survival.¹ We also excluded patients who were transferred out of the hospital after 24 hours of admission ($n = 262$) since we could not follow their subsequent utilization of invasive cardiac procedures, and patients who were not initially admitted to a percutaneous coronary intervention (PCI)-capable facility ($n = 186$); the latter patients were excluded because the likelihood of these patients undergoing invasive management for NSTEMI may be intrinsically different from those admitted to PCI-capable facilities. We also excluded 46 patients with missing admission hematocrit or cardiac catheterization data. Our final sample consisted of 2,634 patients with independently validated NSTEMI who were treated at 3 PCI-capable greater Worcester hospitals during the years under study.

Data Collection

Demographic, medical history, and clinical characteristics, laboratory findings, and receipt of invasive coronary procedures during hospitalization was abstracted from hospital medical records by trained nurse and physician reviewers.²⁰ The random reabstraction of data occurred on an ongoing basis for quality assurance, with discrepancies of data resolved by consensus at regular meetings by all members of the data abstraction team. When a patient was transferred from one hospital facility to another within 24 hours of the index hospital admission, information on procedures performed in the second facility, such as cardiac catheterization, PCI, or coronary artery bypass surgery (CABG), as well as the development of hospital complications, including hemorrhage and death, were captured and adjudicated as part of the same AMI hospitalization. Bleeding episodes were categorized as either major (requiring transfusion) or minor (not requiring transfusion).

Anemia at Hospital Admission

Anemia and its severity on admission were measured using hematocrit levels documented in hospital medical records. The first hematocrit measurement taken within 24 hours after hospital admission was categorized as $\leq 30\%$ (moderate-to-severe anemia), 30.1 to 39.0% (mild anemia), and $> 39.0\%$ (no anemia). This categorization differentiates between patients without clinical anemia and those with mild to significant degrees of anemia. Since we did not find significant differences between men and women in the receipt of cardiac catheterization when the data were stratified according to various hematocrit categories, we defined anemia using a single cutoff hematocrit value of ≤ 39 percent for both men and women, which is similar to the hemoglobin cutoff for anemia in men based on World Health Organization criteria.²¹

Outcomes

The use of cardiac catheterization and subsequent coronary revascularization (PCI or CABG) during hospitalization was abstracted from patients' medical records (including catheterization reports). All patients discharged from greater Worcester hospitals after AMI were followed through a statewide and national search of death certificates to determine their vital status. In this study, we examined 6-month all-cause death rates from the time of hospital admission.

Data Analysis

Differences in baseline demographic and clinical characteristics among patients in relation to severity of anemia were compared using the chi-square test for categorical variables and ANOVA for continuous variables, and tested for trends. We estimated odds ratios (ORs) and

accompanying 95% confidence intervals (CIs) of undergoing cardiac catheterization in relation to severity of anemia, with patients without anemia serving as the referent category. We controlled for confounding using multivariate adjustment and evaluated as potential confounders the variables listed in Table 1. Forward stepwise logistic regression analysis was used for variable selection with a model entry criteria of $p < 0.2$. The final model adjusted for clustering of patients by hospital of admission and by year of hospital admission for AMI.

To determine whether cardiac catheterization use was associated with the risk of dying at 6 months after hospital admission among patients with different severity of anemia, we conducted a propensity-matched analysis in an attempt to minimize the potential effect of selection bias (e.g., healthier patients are more likely to undergo procedures versus sicker patients).^{22, 23} A non-parsimonious logistic regression model including the patient's baseline demographic and clinical characteristics computed each patient's probability (or propensity) of undergoing cardiac catheterization during hospitalization. Patients who underwent cardiac catheterization were matched 1:1 to those who did not, based on the propensity of cardiac catheterization.²⁴ We then examined the matched cohort for balance of characteristics between the catheterization and the non-catheterization group. Conditional logistic regression adjusted for differences in the hospital use of aspirin, plavix, and heparin, and we determined the effects of cardiac catheterization on 6-month post-admission mortality risk for all patients and in the three anemia subgroups defined by their admission hematocrit values.

RESULTS

In general, patients with anemia were older, more likely to be female, to have a DNR order, history of aspirin use, and additional comorbid conditions present compared to patients without anemia (Table 1). These differences were mostly larger for patients with moderate-to-severe anemia versus those with mild anemia, with the exception of the likelihood of being a female or having a history of angina, myocardial infarction, hypertension, or aspirin use, which were higher for patients with mild anemia. In contrast, patients without anemia were more likely to be current smokers and have hyperlipidemia than patients with moderate-to-severe anemia (Table 1). At the time of AMI presentation, patients with anemia had, on average, lower systolic blood pressure, higher serum creatinine levels and platelet counts, a higher frequency of either major or minor bleeding episodes, and were more likely to have heart failure than patients without anemia; trends were stronger among patients with moderate-to-severe anemia (Table 1; $p < 0.05$).

The use of cardiac catheterization during hospitalization for NSTEMI was significantly higher in patients without anemia (58.9%) compared to those with mild anemia (39.5%) and moderate-to-severe anemia (25.6%; $p < 0.01$ for difference and trend). After risk adjustment using forward stepwise regression modeling, differences in cardiac catheterization usage remained significantly lower in patients with anemia; patients with mild anemia had a 20% lower odds (adjusted OR = 0.79; 95% CI: 0.67–0.95) and patients with moderate-to-severe anemia had a 55% lower odds (adjusted OR = 0.45; 95% CI: 0.42–0.49) of receiving cardiac catheterization compared to patients without anemia. Among patients who underwent cardiac catheterization, rates of PCI were unrelated to the severity of anemia ($p = 0.18$); whereas the rates of CABG were significantly higher in patients with moderate-to-severe anemia compared to patients with mild or no anemia ($p = 0.02$, Figure 1).

Patients who underwent cardiac catheterization were younger, more likely to be male, a current smoker, and to have a history of angina, PCI, aspirin use, and hyperlipidemia (Table 2). On admission, they had, on average, lower resting heart rate and creatinine levels and

higher systolic blood pressure and hematocrit levels. Patients who underwent cardiac catheterization were also more likely to have received aspirin, clopidogrel, and heparin during their hospital stay. In contrast, patients who did not undergo cardiac catheterization were more likely to have a do-not-resuscitate order and comorbidities that included myocardial infarction, diabetes, stroke, bleeding, and peptic ulcer disease. They were also more likely to have a higher white count, heart failure, and major and minor bleeding on the day of admission (Table 2).

The logistic regression model to generate the propensity score for cardiac catheterization had excellent predictive discrimination with a c-index of 0.85. Based on the propensity score, 44% of catheterization patients (n = 549) were matched with non-catheterization controls (n = 549). Examination of this matched cohort (Table 3) showed successful matching, with balance of the baseline characteristics between patients who underwent cardiac catheterization and those who did not, with the exception of hospital use of aspirin, clopidogrel, and heparin. After adjusting for hospital use of aspirin, clopidogrel, and heparin with conditional logistic regression modeling, cardiac catheterization was associated with a 52% reduction in 6-month mortality in the full matched sample (n = 1098; adjusted OR = 0.48; 95%CI: 0.32–0.71). The effect of cardiac catheterization differed according to severity of anemia. Cardiac catheterization was associated with reductions in 6-month mortality only in patients without anemia (n=525, adjusted OR = 0.26; 95%CI: 0.09–0.79) but not among patients with mild anemia (n = 503, adjusted OR = 0.55; 95%CI: 0.25–1.23). Small sample size (n = 70) rendered data inconclusive for patients with moderate-to-severe anemia.

DISCUSSION

In this observational study in residents of a large Central New England community, severity of anemia at the time of hospital admission for NSTEMI was associated with lower use of cardiac catheterization. However, the use of cardiac catheterization was associated with lower 6-month death rates only in patients without anemia.

Cardiac catheterization is currently a standard procedure for most patients with confirmed NSTEMI whose management goal is to prolong life and decrease the occurrence of cardiac-related symptoms.^{18, 25, 26} In the current study, 59% of patients without anemia underwent cardiac catheterization, which is comparable to the national rate of 58% reported by the OASIS investigators in 1995–1996,²⁷ and of 62% in the CRUSADE quality improvement initiative in 2000–2002.²⁶ However, we observed cardiac catheterization rates of 40% among patients with mild anemia and 26% among patients with moderate-to-severe anemia. These rates are clearly lower than national patterns and have not been reported in the recent literature. Based on the results of our multivariable-adjusted analysis, these lower catheterization rates cannot be primarily explained by the demographic and clinical profile of patients with anemia and suggest that clinicians are less likely to perform this diagnostic procedure in patients with anemia, a trend that increased with higher severity of anemia.

A number of studies have highlighted the detrimental associations between bleeding and the risk of dying in patients hospitalized with AMI and anemia who undergo PCI as compared to those without anemia,^{10, 28} especially in patients with multi-vessel disease or incomplete revascularization.¹³ However, data are lacking from randomized controlled trials to assess whether patients with anemia would derive any benefits from invasive management or whether a more aggressive treatment strategy may be associated with potential harm. The results of the current study build on the existing literature by showing that, although no harmful outcomes were associated with cardiac catheterization use in NSTEMI patients with anemia, a gradient exists in the potential mortality reductions associated with cardiac catheterization use, where significant benefits were found only in patients without anemia on

admission, and a lesser and non-significant effect in patients with mild anemia. Several reasons can explain the lesser benefits of invasive management in patients with anemia. For example, higher risks of procedural-related complications and adverse outcomes have been found in patients with anemia who undergo PCI or CABG.^{9, 10, 12, 29–32} Patients with anemia also have lower reserve to tolerate bleeding complications, and bleeding risks are increased in patients undergoing an invasive management strategy.^{9, 33} Additionally, the underlying etiological factors leading to anemia may have conferred a worse prognosis in these patients, irrespective of their underlying coronary disease and revascularization status.

Considerable literature suggests that the higher risks of procedural related complications and adverse outcomes in patients with anemia who undergo PCI⁷ or CABG cannot be overlooked and need to be balanced against the potential benefits associated with coronary revascularization.^{9, 10, 12, 29–32} The current study supports these concerns; we observed a higher likelihood of a bleeding history and rates of bleeding on hospital admission among patients with anemia compared to those without anemia. Our results also suggest that the lesser benefits derived from an invasive management strategy may be one of the potential mechanisms associated with an increased risk for dying and the development of non-fatal adverse events in anemic patients with AMI that have been previously noted in the literature.^{1, 28, 34, 35}

Study Strengths and Limitations

Despite the use of propensity matching which allowed us to control for several potentially confounding prognostic factors, the effect of selection bias may still exist given the observational nature of this study. This bias may be attributed in part to the older age of our study population, especially of the severely anemic patients, with high frailty indices,^{36, 37} which could influence the physician's selection of an invasive treatment strategy and impact the outcome of elderly patients. Although we controlled for an extensive list of comorbidities that may partially capture frailty,^{36, 37} other factors such as physical function and capacity to perform daily activities were not collected in our review of data from hospital medical records. As such, the potential benefits that we found related to cardiac catheterization on 6-month mortality may be overestimated. In addition, although we collected a considerable amount of detailed clinical information, we did not have data available on the use of blood transfusions during hospitalization and, therefore, cannot account for the potential impact of blood transfusion use on patient outcomes. The generalizability of our findings may also be limited to the extent of the characteristics of our study population that were matched for in the propensity analysis (e.g., we did not have sufficient sample size to obtain meaningful results in patients with moderate-severe anemia).

Our study also has several strengths. The Worcester Heart Attack Study is population-based and reflects real-life practice patterns that enhance the applicability of our results to daily practice. The utilization of cardiac catheterization in our patient population was comparable to catheterization rates observed in other large observational studies and our findings are potentially generalizable to regional NSTEMI treatment practice patterns of PCI-capable hospitals.^{26, 27}

Conclusions

Severity of anemia at the time of admission for NSTEMI is associated with lower utilization of cardiac catheterization during hospitalization. However, catheterization use was associated with a decreased risk of dying at 6 months post-admission only in patients without anemia. Randomized controlled trials are needed to confirm the findings of this observational study. Additionally, further studies are needed to determine the benefit-to-risk

ratios of invasive therapeutic strategies in NSTEMI, as well as optimal medication regimens, for patients with moderate-to-severe degrees of anemia.

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Figure 1.

Frequency of coronary revascularization (PCI or CABG) among patients who underwent cardiac catheterization according to severity of anemia. Among patients who underwent cardiac catheterization, the rates of PCI (lighter grey bars) were unrelated to the severity of anemia ($p = 0.18$) whereas the rates of CABG (darker grey bars) were significantly higher in patients with moderate-to-severe anemia when compared to patients with mild or no anemia ($p = 0.02$).

Table 1

Characteristics of Patients With NSTEMI in Relation to Severity of Anemia at Hospital Admission

<u>Characteristic</u>	<u>Severity of Anemia (Hematocrit Value at Hospital Admission)</u>			<u>P value for trend</u>
	<u>Moderate-to-Severe Anemia (<=30%)</u> (n = 211)	<u>Mild Anemia (30.1–39%)</u> (n = 1084)	<u>No Anemia (>39%)</u> (n = 1,339)	
Age (mean, years)	77.4 (10.8)	76.7 (11.6)	70.1 (13.7)	<0.01
Female (%)	53.6	56.9	34.7	<0.01
Caucasian (%)	90.1	87.8	89.1	0.49
Current smoker (%)	13.3	11.4	22.9	<0.01
Do-not-resuscitate Order (%)	38.4	34.9	18.5	<0.01
Angina (%)	22.8	25.1	23.4	0.56
Myocardial infarction (%)	45.0	45.5	37.3	<0.01
CABG (%)	19.4	18.5	13.7	<0.01
PCI (%)	24.6	30.8	29.9	0.20
Prior aspirin use (%)	45.5	50.7	43.3	<0.01
Heart failure (%)	49.8	37.4	21.7	<0.01
Hypertension (%)	77.3	77.5	71.0	<0.01
Diabetes mellitus (%)	50.2	43.0	30.0	<0.01
Hyperlipidemia (%)	38.9	48.5	48.4	0.03
Stroke (%)	17.5	16.3	11.1	<0.01
Any bleeding (%)	12.3	6.8	4.2	<0.01
Peptic ulcer disease or Guaiac (+) stool (%)	19.9	7.3	5.9	<0.01
<u>AMI Presentation</u>				
Systolic blood Pressure (mean, mmHg)	133.3 (31.1)	142.4 (34.1)	150.3 (33.1)	<0.01
Resting heart rate (mean, beats per minute)	90.3 (20.5)	89.5 (23.1)	88.7 (24.3)	0.57
Creatinine (mean, mg/dL)	1.88 (1.25)	1.57 (0.94)	1.28 (0.72)	<0.01
White count × 1000 (mean)	10.7 (5.2)	10.7 (6.0)	10.5 (4.8)	0.74
Platelet count × 1000 (mean)	258.0 (110.3)	245.2 (94.7)	238.5 (79.5)	<0.01
Cardiogenic shock (%)	3.8	3.9	2.7	0.24
Heart failure (%)	61.6	50.8	30.9	<0.01
Major bleeding on the day of admission (%)	15.6	1.7	0.5	<0.01
Minor bleeding on the day of admission (%)	10.0	5.3	5.2	0.02

Data are mean (SD) or percentages

Abbreviations: CABG = Coronary Artery Bypass Graft surgery, PCI = Percutaneous Coronary Intervention

Table 2

Characteristics of Patients With NSTEMI in Relation to Cardiac Catheterization During Hospitalization for AMI Before Propensity Match

Characteristic	Did not Receive Cardiac Catheterization (n = 1363)	Received Cardiac Catheterization (n = 1271)	P value for difference
Age (mean, years)	78.9 (10.8)	67.6 (12.8)	<0.01
Female (%)	53.4	36.7	<0.01
Caucasian (%)	88.7	88.6	0.93
Current smoker (%)	11.1	24.2	<0.01
Do-not-resuscitate Order (%)	43.1	9.3	<0.01
Angina (%)	47.4	52.6	0.01
Myocardial infarction (%)	45.2	37.1	<0.01
CABG (%)	16.1	16.1	0.97
PCI (%)	21.3	39.0	<0.01
Prior aspirin use (%)	43.4	49.9	<0.01
Heart failure (%)	42.2	17.7	<0.01
Hypertension (%)	74.0	74.4	0.82
Diabetes mellitus (%)	39.1	34.6	0.02
Hyperlipidemia (%)	36.5	59.6	<0.01
Stroke (%)	19.0	8.2	<0.01
Any bleeding (%)	7.0	4.8	0.02
Peptic ulcer disease or Guaiac (+) stool (%)	9.5	5.6	<0.01
<u>AMI Presentation</u>			
Systolic blood Pressure (mean, mmHg)	143.2 (35.6)	148.3 (31.5)	<0.01
Resting heart rate (mean, beats per minute)	93.1 (23.8)	84.9 (22.4)	<0.01
Creatinine (mean, mg/dL)	1.7 (1.2)	1.3 (0.9)	<0.01
Hematocrit (mean, %)	37.4 (6.8)	40.1 (5.6)	<0.01
White count × 1000 (mean)	11.3 (6.0)	9.8 (4.5)	<0.01
Platelet count × 1000 (mean)	242.9 (95.3)	242.6 (81.4)	0.94
Cardiogenic shock (%)	2.6	3.9	0.06
Heart failure (%)	52.5	29.8	<0.01
Major bleeding on the day of admission (%)	3.2	1.0	<0.01
Minor bleeding on the day of admission (%)	6.5	4.6	0.04
<u>Therapies during hospitalization</u>			
Aspirin (%)	87.3	96.9	<0.01
Clopidogrel (%)	16.6	63.6	<0.01
Heparin (%)	63.5	80.4	<0.01

Data are mean (SD) or percentages

Abbreviations: CABG = Coronary Artery Bypass Graft surgery, PCI = Percutaneous Coronary Intervention

Table 3

Characteristics of Patients With NSTEMI in Relation to Cardiac Catheterization While in Hospital After Propensity Match

Characteristic	Did not Receive Cardiac Catheterization (n = 549)	Received Cardiac Catheterization (n = 549)	P value for difference
Age (mean, years)	73.7 (11.9)	74.2 (10.3)	0.49
Female (%)	47.7	46.6	0.72
Caucasian (%)	88.0	87.4	0.78
Current smoker (%)	16.4	13.8	0.24
Do-not-resuscitate Order (%)	19.5	18.6	0.70
Angina (%)	25.5	26.4	0.73
Myocardial infarction (%)	42.6	42.1	0.85
CABG (%)	18.2	18.4	0.94
PCI (%)	31.0	31.7	0.79
Prior aspirin use (%)	51.9	51.4	0.86
Heart failure (%)	28.1	29.7	0.55
Hypertension (%)	77.2	77.2	1.00
Diabetes mellitus (%)	41.9	42.6	0.81
Hyperlipidemia (%)	50.3	51.6	0.67
Stroke (%)	13.3	13.8	0.79
Any bleeding (%)	4.7	5.3	0.68
Peptic ulcer disease or Guaiac (+) stool (%)	7.5	7.3	0.91
<u>AMI Presentation</u>			
Systolic Blood Pressure (mean, mmHg)	148.4 (35.4)	148.6 (32.8)	0.93
Resting heart rate (mean, beats per minute)	91.0 (22.9)	90.2 (24.6)	0.56
Creatinine (mean, mg/dL)	1.53 (1.18)	1.50 (1.15)	0.64
Hematocrit (mean, %)	38.7 (6.8)	38.6 (5.6)	0.75
White count × 1000 (mean)	10.4 (4.3)	10.2 (5.5)	0.52
Platelet count × 1000 (mean)	242.7 (101.2)	243.1 (88.5)	0.96
Cardiogenic shock (%)	3.5	3.1	0.73
Heart failure (%)	13.5	13.3	0.93
Major bleeding on the day of admission (%)	1.1	1.6	0.44
Minor bleeding on the day of admission (%)	6.9	5.3	0.26
<u>Therapies during hospitalization</u> *			
Aspirin (%)	92.2	96.5	<0.01
Clopidogrel (%)	19.5	61.6	<0.01
Heparin (%)	69.0	82.2	<0.01

* Adjusted for with conditional logistic regression Data are mean (SD) or percentages

Abbreviations: CABG = Coronary Artery Bypass Graft surgery, PCI = Percutaneous Coronary Intervention