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Predicting Long-Term Bleeding After Percutaneous Coronary Intervention

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Abstract

Objectives—To construct a model to predict long-term bleeding events following percutaneous coronary intervention (PCI).

Background—Treatment with dual antiplatelet therapy following PCI involves balancing the benefits of preventing ischemic events with the risks of bleeding. There are no models to predict long-term bleeding events after PCI.

Methods—We analyzed 1-year bleeding outcomes from 3,128 PCI procedures in the PRISM study. Patient-reported bleeding events were categorized according to Bleeding Academic Research Consortium (BARC) definitions. Logistic regression analysis was used to develop a model predicting BARC 1 bleeding.

Results—BARC 0, 1, 2 or 3 bleeding was observed in 574 (18.4%); 2382 (76.2%); 114 (3.6%) and 58 (1.8%) patients, respectively. Compared to patients who had no bleeding, patients with BARC 1 bleeding were more often female (30 vs. 23%), Caucasian (94 vs. 83%), had a higher incidence of DES implantation (83 vs. 76%) and warfarin therapy (7.4 vs. 3.9%), and a lower incidence of diabetes (31 vs. 45%; p-value <0.01 for all comparisons). A 27-variable model had moderate discrimination (c-statistic of 0.674), and good calibration, as did a parsimonious model with 10 variables (c-statistic =0.667). This model performed well in predicting BARC 2 bleeding events as well (c-statistic =0.653).

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Conclusions—Bleeding is common in the first year after PCI, and can be predicted by pre-procedural patient characteristics and use of DES. Objective estimates of bleeding risk may help support shared decision-making with respect to stent selection and duration of antiplatelet therapy following PCI.

Keywords

bleeding; drug eluting stent; antiplatelet therapy; PCI

Introduction

Bleeding is a major complication in patients undergoing percutaneous coronary intervention (PCI). To lay the foundation for quantifying the severity of bleeding, the Bleeding Academic Research Consortium (BARC) created a standardized bleeding definition.⁽¹⁾ While several risk models have been developed to predict peri-procedural bleeding,^(2,3) post-discharge bleeding after PCI is also common, but has been inadequately studied. The majority of prior studies have focused on “major bleeding” complications after PCI; however, many patients report “minor” or “nuisance” (BARC 1) bleeding events and patients with BARC 1 bleeding have worse quality of life and higher readmission rates than those without bleeding, underscoring the clinical importance of these more minor bleeds.^(4,5) Understanding patients’ bleeding risk in the year after PCI can be extremely helpful in selecting drug eluting stents (DES) or bare metal stents (BMS) at the time of PCI and determining the optimal duration of dual anti-platelet therapy (DAPT) following PCI. While DES use markedly reduces the risk of a repeat PCI procedure,⁽⁶⁾ it also necessitates prolonged DAPT to reduce the risk of stent thrombosis. DAPT increases patients’ bleeding risk,⁽⁵⁾ and is typically recommended for 4 weeks⁽⁷⁾ in non-ACS patients treated with BMS, and for at least 12 months in patients receiving DES.⁽⁸⁾ While risk models to predict restenosis have been developed to more explicitly describe the benefits of DES,⁽⁹⁾ models to predict bleeding have largely focused on short-term, rather than long-term bleeding events. There is therefore an unmet need for a risk model to predict long-term bleeding events following PCI, which can address an important gap in clinical care by enabling doctors and patients to compare the benefits of DES in reducing restenosis against the risks of bleeding events related to prolonged DAPT after discharge.⁽¹⁰⁾ To address this gap in knowledge, we developed a model to predict the risks of long-term bleeding events after PCI, including overt bleeding requiring medical care (BARC 2) as well as less severe (BARC 1) bleeding events.⁽¹⁾

MATERIALS AND METHODS

Our study participants were derived from the Patient Risk Information Services Manager (PRISM) prospective observational study.^(11,12) Details of the PRISM study have been described previously.⁽¹³⁾ Briefly, 3,299 consecutive patients undergoing PCI at 10 U.S. hospitals between 2009–2011 were approached to participate in the PRISM study. Consenting patients were enrolled within 24 hours of their index procedure. Institutional Research Board approval was obtained from all participating sites, and all patients provided informed consent for baseline and follow-up assessments. As part of the study, patients were

asked to provide follow-up telephone interviews at 1, 6 and 12 months after discharge. In this analysis, we included all surviving patients who had follow-up data available.

Using a method we had previously used to assess bleeding events after myocardial infarction,(5) at each follow-up interview, we asked patients two questions pertaining to bleeding. The first asked whether they had experienced “no bleed”, “easy bruising”, “easy bleeding”, “occasional nose or gum bleed” or “serious bleeding” since their last interview. If any bleeding outcomes were reported, a follow up question was asked to characterize the treatment for their bruising or bleeding. Choices included “didn’t tell any doctor”, “told doctor, but no treatment”, “doctor stopped a medicine or switched to another medicine”, “treated with transfusion” or “treated by hospitalization”. Patient responses were re-classified according to the BARC classification(1) in which bleeding events are graded from 0–5, as follows: BARC 0 indicates no bleed or bruising, BARC 1 represents bleeding (including bruising) that does not require the patient to seek medical care, BARC 2 represents overt bleeding events requiring medical care (but not BARC 3 events), BARC 3 indicates bleeding that required blood transfusion or hospitalization, BARC 4 indicates coronary artery bypass grafting-related bleeding, and BARC 5 indicates fatal bleeding. The PRISM study excluded patients undergoing coronary artery bypass grafting; therefore, only BARC 0, 1, 2 and 3 categories were evaluated in this analysis.

We categorized patients according to the most severe grade of BARC bleeding experienced within the 12 months after their PCI. Baseline characteristics were compared between these groups for descriptive analyses. Continuous variables were compared using Student’s t-test and categorical variables using the chi-square or Fisher’s exact test. A multivariable logistic regression model was then constructed to identify variables associated with BARC 1 bleeding through 12-month follow-up. The following covariates were selected, *a priori*, for inclusion in the model based on previous bleeding models and clinical judgment: age, gender, ethnicity, high-school education, insurance status, smoking status, body mass index, peripheral arterial disease, diabetes mellitus, chronic kidney disease, prior myocardial infarction, prior PCI, congestive heart failure, hypertension, prior cerebrovascular accident, dyslipidemia, chronic lung disease, glomerular filtration rate, treatment with DES, hemoglobin, platelet count, index presentation with ST-elevation MI (STEMI), PCI status (elective/planned vs. urgent vs. emergent), access site (femoral vs. other), cardiac arrest, prior history of bleeding, and warfarin use at the time of hospital admission. Collinearity was assessed by evaluating the condition index, in which a value of 30 or higher suggests significant multicollinearity.(14)

To create a more parsimonious set of variables for the final model, we used Harrell’s backward selection strategy.(15) The contribution of each covariate in the multivariable model was ranked by F-value, and variables with the smallest contribution to the model were sequentially eliminated until further variable elimination led to a >10% loss in model prediction, as compared with the initial model. A second analysis was performed to predict the performance of the final model to predict BARC 2 bleeding events. The discriminative power of both the full and reduced models was assessed with the c-statistic. Calibration of both models was assessed by plotting observed vs. predicted probabilities within deciles of predicted risk, and the regression line was compared against the line of unity (intercept=0

and slope=1). Internal validation of the model was evaluated by performing 100 bootstrapped samples to derive an optimism-corrected c-statistic. Finally, a simplified scoring tool was developed from the final reduced model by rescaling and rounding the beta weights to integer point values (continuous predictors were categorized to facilitate scoring).

Among the 3128 patients with at least one follow-up reported, 330 (11%) were missing the bleeding outcome at 1 year, of whom 124 (38%) had not reported a bleed at previous follow-up time points. Among the entire population, 82% had no missing data; 13.6% had one variable missing and 4.4% had >1 variables missing at baseline. Platelet count was the most commonly missing variable (5.8% patients). To address loss to follow-up between 6 and 12 months and to address the potential bias, we performed a sensitivity analysis in which we partitioned the outcome into two variables: bleeding between 0 and 6 months and bleeding between 6 and 12 months. We then used multiple imputation methods to estimate the missing 6–12 month data using IVEware (Imputation and Variance Estimation Software; University of Michigan's Survey Research Center, Institute for Social Research, Ann Arbor, MI). We used sequential regression imputation, incorporating all predictor variables and all available outcome data, to construct 50 imputed data sets. After imputing, we re-aggregated the 0–6 month bleeding and 6–12 month bleeding variables into a single 0–12 month outcome. The bleeding risk model was refit on each data set, and the resulting model estimates were pooled across data sets to incorporate uncertainty due to missing data. All analyses were conducted using SAS v9.3 (SAS Institute, Inc., Cary, NC), and statistical significance was determined by a 2-sided p-value of <0.05.

RESULTS

Among 3,299 patients who were enrolled in the PRISM study, 3,128 (95%) patients had follow-up bleeding data available at 1, 6 or 12 months and were included in this analysis. Over the 12 months following PCI, 574 patients (18.4%) reported no bleeding, 2,382 (76.2%) reported BARC 1 bleeding, 114 (3.6%) reported BARC 2 bleeding, and 58 (1.8%) reported BARC 3 bleeding. The incidence of BARC 1 bleeding was 58.8% at 1 month, 71.76% between 1 and 6 months, and 68.69% between 6 months and 1 year. Of those patients who reported a bleed at 1 month and had a follow-up time point (n=735), 682 (93%) reported additional subsequent bleeding between 1 month and 1 year.

Among patients with BARC 1 bleeding, 602 (25.2%) reported easy bruising as the only event during the 12 months of follow-up. Compared with patients who reported no bleeding, those with BARC 1 bleeding were more likely to be female, of Caucasian race, to have chronic lung disease, to have undergone elective/planned PCI, to be on oral anticoagulation with warfarin or to have undergone DES implantation (Table 1). Patients with BARC 1 bleeding were less likely to have diabetes or to have presented with STEMI or NSTEMI, as compared with those having no bleeding event.

The full prediction model is presented in Appendix 1. Multicollinearity was not a cause for concern, as the largest condition index was 2.47. The most important predictors (in terms of F-value) of long-term BARC 1 bleeding were Caucasian race (odds ratio [OR] 2.89, 95% confidence interval [CI] 2.16–3.87), diabetes (OR 0.53, 95% CI 0.43–0.66), female gender

(OR 1.78, 95% CI 1.39–2.27) and DES use (OR 1.55, 95% CI 1.23–1.96). The model demonstrated moderate discrimination (c-index = 0.674). The parsimonious model (Table 2), demonstrated similar discrimination (c-statistic = 0.667; optimism-corrected c-index = 0.647) and good calibration, with an intercept and slope not statistically different than 0 and 1, respectively (both $p = 0.54$), and a correlation of 0.98 between deciles of predicted and observed bleeding (Figure 1). The simplified scoring tool for predicting BARC 1 bleeding after PCI is depicted in Figure 2. Patients in the lowest category of predicted risk (risk score < 40) reported a 12-month BARC 1 bleeding rate of 53.5% as compared with 91.2% of the patients in the highest category of predicted risk (risk score ≥ 70).

The final model also performed well in predicting BARC 2 or greater bleeding events (Table 2). Important predictors of BARC 2 or greater bleeds included Caucasian race (OR 2.53, 95% CI 1.10–5.83) and warfarin use upon arrival (OR 3.62 95% CI 2.37–5.55). There were important differences in predictive value of several variables in predicting BARC 1 vs. BARC 2 or greater bleeding events (Table 2). While DES use was associated with higher odds of BARC 1 bleeding (OR 1.54, 95% CI 1.23–1.94; $p < 0.001$), it was associated with a lower risk of BARC 2 bleeding (OR 0.65 95% CI 0.45–0.92). The discrimination of the model predicting BARC 2 bleed was also slightly lower at 0.653, however the calibration was similar with a correlation of 0.98 between deciles of predicted and observed bleeding, and a slope and intercept not statistically different from the line of unity ($p = 0.87$ for intercept and $p = 0.85$ for slope).

After partitioning the data at 6 months and using multiple imputations, we developed a final parsimonious model which was very similar to our original model (Appendix 2) with the only difference being that age and body mass index were no longer independently associated with bleeding. The effect sizes for the remaining variables were similar in strength to the variables included in the primary analysis.

DISCUSSION

While prior research efforts have largely focused on peri-procedural bleeding complications, (2,3) this is the first model that has been developed to predict long-term bleeding risk in patients undergoing PCI. We found that patient-reported bleeding is exceedingly common after PCI, and that it can be predicted by readily available clinical factors at the time of PCI. In addition, this study is unique in that we characterized the risk of “minor” bleeding and bruising, which impacts patients’ quality of life.(4,5) Understanding patients’ risk for bleeding can be very helpful in setting patients’ expectations for the outcomes after PCI, understanding their tolerance for prolonged DAPT, and in selecting between DES and BMS.

While the use of DES during PCI has been a major advance in the field of interventional cardiology, with a marked reduction in restenosis and the need for repeat revascularization procedures as compared with use of BMS,(6) the use of DES also necessitates prolonged DAPT to reduce the risk of stent thrombosis, which in turn increases bleeding risk.(8) Long-term bleeding after PCI has been associated with an increased rate of all-cause mortality comparable in effect to the rate of mortality following a recurrent myocardial infarction. (16,17) Two recent studies have demonstrated a trade-off between the safety and efficacy of

long-term DAPT after PCI. The PEGASUS study(18) evaluated long-term DAPT with aspirin and ticagrelor beyond 1 year following PCI, and demonstrated a lower incidence of cardiovascular death, myocardial infarction or stroke, but an increased risk of bleeding with prolonged DAPT as compared to placebo. Similarly the DAPT study(19) reported a reduction in ischemic events with DAPT beyond 1 year following PCI, but increased bleeding events as compared with placebo therapy.

In our simplified 10-item model, the use of DES increased the odds of bleeding over the year after PCI by 54%, presumably secondary to prolonged DAPT therapy. Thus, the findings from this study are actionable, in that they may be used to predict the risk of long-term bleeding in patients undergoing PCI so that the choice between BMS and DES and their associated impact on the duration of DAPT can be individualized. Coupling prior models of predicting restenosis(9) with this bleeding model could further support evidence-based shared medical decision-making and personalized care. For example, patients with stable CAD who are at low risk of restenosis with BMS and a high risk of long-term bleeding may prefer to receive BMS at the time of PCI and shorter-term DAPT.

BARC 2 bleeding was much less common than BARC 1 bleeding in our study. In comparing the predictive values of variables predicting BARC 1 and BARC 2 bleeding events, we found important differences. The main predictor of BARC 2 bleeding appears to be Caucasian race and warfarin use upon arrival. Interestingly while DES use was associated with more BARC 1 bleeding, it was associated with lower rates of BARC 2 bleeding events, a finding that, to the best of our knowledge, has not been previously reported. This may be partially explained by lower DES use amongst patients already on warfarin therapy or other, non-quantified aspects of clinical judgment, when clinicians may prefer to use BMS. However, BARC 2 bleeding events by definition consist of events which lead to changes in medical care or therapy. We speculate that while physicians may consider it reasonable to discontinue antiplatelet therapy after 1 month in patients treated with bare metal stents who have bleeding concerns, they are less likely to discontinue antiplatelet therapy in patients treated with DES until they have completed 12 months of DAPT. Thus, patients treated with DES who have bleeding that does not require hospitalization or transfusion may be continued on DAPT and these bleeding events may be less likely to be classified as BARC 2 events. However, this potential explanation requires further study.

Several predictors identified in our model are also predictors of peri-procedural bleeding at the time of PCI, including age, female sex, and chronic kidney disease.(2,3) However, we also identified several novel predictors of long-term bleeding, including use of DES, which was associated with 54% higher odds of minor bleeding; diabetes, which was associated with 44% lower odds of bleeding events; and lower platelet count, chronic lung disease, and warfarin use on arrival, all of which increased patients' risks for bleeding over the year after PCI. We believe that the association of DES with minor bleeding is attributable to the longer duration of DAPT therapy typically prescribed after DES implantation.(5) We hypothesize that the association between diabetes mellitus and lower rates of bleeding may be related to increased platelet reactivity in patients with diabetes, but this requires further investigation. We explicitly did not include post-treatment variables, such as the duration of DAPT use in

this analysis, because we wanted the model to support decision-making at the time of PCI, at which time post-procedure variables that might impact bleeding risk are unavailable.

Our findings should be considered in the context of the several potential limitations. BARC 4 and 5 bleeding, representing bleeding events after coronary artery bypass grafting and fatal bleeding were not assessed in this study. However, BARC 4 and 5 bleeding complications are likely to be less common than BARC 1–3 bleeding and unlikely to substantially affect the bleeding rates or risk factors identified in this study. A second important limitation is the potential of bias due to missing follow-up data between 6 and 12 months. However, this impacted <4% of our total population and our sensitivity analysis using multiple imputation yielded results very similar to our primary findings. Although we performed internal validation of the model with bootstrapping, future efforts to externally validate and refine this model are warranted. Bleeding complications in this study were patient-reported, which may lead to inaccuracy. However, because BARC 1 bleeding is defined as bleeding for which patients did not seek medical care, patient-reporting is the only method available to collect these data. Most of the patients in our study were on clopidogrel as the second antiplatelet agent and not on newer antiplatelet drugs, such as prasugrel or ticagrelor, for which the predictors of bleeding may differ both qualitatively and quantitatively. Similarly, although we included patients who were on warfarin therapy in this analysis, we did not include patients who were on newer oral anticoagulants, which may have different implication for bleeding events. Finally, lack of follow-up data beyond 1 year limits our ability to analyze the predictors of bleeding complications beyond 1 year. Therefore, this model should be updated in the future, to capture these additional variables.

CONCLUSION

A large proportion of patients report bleeding complications after PCI, and these can be predicted by pre-procedural characteristics and DES use. Objective estimates of bleeding risk may help support shared decision-making with respect to stent selection and duration of dual antiplatelet therapy following PCI, and better engage patients in participating in these important decisions. This model should be validated in independent cohorts and its role in shared medical decision-making should be evaluated.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Calibration Plot for BARC 1 Bleeding Prediction Model

Characteristic	Points
Age	
<50	4
50 - 59	3
60 - 69	2
70 - 79	1
≥80	0
Female gender	12
Caucasian race	21
Body mass index	
<25	6
25 - <30	4
30 - <35	3
35 - <40	1
≥40	0
Non-diabetic	11
Chronic lung disease	10
Warfarin on arrival	15
Platelet count (x1000/ μ L)	
<100	15
100 - <150	12
150 - <200	10
200 - <250	7
250 - <300	5
300 - <350	2
≥350	0
Elective procedure	6
Drug-eluting stent used	9

Figure 2.
Simplified Scoring Tool for BARC 1 Bleeding

Table 1

Baseline demographic and clinical characteristics of patients with Bleeding Academic Research Consortium (BARC) 1 bleeding as compared with those with no bleeding at 1-year

Variable	BARC 1 Bleeding n = 2554	No Bleeding n = 574	P-value
Age (years)	64.5 ± 10.9	63.8 ± 10.9	0.176
Female gender	767 (30.0%)	133 (23.2%)	0.001
Caucasian Race	2353 (93.5%)	467 (82.5%)	< 0.001
High school education	2323 (91.3%)	508 (89.0%)	0.078
No insurance	62 (2.5%)	23 (4.2%)	0.027
Current smoker	417 (16.6%)	112 (19.8%)	0.070
Dyslipidemia	2103 (82.3%)	466 (81.2%)	0.513
Hypertension	2113 (82.7%)	485 (84.5%)	0.309
Prior cerebrovascular accident	118 (4.6%)	23 (4.0%)	0.522
Peripheral arterial disease	235 (9.2%)	41 (7.1%)	0.116
Diabetes	789 (30.9%)	257 (44.8%)	< 0.001
Chronic kidney disease	217 (8.5%)	54 (9.4%)	0.483
Prior myocardial infarction	694 (27.2%)	155 (27.0%)	0.934
Prior revascularization	1270 (49.7%)	302 (52.6%)	0.211
Congestive heart failure	276 (10.8%)	50 (8.7%)	0.138
LV Systolic Function			0.189
(1) Normal	1290 (75.0%)	275 (69.8%)	
(2) Mildly Depressed	243 (14.1%)	68 (17.3%)	
(3) Moderately Depressed	100 (5.8%)	29 (7.4%)	
(4) Severely Depressed	86 (5.0%)	22 (5.6%)	
Heart Failure in past 2 weeks	381 (14.9%)	84 (14.6%)	0.863
Chronic lung disease	350 (13.7%)	52 (9.1%)	0.003
Creatinine (mg/dL)	1.1 ± 0.7	1.2 ± 1.0	0.063
GFR (mL/min/1.73m ²)	75.2 ± 30.0	74.4 ± 31.6	0.679
GFR category			0.923
(1) GFR ≥ 60	1835 (73.8%)	413 (73.9%)	
(2) GFR 30–59	580 (23.3%)	128 (22.9%)	
(3) GFR < 30	73 (2.9%)	18 (3.2%)	
Hemoglobin (g/dL)	13.6 ± 1.7	13.6 ± 1.8	0.97
Platelet count (x1000/dL)	217.2 ± 64.0	222.9 ± 66.1	0.061
PCI indication			0.006
(1) Staged	160 (6.3%)	27 (4.7%)	
(2) Stable CAD	901 (35.3%)	180 (31.4%)	
(3) Unstable angina	872 (34.1%)	186 (32.4%)	
(4) NSTEMI	472 (18.5%)	129 (22.5%)	
(5) STEMI	51 (2.0%)	20 (3.5%)	
(6) Other	98 (3.8%)	32 (5.6%)	
PCI status			0.003

Variable	BARC 1 Bleeding n = 2554	No Bleeding n = 574	P-value
(1) Elective/Planned	1756 (68.8%)	353 (61.5%)	
(2) Urgent	712 (27.9%)	195 (34.0%)	
(3) Emergent	86 (3.4%)	26 (4.5%)	
Cardiogenic shock	3 (0.1%)	0 (0.0%)	1
Bare metal stent	388 (15.2%)	120 (20.9%)	< 0.001
Drug eluting stent	2115 (82.9%)	435 (75.8%)	< 0.001
Warfarin on arrival	179 (7.4%)	21 (3.9%)	0.004
DAPT at discharge	2548 (100.0%)	573 (99.8%)	0.334
Intended duration of DAPT			0.034
(1) 1 month	145 (10.0%)	51 (16.1%)	
(2) 12 months	936 (64.5%)	185 (58.4%)	
(3) >12 months or lifelong	286 (19.7%)	58 (18.3%)	
Warfarin on discharge	196 (7.7%)	22 (3.8%)	0.001
Arterial access site			0.617
(1) Femoral	2301 (90.1%)	523 (91.1%)	
(2) Radial	248 (9.7%)	51 (8.9%)	
(3) Brachial	5 (0.2%)	0 (0.0%)	
In hospital bleed	70 (2.7%)	8 (1.4%)	0.061
SAQ Angina Frequency	71.4 ± 24.8	74.2 ± 23.9	0.014
SAQ: Any angina	1927 (75.5%)	401 (69.9%)	0.005
EQ-5D: Visual analog scale	70.2 ± 19.7	70.8 ± 20.0	0.513

LV = left ventricular; GFR = glomerular filtration rate; PCI = percutaneous coronary intervention; CAD = coronary artery disease; NSTEMI = non-ST elevation myocardial infarction; STEMI = ST elevation myocardial infarction; DAPT = dual antiplatelet therapy; SAQ = Seattle Angina Questionnaire; EQ-5D = EuroQuol-5D

Table 2

Reduced final model with a parsimonious set of variables comparing predictive value of BARC 1 as compared with BARC 2 bleeding events during 12-months after percutaneous coronary intervention

Variables	BARC 1 OR (95% CI)	BARC 2 OR (95% CI)
Caucasian race	2.81 (2.13, 3.74)	2.53 (1.10, 5.83)
Diabetes Mellitus	0.56 (0.46, 0.69)	1.06 (0.75, 1.50)
Female gender	1.81 (1.44, 2.28)	1.21 (0.86, 1.71)
Warfarin on arrival	2.12 (1.32, 3.41)	3.62 (2.37, 5.55)
Drug eluting stent	1.54 (1.23, 1.94)	0.65 (0.45, 0.92)
Platelet count (per 50×1000/dL)	0.88 (0.82, 0.95)	1.04 (0.93, 1.17)
Chronic lung disease	1.63 (1.19, 2.24)	1.15 (0.75, 1.78)
PCI status		
Urgent vs. elective	0.75 (0.61, 0.93)	1.24 (0.89, 1.74)
Emergent vs. elective	0.73 (0.46, 1.18)	0.61 (0.19, 1.97)
BMI (per 5 kg/m ²)	0.93 (0.86, 1.01)	0.96 (0.84, 1.11)
Age (per 10 yrs)	0.95 (0.86, 1.04)	1.10 (0.94, 1.29)
C-statistics	0.667	0.653

BARC = Bleeding Academic Research Consortium; PCI = percutaneous coronary intervention; BMI = body mass index