Relation of Body Mass Index to Bleeding During Percutaneous Coronary Interventions

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The relation between body mass index (BMI) and bleeding after percutaneous coronary intervention (PCI) remains incompletely understood. This study aimed to assess the association between BMI and bleeding and mortality after PCI. The study included 14,178 patients with coronary artery disease treated by PCI. Bleeding within 30 days of PCI was defined using the Bleeding Academic Research Consortium criteria. The primary outcome was 1-year all-cause mortality. BMI quartiles were 14.1 to 24.8 kg/m^2 (first quartile [Q1]), >24.8 to 27.1 kg/m^2 (second quartile [Q2]), >27.1 to 29.8 kg/m^2 (third quartile [Q3]), and >29.8 to 56.3 kg/m^2 (fourth quartile [Q4]). In BMI Q1, Q2, Q3, and Q4, the frequency of bleeding was 13.8%, 10.1%, 10.8%, and 7.7%, respectively (odds ratio [OR] 1.90, 95% confidence interval [CI] 1.63 to 2.23, p <0.001, for Q1 vs Q4). Multiple logistic regression showed that BMI was independently associated with bleeding (adjusted OR 1.05, 95% CI 1.04 to 1.07, p <0.001, for any bleeding; adjusted OR 1.07, 95% CI 1.04 to 1.09, p <0.001, for access site bleeding; and adjusted OR 1.03, 95% CI 1.01 to 1.05, p = 0.039, for non−access site bleeding with all 3 risk estimates calculated per 1 kg/m^2 decrease in BMI). Analysis by sex showed an increase in the frequency of bleeding with the decrease in BMI for women and men (p for trend <0.001 for women and men) with no sex-by-BMI interaction (p = 0.90). The Cox proportional hazards model showed that bleeding (adjusted hazard ratio [HR] 2.17, 95% CI 1.67 to 2.82, p <0.001) and BMI (HR 1.03, 95% CI 1.01 to 1.06, p = 0.048, per 1 kg/m^2 decrease in the BMI) were independently associated with increased risk of 1-year mortality with no bleeding-by-BMI interaction (p = 0.81). In conclusion, BMI is inversely associated with the increased risk of bleeding and mortality after PCI. **(Am J Cardiol 2015;115:434−440)**

Bleeding is a common complication of percutaneous coronary intervention (PCI) that is associated with a poor prognosis.[1−3] Several studies have investigated the association between body mass index (BMI) and the risk of peri-PCI bleeding.[4−13] Several characteristics of these studies deserve mentioning. First, many previous studies date back to the 1990s or early 2000s, and they do not reflect the current practice of PCI. Second, in several studies, the association between bleeding and BMI was assessed in the setting of vascular complications of PCI in general, and bleeding was poorly defined. Third, in many studies, the BMI-bleeding association was not risk adjusted.[14] In studies that adjusted for potential confounders, being underweight was no longer associated with a higher risk of post-PCI bleeding compared with normal BMI.[11] Fourth, none of the previous studies addressed the association between BMI and the risk of access site or non−access site bleeding. Fifth, with the exception of 1 study that analyzed the need for blood transfusion in men and women,[9] sex differences of the BMI-bleeding risk association have not been explored. Sixth, although low BMI is suggested to be associated with increased risk of bleeding and death after PCI, bleeding-by-BMI interaction regarding mortality has not been investigated. Finally, the association between BMI and bleeding, defined according to the Bleeding Academic Research Consortium (BARC) criteria[15] which are suggested to be more sensitive than other bleeding criteria,[16] has not been investigated. The aim of this study was threefold: first, to assess the association between BMI and access or non−access site bleeding; second, to perform a sex-based analysis of the BMI-bleeding association; and third, to investigate whether there is a bleeding-by-BMI interaction in predicting the increased risk of mortality after PCI.

Methods

The study included 14,178 patients with stable coronary artery disease (n = 9,033) or non−ST-segment elevation acute coronary syndrome (n = 5,145) who underwent PCI from June 2000 to May 2011. By design, the study represents a retrospective analysis of prospectively collected data. The primary sample included 14,180 patients enrolled in the Intracoronary Stenting and Antithrombotic Regimen trials. The diagnosis of coronary artery disease was based on the clinical criteria and coronary angiography (angiographic documentation of coronary stenosis with ≥50% lumen narrowing in ≥1 major coronary artery or culprit lesions). More

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See page 440 for disclosure information.

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Table 1
Baseline characteristics

Characteristic	Body mass index quartiles				P value
	1 (n=3592)	2 (n=3472)	3 (n=3663)	4 (n=3451)	
Age (years)	69 [61.5; 77]	68 [61; 75]	67 [60; 74]	64 [58; 72]	<0.001
Women	1147 (32%)	664 (19%)	709 (19%)	832 (24%)	<0.001
Diabetes mellitus	805 (22%)	893 (26%)	1144 (31%)	1485 (43%)	<0.001
Requiring insulin	188 (5%)	240 (7%)	296 (8%)	479 (14%)	<0.001
Body mass index (kg/m^2)	23 [22; 24]	26 [25; 27]	28 [27; 29]	32 [31; 35]	<0.001
Arterial hypertension	2592 (72%)	2633 (76%)	2934 (80%)	2905 (84%)	<0.001
Total cholesterol (≥220 mg/dl)	2243 (62%)	2340 (67%)	2577 (70%)	2498 (72%)	<0.001
Current smoker	714 (20%)	545 (16%)	606 (16%)	591 (17%)	<0.001
Prior myocardial infarction	1093 (30%)	968 (28%)	1130 (31%)	1055 (31%)	0.02
Prior coronary artery bypass surgery	367 (10%)	425 (12%)	429 (12%)	390 (11%)	0.05
Acute coronary syndrome	1324 (37%)	1271 (37%)	1298 (35%)	1252 (36%)	0.61
Elevated cardiac troponin	718 (20%)	665 (19%)	701 (19%)	686 (20%)	0.70
Creatinine clearance (ml/min)	68 [53; 86]	79 [62; 97]	87 [69; 107]	102 [80; 126]	<0.001
C-reactive protein (mg/L)	1.3 [0.0; 5.1]	1.4 [0.0; 5.2]	1.6 [0.0; 5.0]	2.7 [0.7; 7.0]	<0.001
Number of narrowed coronary arteries					0.13
1	743 (21%)	653 (19%)	742 (20%)	719 (21%)	
2	949 (26%)	1001 (29%)	1040 (28%)	944 (27%)	
3	1900 (53%)	1818 (52%)	1881 (52%)	1788 (52%)	
Multivessel coronary disease	2849 (79%)	2819 (81%)	2921 (80%)	2732 (79%)	0.14
Left ventricular ejection fraction (%)	59 [49; 64]	59 [50; 64]	60 [40; 65]	58 [50; 65]	0.04
Platelet count (x 109/L)	221 [185; 264]	214 [183; 251]	215 [181; 253]	215 [182; 254]	<0.001
Periprocedural anticoagulant therapy					0.03
Unfractionated heparin (100 U/kg)	594 (17%)	587 (17%)	668 (18%)	656 (19%)	
Unfractionated heparin (140 U/kg)	1273 (35%)	1245 (36%)	1274 (35%)	1180 (34%)	
Bivalirudin	764 (21%)	790 (23%)	807 (22%)	788 (23%)	
Abciximab plus UFH (70 U/kg)	961 (27%)	850 (24%)	914 (25%)	827 (24%)	

Data are median [25th; 75th percentiles] or number of patients (%).
UFH = unfractionated heparin.

Table 2
Frequency of bleeding according to body mass index quartiles

BARC bleeding class	Body mass index quartiles				P value
	1 (n=3592)	2 (n=3472)	3 (n=3663)	4 (n=3451)	
1	184 (5.1%)	139 (4.0%)	184 (5.1%)	125 (3.6%)	<0.001
2	66 (1.8%)	60 (1.7%)	58 (1.6%)	46 (1.3%)	
3a	181 (5.0%)	97 (2.8%)	123 (3.4%)	67 1.9%)	
3b	56 (1.6%)	47 (1.4%)	31 (0.8%)	25 (0.7%)	
3c	5 (0.14%)	5 (0.14%)	1 (0.03%)	1 (0.03%)	
4	3 (0.08%)	3 (0.09%)	0 (0.0%)	3 (0.9%)	
Any bleeding	495 (13.8%)	351 (10.1%)	397 (10.8%)	267 (7.7%)	<0.001
Access-site bleeding	311 (8.7%)	196 (5.6%)	243 (6.6%)	155 (4.5%)	<0.001
Non-access site bleeding	184 (5.1%)	155 (4.5%)	154 (4.2%)	112 (3.2%)	0.001
Bleeding class ≥2	311 (8.7%)	212 (6.1%)	213 (5.7%)	142 (4.1%)	<0.001

Data are number of events (%).
BARC = Bleeding Academic Research Consortium.

detailed inclusion/exclusion criteria are given in a previous publication from our group.[17] Of the 14,180 patients, in 2 of them (both with stable coronary artery disease), information on BMI was not available. Thus, 14,178 patients with available BMI data are included in this study. Written informed consent was obtained in all patients in the setting of primary trials, and each study protocol was approved by the ethics committee in the respective recruitment centers. The study conforms to the Declaration of Helsinki.

Coronary angiography and PCI were performed as per standard practice. Femoral artery was used for vascular access. Before PCI procedure, all patients received 325 to 500 mg of aspirin and 600-mg loading dose of clopidogrel. Peri-PCI antithrombotic/anticoagulant regimen included one of the following options: a combination of unfractionated heparin (70 U/kg of weight) plus glycoprotein IIb/IIIa inhibitor abciximab (0.25 mg/kg of weight, as an intravenous bolus, followed by a continuous intravenous infusion of