

ORIGINAL ARTICLE

Performance of PRECISE-DAPT Score for Predicting Bleeding Complication During Dual Antiplatelet Therapy

BACKGROUND: Dual antiplatelet therapy (DAPT) helps prevent ischemic events after coronary stenting but comes with an increased risk of bleeding. Several risk scores have been proposed for the management of patients receiving DAPT, but no standardized tool exists for the purpose. We sought to compare the performance of the new PRECISE-DAPT (Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy), CRUSADE (Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes with Early Implementation of the American College of Cardiology/American Heart Association Guidelines), and ACUTY (Acute Catheterization and Urgent Intervention Triage Strategy) scores for the prediction of bleeding in Korean patients receiving DAPT.

METHODS AND RESULTS: Nine hundred and four consecutive patients who underwent stent implantation received DAPT. One-year bleedings were assessed using TIMI (Thrombolysis in Myocardial Infarction), GUSTO (Global Use of Strategies to Open Occluded Arteries), and BARC (Bleeding Academic Research Consortium). Bleeding events occurred in 154 patients (17.0%) by BARC type $\geq 3a$ criteria, 119 patients (13.2%) by the TIMI minor or major criteria, and 80 patients (8.8%) by the GUSTO moderate or severe criteria. In the C statistic analysis, CRUSADE, ACUTY, and PRECISE-DAPT scores showed high area under the curve values for 1-year bleeding (area under the curve 0.73, 0.75, and 0.75 for TIMI minor or major bleeding; area under the curve 0.81, 0.79, and 0.82 for GUSTO moderate to severe; and area under the curve 0.79, 0.81, and 0.81 for BARC type $\geq 3a$, respectively). The discriminate ability of PRECISE-DAPT was similar to CRUSADE and ACUTY in bleeding complications. However, the PRECISE-DAPT score was better at reclassifying the risk of 1-year bleeding compared with ACUTY for the 3 bleeding criteria.

CONCLUSIONS: The PRECISE-DAPT score is a simple 5-item risk score that represents a standardized tool for the prediction of 1-year bleeding in Korean patients receiving DAPT, regardless of bleeding definition.

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WHAT IS KNOWN

- Bleeding risk stratification may improve patient management during dual antiplatelet therapy (DAPT).
- Several risk scores have been proposed for the management of patients receiving DAPT, but no standardized tool exists for the purpose.
- The PRECISE-DAPT (Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy) score was recently developed and validated.

WHAT THE STUDY ADDS

- The CRUSADE (Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the American College of Cardiology/American Heart Association Guidelines), ACUITY (Acute Catheterization and Urgent Intervention Triage Strategy), and PRECISE-DAPT scores showed good calibration and discrimination for 1-year bleeding during DAPT after coronary stenting.
- The PRECISE-DAPT score is a simple 5-item risk score that represents a standardized tool for the prediction of 1-year bleeding in Korean patients receiving DAPT, regardless of bleeding definition.

Dual antiplatelet therapy (DAPT) with aspirin and a P2Y₁₂ inhibitor after coronary intervention reduces ischemic events but increases bleeding risk, which has been associated with critical adverse events.^{1–5} International guidelines recommend the careful evaluation of bleeding risk when considering treatment duration; however, the optimal duration of treatment remains a topic of debate.^{6,7} Nevertheless, bleeding risk stratification may improve patient management during DAPT. Bleeding predictors primarily consider the patient's clinical characteristics, the invasiveness of the procedure, and the potency of the antithrombotic regimen. Several bleeding risk scores have been proposed and compared to date, including CRUSADE (Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the American College of Cardiology/American Heart Association Guidelines)⁸ and ACUITY (Acute Catheterization and Urgent Intervention Triage Strategy).⁹ The PRECISE-DAPT (Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy) score was recently developed and validated in 8 multicentre randomized trials.¹⁰ The new score is a simple 5-item risk score that predicts out-of-hospital bleeding during DAPT. 2017 the European Society of Cardiology guideline recommended the PRECISE-DAPT score as guidance for the duration of short (3–6 months) or long (12–24 months) DAPT.¹¹ We sought to compare the PRECISE-DAPT,

CRUSADE, and ACUITY scores for the prediction of bleeding in Korean patients receiving DAPT and compare predictive performance between the 3 bleeding risk scores.

METHODS

The authors declare that all supporting data are available within the article and in the [Data Supplement](#).

Patients

Between November 2008 and November 2015, a total of 904 postpercutaneous coronary intervention patients (Dong-A University Medical Center, Busan, Korea) receiving maintenance DAPT (75 mg/day clopidogrel, or 10 mg/day prasugrel, or 180 mg/day ticagrelor, as well as 100 mg aspirin) were included in our study. Written informed consent was obtained from all patients, and the study protocol was approved by the Ethical Review Board of Dong-A University Hospital. Exclusion criteria were hemodynamic instability, malignancies, active bleeding or major surgery within 4 weeks, severe chronic renal failure, and treatment with oral anticoagulant. Hemodynamic instability was defined as any instability in blood pressure.

Clinical End Point and Variable Definitions

All bleeding events and clinical variables included in this analysis were retrospectively collected. The primary end point for the analysis was bleeding complications defined according to 3 different bleeding severity scales: BARC (Bleeding Academic Research Consortium),¹² TIMI (Thrombolysis in Myocardial Infarction)¹³ and GUSTO (Global Use of Strategies to Open Coronary Arteries).¹⁴ The CRUSADE,⁸ ACUITY,⁹ and PRECISE-DAPT¹⁰ bleeding risk scores were calculated from the patients' clinical characteristics. The CRUSADE score was determined using an online calculator with 8 variables (female sex, diabetes mellitus, chronic heart failure, valvular heart disease, heart rate, systolic blood pressure, glomerular filtration rate, and hematocrit). The ACUITY score consists of 7 variables (female sex, age, type of acute coronary syndrome [ACS]: unstable angina, non-ST-segment-elevation myocardial infarction or ST-segment-elevation myocardial infarction, serum creatinine, and white blood cell count; all analyzed as ordinal categories), whereas the PRECISE-DAPT score was determined using an online calculator with 5 variables (age, creatinine clearance, hemoglobin, white blood cell count, and previous spontaneous bleeding). The individual rating for each variable established for each score was assigned. The total scores for each patient were assessed using an online calculator with each prognostic variable included in the score. There were no secondary end points assessed in the study.

Statistical Analysis

Continuous variables are expressed as mean values with SDs, and categorical variables were presented as frequencies (percentages). Comparisons between 2 mean values for continuous variables were analyzed using Student *t* test. Categorical variables were compared with Pearson χ^2 or Fisher exact test. On the basis of the original descriptions of the risk scores, patients were classified into risk categories.^{8–10} The CRUSADE, ACUITY, and PRECISE-DAPT scores were stratified into 3 risk

categories of bleeding (low, moderate, and high). The predictive values of the CRUSADE, ACUITY, and PRECISE-DAPT scores were assessed using a Cox regression model and receiver operating characteristics curve analysis (using MedCalc Version 12.2.1; MedCalc software, Mariakerke, Belgium) and net reclassification improvement (NRI) and integrated discrimination improvement.¹⁵ The prognostic utility of the risk models for 1-year bleeding was assessed by deriving their C statistics, using receiver operating characteristics curves. In general, a model with a C statistic >0.70 is considered to have acceptable discriminatory capacity.¹⁶ The C statistics for the 3 risk models were compared with each other using a nonparametric test.¹⁷ The calibration of the models was evaluated using the Hosmer-Lemeshow goodness-of-fit statistical analysis. NRI represents the average weighted improvement in discrimination, whereas integrated discrimination improvement takes into account the change in the estimated prediction probabilities as a continuous variable and represents the average improvement in predictive probability. The impact of the reclassification procedure using the superior score was assessed using the NRI approach. Positive values of NRI indicate the predominance for correct reclassification, whereas negative values indicate a predominance of incorrect reclassification. A $P < 0.05$ rejects the null hypothesis for NRI, 0 (16). $P < 0.05$ were considered to indicate significance. Statistical analyses were performed using SPSS Version 18.0 (SPSS, Inc, Chicago, IL).

RESULTS

Baseline Characteristics

The study cohort comprised 904 patients who were treated with DAPT. The baseline demographics and clinical characteristics are shown in Table 1. Bleeding events occurred in 154 patients (17.0%) by BARC type $\geq 3a$ criteria, 119 patients (13.2%) by the TIMI minor or major criteria, and 80 patients (8.8%) by the GUSTO moderate or severe criteria (Figure 1). Background clinical and laboratory variables were distributed differently and depended on future bleeding events. Compared with nonbleeding patients, bleeding patients were older and more frequently female. Of the ACSs, non-ST-segment-elevation myocardial infarction and ST-segment-elevation myocardial infarction, but not unstable angina, were linked with more bleeding. The mean CRUSADE, ACUITY, and PRECISE-DAPT scores were higher in patients who experienced bleeding events at 1-year when compared with the nonbleeding cohort (Tables I, II, and III in the [Data Supplement](#)). The frequency of BARC $\geq 3a$ bleeding, TIMI minor or major bleeding, and GUSTO moderate or severe bleeding across the CRUSADE, ACUITY, and PRECISE-DAPT risk score categories is presented in Figure 2. By applying previously validated criteria, 204 patients (22.6%) based on CRUSADE, 331 patients (36.6%) based on ACUITY, and 335 patients (39.3%) based on PRECISE-DAPT met the threshold for high bleeding risk categorization. The ACUITY and PRECISE-DAPT scores enabled broader inclusion in the high-risk category, whereas

Table 1. Patient Baseline Demographics and Clinical Characteristics in Relation to Bleeding

Variables	Overall (N=904)*
Age, y	65.5±10.5
Female, n (%)	271 (30.0)
BMI, kg/m ²	24.4±3.2
Diagnosis, n (%)	
Angina	593 (65.6)
NSTEMI	261 (28.9)
STEMI	50 (5.5)
Prior antiplatelet therapy, n (%)	472 (52.2)
Risk factor, n (%)	
Diabetes mellitus	384 (42.5)
Hypertension	595 (65.8)
Dyslipidemia	516 (57.1)
Current smoking	240 (26.5)
Past history, n (%)	
Prior MI	219 (24.2)
Prior PCI	369 (40.8)
Prior stroke	93 (10.3)
Heart rate, bpm	75.1±15.4
Systolic BP, mm Hg	130.1±22.7
LVEF, %	58.9±11.0
Total cholesterol, mg/dL	163.8±40.7
HbA1c, %	6.6±1.3
White blood cell count (10 ⁹ /mL)	7.9±3.0
Platelet count, 10 ³ μ L	211.2±62.1
Hemoglobin, g/dL	12.8±2.0
eGFR, mL min ⁻¹ 1.73 m ⁻²	76.1±26.1
P2Y12 inhibitors, n (%)	
Clopidogrel	858 (94.9)
Prasugrel	39 (4.3)
Ticagrelor	7 (0.8)
Bleeding risk scores	
CRUSADE	31.0±14.2
ACUITY	12.3±6.8
PRECISE-DAPT	22.0±12.9

ACUITY indicates Acute Catheterization and Urgent Intervention Triage Strategy; BMI, body mass index; BP, blood pressure; CRUSADE, Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the ACC/AHA Guidelines; eGFR, estimated glomerular filtration rate; Hb, hemoglobin; LVEF, left ventricular ejection fraction; MI, myocardial infarction; NSTEMI, non-ST-segment-elevation myocardial infarction; PCI, percutaneous coronary intervention; PRECISE-DAPT, Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy; and STEMI, ST-segment-elevation myocardial infarction.

*Values are n (%) or mean±SD.

CRUSADE was more restrictive. The transition from a lower to a higher risk category was associated with a significant increase in bleeding rates across the bleeding risk scores (Figure 2).

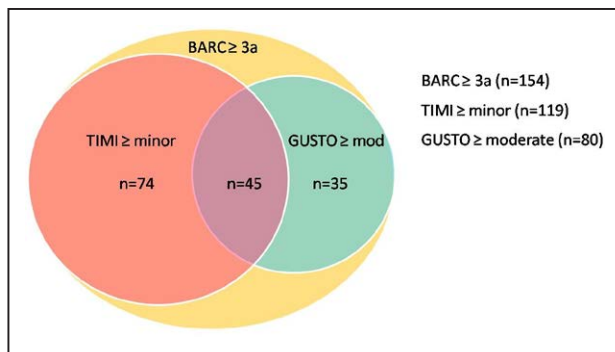


Figure 1. Incidences of 1-y bleeding events according to the 3 bleeding definitions.

The Venn diagram displays the incidences of 1-y bleeding events. BARC indicates Bleeding Academic Research Consortium; GUSTO, Global Use of Strategies to Open Coronary Arteries; and TIMI, Thrombolysis in Myocardial Infarction.

Predictive Performance of the Bleeding Risk Scores

The predictive performances of the CRUSADE, ACUITY, and PRECISE-DAPT scores for 1-year bleeding events were higher in the higher risk category compared with the low-risk category (Table 2). Table 3 presents the

discriminatory capacity of the 3 risk scores in predicting each bleeding definition, including assessing the areas under the curve. In the C statistic analysis, CRUSADE, ACUITY, and PRECISE-DAPT scores showed high area under the curve values for 1-year bleeding (area under the curve 0.73, 0.75, and 0.75 for TIMI minor or major bleeding; area under the curve 0.81, 0.79, and 0.82 for GUSTO moderate to severe; and area under the curve 0.79, 0.81, and 0.81 BARC type $\geq 3a$, respectively). The discriminate ability of PRECISE-DAPT was similar to CRUSADE and ACUITY in bleeding complications (Table 4). Additionally, the PRECISE-DAPT score reclassified the risk of 1-year bleeding compared with ACUITY. When compared with CRUSADE, PRECISE-DAPT was not significantly superior in terms of NRI or integrated discrimination improvement (Table 5). These results were not different relative to the different bleeding definitions.

DISCUSSION

The main findings of this study are as follows. First, the CRUSADE, ACUITY, and PRECISE-DAPT risk scores

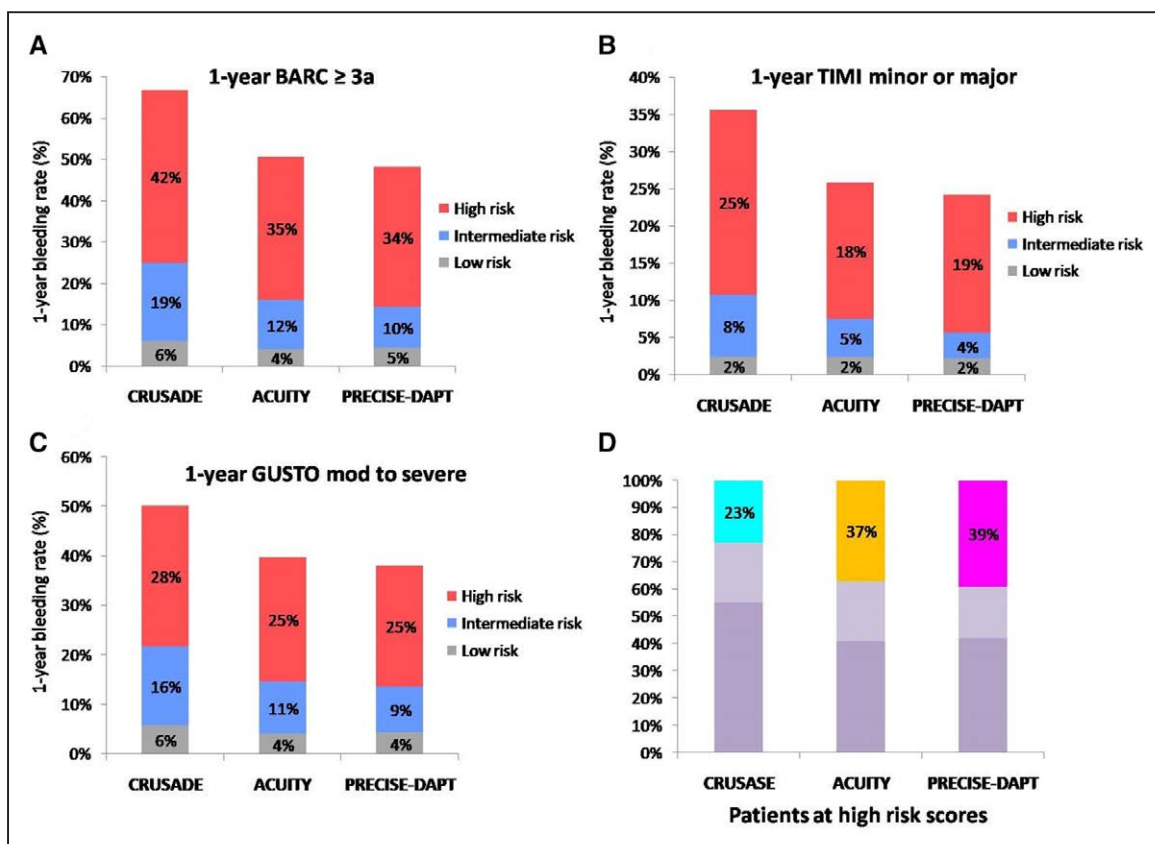


Figure 2. Distribution of CRUSADE, ACUITY, and PRECISE-DAPT risk scores for 1-y bleeding by risk categories.

Bar graphs display 1-y bleeding rate. BARC (Bleeding Academic Research Consortium) $\geq 3a$ bleeding (A), TIMI (Thrombolysis in Myocardial Infarction) minor or major bleeding (B), GUSTO (Global Use of Strategies to Open Coronary Arteries) moderate or severe bleeding (C). The incidence of bleeding was higher in the high-risk category. The ACUITY and PRECISE-DAPT scores had broader inclusion in the high-risk category, whereas the CRUSADE score was more restrictive (D). ACUITY indicates Acute Catheterization and Urgent Intervention Triage Strategy; CRUSADE, Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the American College of Cardiology (ACC)/American Heart Association (AHA) Guidelines; and PRECISE-DAPT, Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy.

Table 2. Predictive Performance of CRUSADE, ACUITY, and PRECISE-DAPT Scores for 1-Year Bleeding According to Bleeding Definition

	BARC $\geq 3a$		TIMI Minor or Major		GUSTO Moderate or Severe	
	HR (95% CI)	P Value	HR (95% CI)	P Value	HR (95% CI)	P Value
CRUSADE score		<0.001		<0.001		<0.001
Low (≤ 30)	Reference		Reference		Reference	
Moderate (31–40)	3.24 (2.19–5.41)		3.00 (1.91–4.69)		3.23 (1.885.56)	
High (>40)	8.17 (5.41–12.3)		5.70 (3.59–9.03)		10.1 (5.8317.6)	
ACUITY score		<0.001		<0.001		<0.001
Low (<10)	Reference		Reference		Reference	
Moderate (10–14)	3.04 (2.02–4.57)		2.81 (1.75–4.50)		1.97 (1.113.49)	
High (>14)	9.71 (6.77–13.9)		7.07 (4.69–10.6)		7.28 (4.4411.9)	
PRECISE-DAPT		<0.001		<0.001		<0.001
Low (≤ 17)	Reference		Reference		Reference	
Moderate (18–24)	2.13 (1.39–3.26)		2.25 (1.38–3.68)		1.47 (0.812.67)	
High (>24)	8.35 (5.86–11.9)		6.45 (4.32–9.64)		8.23 (5.0613.4)	

Each hazard ratio is considered as compared to the reference low bleeding risk category. ACUITY indicates Acute Catheterization and Urgent Intervention Triage Strategy; CRUSADE, Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the ACC/AHA Guidelines; BARC, Bleeding Academic Research Consortium; GUSTO, Global Use of Strategies to Open Coronary Arteries; PRECISE-DAPT, Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy; and TIMI, Thrombolysis in Myocardial Infarction.

demonstrated reasonably good discriminatory capacity with respect to 1-year bleeding in patients treated with DAPT, regardless of the bleeding definition. Second, the PRECISE-DAPT score predicted the TIMI minimal and GUSTO moderate or severe bleeding better than the ACUITY score. In addition, PRECISE-DAPT predicted 1-year bleedings significantly better than ACUITY with improved reclassification performance. Third, the CRUSADE and ACUITY risk scores for short-term bleeding also had good discriminatory ability for predicting long-term bleeding. Finally, the new PRECISE-DAPT score can also predict 1-year

bleeding in Korean patients receiving DAPT. Major bleeding is one of the most common serious adverse events in ACS.¹⁸ In this clinical setting, there is a strong relationship between bleeding and mortality, with major bleeding associated with a 60% increase in risk of hospital death.¹⁹ A significant hemorrhage may lead to cessation of DAPT and potential ischemic recurrence. Moreover, potent DAPT can increase the number of patients at high risk of bleeding complications. Risk stratification has been proposed to select the intensity and duration of DAPT after percutaneous coronary intervention through the bleeding risk

Table 3. Discriminative Values of CRUSADE, ACUITY, and PRECISE-DAPT Scores for Predicting 1-Year Bleeding According to Bleeding Definition

	CRUSADE Score		ACUITY Score		PRECISE-DAPT	
	AUC (95% CI)	P Value	AUC (95% CI)	P Value	AUC (95% CI)	P Value
1-y TIMI bleeding						
Minor	0.73 (0.70–0.76)	<0.001	0.76 (0.73–0.78)	<0.001	0.76 (0.73–0.78)	<0.001
Major	0.69 (0.65–0.72)	<0.001	0.68 (0.65–0.71)	0.001	0.67 (0.64–0.70)	0.002
Minor or major	0.73 (0.70–0.76)	<0.001	0.75 (0.72–0.78)	<0.001	0.75 (0.72–0.78)	<0.001
1-y GUSTO bleeding						
Moderate or severe	0.81 (0.78–0.83)	<0.001	0.79 (0.76–0.82)	<0.001	0.82 (0.80–0.85)	<0.001
1-y BARC bleeding						
BARC 3a	0.79 (0.76–0.81)	<0.001	0.81 (0.78–0.84)	<0.001	0.82 (0.79–0.84)	<0.001
BARC $\geq 3a$	0.79 (0.76–0.81)	<0.001	0.81 (0.78–0.83)	<0.001	0.81 (0.78–0.84)	<0.001
BARC $\geq 3b$	0.69 (0.66–0.72)	<0.001	0.69 (0.66–0.72)	<0.001	0.68 (0.65–0.71)	0.001

ACUITY indicates Acute Catheterization and Urgent Intervention Triage Strategy; AUC, area under the curve; CRUSADE, Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the ACC/AHA Guidelines; BARC, Bleeding Academic Research Consortium; GUSTO, Global Use of Strategies to Open coronary arteries; PRECISE-DAPT, Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy; and TIMI, Thrombolysis in Myocardial Infarction.

Table 4. Discriminative Power Comparison for the 3 Risk Scores in Predicting 1-Year Bleeding

Variables	1-y BARC $\geq 3a$ Bleeding		1-y TIMI Minor or Moderate Bleeding		1-y GUSTO Moderate or Severe Bleeding	
	Z Statistics	P Value	Z Statistics	P Value	Z Statistics	P Value
CRUSADE vs AQUIITY	1.14	0.256	1.01	0.315	0.68	0.498
CRUSADE vs PRECISE-DAPT	1.47	0.141	0.94	0.350	0.86	0.388
AQUIITY vs PRECISE-DAPT	0.38	0.708	0.16	0.876	2.13	0.034

AQUIITY indicates Acute Catheterization and Urgent Intervention Triage Strategy; CRUSADE, Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the ACC/AHA Guidelines; BARC, Bleeding Academic Research Consortium; GUSTO, Global Use of Strategies to Open coronary arteries; PRECISE-DAPT, Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy; and TIMI, Thrombolysis in Myocardial Infarction.

assessment,^{20–22} but no standardized tool exists for this purpose. The CRUSADE and AQUIITY scores were developed to estimate the baseline risk for short-term major bleeding in ACS patients.^{8,9} Previous studies suggest that the CRUSADE score is the most accurate predictor of major bleeding, but the larger number of variables in CRUSADE may be an issue and cause variation in the risk assessment. The new PRECISE-DAPT score consists of 4 continuous parameters (listed from 0 to maximum in score calculation: age, creatinine clearance, hemoglobin, white blood cell count), and the dichotomous parameter previous spontaneous bleeding.¹⁰ The PRECISE-DAPT score, therefore, represents a simple prediction algorithm as a standardized tool for the prediction of 1-year bleeding during DAPT. An additional advantage of PRECISE-DAPT is that it was derived from 8 multicentre randomized clinical trials with independent adjudication of events. In the context of a comprehensive clinical evaluation process, this tool can support clinical decision making for treatment duration. However, the PRECISE-DAPT score does not take into account underlying ischemic risks, so its utility may be limited.

We compared the predictive performance of the new PRECISE-DAPT score and other bleeding scores for 1-year bleeding in Korean patients treated with DAPT using various bleeding definitions. PRECISE-DAPT score predicts long-term bleeding, whereas CRUSADE and AQUIITY scores predict short-term complications. However, a previous study reported that the CRUSADE score predicts major bleeding similarly to AQUIITY and better than HAS-BLED (hypertension, abnormal renal/liver function, stroke, bleeding history or predisposition, labile international normalized ratio, elderly, drugs/alcohol concomitantly) in an all-comer population treated with long-term DAPT.²⁰ We, therefore, also compared PRECISE-DAPT, CRUSADE, and AQUIITY scores for 1-year bleeding. For the C statistic analysis, the discriminate ability of PRECISE-DAPT was similar to CRUSADE and AQUIITY in bleeding complications. Moreover, PRECISE-DAPT, but not CRUSADE, successfully reclassified the risk of 1-year bleeding compared with AQUIITY. The strength in the current study is because of the incorporation of various bleeding definitions (BARC, TIMI, and GUSTO criteria), capturing bleeding complications.

Table 5. NRI and IDI for 1-Year Bleeding

Comparison	Event	Bleeding Correctly Reclassified, P Value (n1)	No Bleeding Correctly Reclassified, P Value (n2)	NRI	P Value	IDI	P Value
CRUSADE* vs AQUIITY	BARC $\geq 3a$	0.36(56)	0.40(300)	−0.04	0.68	0.01	0.45
	TIMI $\geq$ minor	0.31(37)	0.41(319)	−0.10	0.33	−0.00	0.75
	GUSTO $\geq$ moderate	0.55(44)	0.38(312)	0.17	0.14	0.03	0.00
CRUSADE* vs PRECISE	BARC $\geq 3a$	0.38(58)	0.35(262)	0.03	0.77	0.01	0.23
	TIMI $\geq$ minor	0.31(37)	0.36(284)	−0.05	0.61	−0.00	0.89
	GUSTO $\geq$ moderate	0.50(41)	0.34(280)	0.16	0.17	0.03	0.00
AQUIITY* vs PRECISE	BARC $\geq 3a$	0.60(93)	0.11(80)	0.70	0.00	0.00	0.67
	TIMI $\geq$ minor	0.50(59)	0.06(47)	0.56	0.00	0.00	0.82
	GUSTO $\geq$ moderate	0.70(57)	0.15(120)	0.85	0.00	0.01	0.13

AQUIITY indicates Acute Catheterization and Urgent Intervention Triage Strategy; CRUSADE, Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the ACC/AHA Guidelines; BARC, Bleeding Academic Research Consortium; GUSTO, Global Use of Strategies to Open Coronary Arteries; IDI, integrated discrimination improvement; NRI, net reclassification improvement; and PRECISE-DAPT, Predicting Bleeding Complication in Patients Undergoing Stent Implantation and Subsequent Dual Antiplatelet Therapy.

*The model considered each bleeding risk score as a reference value for the others.

Study Limitations

We note several limitations to our study design. As a single-center retrospective study, the results provided are hypothesis generating, and the scores evaluated were not validated in an all-comer population and were designed mostly to predict events within 1 year after the index procedure. It should also be emphasized that there may be confounders to our analysis that could potentially impact the conclusions, including potentially missed bleeding events. Furthermore, we did not evaluate ischemic risk. Ischemia and bleeding have overlapping risk factors (eg, older age, renal dysfunction), and ACS patients have a higher risk of death/ischemia and bleeding complications. Future studies need to assess such ischemic complications and mortality. A randomized trial and bigger sample sizes are required to support or refute our findings.

Conclusions

The CRUSADE, ACUITY, and PRECISE-DAPT scores showed good calibration and discrimination for 1-year bleeding during DAPT after coronary stenting. So, the new PRECISE-DAPT score is a simple 5-item risk score that represents a standardized tool for the prediction of 1-year bleeding in Korean patients receiving DAPT, regardless of bleeding definition.

ARTICLE INFORMATION

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Disclosures

None.

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