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ORIGINAL ARTICLE

The PRECISE-DAPT score and 5-year outcomes after percutaneous coronary intervention: a large-scale, real-world study from China

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Aims The PRECISE-DAPT (predicting bleeding complications in patients undergoing stent implantation and subsequent dual-antiplatelet therapy) score is recommended by guidelines for predicting out-of-hospital bleeding in patients after percutaneous coronary intervention (PCI). However, the long-term prognostic value of the PRECISE-DAPT score in patients after PCI remains unclear.

Methods and results We performed a prospective study of 10 724 patients who underwent PCI throughout 2013 in Fuwai Hospital. The bleeding endpoint was Bleeding Academic Research Consortium 2, 3, or 5 bleeding. The ischaemic endpoints were all-cause death and major adverse cardiovascular and cerebrovascular events (MACCE). After a 5-year follow-up, 10 109 patients were finally analysed. A total of 415 (4.11%) patients experienced bleeding, 364 (3.60%) experienced all-cause death, and 2049 (20.27%) had MACCE. Using Cox regression, the risks of bleeding [hazard ratio (HR): 1.721, 95% confidence interval (CI): 1.180–2.511, $P = 0.005$], MACCE (HR: 1.607, 95% CI: 1.347–1.917, $P < 0.001$), and all-cause-death (HR: 3.902, 95% CI: 2.916–5.221, $P < 0.001$) in patients with a high score were significantly higher than those in patients with a low score. The PRECISE-DAPT score showed prognostic value for 5-year events of bleeding (*C*-statistic: 0.566, 95% CI: 0.537–0.594), MACCE (*C*-statistic: 0.540, 95% CI: 0.527–0.553), and all-cause death (*C*-statistic: 0.673, 95% CI: 0.644–0.702).

Conclusion After 5 years of follow-up, the PRECISE-DAPT score has a statistically significant predictive value for long-term bleeding events in the Chinese PCI population, and also some prognostic value for death and MACCE.

One-sentence Summary In this real-world, large-sample study, the PRECISE-DAPT (predicting bleeding complications in patients undergoing stent implantation and subsequent dual-antiplatelet therapy) score shows a statistically significant 5-year predictive value for bleeding in Chinese patients with percutaneous coronary intervention and dual-antiplatelet therapy. The study also shows that the PRECISE-DAPT score has moderate predictive value for all-cause death.

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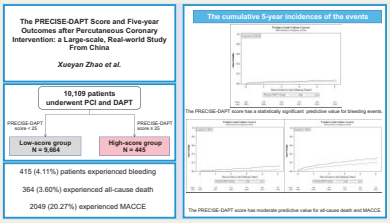
Graphical Abstract The PRECISE-DAPT (predicting bleeding complications in patients undergoing stent implantation and subsequent dual-antiplatelet therapy) score shows a statistically significant 5-year predictive value for bleeding in Chinese patients with percutaneous coronary intervention and dual-antiplatelet therapy. The study also shows that the PRECISE-DAPT score has moderate predictive value for all-cause death.



Keywords PRECISE-DAPT score • Percutaneous coronary intervention • Bleeding • Major adverse cardiovascular and cerebrovascular events • Death

Introduction

Dual-antiplatelet therapy (DAPT) is the standard treatment after percutaneous coronary intervention (PCI). DAPT significantly reduces stent thrombosis events, but it may increase the risk of bleeding.[1] Once bleeding occurs, it may also increase the risk of cardiac events.[2] A recent study[3] suggested that if patients have both complex PCI and a high risk of bleeding, bleeding, more than ischaemic risk, should inform decision-making on the duration of DAPT. Therefore, early warning of patients with a high risk of bleeding after PCI is important, and it is a challenging and difficult topic at present.

The PRECISE-DAPT (predicting bleeding complications in patients undergoing stent implantation and subsequent dual-antiplatelet therapy) score[4] is a simple five-item risk score. This score provides a tool for predicting out-of-hospital bleeding during DAPT within 12 months, and has been recommended by the current guidelines.[5,6] Additionally, a number of recent studies have shown that this score shows good clinical application value in older patients,[7] acute coronary syndrome in non-revascularized patients,[8] and patients with atrial fibrillation who take oral anticoagulants after PCI.[9,10]

However, the predictive value of the PRECISE-DAPT score for long-term follow-up of bleeding in patients after PCI with DAPT is still unclear. To date, only one study[11] ($n = 1565$) has evaluated the predictive value of the PRECISE-DAPT score for 5-year bleeding in patients with coronary heart disease. This previous study showed only a weak predictive value [area under the curve (AUC): 0.571]. However, in this study, only 77% of patients received PCI, 85.5% of patients used P2Y12 receptor inhibitors, and 21.1% of patients were treated with oral anticoagulants, which is different from the original PRECISE-DAPT study.

Therefore, we aimed to use a large-sample dataset in the real world to evaluate the prognostic value of the PRECISE-DAPT score for 5-year bleeding in patients undergoing PCI with DAPT. We further aimed to examine whether this score has long-term predictive value for death and major adverse cardiovascular and cerebrovascular events (MACCE), and whether the score is applicable to the Asian population.

Methods

Study design and patients

This study was a prospective, single-centre, observational cohort study. Between January 2013 and December 2013, 10 724 consecutive patients undergoing PCI were prospectively enrolled in Fuwai Hospital, National Center for Cardiovascular Diseases (Beijing, China). To be consistent with the inclusion and exclusion criteria for the PRECISE-DAPT score,[4] we excluded the patients who did not successfully receive eluting stents, those who were treated with oral anticoagulants, and patients lost to follow-up. All patients were treated with aspirin and P2Y12 receptor antagonist at baseline. After PCI, all patients were prescribed aspirin 100 mg daily indefinitely, and clopidogrel 75 mg daily or ticagrelor 90 mg twice daily was advised for at least 1 year. This study complies with the Helsinki Declaration. The Fuwai Institutional Review Board approved the study protocol (approval number: 2013-449) and all the patients provided written informed consent.

Definitions and endpoints

The PRECISE-DAPT score in this study was determined according to the original PRECISE-DAPT score.[4] The PRECISE-DAPT score for each patient was calculated by an online web calculator (http://www.precisedaptscore.com), including five variables (age, haemoglobin, white blood cell count, creatinine clearance, and previous history of bleeding). The parameters of the PRECISE-DAPT score were defined using the first laboratory results within 24 h of admission. The bleeding endpoint was defined by the Bleeding Academic Research Consortium (BARC),[12] which included BARC type 2, 3, or 5 bleeding. The PARIS (patterns of non-adherence to anti-platelet regimen in stented patients) score in this study was calculated according to the original PARIS score.[13] The SYNTAX (synergy between percutaneous coronary intervention with taxus and cardiac surgery) score was calculated by using a web calculator (http://www.syntaxscor e.com).[14] The ischaemic endpoints included all-cause death and MACCE. MACCE was defined as all-cause death, myocardial infarction (MI), revascularization, or stroke. Death was defined as all-cause death. MI was defined as spontaneous MI, which included patients who presented with clinical symptoms or electrocardiographic changes consistent with myocardial ischaemia in the setting of increased cardiac biomarkers greater than the upper limit of normal, in accordance with the universal definition.[15] Revascularization was defined as unplanned repeated revascularization for ischaemic symptoms by PCI

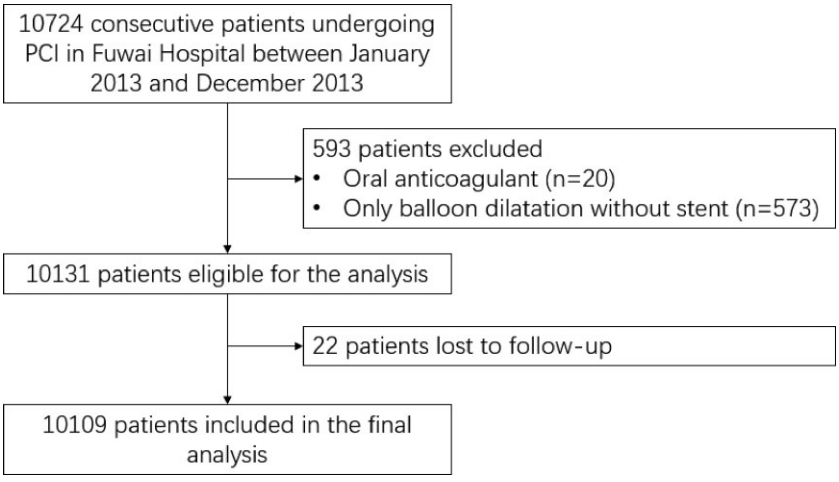


Figure 1 Patient flow chart for the study cohort.

or coronary artery bypass grafting. Creatinine clearance was calculated using the Cockcroft–Gault formula.

Follow-up

All patients were followed up by a clinic visit or by phone at 30 days, 6 months, 1 year, 2 years, and 5 years, with a 91.54% follow-up rate at 5 years. Patients were advised to return for coronary angiography if there were clinical symptoms or documentation of myocardial ischaemia. Time to event was calculated as the duration between the date of PCI and the date of the event (bleeding, MACCE, or death) or the date of loss to follow-up, whichever occurred first. All endpoint events were adjudicated centrally by two independent cardiologists and possible disagreement was resolved by consensus; the event adjudicators were blinded to the clinical variables and PRECISE-DAPT score.

Statistical analysis

Categorical variables were expressed as frequency (percentage), whereas continuous variables were expressed as mean ± standard deviation. Continuous variables were compared by the Student's *t*-test, and the Pearson χ^2 test or Fisher's exact test was used to compare categorical variables. According to the risk stratification of the original PRECISE-DAPT score,[4] patients were divided into the high-score group of PRECISE-DAPT (≥25) and the low-score group of PRECISE-DAPT (<25). We used the Kaplan–Meier method to estimate survival curves and differences were compared with the log-rank test. Cox proportional hazards regression was used for survival analysis. Hazard ratios (HRs) and 95% confidence intervals (CIs) were calculated. The predictive value of the PRECISE-DAPT score was assessed with the *C*-statistic. To compare the predictive value for bleeding between the PARIS bleeding score and PRECISE-DAPT score, the *C*-statistic, continuous net reclassification improvement, and integrated discrimination improvement were calculated. All statistical analyses were performed at a significance level of 0.05 (two-sided). Statistical analysis was performed with SAS 9.2 software (SAS Institute Inc., Chicago, IL, USA).

Results

Patients' characteristics

Out of a total of 10 724 consecutive patients undergoing PCI in Fuwai Hospital between January 2013 and December 2013, after excluding the patients who received only balloon dilatation without stent ($n = 573$), the patients who received an oral anticoagulant ($n = 20$), and the patients who were lost to follow-up ($n = 22$), finally, 10 109 patients were included in this study (*Figure 1*). Baseline characteristics are shown in *Table 1*. The mean age of the patients was 58.3 ± 10.3 years and 7787 (77.03%) patients were men. Among them, 6431 (63.6%) patients had acute coronary syndrome (including acute MI and unstable angina pectoris). Most (99.87%) patients took clopidogrel and only a few (0.13%) took ticagrelor. The distribution of PRECISE-DAPT scores in the population is shown in *Figure 2*. Using the 25 points recommended in the guidelines as the cut-off point, patients were divided into the high-score PRECISE-DAPT group (score ≥ 25, $n = 445$) and the low-score PRECISE-DAPT group (score < 25, $n = 9664$). The high-score group was older, had a higher rate of women, and had a lower body mass index compared with the low-score group. In the high-score group, there were higher rates of a history of previous PCI, previous coronary artery bypass grafting, hypertension, diabetes, chronic obstructive pulmonary disease, peripheral vascular disease, and previous stroke compared with the low-score group. In the high-score group, fewer patients were smokers and more patients had acute MI and unstable angina pectoris compared with the low-score group. The high-score group had lower haemoglobin levels and estimated glomerular filtration rate, a higher white blood cell count, a higher SYNTAX score, and higher rates of femoral artery puncture and intra-aortic balloon pump compared with the low-score group. The high-score group also had a lower rate of aspirin treatment at discharge (*Table 1*).

After the 5-year follow-up, 415 (4.11%) patients experienced BARC 2, 3, or 5 bleeding, 364 (3.60%) experienced all-cause death (among them, 10 patients experienced haemorrhagic death and

Table 1 Baseline characteristics of study population with high and low PRECISE-DAPT score

Variables	Low-score group (score < 25, *N* = 9664)	High-score group (score ≥ 25, *N* = 445)	*P*-value
Demographics			
Age (years)	57.7 ± 9.9	72.7 ± 8.3	<0.001
Men	7552 (78.1)	235 (52.8)	<0.001
BMI (kg/m^2)	25.9 ± 3.2	25.5 ± 3.3	0.004
Cardiovascular risk factors			
Previous PCI	2259 (23.4)	146 (32.8)	<0.001
Previous CABG	374(3.9)	28 (6.3)	0.011
Hypertension	6143 (63.6)	348 (78.2)	<0.001
Diabetes	2869 (29.7)	155 (34.8)	0.021
COPD	212 (2.2)	26 (5.8)	<0.001
PVD	245 (2.5)	22 (4.9)	0.002
Previous stroke	934 (9.7)	138 (31.0)	<0.001
Previous MI	1799 (18.6)	96 (21.6)	0.118
Smoking status			
Never smoker	3957 (40.9)	249 (56.0)	<0.001
Ever smoker	133 (1.4)	6 (1.3)	
Current smoker	5574 (57.7)	190 (42.7)	
Initial presentation			
Clinical presentation			
AMI	1767 (17.3)	153 (31.2)	<0.001
UAP	4301 (42.0)	210 (42.8)	
SAP	3324 (32.5)	100 (20.4)	
LVEF (%)	63.0 ± 7.1	59.1 ± 9.3	<0.001
Laboratory results at admission			
Hb (g/dL)	14.4 ± 1.5	12.6 ± 1.9	<0.001
WBC (10^9/L)	6.8 ± 1.9	7.9 ± 3.0	<0.001
eGFR (mL/min)	92.8 ± 13.4	61.4 ± 17.1	<0.001
Procedural presentation			
SYNTAX score[a]	11.4 ± 7.9	14.4 ± 9.5	<0.001
Number of stents	2.0 (1.0–2.0)	2.0 (1.0–2.0)	0.567
Femoral artery puncture	683 (7.1)	61 (13.7)	<0.001
IABP	94 (1.0)	28 (6.3)	<0.001
GPI	1579 (16.3)	63 (14.2)	0.223
Medication at discharge			
Aspirin	9547 (98.8)	433 (97.3)	0.006
Clopidogrel	9649 (99.8)	444 (99.8)	0.718
Statin	9276 (96.0)	420 (94.4)	0.095
Beta blocker	8699 (90.0)	399 (89.7)	0.809

Values are mean ± standard deviation or *n* (%).
BMI, body mass index; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease; PVD, peripheral vascular disease; MI, myocardial infarction; AMI, acute myocardial infarction; UAP, unstable angina pectoris; SAP, stable angina pectoris; LVEF, left ventricular ejection fraction; Hb, haemoglobin; WBC: white blood cell count; eGFR, estimated glomerular filtration rate; IABP, intra-aortic balloon pump; GPI: glycoprotein IIb/IIIa inhibitor.
[a] Calculated using an online calculator (http://www.syntaxscore.com) by a dedicated research group blinded to the clinical data.

217 patients experienced cardiac death), and 2049 (20.27%) had MACCE.

Comparison of the 5-year event rates between the high-score and low-score PRECISE-DAPT groups

When we used BARC 2, 3, or 5 bleeding as the endpoint, the incidence of bleeding events in the high-score group was significantly higher than that in the low-score group (6.52% vs. 3.99%, $P < 0.001$). When all-cause death was used as the event endpoint, the risk of events in the high-score group was significantly higher than that in the low-score group (11.91% vs. 3.22%, $P < 0.001$). When MACCE was used as the endpoint, the event rate in the high-score group was significantly higher than that in the low-score group (29.66% vs. 19.84%, $P < 0.001$). When cardiac death was used as the event endpoint, the risk of events in the high-score group was significantly higher than that in the low-score group (7.4% vs. 1.9%, $P < 0.001$).

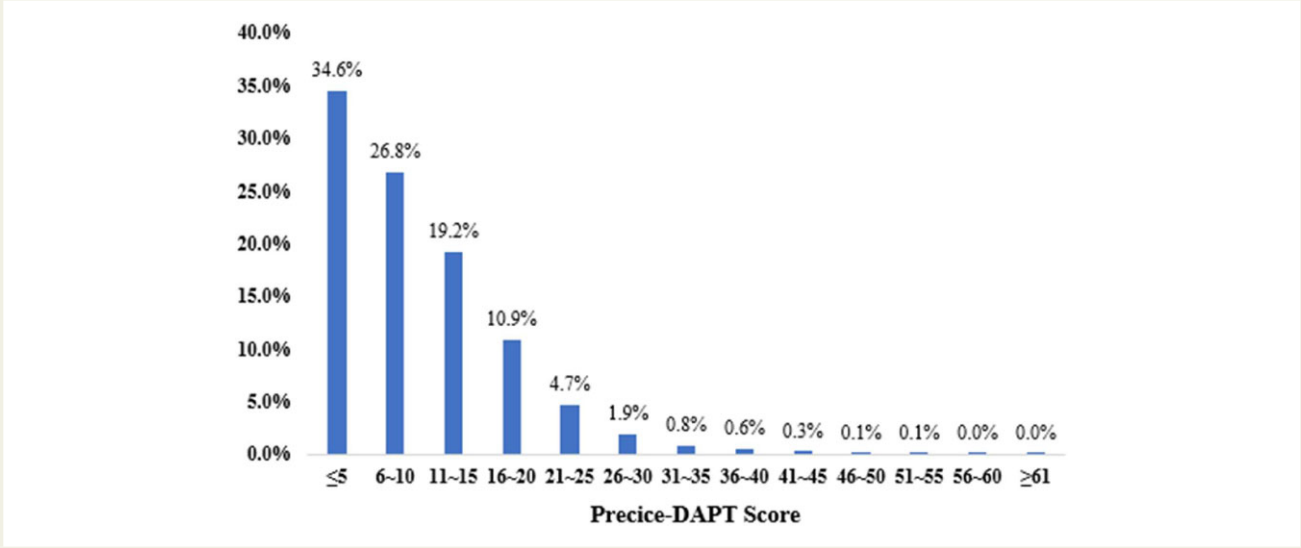


Figure 2 Distribution of PRECISE-DAPT score in the study population.

Table 2 Clinical outcomes at 5 years and hazard ratios of high vs. low PRECISE-DAPT scores

	Low score (n = 9664)	High score (n = 445)	P-value
BARC 2, 3, or 5 bleeding			
No. of events	386	29	
Person-years	44 609.0	1926.0	
Incidence rate, N/1000 person-years	8.7	15.1	
Hazard ratio	Reference	1.721 (1.180, 2.511)	0.0048
MACCE			
No. of events	1917	132	
Person-years	40 776.0	1733.1	
Incidence rate, N/1000 person-years	47.0	76.2	
Hazard ratio	Reference	1.607 (1.347, 1.917)	<0.0001
All-cause death			
No. of events	311	53	
Person-years	45 746.5	2005.5	
Incidence rate, N/1000 person-years	6.8	26.4	
Hazard ratio	Reference	3.902 (2.916, 5.221)	<0.0001

PRECISE-DAPT, predicting bleeding complications in patients undergoing stent implantation and subsequent dual-antiplatelet therapy; BARC, Bleeding Academic Research Consortium; MACCE = major adverse cardiovascular and cerebrovascular events.

Cox regression analysis for event rates

By the time of the 5-year follow-up, the median time of bleeding was 1.39 years. The risk of bleeding in patients with a high PRECISE-DAPT score was 1.721 times higher than that in patients with a low PRECISE-DAPT score (HR: 1.721, 95% CI: 1.180–2.511). The median time of all-cause death was 2.80 years. The risk of all-cause death in patients with a high PRECISE-DAPT score was 3.902 times higher than that in patients with a low PRECISE-DAPT score (HR: 3.902, 95% CI: 2.916–5.221). The median time of MACCE was 1.62 years. The risk of MACCE in patients with a high PRECISE-DAPT score was 1.607 times higher than that in patients with a low PRECISE-DAPT score (HR: 1.607, 95% CI: 1.347–1.917) (*Table 2*).

Kaplan–Meier survival curve analysis

Using a PRECISE-DAPT score of 25 as the cut-off point, Kaplan–Meier survival curve analysis showed that patients with a high score had a higher cumulative 5-year incidence of bleeding (log rank, $P = 0.004$), all-cause death (log rank, $P < 0.001$), and MACCE (log rank, $P < 0.001$) than those with a low score (*Figure 3*).

In further analysis, by PRECISE-DAPT score quartiles, Kaplan–Meier survival curve analysis also showed that patients with a high score had a higher cumulative 5-year incidence of bleeding (log rank,

$P < 0.001$), all-cause death (log rank, $P < 0.001$), and MACCE (log rank, $P < 0.001$) than those with a low score (*Figure 4*).

Predictive value of the PRECISE-DAPT score in the 5-year follow-up

We calculated the *C*-statistic of the PRECISE-DAPT score for different events as a continuous variable. The PRECISE-DAPT score showed a relatively limited predictive value for 5-year bleeding events with a *C*-statistic of 0.566 (95% CI: 0.537–0.594). The PRECISE-DAPT score showed a moderate predictive value for 5-year all-cause death with a *C*-statistic of 0.673 (95% CI: 0.644–0.702) and a predictive value for MACCE with a *C*-statistic of 0.540 (95% CI: 0.527–0.553).

Subgroup analysis of the DAPT duration

Except for the lack of related information in two patients, among the 10 107 patients, there were 3092 patients (30.59%) with DAPT duration ≤1 year, 4619 patients (45.70%) with 1–2 years, and

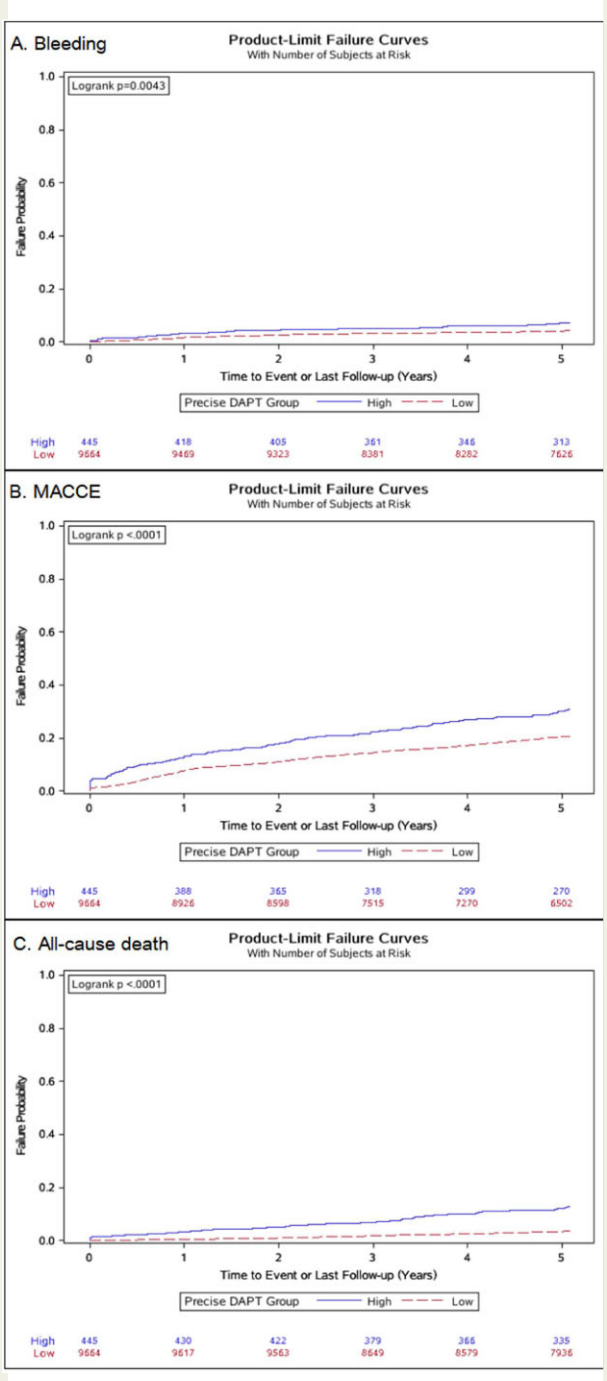


Figure 3 Kaplan–Meier estimate of the cumulative 5-year incidences of the events by using 25 as the cut-off point.

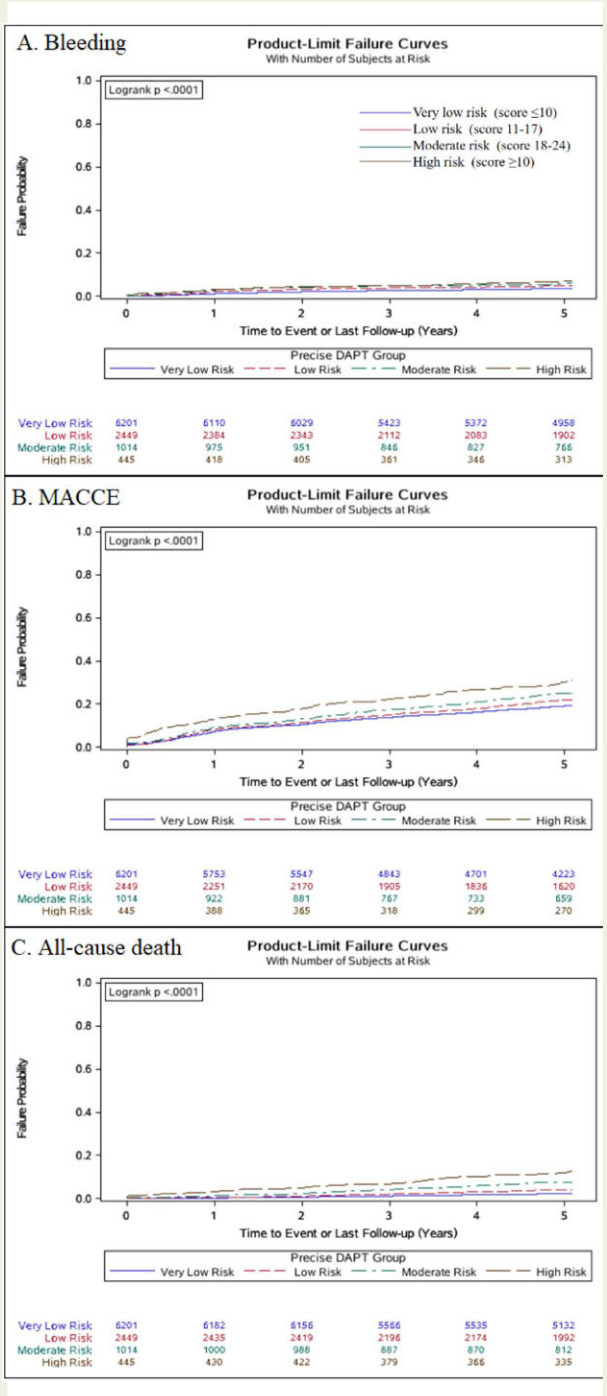


Figure 4 Kaplan–Meier estimate of the cumulative 5-year incidences of the events stratified by score quartiles.

2396 patients (23.71%) with >2 years. When we used BARC 2, 3, or 5 bleeding as the endpoint, in the ≤1 year group, the PRECISE-DAPT score showed a predictive value for 5-year bleeding events with a *C*-statistic of 0.586 (95% CI: 0.538–0.634). However, the PRECISE-DAPT score has no predictive value for bleeding in the 1–2-year group with a *C*-statistic of 0.571 (95% CI: 0.526, 0.616) and the >2-year group with a *C*-statistic of 0.520 (95% CI: 0.464, 0.576).

Comparison of the predictive value for bleeding between the PARIS bleeding score and PRECISE-DAPT score

When we used BARC 2, 3, or 5 bleeding as the endpoint, the PARIS bleeding score showed a predictive value for 5-year bleeding events with a *C*-statistic of 0.562 (95% CI: 0.534, 0.590).

When compared with the PRECISE-DAPT score, there was no improved predictive value for bleeding in the PARIS bleeding score (*C*-statistic: 0.562 vs. 0.566, $P = 0.884$; net reclassification improvement: −0.042, $P = 0.399$; integrated discrimination improvement: −0.0003, $P = 0.426$).

Discussion

In this real-world, large-sample (10 109 patients), 5-year follow-up study of Chinese people after PCI, the main findings were as follows: (i) We found a statistically significant predictive value of the PRECISE-DAPT score for 5-year bleeding. (ii) The PRECISE-DAPT score also had predictive value in the Asian population. (iii) The PRECISE-DAPT score not only had prognostic value for bleeding, but also had some prognostic value for death and MACCE.

Our study showed that the PRECISE-DAPT score had a statistically significant predictive value for 5-year bleeding in patients with coronary stent implantation and DAPT. In addition, previously, the PRECISE-DAPT score was usually recommended for 12 months after PCI, and since our study showed that the score still has some predictive value for bleeding at 5 years, this would extend the time scope for the use of the score. For patients with an increased PRECISE-DAPT score on admission, attention should be paid to the increased risk of long-term bleeding. In the original PRECISE-DAPT study,[4] when thrombolysis in MI major or minor bleeding was used as the endpoint of the event, the *C*-statistic for 1-year bleeding was 0.73. In an external verification cohort study (PLATO study), the *C*-statistic for 1-year bleeding was 0.70 and it was 0.66 in the BemPCI study.[4] Our results suggest that the predictive value of the PRECISE-DAPT score for long-term bleeding is less than that of 1-year bleeding. In our study, only 30.59% of patients had DAPT duration ≤1 year. In subgroup analysis of the DAPT duration, it can be seen that the PRECISE-DAPT score has no diagnostic value in patients with DAPT duration >1 year. This may have contributed to the low 5-year *C*-statistic in this study.

Establishing a long-term bleeding risk score for patients with PCI and DAPT is important because a considerable number of patients would take the initiative to prolong the duration of DAPT.[16] Additionally, the current guidelines[5] recommend extending the duration of DAPT for people at a high risk of thrombosis. However, to date, there has only been one study conducted by Zdanyte *et al.*[11] who evaluated the 5-year predictive value of the PRECISE-DAPT score for bleeding. In this previous study, the PRECISE-DAPT score showed only a weak predictive value for bleeding, regardless of the follow-up period (1 year, AUC: 0.571; 3 years, AUC: 0.571; 5 years, AUC: 0.571).[11] Though there were some differences between our study and the study by Zdanyte *et al.*,[11] such as only 77.0% of patients received PCI, 85.5% used P2Y12 receptor inhibitors, and 21.1% were treated with oral anticoagulants in Zdanyte *et al.*'s study, our study enrolled patients with PCI and DAPT, which is consistent with the original PRECISE-DAPT study. Additionally, we enrolled a much higher number of patients than that in Zdanyte *et al.*'s study[11] (6.5 times), and our study had a higher 5-year follow-up rate (91.5% vs. 85.5%). However, in our study, we also only see the limited predictive value of the PRECISE-DAPT score for long-term bleeding. In another study of Asif *et al.*,[17] during the 3-year follow-up, after adjustment for baseline characteristics, no significant differences in major bleeding risk were found between the PRECISE-DAPT high-score group and low-score group. However, the study also did not exclude anticoagulant patients, and not all patients were treated with DAPT. In the future, we may need to add other clinical indicators or biomarkers to improve the predictive value of this score for long-term bleeding.[18]

Our study showed that the PRECISE-DAPT score had some predictive value in the Asian population. Notably, Europeans, Americans, and Asians are generally believed to have different risks of bleeding and thrombosis. The consensus of defining a high risk of bleeding in patients undergoing PCI[19] is that bleeding scores developed in Western populations may underestimate the risk of bleeding in Asian populations. Our previous studies showed[18] that the patterns of non-adherence to anti-platelet regimen in stented patients bleeding score only had a limited predictive value of 2-year bleeding in the Chinese PCI population (AUC: 0.568). Therefore, whether the PRECISE-DAPT score can be equally applied to Asian populations is an interesting topic worthy of discussion. Our study showed that, in the Chinese PCI population, the PRECISE-DAPT score had predictive value for bleeding with limited value. Recently, a study from Korea[20] showed that during a follow-up of 1 year, the risk of bleeding with a PRECISE-DAPT score >24 points for 1-year BARC ≥3a is 8.35 times higher than that of patients with a score of ≤17 (HR: 8.35, 95% CI: 5.86–11.90); another study from them showed when followed up to 18 months, the PRECISE-DAPT score improved the clinical outcomes in patients with acute coronary syndrome after PCI.[21] The above-mentioned studies suggest that the PRECISE-DAPT score may also be applied to the Asian population. However, for the Asian population, there is still a lack of excellent scores for predicting long-term bleeding, which is also the direction of future research.

While evaluating the predictive value of bleeding using the PRECISE-DAPT score, we also further evaluated the predictive value of this score in death (*C*-statistic: 0.673) and MACCE (*C*-statistic: 0.540). We found that the PRECISE-DAPT score had some predictive value for death and MACCE. We consider that this finding is due to the five indicators included in the PRECISE-DAPT score, including age,[22–24] leukocyte count,[25–27] chronic kidney failure,[28,29] previous bleeding,[30] and haemoglobin level.[31,32] These are not only risk factors for bleeding, but also risk factors for death and thrombosis events. A few previous studies evaluated the predictive value

of the PRECISE-DAPT for death or thrombotic events. Tanik *et al.*[33] found that the PRECISE-DAPT score predicted hospital death in patients with ST elevated MI treated with PCI, and it was non-inferior compared with the thrombolysis in myocardial infarction risk score. Ando et al.[34] studied 552 patients with acute MI who were followed up for 1424 days and found that a high PRECISE-DAPT score was associated with higher long-term all-cause mortality. However, the above-mentioned studies studied patients with acute MI. Zdanyte *et al.*[11] found that the PRECISE-DAPT score predicted all-cause death, MI, and ischaemic stroke after a 5-year follow-up of patients with coronary heart disease (77.0% patients were treated with PCI). To the best of our knowledge, our study is the first to show that the PRECISE-DAPT score has moderate predictive value for long-term all-cause death in patients with PCI and DAPT. Nevertheless, it is worth noting that the PRECISE-DAPT score is still a bleeding prediction score with limited predictive value for death and MACCE.

There are some limitations to our study that should be considered. First, this was a single-centre study, which may potentially limit the generalizability of our findings. Second, in this study, most patients took clopidogrel. Therefore, trials are required in the future to evaluate the efficacy of this score for new antiplatelet drugs and relevant changes to P2Y12 receptor inhibitors. Third, because of database restrictions, this study has uncertainty regarding the compliance with long-term aspirin use. Fourth, the bleeding event endpoint in this study was defined according to BARC2, 3, or 5 bleeding; the predictive value of the PRECISE-DAPT score for BARC 3 or 5 bleeding as a bleeding endpoint warrants further study.

Conclusions

We used a large sample of real-world data to show that the PRECISE-DAPT score has a statistically significant 5-year predictive value for bleeding in patients with PCI and DAPT, and also has some predictive value for all-cause death and MACCE. Additionally, the PRECISE-DAPT score can be applied to the Asian population. Our findings may help to identify high-risk patients at an early stage and expand the scope of application of the PRECISE-DAPT score in patients with PCI.

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Author Contributions

J.Y., B.X., Y.H., and X.Z. contributed to the concept and design of the study; X.Z. wrote the manuscript; F.L. conducted the statistical analysis; J.Y. revised the intellectual content; J.L., P.Z., L.J., X.T., J.X., and Y.S. contributed to data collection; J.C., S.Q., Y.Y., and R.G. contributed to interpretation of data; all authors approved the final version of the manuscript.

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Data availability

Due to ethical restrictions related to the consent given by subjects at the time of study commencement, our datasets are available from the corresponding author upon reasonable request after permission of the Institutional Review Board of State Key Laboratory of Cardiovascular Disease, Fuwai Hospital, National Center for Cardiovascular Diseases.

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