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Blood Routine Test Parameters Score, a Novel Predictor of Adverse Outcomes of Coronary Artery Disease Patients with or without Diabetes Who Underwent Percutaneous Coronary Intervention: A Retrospective Cohort Study

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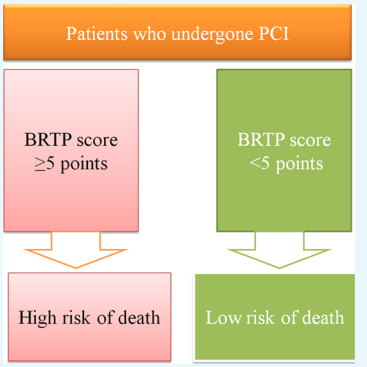
ABSTRACT: Background: In this study, we developed a novel risk score named the blood routine test parameters (BRTP) score to predict the clinical outcomes in coronary artery disease (CAD) patients who had undergone percutaneous coronary intervention (PCI). Methods: There were 6049 patients with CAD after PCI enrolled in CORFCHD-PCI from January 2008 to December 2016. We divided these patients into two groups according to diabetes (diabetic group, n = 3809, and nondiabetic group, n = 2240). During a follow-up time of 35.9 ± 22.6 months, we compared the incidences of all-cause mortality (ACM) and cardiac mortality (CM), which were assigned as the primary outcomes between patients with a high BRTP score (≥5 points) and those with a low BRTP score (<5 points). Results: We found that the BRTP score independently predicted the risk for ACM and CM in both diabetic patients [ACM, hazard risk (HR) = 1.748 (95% confidence interval (CI): 1.186−2.575), P = 0.005; CM, HR = 1.728 (95% CI: 1.120−2.667), P = 0.014] and nondiabetic patients [ACM, HR = 1.682 (95% CI: 1.208−2.340), P = 0.002; CM, HR = 1.718 (95% CI: 1.188−2.484), P = 0.004]. However, the BRTP score was found to be an independent predictor for major adverse cardiovascular event (MACE) and major adverse cardiovascular and cerebrovascular event (MACCE) in diabetic patients [MACE, HR = 1.366 (95% CI: 1.076−1.734), P = 0.010; MACCE, HR = 1.330 (95% CI: 1.035−1.710), P = 0.026] but not in nondiabetic patients [MACE, HR = 1.241 (95% CI: 0.994−1.549), P = 0.056; MACCE, HR = 1.238 (95% CI: 0.981−1.562), P = 0.072]. Conclusions: This study suggests that the BRTP score is an independent and novel predictor of mortality in CAD patients who had undergone PCI, especially in patients with comorbidity of diabetes. Trial registration: ChiCTR-ROC-16010153. Registered 14, December, 2016.



INTRODUCTION

Percutaneous coronary intervention (PCI) has been widely used in the treatment of coronary artery disease (CAD) patients.[1,2] However, accurate risk stratification and prognosis assessment to identify the high-risk patients before PCI are very important. Recently, many new hematologic biomarkers, such as the white blood cell count (WBC),[3,4] hemoglobin (HB),[5,6] platelet count (PC),[7,8] neutrophil−lymphocyte ratio (NLR),[9,10] red blood cell distribution width (RDW),[11,12] mean platelet volume (MPV),[13,14] and platelet distribution width (PDW),[15,16] have been reported to be independent predictors for prognosis in CAD patients. Gebhard et al. analyzed 1262 consecutive CAD patients to observe the relation between WBC and clinical outcomes and found that the elevated WBC count was associated with all-cause mortality (ACM) in CAD patients who underwent PCI.[3] Wada et al.[10] reported that the NLR was positively associated with the long-term prognosis in 2070 CAD patients who underwent PCI. Bressi et al. also reported an association of the NLR with adverse outcomes in CAD patients.[17] In a Japanese Multicenter Registry study, the authors found that the decreased HB level was associated with poor outcomes in CAD patients who received PCI therapy.[5] In addition, our previous study also demonstrated that RDW could predict the risk of cardiac death in CAD patients post-PCI. Furthermore, accumulated evidence suggested that MPV, PDW, and PC were also independent predictors of adverse outcomes in patients with CAD.[11]

Although these indices were reported to be independent predictors of CAD patients who underwent PCI, there is a limitation in using single indices to predict outcomes in CAD patients. Blood routine examination parameters are very easy to obtain in clinical practice, and the joint analysis of blood routine parameters to develop a new predictive scoring system is an

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Table 1. Characteristics of Participants of the Two Groups[a]

	total				nondiabetes				diabetes			
variables	BRTP <5 (n = 4840)	BRTP ≥5 (n = 1109)	t or χ^2	P value	BRTP <5 (n = 3122)	BRTP ≥5 (n = 687)	t or χ^2	P value	BRTP <5 (n = 1718)	BRTP ≥5 (n = 522)	t or χ^2	P value
sex, male, n (%)	3698 (76.4)	800 (66.2)	53.145	<0.001	2394 (76.6)	472 (68.7)	19.235	<0.001	1304 (75.9)	328 (62.8)	34.567	<0.001
smoking, n (%)	2000 (41.3)	421 (34.8)	17.027	<0.001	1291 (41.4)	254 (37.0)	4.479	0.034	709 (41.3)	167 (32.0)	14.468	<0.001
alcohol drinking, n (%)	1473 (30.4)	294 (24.3)	17.500	<0.001	947 (30.3)	183 (26.6)	3.686	0.055	526 (30.6)	111 (21.3)	17.208	<0.001
family history, n (%)	634 (13.1)	126 (10.4)	6.312.	0.012	384 (12.3)	70 (10.2)	2.389	0.122	250 (14.6)	56 (10.7)	4.963	0.026
hypertension, n (%)	1996 (41.2)	560 (46.3)	10.230	0.001	1161 (37.2)	273 (39.7)	11.543	0.001	835 (48.6)	287 (55.0)	6.514	0.011
age (years)	59.14 ± 10.83	60.90 ± 10.73	−5.064	<0.001	58.74 ± 10.93	60.40 ± 11.22	−3.597	<0.001	59.87 ± 10.63	61.56 ± 10.02	−3.215	0.001
SBP (mmHg)	126.76 ± 18.35	128.11 ± 20.35	−2.226	0.026	125.86 ± 18.22	126.99 ± 19.56	−1.449	0.147	128.41 ± 18.47	129.58 ± 21.28	−1.225	0.221
DBP (mmHg)	76.44 ± 11.18	75.80 ± 11.79	1.760	0.078	76.46 ± 11.16	75.69 ± 11.89	1.617	0.106	76.40 ± 11.22	75.94 ± 11.67	0.808	0.419
BUN (mmol/L)	5.48 ± 1.62	5.70 ± 1.91	−4.096	<0.001	5.45 ± 1.57	5.58 ± 1.78	−1.773	0.076	5.52 ± 1.71	5.86 ± 2.05	−3.775	<0.001
Cr (μmol/L)	75.64 ± 19.49	77.01 ± 23.87	−2.048	0.041	75.47 ± 18.97	75.73 ± 20.40	−0.305	0.760	75.94 ± 20.39	78.61 ± 27.53	−2.387	0.017
UA (mmol/L)	323.98 ± 88.08	320.55 ± 98.26	1.161	0.246	329.95 ± 86.14	325.18 ± 98.38	1.241	0.215	313.36 ± 90.49	314.78 ± 97.90	−0.306	0.760
GLU (mmol/L)	6.47 ± 3.06	7.02 ± 3.40	−5.400	<0.001	6.44 ± 3.09	6.67 ± 3.16	−2.990	0.003	8.95 ± 3.90	9.32 ± 3.95	−1.881	0.060
TG (mmol/L)	1.90 ± 1.28	1.92 ± 1.24	−0.436	0.663	1.80 ± 1.12	1.79 ± 1.04	0.226	0.821	2.07 ± 1.50	2.07 ± 1.43	−0.087	0.931
TC (mmol/L)	3.95 ± 1.11	4.00 ± 1.12	−1.372	0.170	3.90 ± 1.09	3.95 ± 1.06	−1.178	0.239	4.04 ± 1.13	4.06 ± 1.19	−0.292	0.770
HDL-C (mmol/L)	1.02 ± 0.49	1.03 ± 0.46	−0.979	0.328	1.01 ± 0.50	1.05 ± 0.51	−1.476	0.140	1.02 ± 0.47	1.02 ± 0.40	0.292	0.771
LDL-C (mmol/L)	2.46 ± 0.91	2.48 ± 0.93	−0.675	0.499	2.43 ± 0.92	2.46 ± 0.93	−0.764	0.445	2.50 ± 0.91	2.50 ± 0.92	0.090	0.928
ApoA1 (mmol/L)	1.16 ± 0.31	1.20 ± 0.36	−3.654	<0.001	1.16 ± 0.33	1.19 ± 0.34	−2.601	0.009	1.16 ± 0.27	1.20 ± 0.38	−2.575	0.010
ApoB (mmol/L)	0.85 ± 0.39	0.87 ± 0.44	−1.835	0.066	0.83 ± 0.39	0.86 ± 0.44	−1.597	0.110	0.87 ± 0.39	0.89 ± 0.43	−0.592	0.554
Lp(a) (mmol/L)	219.69 ± 169.56	226.38 ± 177.15	−0.491	0.623	222.20 ± 176.17	221.85 ± 175.25	0.045	0.964	215.30 ± 178.82	223.49 ± 175.53	−0.902	0.367
LVEF (%)	61.03 ± 7.09	61.25 ± 6.83	−0.920	0.358	61.04 ± 7.17	61.31 ± 6.94	−0.849	0.396	61.00 ± 6.96	61.16 ± 6.68	0.442	0.658
LVEDD (mm)	50.00 ± 5.48	49.88 ± 5.74	0.631	0.528	50.00 ± 5.60	50.10 ± 5.82	−0.348	0.728	49.99 ± 5.25	49.60 ± 5.62	1.369	0.171
CCB, n (%)	558 (11.6)	133 (11.0)	0.296	0.586	366 (11.8)	72 (10.5)	0.877	0.349	192 (11.2)	61 (11.7)	0.087	0.769
β-blocker, n (%)	1961 (40.7)	467 (38.8)	1.544	0.214	1247 (40.1)	268 (39.2)	0.213	0.645	714 (41.8)	199 (38.2)	2.120	0.145
ACEI or ARB, n (%)	1087 (22.6)	280 (23.2)	0.223	0.637	696 (22.4)	141 (20.6)	1.057	0.304	391 (22.9)	139 (26.7)	3.088	0.079
statins, n (%)	2646 (55.2)	613 (51.1)	6.326	0.012	1676 (54.1)	340 (49.9)	2.458	0.117	970 (57.1)	273 (52.7)	3.105	0.078

[a]ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; SBP, systolic blood pressure; DBP, diastolic blood pressure; BUN, blood urea nitrogen; UA, uric acid; Cr, creatinine; GLU, glucose; TG, triglyceride; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; ApoA1, apolipoprotein A1; ApoB, apolipoprotein B; Lp(a), lipoprotein a; and CCB, calcium channel blocker.

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important topic. In the present study, we enrolled 6049 CAD patients and established a new predictive model named the blood routine test parameters (BRTP) score and used this novel model to predict the outcomes of CAD patients who had undergone PCI.

RESULTS

Baseline Data. In the present study, as shown in Table 1, in total, there were significant differences between the lower and higher BRTP groups in terms of sex, smoking, alcohol drinking, family history, hypertension, age, systolic blood pressure (SBP), blood urea nitrogen (BUN), creatinine (Cr), glucose (GLU), apolipoprotein A1 (ApoA1), and statin therapy (all $P < 0.05$). We did not find significant differences between the two groups in regard to drug therapy, diastolic blood pressure (DBP), serum lipid parameters, as well as cardiac ultrasound parameters (all $P > 0.05$). In diabetic patients, we found that sex, smoking, alcohol drinking, family history, hypertension, BUN, Cr, and ApoA1 had significant differences between the two groups (all $P < 0.05$). In nondiabetic patients, we found that age, sex, hypertension, smoking, GLU, and ApoA1 had significant differences between the two groups (all $P < 0.05$).

Clinical Outcomes. As shown in Figure 1, with the increasing BRTP score, the incidences of ACM, cardiac mortality (CM), major adverse cardiovascular and cerebrovascular event (MACCE), and major adverse cardiovascular event (MACE) increase significantly. Using the receiver operating characteristic (ROC) curve, we identified that the optimum cutoff value is 5. In ROC curve analysis, the area under the curve (AUC) of the BRTP score for predicting long-term mortality was 0.890 (95% confidence interval (CI) 0.861−0.918; $P < 0.001$; sensitivity, 85.7%; specificity, 91.3%). The AUCs obtained using a single blood routine test parameters are from 0.591 to 0.724, which are significantly lower than those of the BRTP score (Figure 2). According to the optimum cutoff value, we divided the patients into two groups according to whether the BRTP score was ≥5 (lower group, BRTP score <5; higher group, BRTP score ≥5).

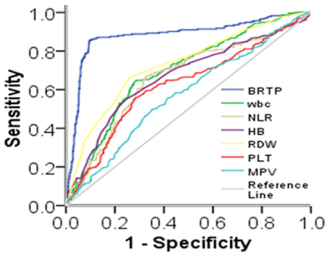

Figure 1. ROC analysis of BRTP and other blood routine test parameters.

As shown in Table 2 and Figure 3, in total population, there were significant differences between the lower and higher BRTP groups in the incidences of ACM (4.2 vs 8.9%, $P < 0.001$), CM (3.4 vs 7.3%, $P < 0.001$), MACEs (11.8.0 vs 17.6%, $P < 0.001$), and MACCEs (12.9 vs 19.6%, $P < 0.001$). We also found similar trends in both diabetic and nondiabetic groups.

The results of the Kaplan−Meier survival analysis are shown in Figure 4. In total, the patients in the higher BRTP group have significantly lower cumulative survival and are at a significantly higher accumulated risk for MACCEs and MACEs compared with patients in the lower BRTP group. In diabetic patients, we also found that ACM, CM, MACCEs, and MACEs were significantly different between the lower and higher BRTP groups. However, in nondiabetic patients, we found that ACM and CM but not MACCEs and MACEs had significant differences between the lower and higher BRTP groups.

As shown in Table 3, univariate and multivariate COX regression analyses were performed to assess the prognostic value of the BRTP score and adverse outcomes before and after adjusting for confounders, including sex, smoking, alcohol drinking, family history, hypertension, age, SBP, BUN, Cr, GLU, ApoA1, and statin therapy. In total, compared to the lower

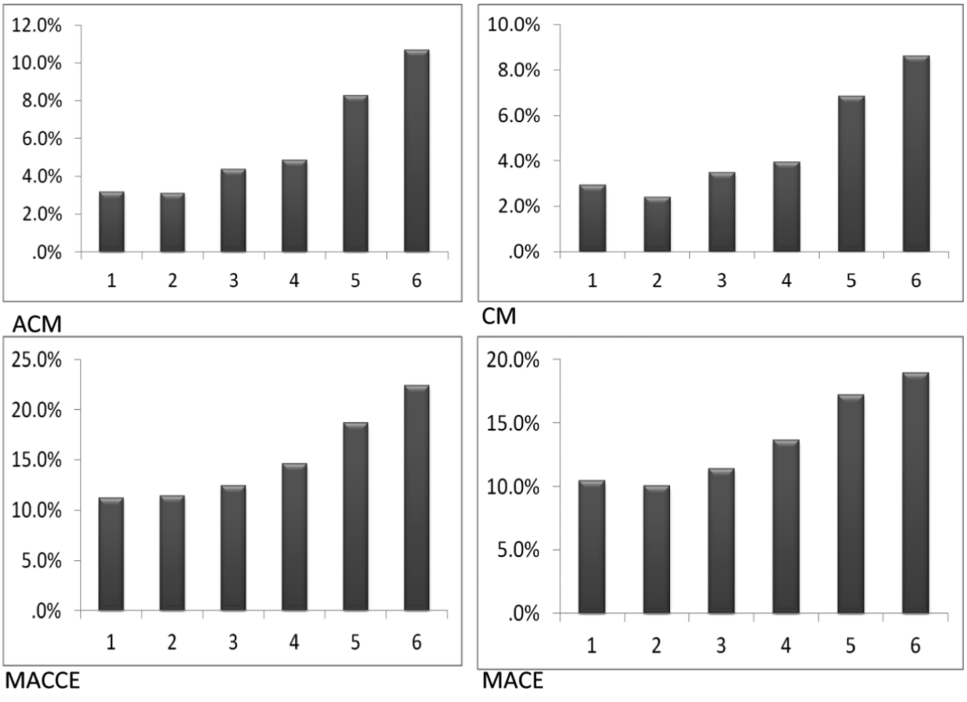

Figure 2. BRTP score (continuous variable) and outcomes of CAD patients who underwent PCI.

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Table 2. Comparison of Outcomes between Groups[a]

	total				nondiabetic patients				diabetes			
outcomes	BRTP <5 (n = 4840)	BRTP ≥5 (n = 1109)	χ^2	P value	BRTP <5 (n = 3122)	BRTP ≥5 (n = 687)	χ^2	P value	BRTP <5 (n = 1718)	BRTP ≥5 (n = 522)	χ^2	P value
ACM, n (%)	202 (4.2)	107 (8.9)	43.639	<0.001	130 (4.2)	61 (8.9)	26.284	<0.001	72 (4.2)	46(8.8)	17.134	<0.001
CM, n (%)	163 (3.4)	88 (7.3)	37.203	<0.001	105 (3.4)	51 (7.4)	23.635	<0.001	58 (3.4)	37 (7.1)	13.584	<0.001
MACCE, n (%)	625 (12.9)	237 (19.6)	35.428	<0.001	394 (12.6)	123 (17.9)	13.401	<0.001	231 (13.4)	114 (21.8)	21.646	<0.001
MACE, n (%)	572 (11.8)	213 (17.6)	28.812	<0.001	358 (11.5)	113 (16.4)	12.894	<0.001	214 (12.5)	100 (19.2)	14.914	<0.001

[a]ACM, all-cause mortality; CM, cardiac mortality; MACE, major adverse cardiovascular event; and MACCE, major adverse cardiovascular and cerebrovascular event.

Table 3. Univariate and Multivariable Analyses of the BRTP Score and Outcomes[a]

	total				nondiabetes				diabetes			
outcomes	HR (95% CI)	P value	adjusted HR (95% CI)[b]	P value	HR (95% CI)	P value	adjusted HR (95% CI)[b]	P value	HR (95% CI)	P value	adjusted HR (95% CI)[b]	P value
ACM	1.881 (1.488−2.379)	**<0.001**	1.720 (1.341−2.206)	**<0.001**	1.809 (1.334−2.454)	**<0.001**	1.682 (1.208−2.340)	**0.002**	1.962 (1.355−2.841)	**<0.001**	1.748 (1.186−2.575)	**0.005**
CM	1.925 (1.485−2.496)	**<0.001**	1.747 (1.322−2.307)	**<0.001**	1.880 (1.345−2.629)	**<0.001**	1.718 (1.188−2.484)	**0.004**	1.970 (1.303−2.977)	**<0.001**	1.728 (1.120−2.667)	**0.014**
MACCEs	1.350 (1.162−1.568)	**<0.001**	1.325 (1.128−1.556)	**0.001**	1.214 (0.991−1.487)	0.061	1.241 (0.994−1.549)	0.056	1.504 (1.201−1.882)	**<0.001**	1.366 (1.076−1.734)	**0.010**
MACEs	1.326 (1.133−1.553)	**<0.001**	1.305 (1.102−1.546)	**0.002**	1.228 (0.994−1.518)	0.057	1.238 (0.981−1.562)	0.072	1.426 (1.124−1.808)	**0.003**	1.330 (1.035−1.710)	**0.026**

[a]ACM, all-cause mortality; CM, cardiac mortality; MACE, major adverse cardiovascular event; MACCE, major adverse cardiovascular and cerebrovascular event; and TVR, target vessel reconstruction.
[b]Adjustments of sex, smoking, alcohol drinking, family history, hypertension, age, SBP, BUN, Cr, GLU, ApoA1, and statin therapy.

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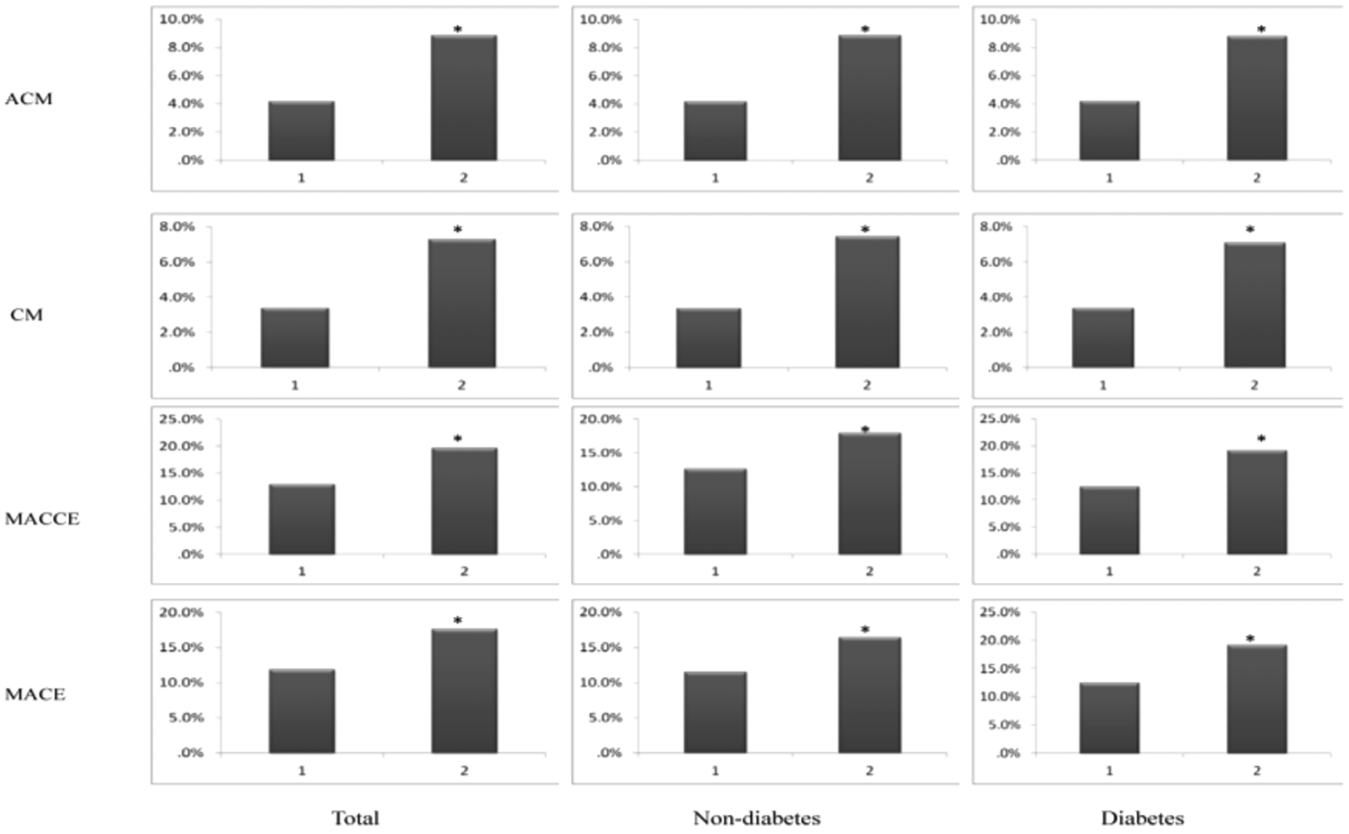

Figure 3. BRTP score (dichotomous variable) and outcomes of CAD patients who underwent PCI.

BRTP group, the risks for ACM, CM, MACCEs, and MACEs were increased 88.1% (hazard risk [HR] = 1.881, 95% CI: 1.488−2.379, $P < 0.001$), 92.5% (HR = 1.925, 95% CI: 1.485−2.496, $P < 0.001$), 35.0% (HR = 1.350, 95% CI: 1.162−1.568, $P < 0.001$), and 32.6% (HR = 1.326, 95% CI: 1.133−1.553, $P < 0.001$) in the higher BRTP group, respectively. After adjustment of confounders, the differences remained significant. In the nondiabetic group, we found that only ACM and CM had significant differences, with patients in the higher BRTP group having an increased risk of ACM by 1.809 times (HR = 1.809, 95% CI: 1.334−2.454, $P < 0.001$) and CM by 1.880 times (HR = 1.880, 95% CI:1.345−2.629, $P < 0.001$) compared to those in the lower BRTP group. In diabetic patients, the ACM, CM, MACCEs, and MACEs remained significantly different not only before but also after adjusting for confounders.

DISCUSSION

We first developed a novel predictive model named the BRTP score with blood routine test parameters in the present study. Using the BRTP model, we successfully predicted adverse outcomes in CAD patients who had undergone PCI with or without diabetes.

Although well-known risk prediction models, such as the SYNTAX risk score[18] and ACEF risk score,[19] have been used for patients who underwent PCI, these models did not include blood routine test variables, which have been demonstrated to be effective and accurate predictors in recent years. The prognostic role of blood routine test variables, such as WBC,[3,4] NLR,[9,10] HB,[5,6] PC,[13,14] RDW,[11,12] MPV,[13,14] and PDW, in patients with CAD has been recognized previously.[15,16] In our study, we included all of these seven variables in the model and found that these variables were all independent predictors for ACM in patients who underwent PCI. When we combined these seven variables together and established a novel score, the BRTP score, we found that the BRTP score has the strongest predictive power with an AUC of 0.890, a sensitivity of 85.7%, and a specificity of 91.3%.

In our study, we divided 6049 CAD patients into two groups according to the BRTP score by the cutoff value of 5. The results suggested that patients in the higher BRTP group had a significantly increased risk of mortality with or without diabetes. Furthermore, in diabetic patients, the BRTP score was also a strong predictor for MACE and MACCE. In addition, several baseline characteristic variables, including sex, smoking, alcohol drinking, family history, hypertension, age, SBP, BUN, Cr, GLU, ApoA1, and statin therapy, showed significant differences between the two groups. After the adjustment of these confounders, the BRTP score remained an independent predictive value for adverse prognosis.

Furthermore, compared with the existing complex models, BRTP has advantages of simplicity and easy calculation. In the BRTP score, we included two WBC parameters (WBC count and NLR), two red blood cell parameters (RDW and HB), and three platelet parameters (PC, MPV, and PDW). WBC and NLR reflect the body's inflammatory state, RDW reflects oxidative stress and chronic inflammation, HB reflects the body's ability to carry oxygen, and platelet parameters not only reflect coagulation function but also show chronic inflammation. Therefore, comprehensive analysis of these parameters can accurately reflect the overall inflammatory response, compensatory capacity, and coagulation function of the body.

In addition, the predictive, preventive, and personalized medicine (PPPM) of cardiovascular disease (CVD) health is the key for ideal cardiovascular health.[20] Suboptimal health status

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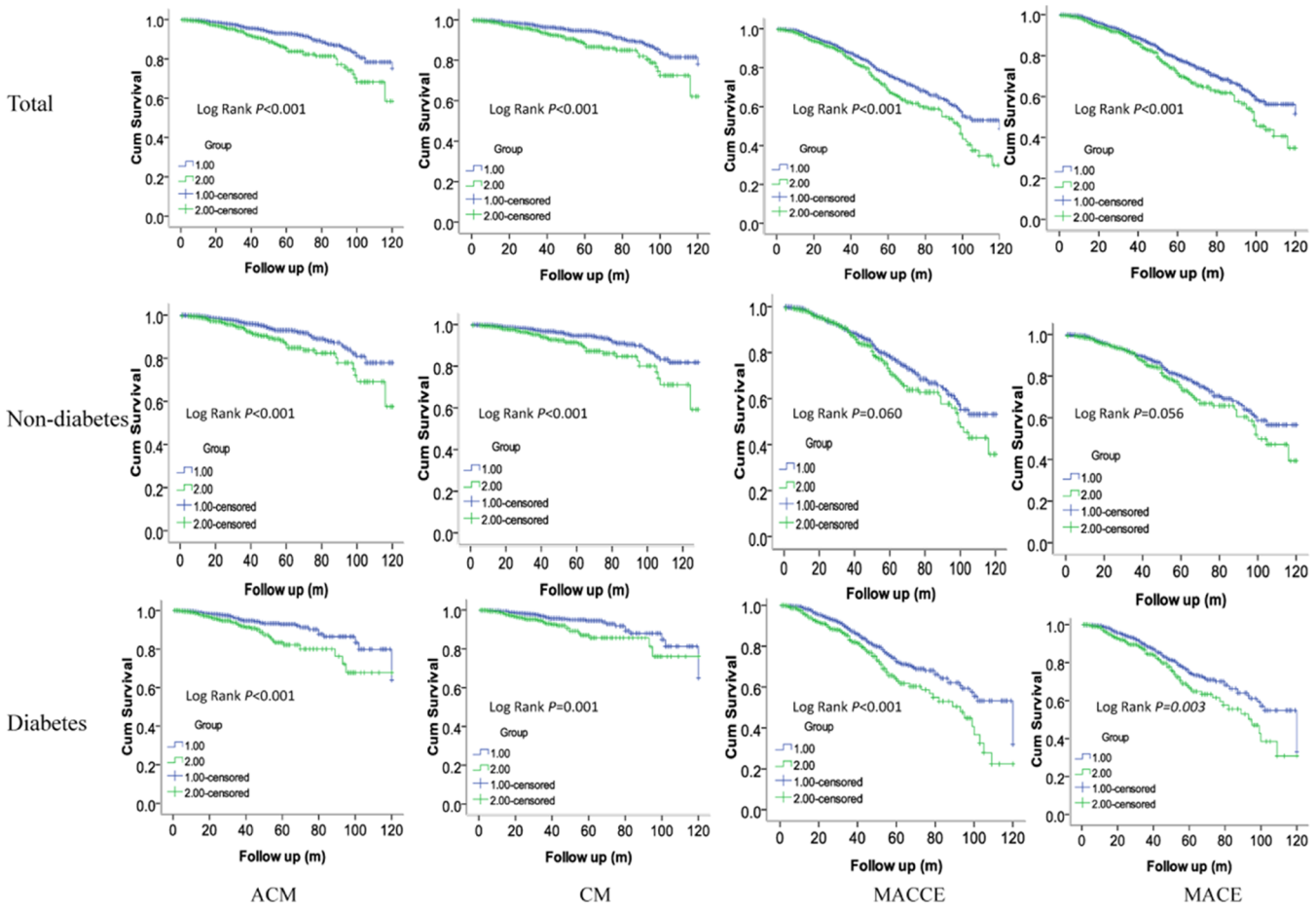

Figure 4. Cumulative Kaplan−Meier estimates of the time to the first adjudicated occurrence of primary and secondary endpoints. (1) Lower BRTP score; (2) higher BRTP score.

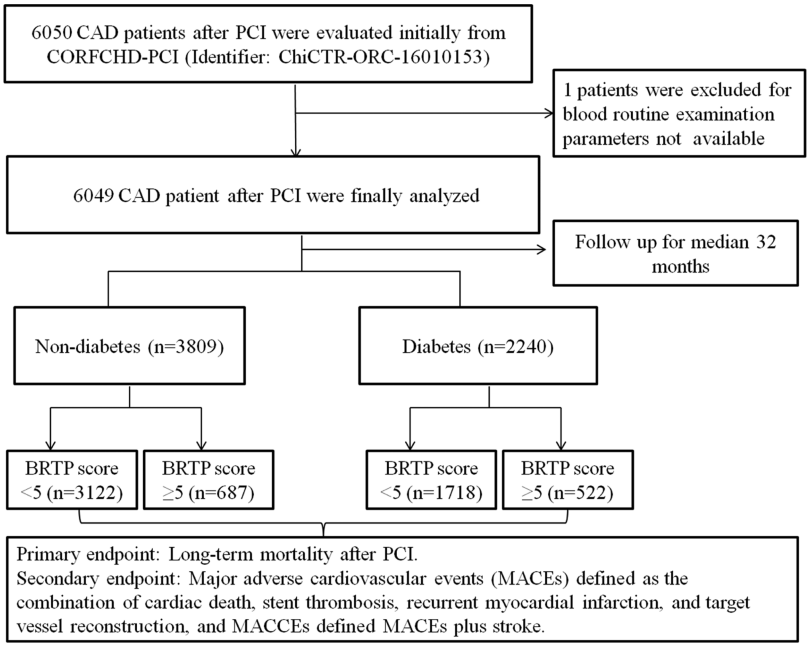

Figure 5. Flowchart of participant inclusion.

(SHS) is an issue worthy of attention. SHS is defined as a physical state between health and illness.[21−23] Previously, SHS was suggested to be associated with a majority of components of cardiovascular health metrics. There were many connections between SHS and cardiovascular risk as well as the development of cardiovascular disease.[24] Ideally, CV health metrics are

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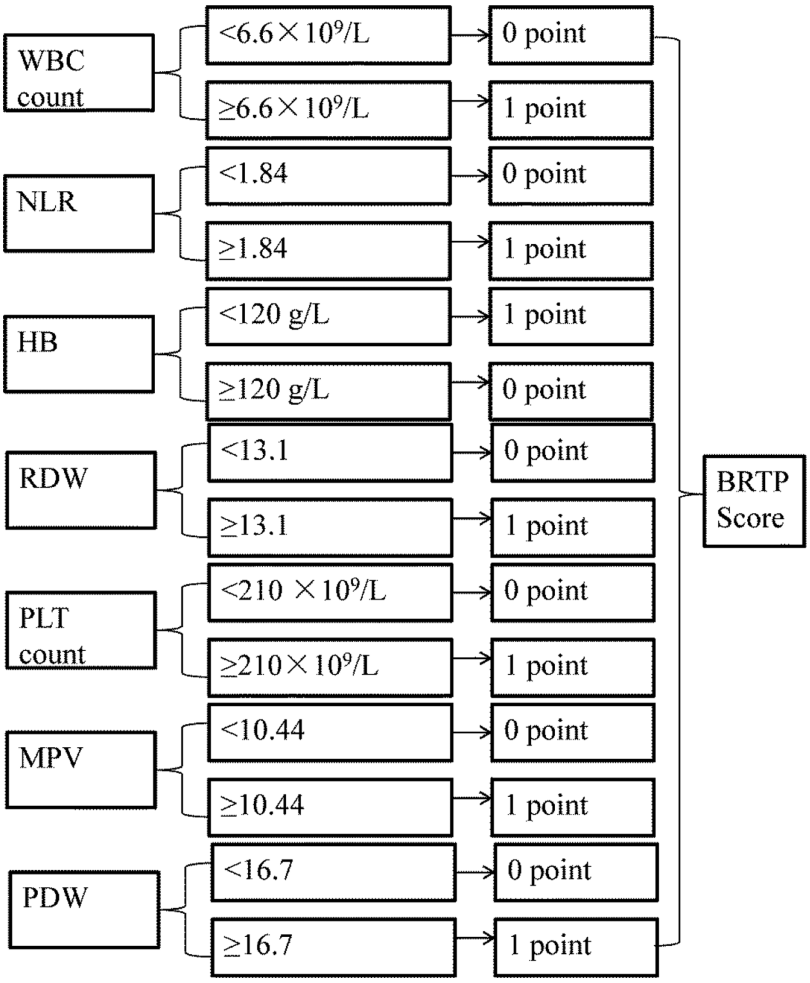

Figure 6. Establishment of the BRTP score.

associated with a lower prevalence of SHS. Thus, the identification of SHS is important for PPPM. Hou et al.'s overall and dose−response meta-analysis indicates that RDW may be a prognostic indicator for CVD outcomes.[25] Furthermore, RDW is a key component of the BRTP score. Therefore, our study provided a novel and important tool for the prediction of CVD outcomes, which contributed to the development of PPPM.

Our study has several strengths: first, our study has a large sample size, which may improve the statistical power. Second, in the present study, the follow-up time is up to 10 years. Finally, we established a novel score, which has very strong predictive power. However, the limitations should also be mentioned. On the one hand, only the baseline blood routine test parameters were collected. Therefore, the effect of dynamic change of these variables cannot be analyzed. On the other hand, the single retrospective cohort design may be another limitation. Therefore, a multicenter, prospective verification is warranted.

CONCLUSIONS

In conclusion, the present study suggests that the baseline BRTP score is an independent predictor of adverse outcomes in CAD patients who underwent PCI, especially in CAD patients with diabetes.

METHODS

Study Design and Population. In the present study, we enrolled 6049 CAD patients who underwent PCI from the Clinical Outcomes and Risk Factors of Patients with Coronary Heart Disease after PCI (CORFCHD-PCI) study. The detailed design of CORFCHD-PCI has been published previously.[26] Briefly, the CORFCHD-PCI (identifier: ChiCTR-ROC-16010153) is a large, single-center retrospective cohort study including 6050 CAD patients who were hospitalized at the First Affiliated Hospital of Xinjiang Medical University from January 2008 to December 2016. All of the participants who underwent coronary angiography with stenosis ≥70% and received at least one stent via implantation have been investigated initially. The patients who had serious heart failure, serious hematologic disease, rheumatic heart disease, valvular heart disease, congenital heart disease, pulmonary heart disease, and serious dysfunction of the liver or kidneys have been excluded from the present study as described previously.[27] Among these 6050 patients, one patient was excluded as the blood routine test parameters were not available. Finally, a total of 6049 patients were included in the present study. Figure 5 shows a flow chart of the inclusion and exclusion criteria used in the selection of participants.

This study complies with the Declaration of Helsinki. An ethics committee of the First Affiliated Hospital of Xinjiang Medical University approved the protocol. Because this study is

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designed as a retrospective cohort study, the ethics committee waived the need to obtain informed consent from eligible patients.

Collection of Clinical and Demographic Characteristics. The data collection methods have been described in detail previously.[26,27] Briefly, the data of demography, clinical outcomes, cardiovascular risk factors, and laboratory data have been collected and recorded.

Definitions. Diabetes mellitus was defined as patients with a definite history of diabetes and treatment with glucose-lowering agents or a fasting plasma glucose ≥7.1 mmol/L or 2-h postload glucose ≥11.1 mmol/L.[28] Diagnosis of hypertension was performed according to the American Heart Association recommendations[29] as the patient having a definite history of hypertension and on active treatment with antihypertensive drugs or with blood pressure measurements ≥140/90 mmHg on at least three resting measurements.

Blood Routine Test. Two milliliters of venous blood samples were collected in standardized dipotassium ethylenediaminetetraacetic acid (EDTA) tubes. The blood routine test was measured using an automated blood counter within 2 h of collection to minimize variations due to sample aging.

BRTP Score Establishment. A novel blood routine test-based prognostic score, BRTP, was established in our study. Levels of WBC, HB, PC, NLR, RDW, MPV, and PDW that were higher and lower than the cutoff values were considered as 0 and 1 point, respectively. The thresholds for these parameters were defined according to the YOUDEN index (sensitivity + specificity − 1) calculated based on the sensitivity and specificity of each possible cutoff point in the ROC analyses. The optimum cutoff values are shown in Figure 6. The total points with <5 and ≥5 were defined as low and high BRTP scores, respectively.

Endpoints. The definitions of primary (all-cause mortality and cardiac mortality) and secondary endpoints (MACE and MACCE) were described previously.[30]

Follow-Up. All of the patients were followed-up for at least 24 months, and the longest follow-up duration was 120 months. The follow-up was performed either by office visits or by telephone contacts as necessary.

Statistical Analyses. We utilized SPSS 22.0 for Windows statistical software (SPSS Inc, Chicago, IL) to analyze the data. The continuous data were presented as the mean ± standard deviation (mean ± SD). The categorical data were presented as frequencies and percentages. The BRTP score was analyzed as both continuous and categorical variables. The differences between normally distributed variables were analyzed by a *t* test, while non-normally distributed variables were analyzed by a nonparametric test. The categorical variables were compared using a χ^2 test. We utilized Kaplan−Meier analysis and a log-rank test to compare the outcomes between groups. Multivariable COX regression analysis was used to assess the predictive value of the BRTP score for outcomes during a 10-year follow-up. $P < 0.05$ was considered significant.

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Notes

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LIST OF ABBREVIATIONS

BRTP score:blood routine test parameters score
WBC:white blood cell count
HB:hemoglobin
PC:platelet count
NLR:neutrophil−lymphocyte ratio
RDW:red blood cell distribution width
MPV:mean platelet volume
PDW:platelet distribution width
PCI:percutaneous coronary intervention
CAD:coronary artery disease
MACEs:major adverse cardiac events
MACCEs:major adverse cardiac and cerebrovascular events
HR:hazard ratio
CI:confidence interval

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