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ORIGINAL RESEARCH

Retrospective Cohort Study: Nomogram for 1-Year in-Stent Restenosis After PCI in Coronary Heart Disease

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Objective: To construct a nomogram for risk prediction of in-stent restenosis (ISR) within one year after percutaneous coronary intervention (PCI) for coronary heart disease (CHD).

Methods: This study included 842 patients with severe CHD who underwent PCI at Changzhou Affiliated Hospital of Nanjing University of Chinese Medicine between March 2016 to March 2024. Based on the occurrence of ISR within one year post-PCI, patients were stratified into two groups: the ISR group (n=112) and the non-ISR group (n=730). Potential risk factors were initially identified using LASSO regression, followed by multivariate logistic regression to determine independent predictors. A nomogram prediction model was developed using R software (version 4.2.6) and internally validated via the bootstrap resampling method (1000 iterations). Model performance was assessed through receiver operating characteristic (ROC) curve analysis, calibration curve analysis, and decision curve analysis (DCA).

Results: This analysis revealed seven risk factors for ISR: diabetes (OR=1.380, 95% CI: 1.090–1.747), neutrophil/lymphocyte ratio (NLR, OR=2.312, 95% CI: 1.830–2.922), low-density lipoprotein (LDL) > 1.8 mmol/L (OR=2.159, 95% CI: 1.080–4.315), calcified lesions (OR=3.780, 95% CI: 2.051–6.968), stent diameter <3 mm (OR=2.595, 95% CI: 1.404–4.796), smoking (OR=2.796, 95% CI: 1.511–5.174) and no intravascular ultrasound (IVUS) assisted (OR=2.176, 95% CI: 1.342~3.257). These seven factors were incorporated into the nomogram model. The model demonstrated excellent discriminative ability, with an area under the curve (AUC) of 0.892 (95% CI: 0.859–0.924) and a consistency index (C-index) of 0.923. Calibration analysis showed close agreement between predicted and observed outcomes, while DCA indicated strong clinical utility across a wide probability threshold range (5.0%–86.2%). The relative importance of the risk factors, ranked in descending order, was as follows: calcified lesions, stent diameter <3 mm, no IVUS assisted, LDL>1.8 mmol/L, smoking, NLR and diabetes.

Conclusion: The study identifies several risk factors for ISR in CHD patients within one year after PCI. The constructed nomogram model has good predictive efficiency and clinical applicability.

Keywords: coronary heart disease, percutaneous coronary intervention, in-stent restenosis, risk factors, nomogram model

Introduction

Coronary heart disease (CHD) continues to be a leading contributor to the global burden of cardiovascular diseases, posing a significant public health challenge. According to the 2023 World Health Organization report, CHD-related deaths account for approximately 16% of total global mortality, with its prevalence steadily increasing in aging populations.[1] Percutaneous coronary intervention (PCI) has emerged as the primary revascularization strategy for significant coronary artery stenosis, defined as ≥70% diameter stenosis in non-left main vessels or ≥50% in left main/ proximal LAD/ stent restenosis, with over 4 million procedures performed annually worldwide.[2] While the introduction of drug-eluting stents has markedly reduced postoperative restenosis rates—from 20–30% in the bare-metal stent era to 5%-10%—in-stent restenosis (ISR) remains a critical determinant of PCI's long-term efficacy.[3]

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Clinical evidence indicates that ISR patients face a substantially elevated risk of major adverse cardiovascular events, with an incidence rate reaching 18.7% within the first year post-PCI.[4] Moreover, the necessity for repeat revascularization imposes considerable economic burdens. Given the invasive risks of angiography and limited resource requirements, current guidelines do not recommend routine annual angiographic surveillance for asymptomatic patients, but instead recommend noninvasive functional ischemia assessment as a first choice.[5] Consequently, there is an urgent need to develop accurate risk stratification tools to identify high-risk CHD patients prone to ISR after PCI, enabling personalized monitoring and optimized interventions.

ISR following PCI in CHD involves multifactorial processes including vascular intimal hyperplasia, arterial remodeling, and inflammatory responses.[6] While existing studies have identified potential risk factors (eg, diabetes, elevated NLR, stent diameter <3 mm),[7–9] evidence remains inconsistent. Notably, intravascular imaging such as intravascular ultrasound (IVUS) and optical coherence tomography is now mandated by guidelines for evaluating ISR mechanisms, enabling precise characterization of neointimal hyperplasia, stent underexpansion, or neoatherosclerosis-critical distinctions that directly inform targeted therapeutic strategies.[10] IVUS-guided PCI reduces ISR risk by 38% through optimized stent deployment,[11] yet this protective effect is underrepresented in current models. Additionally, East Asian-specific factors like calcified lesion burden are inadequately addressed in Western-derived prediction systems.[12] Current ISR prediction models at one-year post-PCI exhibit limitations:[13] (1) Single-center designs with limited samples (n<500) lacking robust validation; (2) Variable selection reliant on conventional methods omitting key predictors; (3) Absence of dynamic visual tools. While SYNTAX score II and CLI-OPCI incorporate ISR-related variables, their primary purpose is revascularization guidance rather than dedicated ISR prediction.[14] Nomograms offer visual quantitative risk assessment but remain underutilized in ISR contexts.[15]

To address these gaps, this study integrates ISR risk factors within one-year post-PCI to develop and validate a retrospective cohort study-based nomogram. The model aims to refine post-PCI management through targeted high-risk patient identification.

Materials and Methods

Study Population

This study enrolled patients with severe CHD who underwent PCI at the Department of Cardiology, Changzhou Affiliated Hospital of Nanjing University of Chinese Medicine, between March 2016 to March 2024. Severe CHD was defined as ≥70% diameter stenosis in non-left main vessels or ≥50% in left main/proximal LAD, in accordance with the Guidelines for the Diagnosis and Treatment of Stable Coronary Heart Disease.[16] According to whether ISR occurred during follow-up angiography within 1 year, patients were stratified into ISR group and non-ISR group. ISR was defined as a stenosis of the blood vessel diameter greater than 50% within 5 mm of the original stent and its edge.[17]

Inclusion Criteria

(1) Fulfilled the established diagnostic criteria for the condition under investigation; (2) Underwent percutaneous coronary intervention (PCI) for the first time at our institution; (3) Completed follow-up coronary angiography at our hospital within one year post-PCI.

Exclusion Criteria

(1) Unavailable or incomplete contact information, precluding follow-up; (2) Incomplete or missing medical records; (3) Severe hepatic or renal dysfunction; (4) Coagulation disorders or active malignant tumors.

Study Design and Data Collection

This retrospective comparative study analyzed clinical data from two patient groups. The collected parameters included: gender, age, family history of coronary heart disease, smoking, drinking, hypertension, diabetes, stroke history, regular medication, glycated hemoglobin, uric acid, LDL was >1.8 mmol/L, NLR, creatinine, follow-up months, multi vessel, target vessel (left anterior descending, left circumflex artery, right coronary artery),

emergency PCI, chronic total occlusion lesions, calcified lesions, bifurcation lesions, opening lesions, twisted angle lesions, total stent length, stent diameter < 3 mm, stent numbers, no IVUS assisted, etc. The study defined smoking as the consumption of ≥1 cigarette per day for a cumulative duration of ≥6 months, and the study defined drinking as at least one alcoholic beverage per month on average during the past 12 months.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation (x ± s) and compared using Student's *t*-test, while categorical variables were presented as percentages (%) and analyzed using the chi-square (χ^2) test. Logistic regression analysis was conducted using SPSS 24.0 (IBM Corp., Armonk, NY, USA). For feature selection and model evaluation, LASSO regression was performed, followed by the construction of receiver operating characteristic (ROC) curves, calibration curves, and decision curve analysis (DCA) using the "glmnet" and "rms" packages in R 4.2.6 (R Foundation for Statistical Computing, Vienna, Austria). To ensure model robustness, internal validation was carried out via the Bootstrap resampling method (1000 iterations). Additionally, the relative importance scores of risk factors were computed using Python 3.8.0 (Python Software Foundation). A two-tailed P-value < 0.05 was considered statistically significant.

Results

Comparison of Baseline Characteristics Between the Two Patient Groups

A total of 842 eligible patients were enrolled in the study, comprising 112 patients in the ISR group and 730 patients in the non-ISR group. The patient selection process is illustrated in Figure 1. Comparative analysis revealed significant differences between the two groups in several baseline and clinical characteristics, including age, regular medication, glycated hemoglobin, NLR, LDL>1.8 mmol/L, total stent length, stent diameter <3mm, number of stents, smoking, diabetes, calcified lesions, bifurcation lesions, no IVUS Assisted, and stroke history (all P < 0.05). Detailed data are presented in Table 1.

Screening of Risk Factors for ISR in CHD Patients One Year Post-PCI

Potential risk factors for ISR were preliminarily screened using LASSO regression analysis. The dependent variable was the occurrence of ISR within one year after PCI, while the independent variables comprised the 27 factors included in the study. The results showed that regular medication, diabetes, NLR, LDL>1.8 mmol/L, calcified lesions, bifurcation lesions, stent length, stent diameter <3mm, stent numbers, smoking, and no IVUS assisted were potential risk factors, as shown in Figures 2 and 3 for details.

Logistic Regression Analysis of Risk Factors for ISR Within One Year After PCI in CHD Patients

The dependent variable was whether ISR occurred within 1 year after PCI in CHD patients, and the independent variables were 11 potential risk factors, including regular medication, diabetes, NLR, LDL>1.8 mmol/L, calcified lesions, bifurcation lesions, total stent length, stent diameter < 3mm, stent numbers, smoking, and no IVUS assisted. The results showed that diabetes, NLR, LDL>1.8 mmol/L, calcified lesions, stent diameter < 3mm, smoking, and no IVUS assisted were independent risk factors for ISR within 1 year after PCI in CHD patients (P<0.05), as shown in Table 2. By calculating the relative importance scores of the seven risk factors, the relative importance ranking of the risk factors is as follows: calcified lesions, stent diameter <3mm, no IVUS assisted, LDL>1.8 mmol/L, smoking, NLR, and diabetes, as shown in Figure 4.

Development and Validation of the Nomogram Model

As shown in Figure 5, a risk prediction nomogram model for ISR within 1 year after PCI in CHD patients was constructed based on 7 risk factors, including diabetes, NLR, LDL >1.8 mmol/L, calcified lesions, minimum stent inner diameter <3mm, smoking history, and no IVUS assisted. The nomogram model was internally validated by the Bootstrap method (repeated sampling 1000 times), and the AUC of the nomogram model was 0.892(95% CI (0.859,

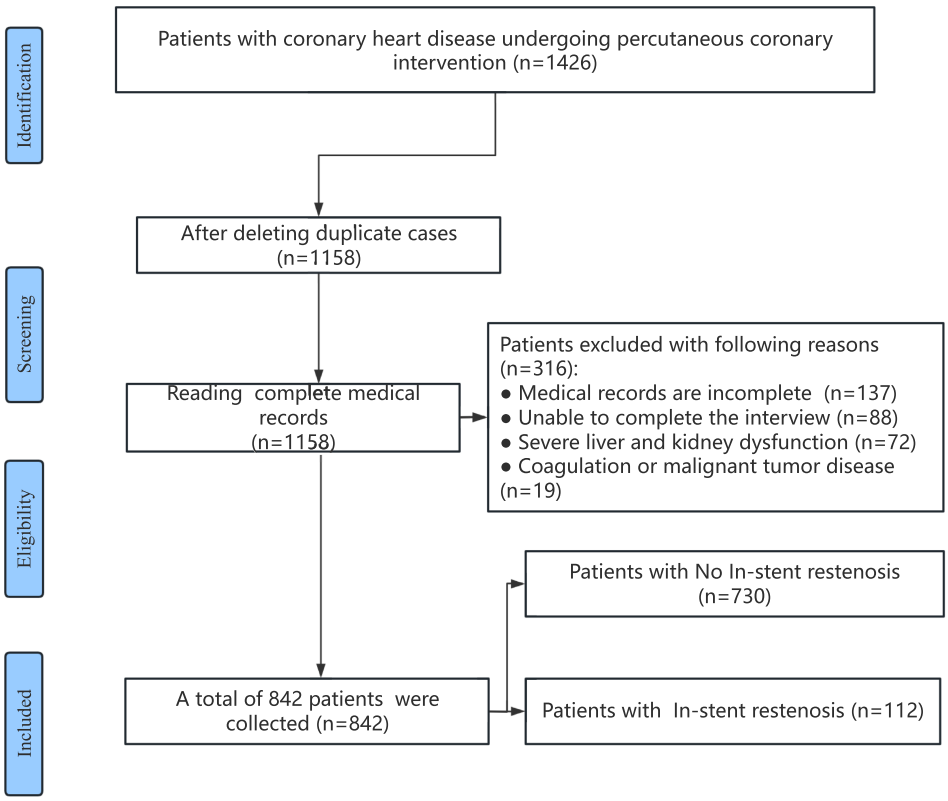

Figure 1 Flowchart of screening of study cases.

0.924) (Figure 6), the consistency index (C-index) was 0.923, the results of the Hosmer-Lemeshow test showed that there was no statistically significant difference between the actual and predicted probabilities of ISR within 1 year after PCI in CHD patients ($\chi 2$=13.835, P=0.086), and the calibration curve was close to the ideal curve (Figure 7), indicating that the calibration of the model was good. The decision curve showed that the threshold range of the prediction model with good clinical practicality was 0.05–0.862 (Figure 8). What's more, in order to increase the clinical practicality of the nomogram model, we drew a dynamic nomogram version, which can be obtained from the following webpage: https://cxf12345.shinyapps.io/CHD_PCI_ISR/

Discussion

In this retrospective study, we analyzed the clinical data of 842 CHD patients who underwent PCI to investigate the risk factors for ISR within one year post-procedure. Based on our findings, we developed a high-performance nomogram prediction model. Notably, our results not only corroborated previously established risk factors for post-PCI ISR but also identified key predictors with distinct significance in the Chinese population, including calcified lesions, stent diameter <3 mm, and the absence of IVUS guidance. This study provides clinicians with a practical tool for individualized ISR risk assessment, thereby facilitating optimized treatment strategies for CHD patients undergoing PCI.

This study identified 7 independent risk factors for ISR within 1 year after PCI in CHD patients, including diabetes, LDL>1.8 mmol/L, NLR, calcified lesions, stent diameter <3 mm, no IVUS assisted, and smoking. Mounting evidence suggests that diabetes contributes to endothelial dysfunction and accelerates neointimal hyperplasia due to sustained hyperglycemia, thereby elevating the risk of ISR.[18] Consistent with this perspective, our study identified diabetes (OR = 1.380) as an independent risk factor for ISR within one year following PCI in CHD patients. However, while glycated hemoglobin exhibited significant differences in univariate analysis (P < 0.001), it did not emerge as a significant predictor in the multivariate model, possibly because its influence was already accounted for by the presence of diabetes. Furthermore, our findings highlight a strong association between LDL levels >1.8 mmol/L (OR = 2.159) and ISR,

Table 1 Comparison of General Information Between the Two Groups of Patients

Variables	Non-ISR Group (N=730)	ISR Group (N=112)	$t/\chi 2$	*p*-value
Age, Mean±SD	62.66±9.19	64.55±8.34	2.058	0.040
Regular Medication, Mean±SD	0.71±0.46	0.55±0.50	3.239	0.001
Glycated Hemoglobin, Mean±SD	6.79±1.22	7.24±1.44	3.544	<0.001
Uric Acid, Mean±SD	387.39±79.12	387.29±93.13	0.012	0.990
NLR, Mean±SD	2.54±1.25	3.74±1.60	9.101	<0.001
Total Stent Length, Mean±SD	32.54±10.28	36.90±12.73	4.035	<0.001
Stent Number, Mean±SD	1.81±1.37	2.18±1.57	2.580	0.010
Creatinine, Mean±SD	88.79±20.16	86.52±19.97	1.111	0.267
Follow Up Months, Mean±SD	12.90±4.02	12.68±4.23	0.538	0.591
LDL>1.8 mmol/L, n (%)	428(58.63%)	88(78.57%)	16.274	<0.001
Stent diameter < 3mm, n (%)	318(43.56%)	74(66.07%)	19.774	<0.001
Gender, n (%)	517 (70.82%)	80 (71.43%)	0.017	0.895
Smoking, n (%)	318 (43.56%)	75 (66.96%)	21.367	<0.001
Diabetes, n (%)	318 (43.56%)	64 (57.14%)	7.226	0.007
Hypertension, n (%)	527 (72.19%)	83 (74.11%)	0.178	0.673
Multi Vessel, n (%)	436 (59.73%)	65 (58.04%)	0.115	0.734
Target Vessel, n (%)			3.070	0.215
Left anterior descending	363 (49.73%)	56 (50.00%)		
Left circumflex artery	224 (30.68%)	41 (36.61%)		
Right coronary artery	143 (19.59%)	15 (13.39%)		
Emergency PCI, n (%)	164 (22.47%)	17 (15.18%)	3.056	0.080
Chronic Total Occlusion Lesions, n (%)	192 (26.30%)	21 (18.75%)	2.930	0.087
Calcified lesions, n (%)	254 (34.79%)	73 (65.18%)	37.739	<0.001
Bifurcation lesions, n (%)	202 (27.67%)	51 (45.54%)	14.743	<0.001
Ostial Lesions, n (%)	148 (20.27%)	28 (25.00%)	1.312	0.252
Angulated Lesions, n (%)	215 (29.45%)	29 (25.89%)	0.598	0.439
No IVUS Assisted, n (%)	461(63.15%)	90 (80.35%)	15.537	<0.001
Family History of Coronary Heart Disease, n (%)	220 (30.14%)	26 (23.21%)	2.250	0.134
Drinking, n (%)	256 (35.07%)	39 (34.82%)	0.003	0.959
Stroke History, n (%)	102 (13.97%)	25 (22.32%)	5.284	0.022

Abbreviations: ISR, in-stent restenosis; SD, standard deviation; NLR, neutrophil/lymphocyte ratio; LDL, low-density lipoprotein; Smoking, the study defined smoking as the consumption of ≥1 cigarette per day for a cumulative duration of ≥6 months; PCI, Percutaneous coronary intervention; IVUS, intravascular ultrasound; Drinking, the study defined drinking as at least one alcoholic beverage per month on average during the past 12 months.

reinforcing the current guideline recommendations for stringent lipid-lowering targets in CHD patients. Interestingly, East Asian populations may exhibit greater sensitivity to LDL-C compared to their European and American counterparts.[19] The NLR (OR = 2.312), a sensitive marker of systemic inflammation, demonstrated superior predictive value for ISR at one-year post-PCI compared to traditional markers such as C-reactive protein. This observation aligns with the hypothesis that neutrophil-derived matrix metalloproteinases directly promote smooth muscle cell migration,[20] supporting the "inflammation-restenosis axis" theory proposed in recent literature.[21] Among procedural factors, calcified lesions (OR = 3.780) exhibited the strongest predictive power for ISR, likely due to their association with incomplete stent expansion and more pronounced vascular intimal injury during balloon dilation, which may trigger excessive reparative responses.[22] Additionally, stent diameter <3 mm (OR = 2.595) was linked to an elevated ISR risk, potentially attributable to heightened shear stress in small vessels and delayed endothelial recovery.[23] Conversely, IVUS guidance (protective factor, OR = 0.255) significantly mitigated ISR risk by optimizing stent apposition and expansion while minimizing flow disturbances.[24] Our study quantitatively validated this effect, addressing a gap in prior research that relied solely on qualitative assessments. Smoking emerged as an independent risk factor for ISR, likely mediated by endothelial dysfunction and exacerbated inflammation.[25] Population-specific data from Chinese cohorts further indicate that smokers face a >50% increased ISR risk, with a dose-dependent relationship.[26] Consequently, current guidelines strongly advocate for smoking cessation post-PCI to reduce ISR risk.[27]

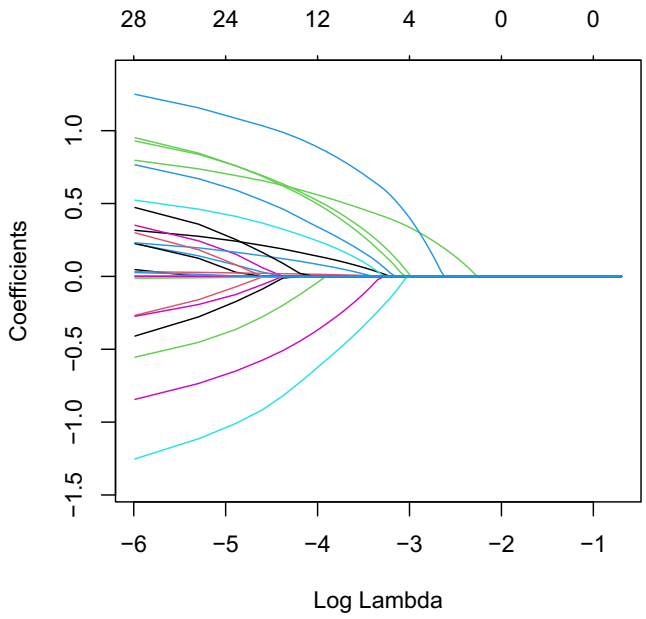

Figure 2 Coefficient paths of LASSO regression.
Note: Top numbers indicate the number of nonzero coefficients at each lambda value; bottom numbers show the corresponding log(lambda) values. Lines of different colors represent different variables, and each curve represents the changing trajectory of the coefficient of each independent variable.

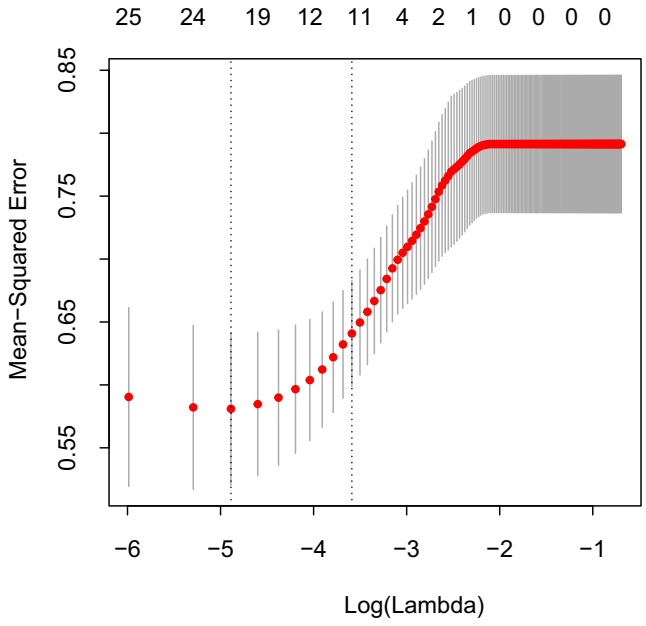

Figure 3 LASSO regression verification results.
Note: The lower horizontal axis is the logarithm of the lambda penalty coefficient, and the upper horizontal axis is the number of variables required for the corresponding model. The dashed line on the left is lambda.min, and the dashed line on the right is lambda.1se, which refers to the position one standard error away from lambda.min.

This study introduces several methodological advancements. First, regarding variable selection, we employed LASSO regression to reduce dimensionality from 27 candidate variables, thereby mitigating the alpha error inflation inherent in traditional stepwise regression. A particularly intriguing observation was that while regular medication usage exhibited a protective effect in univariate analysis (P = 0.001), it was excluded from the final predictive model. This may be attributed to its influence being overshadowed by more direct biomarkers, such as diabetes and LDL levels. Second, in terms of predictive factor composition, our model demonstrates a significant improvement over the SYNTAX score II,

Table 2 Logistic Regression Analysis of Risk Factors for ISR in CHD Patients After PCI

Variables	Partial Regression Coefficient	Standard Error	Z value	OR (95% CI)	*P* value
Smoking	1.028	0.314	3.276	2.796(1.511~5.174)	0.001
Regular Medication	−0.453	0.290	1.561	0.636(0.360~1.123)	0.118
Diabetes	0.322	0.120	2.675	1.380(1.090~1.747)	0.007
NLR	0.838	0.119	7.018	2.312(1.830~2.922)	0.000
LDL>1.8 mmol/L	0.770	0.353	2.179	2.159(1.080~4.315)	0.029
Calcified lesions	1.330	0.312	4.262	3.780(2.051~6.968)	0.000
Bifurcation lesions	0.522	0.309	1.693	1.686(0.921~3.087)	0.090
Stent Length	0.181	0.248	0.727	1.198(0.736~1.949)	0.467
Stent Diameter < 3mm	0.954	0.313	3.043	2.595(1.404~4.796)	0.002
Stent Number	0.290	0.298	0.973	1.336(0.745~2.396)	0.331
No IVUS Assisted	0.777	0.247	3.153	2.176(1.342~3.527)	0.002

Abbreviations: ISR, in-stent restenosis; CHD, coronary heart disease; PCI, Percutaneous coronary intervention; OR, Odds Ratio; NLR, neutrophil/lymphocyte ratio; LDL, low-density lipoprotein; Smoking, the study defined smoking as the consumption of ≥1 cigarette per day for a cumulative duration of ≥6 months; IVUS, intravascular ultrasound.

which relies solely on anatomical features. By integrating multidimensional variables—including clinical factors (diabetes, smoking status), biochemical markers (NLR, LDL), and procedural details (IVUS, stent diameter)—our nomogram achieves superior predictive performance, as evidenced by an AUC of 0.892. Finally, rigorous validation strategies further reinforce the robustness of our model. Internal validation using the Bootstrap method (1000 resamples) yielded a high C-index of 0.923, while the calibration curve exhibited excellent agreement with the ideal line (Figure 7). DCA confirmed the model's clinical utility, demonstrating significantly greater net benefit than the "intervene-all" or "intervene-none" strategies across a wide decision threshold range (5.0–86.2%) (Figure 8).

This study delivers three key advancements. First, we highlight calcified lesions as the dominant ISR predictor (OR=3.780) in East Asians—a group underrepresented in Western models. This addresses a critical gap in risk stratification for regions with high calcified lesion prevalence. Second, although lack of IVUS assistance is known to increase the risk of ISR, its specific risk has not been quantified. Our model fills this gap and quantifies the risk of ISR

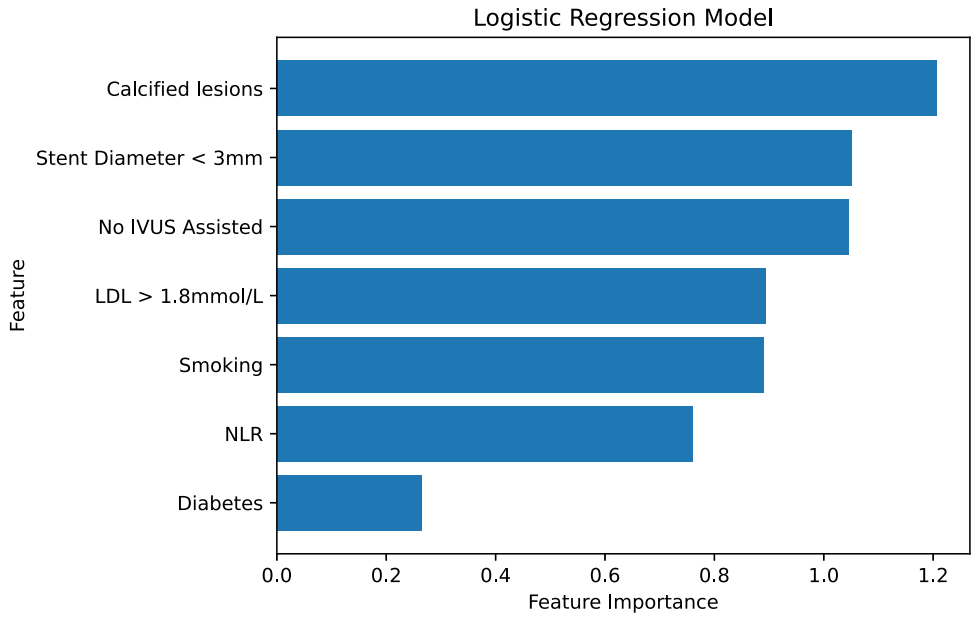

Figure 4 Ranking of risk factors by importance.
Abbreviations: NLR, neutrophil/lymphocyte ratio; LDL, low-density lipoprotein; Smoking, the study defined smoking as the consumption of ≥1 cigarette per day for a cumulative duration of ≥6 months; IVUS, intravascular ultrasound.

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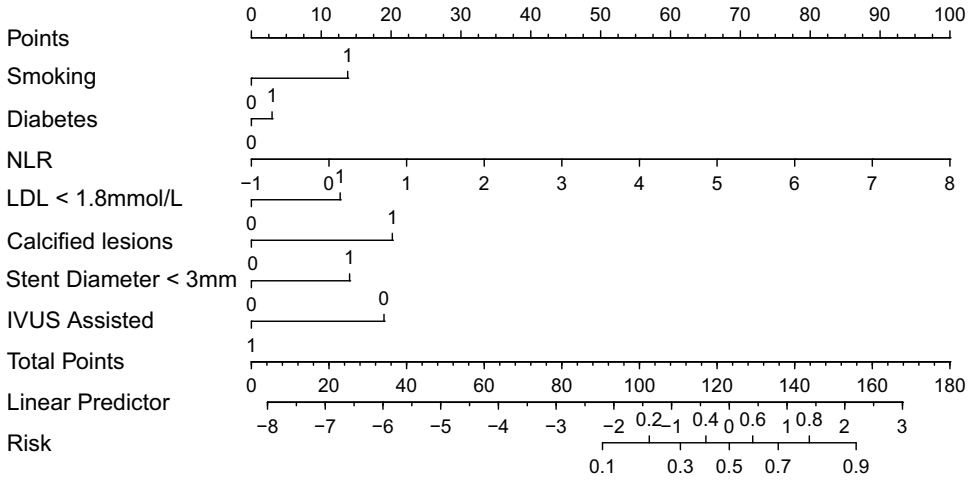

Figure 5 Nomogram model for the risk of ISR after PCI in CHD patients.
Abbreviations: ISR, in-stent restenosis; CHD, coronary heart disease; PCI, Percutaneous coronary intervention; NLR, neutrophil/lymphocyte ratio; LDL, low-density lipoprotein; Smoking, the study defined smoking as the consumption of ≥1 cigarette per day for a cumulative duration of ≥6 months; IVUS, intravascular ultrasound.

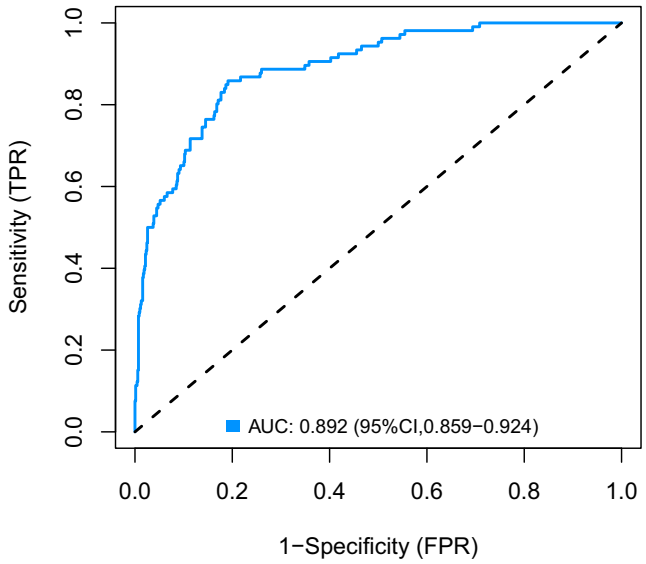

Figure 6 ROC curve display of model prediction performance.

caused by lack of IVUS assistance (OR = 2.176). Third, The web-based dynamic nomogram (https://cxf12345.shinyapps.io/CHD_PCI_ISR/) is the first to integrate multidimensional predictors (anatomical, procedural, inflammatory) into a real-time ISR risk calculator. This enables personalized surveillance and optimizes resource allocation in settings where routine angiography is impractical. For instance, the model predicts a 48.6% one-year post-PCI ISR risk for a CHD patient with diabetes, a NLR of 3.5, and calcified lesions treated with a 2.5 mm stent. Such high-risk predictions warrant consideration of intensified imaging surveillance or drug-coated balloon strategies to mitigate adverse outcomes.

Despite its contributions, this study has several limitations. First, the retrospective design and relatively short follow-up period (only 1 year) may restrict the robustness of our findings. Although the large sample size strengthens the statistical power, the results should be further validated through prospective studies to confirm their reliability. Second, the prediction model was developed using single-center data and lacks external validation. Future research should assess its generalizability by testing the model in multicenter cohorts, particularly in European and American populations, to ensure broader applicability. Finally, the biomarker analysis was limited in depth, as emerging markers such as IL-6 and

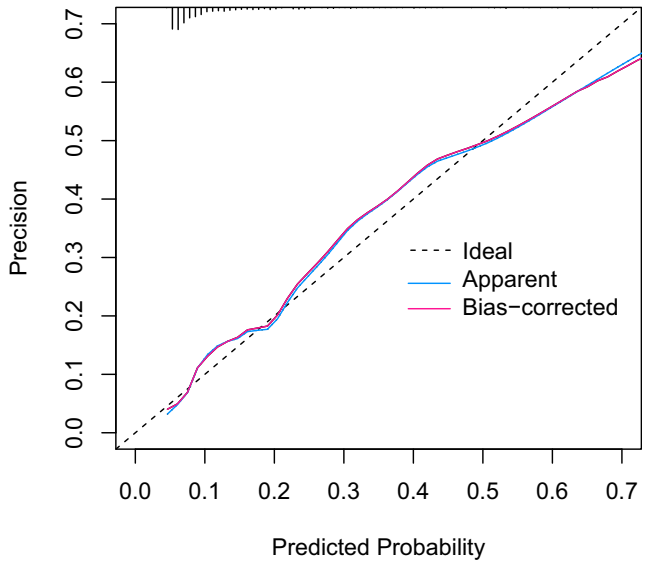

Figure 7 Calibration curve display of model prediction performance.

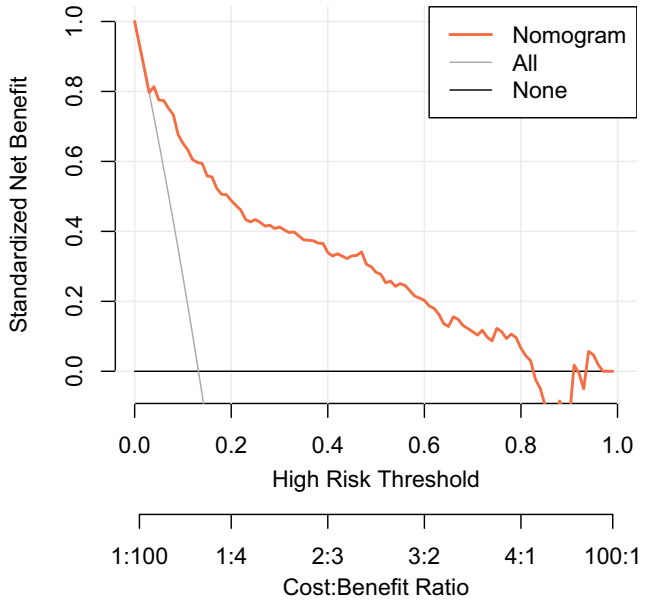

Figure 8 Decision curve display of model prediction performance.

genetic polymorphism data were not included. Incorporating these factors in future studies could enhance the predictive accuracy of the model.

Conclusions

The present study demonstrated that ISR following PCI in patients with CHD arises from a combination of multiple risk factors, with calcified lesions, smaller stent diameter, and the absence of IVUS guidance identified as the predominant contributors. A nomogram model incorporating seven independent predictors was developed, demonstrating discriminative ability and high calibration accuracy. This model offers clinicians an intuitive and quantitative tool for individualized risk assessment, thereby facilitating optimized therapeutic decision-making for high-risk patients.

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Abbreviations

CHD, Coronary heart disease; PCI, Percutaneous coronary intervention; ISR, in-stent restenosis; IVUS, intravascular ultrasound; OR, Odds Ratio; SD, standard deviation; NLR, neutrophil/lymphocyte ratio; LDL, low-density lipoprotein; ROC, receiver operating characteristic; AUC, area under the curve; DCA, decision curve analysis; C-index, consistency index; Smoking, the study defined smoking as the consumption of ≥1 cigarette per day for a cumulative duration of ≥6 months; Drinking, the study defined drinking as at least one alcoholic beverage per month on average during the past 12 months.

Data Sharing Statement

The data that supports the findings of this study are available from the corresponding author (Zhenhua Gu, Email: 18101490727@163.com) on request.

Ethics Approval and Consent to Participate

This study was approved by the Institutional Review Board of Changzhou Hospital Affiliated to Nanjing University of Chinese Medicine. Given that this study was a retrospective analysis, the need for consent to participate was waived by the Medical Ethics Committee of Changzhou Affiliated Hospital of Nanjing University of Chinese Medicine. Also, the Medical Ethics Committee waived the need for patient consent to review their medical records, provided that all data remained strictly confidential. No identifying patient information was included in the manuscript. We declare that our research complies with the Declaration of Helsinki.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declared that they have no competing interests in this work.

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