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Correlations of SYNTAX-II Score and NT-IGFBP-4 with Endothelial Function and Inflammatory Response in Patients with Coronary Heart Disease

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KEYWORDS Atherosclerosis. Biomarkers. Cardiovascular Events. Percutaneous Coronary Intervention. Risk Stratification. Vascular Biology

ABSTRACT This study aimed to investigate the correlations of the synergy between percutaneous coronary intervention (PCI) with TAXUS and Cardiac Surgery (SYNTAX)-II score and N-terminal insulin-like growth factor binding protein 4 (NT-IGFBP-4) with endothelial function and inflammatory response in patients with coronary heart disease (CHD). Clinical data and laboratory parameters were collected, including total cholesterol (TC), endothelin-1 (ET-1), nitric oxide (NO), C-reactive protein (CRP), total plaque volume, serum NT-IGFBP-4 levels, and the SYNTAX-II score. Multivariate analysis showed that TC, ET-1, CRP, total plaque volume, serum NT-IGFBP-4, and the SYNTAX-II score were independent risk factors for cardiovascular adverse events in patients with CHD, whereas NO was identified as a protective factor ($P<0.05$). Correlation analysis demonstrated that the SYNTAX-II score and NT-IGFBP-4 levels were positively associated with inflammatory response and negatively associated with endothelial function. These findings indicate that the SYNTAX-II score and serum NT-IGFBP-4 are closely correlated with endothelial dysfunction and inflammation in patients with CHD.

INTRODUCTION

Coronary heart disease (CHD) remains a leading cause of morbidity and mortality worldwide and represents a major public health challenge (Al-Khlaiwi et al. 2024). Its pathogenesis is multifactorial and involves complex interactions among lipid metabolism disorders, endothelial dysfunction, inflammatory activation, and atherosclerotic plaque progression (Malekmohammad et al. 2021; Ajoolabady et al. 2024). Accumulating evidence from recent studies has highlighted that endothelial dysfunction is an early and critical event in the development of CHD, characterised by impaired nitric oxide bioavailability, increased vasoconstrictor production, and loss of vascular homeostasis (Mudau et al. 2012; Sun et al. 2020). These alterations not only promote atherosclerosis initiation but also accelerate plaque instability and adverse cardiovascular events.

In parallel, chronic low-grade inflammation has been recognised as a central driver of CHD progression. Elevated inflammatory mediators such as C-reactive protein, endothelin-1, and pro-inflammatory cytokines contribute to endothelial injury, leukocyte recruitment, and plaque vulnerability, thereby aggravating disease severity and prognosis (Mlynarska et al. 2025; Henein et al. 2022)). Given the close interplay between endothelial dysfunction and inflammatory response, simultaneous assessment of these processes may provide a more comprehensive understanding of CHD pathophysiology.

The synergy between percutaneous coronary intervention (PCI) with TAXUS and Cardiac Surgery (SYNTAX)-II scoring system has been widely used to evaluate the complexity of coronary artery disease (Sianos et al. 2005). By integrating angiographic characteristics with key clinical variables, SYNTAX-II offers improved risk stratification and guidance for revascularisation strategies compared with anatomical assessment alone (Farooq et al. 2013). However, the SYNTAX-II score primarily reflects lesion complexity and procedural risk, and its association with underlying biological processes such as endothelial dysfunction and systemic inflammation remains insufficiently explored.

In recent years, N-terminal insulin-like growth factor binding protein 4 (NT-IGFBP-4) has

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emerged as a novel biomarker implicated in cardiovascular diseases (Hjortebjerg et al. 2017). Previous studies suggest that IGFBP-4 participates in endothelial cell regulation, and inflammatory signalling, and elevated NT-IGFBP-4 levels have been associated with adverse cardiovascular outcomes (Li et al. 2025; Hjortebjerg et al. 2015). Nevertheless, limited data are available regarding the relationship between NT-IGFBP-4 and endothelial function or inflammatory status in patients with CHD, particularly in conjunction with established clinical risk scores.

Objective

The objective of this study was to investigate the associations of the SYNTAX-II score and serum NT-IGFBP-4 with endothelial function and inflammatory response in patients with CHD.

MATERIAL AND METHODS

Subjects

This was a single-centre, observational cohort study. Patients (n=64) with CHD admitted to the researchers' hospital from April 2021 to October 2023 were consecutively enrolled to minimise selection bias and assigned into a presence group (n=43) and an absence group (n=21) according to the presence or absence of cardiovascular adverse events (CVAEs) during follow-up after PCI.

Inclusion criteria were as follows:

1. patients diagnosed with CHD according to clinical manifestations, coronary angiography and other examination results
2. aged ≥18 years old
3. patients who successfully underwent PCI recently with stable postoperative conditions
4. availability of complete clinical, laboratory, and follow-up data.

The study protocol was reviewed and approved by the ethics committee of the hospital, and written informed consent was obtained from all participants.

Exclusion criteria included:

1. severe congenital heart disease, cardiomyopathy, valvular heart disease or other comorbidities that might confound cardiovascular outcomes
2. severe infection (such as sepsis, severe pneumonia) or major trauma within the previous month
3. history of severe mental illness or inability to comply with medical instructions or follow-up procedures
4. active tuberculosis, AIDS or other severe infectious diseases.

Collection of Baseline Data

Clinical baseline data were collected at admission using standardised case report forms by trained investigators, including name, gender, age, height, weight, blood pressure, medical history, smoking history, and family history of cardiovascular disease. Standardised data collection procedures were applied to minimise selection and information bias. Body mass index (BMI) was calculated accordingly. Fasting venous blood samples were obtained on the morning of the second hospital day after an overnight fast of at least 8 hours for biochemical analyses, including blood lipid profile and glucose levels.

Coronary Angiography and Calculation of SYNTAX-II Scores

Coronary angiography was performed using the Seldinger technique following standard institutional protocols. All angiographic images were independently reviewed by two experienced interventional cardiologists blinded to clinical outcomes. The SYNTAX-II score was calculated by integrating angiographic lesion characteristics and clinical variables using the online calculator (www.syntaxscore.com). Interobserver variability was assessed, and any discrepancies were resolved by consensus with a third senior interventional cardiologist.

Detection of Serum NT-IGFBP-4

Serum NT-IGFBP-4 level was measured using a double-antibody sandwich immunoassay with monoclonal antibodies against IBP3 and IBP144 (Hytest, Finland; reference value: 1.0-2.5 ng/mL). Blood samples were centrifuged within

2 hours of collection and stored at -80 °C until analysis. All measurements were performed in duplicate, and the mean value was used for statistical analysis.

Detection of Endothelial Function

Endothelial function was assessed by measuring serum nitric oxide (NO) and endothelin-1 (ET-1) levels. NO levels (reference range: 10.3-66.8 ìmol/L) were determined using the nitrate reductase method while ET-1 levels (reference value: 50.0-100.0 nmol/L) were measured by radioimmunoassay. Commercial assay kits were obtained from Shenzhen Zike Biotechnology Co. Ltd. All assays were conducted according to the manufacturer's instructions with appropriate internal quality controls.

Detection of Inflammatory Response

Peripheral venous blood samples were collected at predefined time points before PCI to evaluate systemic inflammatory status. Inflammatory markers included white blood cell count (WBC; reference range: 4.5-11.0×10^9/L), C-reactive protein (CRP; reference range: 1.0-10.0 mg/L), tumour necrosis factor-α (TNF-α; reference range: 10.0-25.0 pg/L), and interleukin-6 (IL-6; reference range: 0-43.5 pg/L). These biomarkers were selected to reflect both acute-phase response and pro-inflammatory cytokine activity.

Follow-up

All patients were followed up with for one year after PCI. CVAEs, including all-cause death, cardiac death, nonfatal myocardial infarction, and unplanned target vessel revascularisation were recorded. Follow-up data were obtained through scheduled outpatient visits and structured telephone interviews, and outcome events were independently verified using medical records.

Statistical Analysis

Statistical analyses were performed using SPSS 26.0. Continuous variables were expressed as mean ± standard deviation (SD) and compared using student's t-test or analysis of variance, as appropriate. Categorical variables were presented as [n (%)] and compared using the χ^2 test. Multivariate logistic regression analysis was performed to identify independent predictors of CVAEs, with variables selected based on clinical relevance and univariate analysis results. Receiver operating characteristic (ROC) curve analysis was used to assess the predictive performance of serum NT-IGFBP-4 and SYNTAX-II score. Pearson correlation analysis was conducted to evaluate associations between variables. $P<0.05$ indicated statistical significance.

RESULTS

Clinical Data

Compared with the absence group, patients in the presence group exhibited higher levels of TC, ET-1, CRP and total plaque volume, while NO level was significantly lower (all $P<0.05$) (Table 1). No significant differences were observed between the two groups with respect to age, sex, body mass index, smoking history, blood pressure, renal function indicators, fasting blood glucose, or other baseline clinical characteristics ($P>0.05$).

Serum NT-IGFBP-4 Levels and SYNTAX-II Scores

As shown in Table 2, patients in the presence group exhibited significantly higher serum NT-IGFBP-4 levels compared with those in the absence group (2.04±0.45 ng/mL vs. 1.42±0.32 ng/mL, $t=5.644$, $P=0.001$). Similarly, the SYNTAX-II score was markedly higher in the presence group than in the absence group (28.35±5.12 vs. 20.18±4.36, $t=6.278$, $P=0.001$). These findings demonstrate significant differences in serum NT-IGFBP-4 levels and SYNTAX-II scores between patients with and without cardiovascular adverse events following PCI.

Influencing Factors for CVAEs in Patients with CHD

Using the occurrence of CVAEs as a dependent variable (Yes=1, No=0), TC, NO, ET-1, CRP, total plaque volume, serum NT-IGFBP-4, and SYNTAX-II score were included as independent variables and were entered into the model as

Table 1: Clinical data of two groups

Clinical data		*Presence group (n=43)*	*Absence group (n=21)*	t/χ^2	*P*
Gender	Male	23 (53.49)	12 (57.14)	0.076	0.782
	Female	20 (46.51)	9 (42.86)		
Age (year)		62.35± 8.21	61.87± 7.98	0.221	0.825
BMI (kg/m^2)		25.12± 3.05	24.89± 2.87	0.288	0.773
Smoking history	Yes	28 (65.12)	9 (42.86)	2.866	0.090
	No	15 (34.88)	12 (57.14)		
History of diabetes mellitus	Yes	13 (30.23)	6 (28.57)	0.018	0.891
	No	30 (69.77)	15 (71.42)		
History of hypertension	Yes	11 (25.58)	5 (23.81)	0.023	0.877
	No	32 (74.42)	16 (76.19)		
SBP (mmHg)		132.23 ±15.87	133.65±14.93	0.101	0.919
DBP (mmHg)		82.15±10.32	81.88± 9.86	1.207	0.231
TC (mmol/L)		5.18± 1.02	4.27± 0.75	3.630	0.001
TG (mmol/L)		1.85± 0.63	1.73± 0.38	0.802	0.425
LDL-C (mmol/L)		3.21± 0.85	2.94± 0.53	1.331	0.187
HDL-C (mmol/L)		1.28± 0.31	1.37± 0.33	1.067	0.289
BUN (mmol/L)		5.32± 1.21	4.86± 1.18	1.439	0.155
Cr (imol/L)		85.37±15.32	81.79±14.89	0.885	0.379
Fasting blood glucose (mmol/L)		5.87± 1.36	5.79± 1.28	0.225	0.822
NO (imol/L)		51.46± 6.27	69.47± 5.74	11.082	0.001
VEGF (ng/L)		48.53± 5.42	49.46± 5.60	0.637	0.526
ET-1 (nmol/L)		75.34± 7.88	58.63± 7.43	8.111	0.001
WBC (×10^9/L)		8.51± 2.04	7.83± 1.87	1.285	0.203
CRP (mg/L)		7.34± 2.11	4.02± 1.24	6.654	0.001
TNF-α(pg/L)		22.31± 3.23	21.45± 3.56	0.967	0.337
IL-6 (pg/L)		25.34± 4.13	24.87± 4.22	0.424	0.672
Total plaque volume (mm^3)		125.36±11.69	102.13± 7.11	8.362	0.001
Calcified plaque volume (mm^3)		5.56± 1.53	5.91± 1.81	0.808	0.421
Non-calcified plaque volume (mm^3)		69.24± 6.34	66.21± 5.87	1.838	0.070
Lesion length (mm)		24.15± 3.17	23.37± 2.88	0.951	0.345

Table 2: Serum NT-IGFBP-4 and SYNTAX-II scores

Group	*n*	*Serum NT-IGFBP-4 level (ng/mL)*	*SYNTAX-II score (point)*
Presence	43	2.04±0.45	28.35±5.12
Absence	21	1.42±0.32	20.18±4.36
t		5.644	6.278
P		0.001	0.001

continuous variables (Table 3). A multivariate stepwise logistic regression model was then constructed to identify factors associated with CVAEs.

The multivariate analysis showed that higher TC (OR=2.749, 95% CI: 1.437-5.257), ET-1 (OR=1.445, 95% CI: 1.195-1.749), CRP (OR=2.499, 95% CI: 1.598-3.908), total plaque volume (OR=1.324, 95% CI: 1.155-1.518), serum NT-IGFBP-4 levels (OR=1.494, 95% CI: 1.209-1.846), and SYNTAX-II scores (OR=54.646, 95% CI: 7.033-424.585) were significantly associated with the presence of CVAEs (all P<0.05). In contrast, NO was inversely associated with CVAEs (OR=0.695, 95% CI: 0.579-0.834, P=0.001), indicating a protective association (Table 4).

Table 3: Variable assignment

Variable	*Implication*	*Assignment*
X1	TC	Continuous variable
X2	NO	Continuous variable
X3	ET-1	Continuous variable
X4	CRP	Continuous variable
X5	Total plaque volume	Continuous variable
X6	Serum NT-IGFBP-4 level	Continuous variable
X7	SYNTAX-II score	Continuous variable
Y	CVAEs	Yes=1, No=0

Table 4: Multivariate logistic regression analysis results of CVAEs in CHD patients

Item	*B*	*SE*	*Wald*	*P*	*OR*	*95% CI*
TC	1.001	0.331	9.342	0.002	2.749	1.437- 5.257
NO	-0.364	0.093	15.294	0.001	0.695	0.579- 0.834
ET-1	0.368	0.097	14.368	0.001	1.445	1.195- 1.749
CRP	0.916	0.288	16.122	0.001	2.499	1.598- 3.908
Total plaque volume	0.281	0.070	16.153	0.001	1.324	1.155- 1.518
Serum NT-IGFBP-4 level	0.401	0.108	13.862	0.001	1.494	1.209- 1.846
SYNTAX-II score	4.001	1.046	14.628	0.001	54.646	7.033-424.585

ROC Curves of Influencing Factors for CVAEs in CHD Subjects

ROC curve analysis was performed using the occurrence of CVAEs as a dependent variable (Yes=1, No=0). Indicators that were statistically significant in the multivariate analysis, including TC, NO, ET-1, CRP, total plaque volume, serum NT-IGFBP-4 levels, and SYNTAX-II scores, were evaluated individually. As shown in Table 5 and Figure 1, the areas under the ROC curve (AUCs) for TC, NO, ET-1, CRP, total plaque volume, serum NT-IGFBP-4 levels, and SYNTAX-II scores ranged from 0.777 to 0.967, indicating varying degrees of discriminative ability for distinguishing patients with and without CVAEs. The corresponding sensitivity, specificity, Youden index, and optimal cut-off values for each indicator are summarised in Table 5.

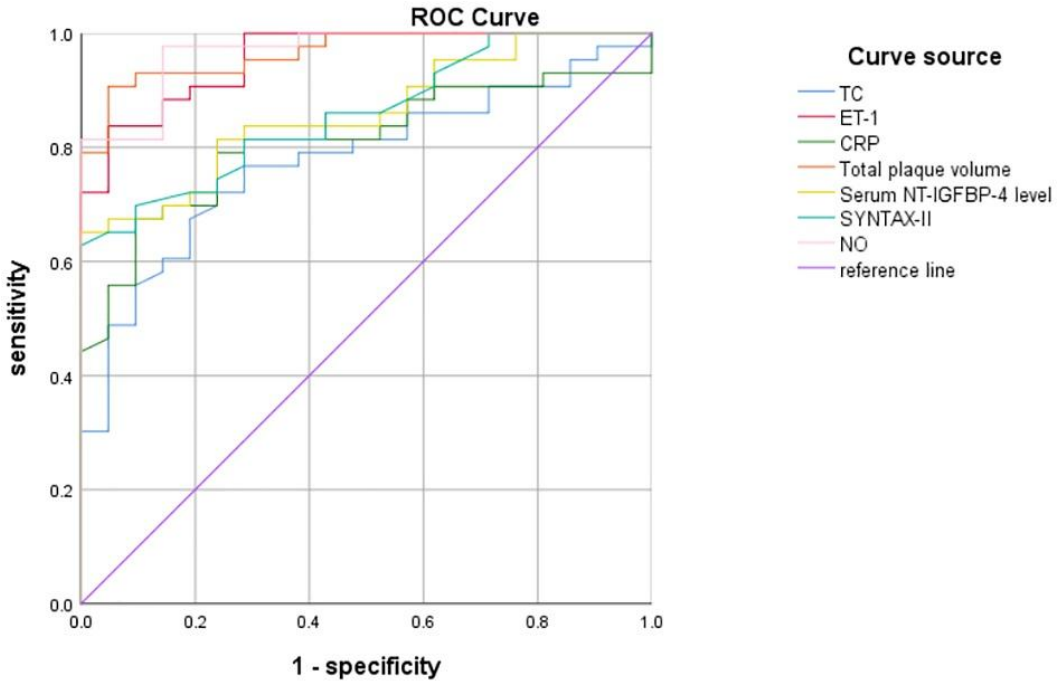

Fig. 1. ROC curves of influencing factors for CVAEs in CHD subjects

Table 5: Predictive values of influencing factors for CVAEs in CHD subjects

Factor	*AUC*	*95% CI*	*P*	*Specificity*	*Sensitivity*	*Youden index*	*Cut-off value*
TC	0.777	0.664-0.891	0.001	0.762	0.721	0.483	4.71 mmol/L
NO	0.957	0.931-1.00	0.001	0.524	0.860	0.384	66.13 ìmol/L
ET-1	0.957	0.913-1.000	0.001	0.667	0.791	0.458	65.22 nmol/L
CRP	0.910	0.834-0.986	0.001	0.714	0.698	0.412	5.14 mg/L
Total plaque volume	0.967	0.930-1.000	0.001	0.810	0.744	0.554	115.32 mm^3
Serum NT-IGFBP-4 level	0.859	0.772-0.947	0.001	0.571	0.814	0.385	1.73 ng/mL
SYNTAX-II score	0.858	0.771-0.946	0.001	0.619	0.837	0.456	24.36 points

Correlations of SYNTAX-II Score and Serum NT-IGFBP-4 with Endothelial Function and Inflammatory Response in Patients with CHD

Pearson correlation analysis demonstrated that the SYNTAX-II score was significantly correlated with serum NT-IGFBP-4 levels (r=0.373, P=0.002). In addition, the SYNTAX-II score showed a significant positive correlation with inflammatory response indicators (r=0.306, P=0.014) and a significant negative correlation with endothelial function parameters (r=-0.472, P<0.001). Similarly, serum NT-IGFBP-4 levels were positively correlated with inflammatory response (r=0.324, P=0.009) and negatively correlated with endothelial function (r=-0.490, P<0.001). The correlation coefficients and corresponding significance levels are summarised in Table 6.

DISCUSSION

SYNTAX-II scoring system is widely used in clinical practice to evaluate coronary artery lesions and provides a comprehensive assessment of lesion complexity, thereby playing an important role in treatment decision-making and prognostic evaluation in patients with CHD. In this study, serum NT-IGFBP-4 levels increased progressively with higher SYNTAX-II scores in CHD patients, and this trend was closely aligned with changes in endothelial function and inflammatory indicators. These findings suggest that the SYNTAX-II score reflects not only the anatomical severity of coronary artery disease but may also be associated with endothelial dysfunction and inflammatory activation, highlighting its value in the comprehensive assessment of CHD.

Consistent with this observation, patients in the presence group exhibited significantly higher SYNTAX-II scores than those in the absence group, indicating a close association between the SYNTAX-II score and the occurrence of CVAEs following PCI. The SYNTAX-II scoring system integrates multiple clinical and anatomical factors related to coronary artery disease, and higher scores are generally indicative of more severe and complex coronary lesions (Karagiannidis et al. 2022). Patients with elevated SYNTAX-II scores often present with a greater number of diseased vessels, more severe stenosis, and more complex lesion morphology,

Table 6: Associations of SYNTAX-II score and serum NT-IGFBP-4 with endothelial function and inflammatory response in patients with CHD

		SYNTAX-II	*Serum NT-IGFBP-4*	*Inflammatory response*	*Endothelial function*
SYNTAX-II score	Pearson correlation	1	0.373**	0.306*	-0.472**
	Sig. (2-tailed)		0.002	0.014	0.000
Serum NT-IGFBP-4	Pearson correlation	0.373**	1	0.324**	-0.490**
	Sig. (2-tailed)	0.002		0.009	0.000
Inflammatory response	Pearson correlation	0.306*	0.324**	1	0.536**
	Sig. (2-tailed)	0.014	0.009		0.000
Endothelial function	Pearson correlation	0.472**	0.490**	0.536**	1
	Sig. (2-tailed)	0.000	0.000	0.000	

**: Correlation is significant at the 0.01 level (2-tailed)
*: Correlation is significant at the 0.05 level (2-tailed)

all of which may increase the risk of CVAEs. Extensive vessel involvement may compromise myocardial perfusion over a larger area, while severe stenosis predisposes patients to myocardial ischemia or infarction. In addition, complex lesion morphology may increase procedural difficulty and interventional risk, thereby adversely affecting clinical outcomes (Räber et al. 2022).

Furthermore, the present study demonstrated that the SYNTAX-II score was positively correlated with inflammatory response and negatively correlated with the endothelial function. These results further support the notion that the SYNTAX-II score reflects not only anatomical disease burden but is also associated with the key pathophysiological process underlying CHD. Chronic inflammation plays a pivotal role in the initiation and progression of CHD. In patients with more severe coronary artery lesions, systemic inflammatory activation is more likely to occur, leading to increased release of inflammatory mediators such as CRP (Stone et al. 2023). Endothelial dysfunction is recognised as an early hallmark of CHD and a critical contributor to disease progression. Patients with higher SYNTAX-II scores may experience greater endothelial injury, manifested by decreased NO bioavailability and increased ET-1 production, which together promote vascular dysfunction and increase susceptibility to cardiovascular adverse events (Zhang et al. 2021).

In this study, serum NT-IGFBP-4 levels were significantly higher in the presence group than in the absence group, suggesting a potential association between NT-IGFBP-4 and the occurrence of post-PCI CVAEs. However, the biological role of NT-IGFBP-4 as a novel biomarker in CHD has not yet been fully elucidated. A possible mechanism is that NT-IGFBP-4 may influence vascular smooth muscle cell proliferation and migration, as well as endothelial cell function, through modulation of the insulin-like growth factor (IGF) signalling pathway (Dreier et al. 2021). Elevated NT-IGFBP-4 levels in patients with CHD may represent a compensatory response to coronary artery injury, which may be insufficient to completely prevent the occurrence of CVAEs (Sjúrgarson et al. 2023).

Furthermore, the researchers' correlation analysis demonstrated that serum NT-IGFBP-4 levels were positively correlated with the inflammatory response and negatively correlated with endothelial function. These findings suggest that NT-IGFBP-4 may be involved in both inflammatory activation and endothelial dysfunction in CHD. During inflammatory activation, the expression or release of NT-IGFBP-4 may be upregulated, while increased NT-IGFBP-4 levels may, in turn, influence inflammatory cell activity and cytokine release (Hjort et al. 2023). In addition, the observed negative association between NT-IGFBP-4 levels and endothelial function may be related to impaired endothelial cell metabolism and function, thereby exacerbating endothelial dysfunction, and contributing to CHD progression (Akiyama et al. 2022).

The present study demonstrated significant intergroup differences in TC, NO, ET-1, CRP and total plaque volume. TC is a major lipid component, and elevated TC levels are closely associated with the development of atherosclerosis (Rexhaj et al. 2024). The higher TC levels observed in the presence group may have contributed to accelerated plaque formation and progression, thereby increasing the risk of CVAEs. NO is a key endothelium-derived vasodilator that plays a critical role in maintaining vascular homeostasis and inhibiting atherosclerotic processes (Haghikia et al. 2022). The relatively higher NO levels in the absence group may have contributed to preserved vascular function and a reduced risk of CVAEs, supporting its protective factor in CHD. In contrast, ET-1 is a potent vasoconstrictor and elevated ET-1 levels in the presence group may promote vasoconstriction, exacerbate myocardial ischemia and accelerate disease progression (Saucedo-Orozco et al. 2022). CRP is a well-established marker of systemic inflammation, and its higher levels in the presence group indicate that inflammatory activation is involved in the occurrence of CVAEs. In addition, a larger total plaque volume reflects more severe coronary atherosclerotic burden, increasing the likelihood of vascular stenosis or occlusion and subsequent adverse cardiovascular events (Kataoka et al. 2023).

Multivariate logistic regression analysis further showed that TC, ET-1, CRP, and total plaque volume were significantly associated with CVAEs, whereas NO exhibited a protective association, underscoring the potential importance of lipid metabolism, endothelial function, inflammatory

response, and plaque burden in CHD progression. From a clinical perspective, these findings highlight the relevance of comprehensive risk assessment incorporating lipid profiles, endothelial markers, inflammatory indicators, and plaque characteristics. Interventions aimed at improving endothelial function and reducing inflammatory and atherosclerotic burden may be beneficial for lowering the risk of CVAEs, although prospective studies are required to confirm these potential clinical implications (Mehran et al. 2022).

In addition, ROC curve analysis demonstrated that the AUC values for TC, NO, ET-1, CRP, total plaque volume, serum NT-IGFBP-4, and SYNTAX-II score were all greater than 0.600, indicating varying degrees of discriminative ability for distinguishing patients with and without CVAEs in CHD. In general, a higher AUC value reflects better discrimination between outcome groups (Yamal et al. 2023). Notably, the SYNTAX-II score exhibited a relatively higher AUC, suggesting its potential utility in risk stratification of post-PCI CVAEs. Similarly, serum NT-IGFBP-4 demonstrated moderate discriminative performance, providing additional information that may complement existing clinical assessments (Li et al. 2022).

Several limitations of the present study should be acknowledged. First, this was a single-centre observational study with a relatively limited sample size, which may restrict the generalisability of the findings. Although the study population was well defined and data were collected using standardised procedures, the modest sample size may have reduced the statistical power to detect weaker associations. Second, due to the observational design, causal relationships between the SYNTAX-II score, NT-IGFBP-4 levels, endothelial dysfunction, inflammatory response, and CVAEs cannot be established. Third, although a one-year follow-up was performed, longer-term outcomes were not assessed. Therefore, future multicentre studies with larger sample sizes and extended follow-up periods are warranted to validate and expand upon these findings.

CONCLUSION

In conclusion, the present study demonstrates that the SYNTAX-II score and serum NT-IGFBP-4 levels are associated with endothelial function and inflammatory response in patients with CHD. These findings suggest that integrating anatomical-clinical risk assessment with circulating biomarkers may contribute to a more comprehensive evaluation of disease severity. Although the clinical implications require further confirmation, the SYNTAX-II score and NT-IGFBP-4 may offer complementary information for risk assessment in CHD. Future large-scale, multicentre studies are needed to further elucidate the underlying mechanisms and to clarify how these indicators can be optimally applied in clinical practice.

RECOMMENDATIONS

The SYNTAX-II score and serum NT-IGFBP-4 are associated with endothelial dysfunction and inflammatory activity in patients with CHD. These indicators may provide complementary information for risk assessment and disease evaluation, although their clinical application requires further validation in large-scale prospective studies.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Huiqing Lv was responsible for the conceptualisation, methodology design, formal analysis, and drafting of the original manuscript. Xin Ge contributed to data curation, investigation, and resource collection. Yiduo Zheng performed software processing, validation, and data visualisation. Jing Zuo participated in manuscript revision and provided supervision throughout the research process. Fusheng Xu managed the project and was involved in funding acquisition. Juan Cui contributed to the study methodology, supervised the research, and assisted in reviewing and editing the manuscript. All authors read and approved the final version of the manuscript.

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