International Journal of General Medicine

Dovepress
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ORIGINAL RESEARCH

# Changes in Serum PDGF-C and TGF-β1 Levels After PCI in Premature Coronary Artery Disease: Combined Predictive Value for MACCE

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**Objective:** This study evaluates dynamic changes in platelet derived growth factor C (PDGF-C) and transforming growth factor β1 (TGF-β1) levels after percutaneous coronary intervention (PCI) in patients with premature coronary artery disease (PCAD) and their combined predictive value for major adverse cardiac and cerebrovascular events (MACCE).

**Methods:** A total of 100 PCAD patients admitted to the hospital from July 2021 to July 2023 who had completed 2 years of follow-up were retrospectively selected as the research objects. The patients were divided into MACCE group and non-MACCE group according to the occurrence of MACCE. The changes of serum PDGF-C and TGF-β1 levels were compared before operation, 1 year after operation and 2 years after operation. Cox regression was used to test the influencing factors. Receiver operating characteristic (ROC) curve was used to predict the predictive value. The decision curve was used to analyze the predicting value of serum PDGF-C and TGF-β1.

**Results:** Compared with that before operation, serum PDGF-C levels increased, while TGF-β1 levels decreased at 1 year and 2 years post-PCI ($P<0.05$). The levels of hs-CRP, HDL-C, MPV and PDGF-C in the MACCE group were higher than those in the non-MACCE group, and the level of TGF-β1 was lower than that in the non-MACCE group ($P<0.05$). The hs-CRP, MPV and PDGF-C were identified as independent risk factors for MACCE ($HR>1$, $P<0.05$), and TGF-β1 was identified as a protective factor ($HR<1$, $P<0.05$). The AUC of PDGF-C levels and TGF-β1 levels n in predicting MACCE after PCI in PCAD patients were 0.796 and 0.837, respectively. Combined prediction has higher sensitivity and specificity than individual markers. The decision curve showed that within the threshold range of 0.141–0.202 and 0.216–0.998, the net return rate of the combination of PDGF-C and TGF-β1 levels in predicting MACCE after PCI in PCAD patients was better than that of either alone.

**Conclusion:** hs-CRP, MPV, PDGF-C and TGF-β1 were the influencing factors of MACCE in PCAD patients after PCI. Combined detection of PDGF-C and TGF- β1 enhanced predictive accuracy for MACCE, offering potential value for risk stratification in PCAD patients post-PCI.

**Keywords:** premature coronary artery disease, major adverse cardiac and cerebrovascular events, biomarkers, prediction model, risk stratification of

## Introduction

Coronary artery disease (CAD) is a common clinical cardiovascular disease, which occurs mostly in middle-aged and elderly people, with high morbidity and high mortality. The clinical manifestations of patients are palpitations, fatigue and other symptoms, which are easy to cause myocardial ischemia and hypoxia, threatening the life safety of patients.[1,2] Premature coronary artery disease (PCAD) is a special form of CAD, which refers to CAD occurring before the age of 65 in women and 55 in men. Coronary plaque tissue is more fibrous and has less necrotic calcified components in PCAD

Received: 6 December 2024
Accepted: 4 April 2025
Published: 30 April 2025

than in advanced CAD using coronary computed tomography. However, they often have an acute onset, often without premonitory symptoms, and the course of the disease progresses rapidly. If the treatment is not timely, it may cause myocardial infarction and lead to death.[3,4] With the increase of bad living habits and the younger age of underlying diseases, the onset age of PCAD gradually tends to be younger, and the mortality rate is as high as 113/100 000, which has become a global public health problem.[5] Young and middle-aged people are the main labor force in society and family. Once PCAD occurs, the loss of social economy and labor force will be far greater than that of the elderly, which will increase the medical burden of patients' families and society. The trend of PCAD cases and their clinical outcomes over time can clearly reflect the evolution of cardiovascular disease epidemiology, risk factors and medical needs.

At present, percutaneous coronary intervention (PCI) is the main way to treat PCAD, which can reconstruct coronary blood flow, relieve coronary artery stenosis, restore myocardial blood perfusion, and improve the clinical symptoms of patients. However, some PCAD patients are prone to major adverse cardiovascular and cerebrovascular events (MACCE) such as recurrent myocardial infarction and stroke after PCI treatment, which affects the prognosis of patients and increases the risk of rehospitalization and death.[6] Therefore, there is an urgent need to find a predictor of MACCE in PCAD patients after PCI, so that medical staff can carry out early intervention to reduce the risk of MACCE after PCI. In addition to cardiac ultrasound detection, serum detection has become an important means of clinical assistance in evaluating the condition of PCAD patients.[7] Platelet-derived growth factor C (PDGF-C) is closely related to the occurrence and development of tumors, atherosclerosis and other diseases, and it has good clinical value in predicting major MACCE of CAD.[8] Transforming growth factor beta 1 (TGF-β1) is a multifunctional cytokine that can prevent the formation of atherosclerotic plaques and delay the progression of PCAD. Edsfeldt et al[9] confirmed that high levels of TGF-β 1 can reduce inflammation and matrix degradation, which can reduce the risk of MACCE in patients with atherosclerosis in the future. In addition, compared with other commonly used biomarkers such as high-sensitivity troponin and C-reactive protein, serum PDGF-C and TGF-β1 have a longer metabolism time and can remain stable for a long time.[10,11] At present, there are many clinical studies on the relationship between serum PDGF-C and TGF-β1 and the severity of CAD or postoperative MACCE, but there are few studies on PCAD.

In view of this, this study retrospectively selected the clinical data of 100 PCAD patients who had completed 2 years of follow-up, and focused on analyzing the changes of serum PDGF-C and TGF-β1 levels in PCAD patients after PCI and their value in predicting MACCE.

# Materials and Methods

## General Materials

A retrospective study was conducted and a single-blind experiment was conducted. The clinical data of 100 PCAD patients admitted to the hospital from July 2021 to July 2023 who had completed 2 years of follow-up were selected. The Bayesian sample size calculation method was adopted for sample size.[12]

## Subjects Inclusion

Inclusion Criteria: (1) The patients met the diagnostic criteria for PCAD, and the age of female patients was <65 years old and the age of male patients was <55 years old;[13] (2) All patients underwent successful PCI; (3) The time from onset to admission was less than 12 hours; (4) The patients with good adherence; (5) The patients with complete clinical data; (6) Informed consent was obtained from patients and their families. Exclusion criteria: (1) Patients with contraindications to PCI; (2) Patients receiving anticoagulant or antiplatelet therapy before enrollment; (3) Patients with malignant tumors; (4) Patients with immune system diseases and blood diseases; (5) Patients with important organ dysfunction such as liver and kidney; (6) Patients who were infected on admission; (7) Patients with mental illnesses; (8) Patients with severe heart failure; (9) Patients with poor PCI effect, poor stent expansion, etc. According to the inclusion and exclusion criteria, a total of 100 PCAD patients were included in this study. There were 68 males and 32 females. The average age was (52.84 ± 3.85) years (45–64 years). The duration of PCAD was 1–3 years, with an average of (2.12 ± 0.58) years. The body mass index (BMI) was 22–25 kg/m2, with an average BMI of 23.51±1./m2. This study was approved by the Ethics committee of our hospital (Approval No: E2023-077-02), and complied with the Declaration of Helsinki.

## PCI Surgery

Routine disinfection was followed by drape. After local anesthesia, the patient underwent femoral artery puncture. A disposable guide wire GGW-10-35-260 (Medi Globe GmbH, Import License Number: 20222020252) was introduced through the puncture site. Sheath MI2355A (Medtronic, Inc., Import License Number: 20193030497) was introduced through the guide wire. Access was established through the outer sheath after the guidewire and inner sheath were pulled out to check the specific condition of the stenosis. A stent was inserted to dilate the vessels and keep it open. Finally, routine hemostasis was performed. The patients were followed up for 2 years, and telephone follow-up was conducted once a week for the first half of the year, and then once a month.

## Assessment and Grouping of MACCE

During the follow-up period, the occurrence of any of the following items was defined as the occurrence of MACCE: (1) Cardiac death; (2) Heart failure; (3) Recurrent myocardial infarction; (4) Malignant arrhythmia; (5) Repeat revascularization was required; (6) Stroke. All met the relevant diagnostic criteria.[14] According to the occurrence of MACCE, the patients were divided into MACCE group and non-MACCE group.

## Baseline Data Collection

Before surgery, the baseline data of patients were collected using the hospital's electronic medical record system, including age, BMI, duration of disease, gender, hypertension,[15] diabetes,[16] duration of surgery, and mean platelet volume (MPV) during hospital stay [The level of MPV was detected by an automatic hematology analyzer BC-5000 (Mindray Biomedical, Registration certificate number: 20172220313)]. A total of 3 mL of venous blood was collected from the patients and centrifuged. The levels of high-sensitivity C-reactive protein (hs-CRP), triglycerides (TG), serum total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and low-density cholesterol (LDL-C) were detected by a fully automated biochemical analyzer cobas pure c 303 (Roche Diagnostics GmbH, Import License Number: 20232220473).

### Detection of Serum PDGF-C and TGF-β1 Levels

Before operation, 1 year and 2 years after operation, 3 mL of venous blood was collected from the patient and centrifuged. The serum levels of PDGF-C and TGF-β1 were detected by enzyme-linked immunosorbent assay (ELISA) at 450 nm wavelength on an ELISA reader ELx808 (BioTek Instruments, Inc., Import License Number: 20192220540). The detection kits were obtained from Huamei Bioengineering Co., Ltd. and Shanghai Enzyme Linked Biotechnology Co., Ltd. Quality control: During the experiment, the same batch of 96-well plates were used to avoid the effect of batch differences on the experimental results. Blank, negative, and positive controls were set for each experiment to monitor the validity of the experiment. The plate washing process was carried out in strict accordance with the instructions to ensure that the plate was washed thoroughly and to avoid residual substances interfering with the test results. The microplate reader was preheated and calibrated before use to ensure the accuracy of wavelength and the reliability of absorbance detection.

## Statistical Analysis

SPSS 25.0 software was used for data processing. Measurement data were represented as $\bar{x} \pm s$. Independent sample *t*-test was used for comparison between two groups, and repeated measure ANOVA was used for comparison among multi time point within groups. Enumeration data were represented as n% and a chi-square test was used for the analysis. Cox regression was used to analyze the influencing factors of MACCE in PCAD patients after PCI. Receiver operating characteristic (ROC) curve was used to predict the predictive value of serum PDGF-C and TGF-β1 levels for MACCE in PCAD patients after PCI. AUC < 0.5 indicated no value, $0.5 \leq$ AUC<0.7 indicated low value, $0.7 \leq$ AUC $\leq 0.9$ indicated medium value, and >0.9 indicated high value. R4.1.3 statistical software was used to draw the decision curve of serum PDGF-C and TGF-β 1 for predicting MACCE in PCAD patients after PCI, with the high-risk threshold as the abscissa and the net rate of return as the ordinate. The test level was $\alpha$=0.05.

# Results

## Serum Levels of PDGF-C and TGF-β1

The results of repeated measure ANOVA showed that the main effect of PDGF-C measurement frequency was significant ($F$=393.071, $P$<0.001, bias η2=0.799). The main effect of TGF-β1 measurement frequency was significant ($F$=151.845, $P$<0.001, bias η2=0.605). Compared with that before operation, the level of serum PDGF-C increased and the level of TGF-β1 decreased successively at 1 year and 2 years after operation, and all reached a significant level ($P$<0.05, Table 1, Figures 1 and 2).

## Incidence Rate of MACCE

According to the occurrence of MACCE, 100 PCAD patients treated with PCI were divided into MACCE group (n = 35) and non-MACCE group (n = 65). The incidence of MACCE was 35.00%. There were 3 cases (8.57%) of cardiac death, 9 cases (25.71%) of heart failure, 11 cases (31.43%) of recurrent myocardial infarction, and 12 cases (34.29%) of malignant arrhythmia.

## Baseline Data

The levels of hs-CRP, HDL-C, MPV and PDGF-C in MACCE group were statistically higher than those in the non-MACCE group, and the level of TGF-β1 was statistically lower than that in the non-MACCE group ($P$<0.05, Table 2).

## Influencing Factors of MACCE in PCAD Patients After PCI Surgery

COX regression analysis was performed with the occurrence of MACCE as the dependent variable (1 = occurrence of MACCE, 0 = absence of MACCE), and hs-CRP, HDL-C, MPV, PDGF-C and TGF-β1 as independent variables (all continuous variables). The results showed that hs-CRP, MPV and PDGF-C were independent risk factors for the occurrence of MACCE in PCAD patients after PCI ($HR$>1, $P$<0.05), and TGF-β1 was a protective factor ($HR$<1, $P$<0.05, Table 3). The fit of Homos-Remeshaw was good ($\chi^2$=13.789, $P$=0.087).

## The Predictive Value of PDGF-C and TGF-β1 for MACCE After PCI in PCAD Patients

The results of ROC curve showed that the AUC of PDGF-C levels, TGF-β1 levels, and the combined detection in predicting MACCE in PCAD patients after PCI was 0.796, 0.837 and 0.900, respectively. The combined detection had the highest predictive value, with the Youden index of 0.682, the specificity of 0.815 and the sensitivity of 0.857, respectively (Table 4 and Figure 3).

**Table 1** Comparison of Changes in Serum PDGF-C and TGF - β 1 Levels After PCI Treatment ($\bar{x} \pm s$)

| Groups | PDGF-C (ng/L) | | | TGF-β1 (ng/mL) | | |
|---|---|---|---|---|---|---|
| | Before Surgery | 3 Months After Surgery | 6 Months After Surgery | Before Surgery | 3 Months After Surgery | 6 Months After Surgery |
| PCAD patients (n=100) | 265.47±28.13 | 207.42±21.26* | 193.53±20.98*[a] | 3.46±0.83 | 5.52±1.12* | 6.01±1.37*[a] |
| Main effect of groups | - | | | - | | |
| Main effect of measurement frequency | $F$=393.071, $P$<0.001, bias η2=0.799 | | | $F$=151.845, $P$<0.001, bias η2=0.605 | | |
| Groups* Measurement frequency | - | | | - | | |

**Notes**: *$P$<0.05 compared with preoperative data in the same group; [a]$P$<0.05 compared with 3 months after surgery in the same group.

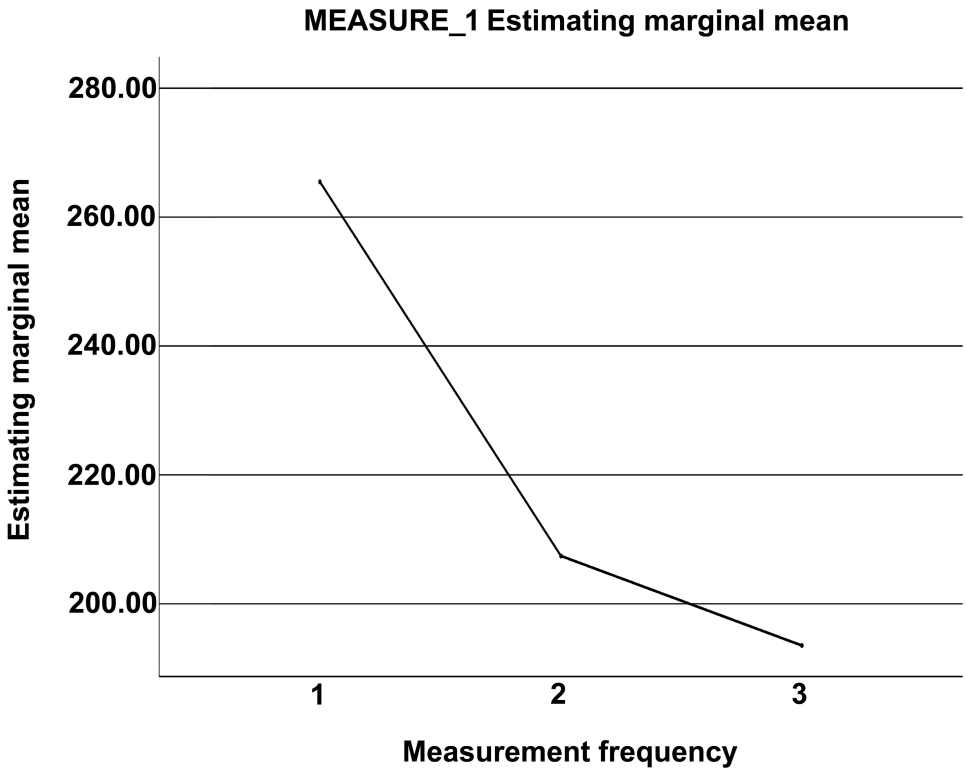


**Figure 1** Comparison about simple effects of PDGF-C measurement sequence.

## Decision Curve of PDGF-C and TGF-β1 on MACCE Occurrence in PCAD Patients After PCI

The results of decision curve showed that within the threshold range of 0.141–0.202 and 0.216–0.998, the net yield of the combination of PDGF-C and TGF-β1 in predicting MACCE after PCI in PCAD patients was better than that of either alone (Figure 4).

# Discussion

Although PCI has a certain effect on PCAD, some patients still have MACCE after operation, which causes sequelae such as neurological damage and targeted organ damage, and affects the quality of life and labor ability of patients.[16] Therefore, how to accurately predict the occurrence of MACCE after PCI in PCAD patients and carry out effective intervention measures accordingly to reduce the risk of MACCE after PCI is an important problem that needs to be solved in the clinical treatment of PCAD. According to Shi et al,[17] the incidence of MACCE in PCAD patients after PCI was 29.09%, which was lower than that in this study [35.00% (35/100)]. The relatively high MACCE rate was mainly due to the longer follow-up period; thus, additional information on recurrent events or late complications may be available for long-term risk assessment. Moreover, the sample size was small, resulting in a relatively high MACCE rate.

PDGF-C, a member of the PDGF family, is located on chromosome 4 and is mainly secreted by vascular endothelial cells. PDGF-C can induce the migration and differentiation of monocytes and macrophages through the PI3K/Akt pathway, which aggravates inflammatory response, accelerate the formation of atherosclerotic plaque, thus increasing the risk of PCAD by blocking coronary arteries and reducing blood supply to the heart.[18] TGF-β1 is a multifunctional cytokine, which is mainly secreted by platelets and macrophages. It can indirectly participate in the inflammatory response pathway of CAD by upregulating the expression of programmed cell death ligand 1 on antigen-presenting cells. TGF-β1 inhibits the secretion of interleukin-1 and tumor necrosis factor-α, promotes the apoptosis of neutrophils involved in plaque formation, stabilizes the plate, and reduces vascular damage. Thus, TGF-β1 reduces the risk of vascular intimal hyperplasia and vascular stenosis, thereby delaying the development of PCAD.[19] According to the study by Dong et al,[20] targeting Epsins to inhibit fibroblast growth factor signaling and

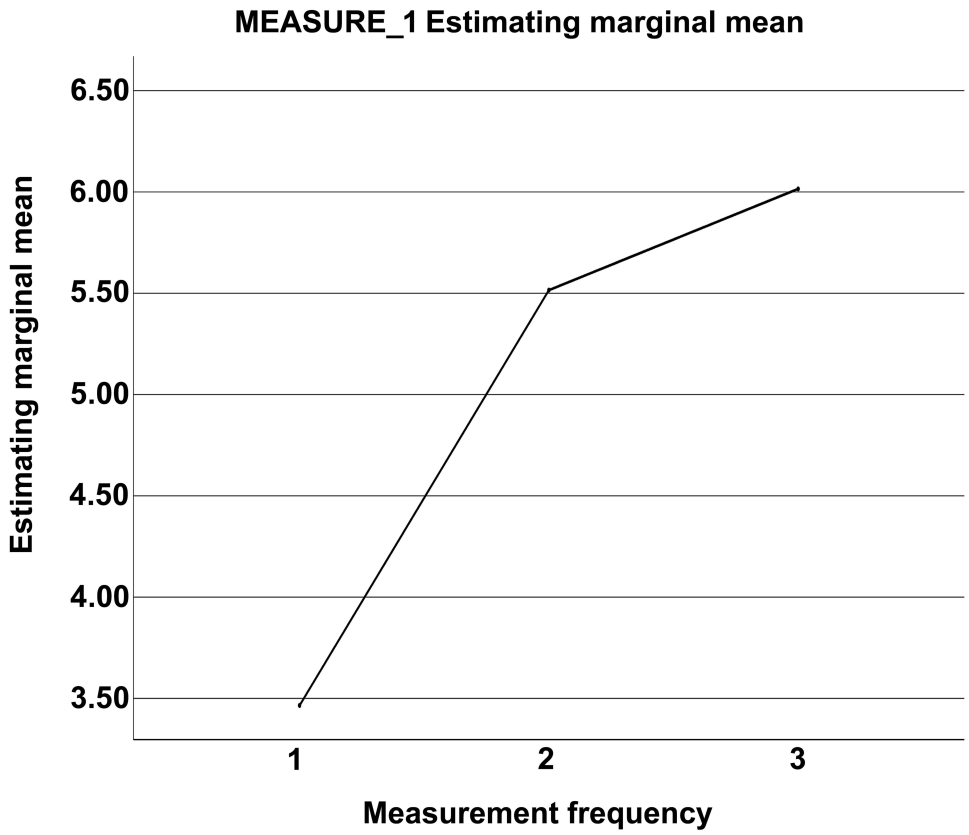


**Figure 2** Comparison about simple effects of TGF-β1 measurement sequence.

enhance TGF-β1 signaling can effectively limit the transition of endothelial cells to mesenchymal in atherosclerosis and reduce the risk of MACCE. According to Liang et al,[21] the level of PDGF-C can predict the risk of short-term and long-term MACCE in patients with non-ST-segment elevation myocardial infarction after discharge, which is similar to the results of this study. It can be seen that PDGF-C and TGF-β1 are closely related to the occurrence and development of PCAD patients, and improving their levels has positive significance for the prognosis of patients. The results of this study showed that the serum PDGF-C levels gradually increased and the TGF-β1 levels gradually decreased in PCAD patients after PCI treatment. The reason may be that PCI is a minimally invasive surgery for the treatment of PCAD and CAD, which can further expand the patient's blood vessels through intervention and improve the patient's myocardial ischemia and heart function, thus achieve the effect of alleviating the disease. Therefore, it is speculated that PCI intervention can help serum PDGF-C and TGF-β1 to return to normal levels to a certain extent.[22,23]

The results of COX regression analysis showed that hs-CRP, MPV, PDGF-C and TGF-β1 are the influencing factors of MACCE in PCAD patients after PCI. Moreover, PDGF-C and TGF-β1 have certain value in predicting MACCE in PCAD patients after PCI. hs-CRP is a kind of CRP in plasma, which can reflect the inflammatory state of the body. Higher levels of hs-CRP can impair endothelial cell function and induce endothelial cell apoptosis. PDGF-C can promote the proliferation of vascular smooth muscle cells, increase the thickness of vascular wall, and aggravate luminal stenosis. Both of them can promote the progression of PCAD, aggravate the disease process of PCAD patients, and then increase the risk of MACCE after PCI.[8,24] MPV generally refers to the mean platelet volume, which can reflect the changes of platelet size. High levels of MPV can promote the secretion of related thrombotic factors, make thrombosis easier to form, further aggravate vascular lumen stenosis, promote inflammatory response, and induce plaque rupture.[25] In the long run, this may lead to MACCE. The decrease of regulatory T cells (Treg) is also one of the important pathogenesis of PCAD, which is similar to the results of this study. Moreau et al[26] confirmed that Treg and TGF-β1 levels were positively correlated. They believed that TGF-β1 had a certain significance in Treg to maintain the body's immune stability, and low level of TGF-β1 may promote the progress of PCAD and increase the risk of MACCE after

**Table 2** Comparison of Baseline Data Between Two Groups ($\bar{x} \pm s$)/n (%)

| Variable | | MACCE Group (n=35) | Noe MACCE Group (n=65) | $\chi^2$/t value | *P* value |
|---|---|---|---|---|---|
| Age (year) | | 49.27±3.26 | 50.65±3.58 | 1.896 | 0.061 |
| BMI (kg/m$^2$) | | 22.83±1.02 | 22.41±1.15 | 1.810 | 0.073 |
| The course of disease (year) | | 2.43±0.51 | 2.23±0.49 | 1.919 | 0.058 |
| Gender | Male | 23 (65.71) | 45 (69.23) | 0.129 | 0.719 |
| | Female | 12 (34.29) | 20 (30.77) | | |
| Positive hypertension | | 8 (22.86) | 18 (27.69) | 0.276 | 0.599 |
| Positive diabetes | | 9 (25.71) | 22 (33.85) | 0.703 | 0.402 |
| hs-CRP (mg/L) | | 13.39±1.69 | 11.71±1.14 | 5.908 | <0.001 |
| TG (mmol/L) | | 1.89±0.43 | 1.75±0.48 | 1.441 | 0.153 |
| TC (mmol/L) | | 4.57±1.03 | 4.26±1.15 | 1.332 | 0.186 |
| HDL-C (mmol/L) | | 1.67±0.43 | 1.48±0.45 | 2.05 | 0.044 |
| LDL-C (mmol/L) | | 2.08±0.54 | 2.01±0.47 | 0.674 | 0.502 |
| MPV (fL) | | 12.19±1.62 | 10.36±1.58 | 5.476 | <0.001 |
| PDGF-C (ng/L) | | 264.43±20.42 | 239.76±20.38 | 5.770 | <0.001 |
| TGF-β1 (ng/mL) | | 3.01±0.59 | 3.71±0.63 | 5.416 | <0.001 |
| Duration of surgery (min) | | 63.56±7.24 | 60.92±7.01 | 1.776 | 0.079 |
| Hospitalization time (d) | | 5.46±1.23 | 5.62±1.38 | 0.574 | 0.567 |

**Table 3** Influencing Factors of MACCE in PCAD Patients After PCI Surgery

| Influencing Factors | *β* | Standard Error | *Wald*$\chi^2$ | *P* value | *HR* | 95% Confidence Interval |
|---|---|---|---|---|---|---|
| hs-CRP | 0.311 | 0.143 | 4.721 | 0.030 | 1.364 | 1.031–1.806 |
| HDL-C | 0.139 | 0.380 | 0.133 | 0.715 | 1.149 | 0.546–2.418 |
| MPV | 0.206 | 0.104 | 3.969 | 0.046 | 1.229 | 1.003–1.506 |
| PDGF-C | 0.024 | 0.009 | 6.417 | 0.011 | 1.024 | 1.005–1.043 |
| TGF-β1 | −0.643 | 0.301 | 4.561 | 0.033 | 0.526 | 0.291–0.948 |

**Table 4** The Predictive Value of PDGF-C and TGF-β1 for MACCE After PCI in PCAD Patients

| Items | AUC | Cut-off Value | 95% CI | *P* value | Specificity | Sensitivity | Youden's Index |
|---|---|---|---|---|---|---|---|
| PDGF-C | 0.796 | 250.135 | 0.704–0.888 | <0.001 | 0.692 | 0.800 | 0.492 |
| TGF-β1 | 0.837 | 3.450 | 0.760–0.914 | <0.001 | 0.662 | 0.886 | 0.548 |
| Combined detection | 0.900 | 0.368 | 0.836–0.964 | <0.001 | 0.815 | 0.857 | 0.672 |

PCI. ROC curve analysis showed that the AUC of PDGF-C levels, TGF-β1 levels and the combined examination in predicting MACCE in PCAD patients after PCI were all greater than 0.70, which indicated that PDGF-C and TGF-β1 had certain predictive value, and the combination of the two had the highest predictive value. The results of the decision curve show that within the threshold range of 0.141–0.202 and 0.216–0.998, the net yield of the combination of PDGF-C and TGF-β1 in predicting MACCE after PCI in PCAD patients was better than that of either alone. The results of the ROC curve analysis and the decision curve

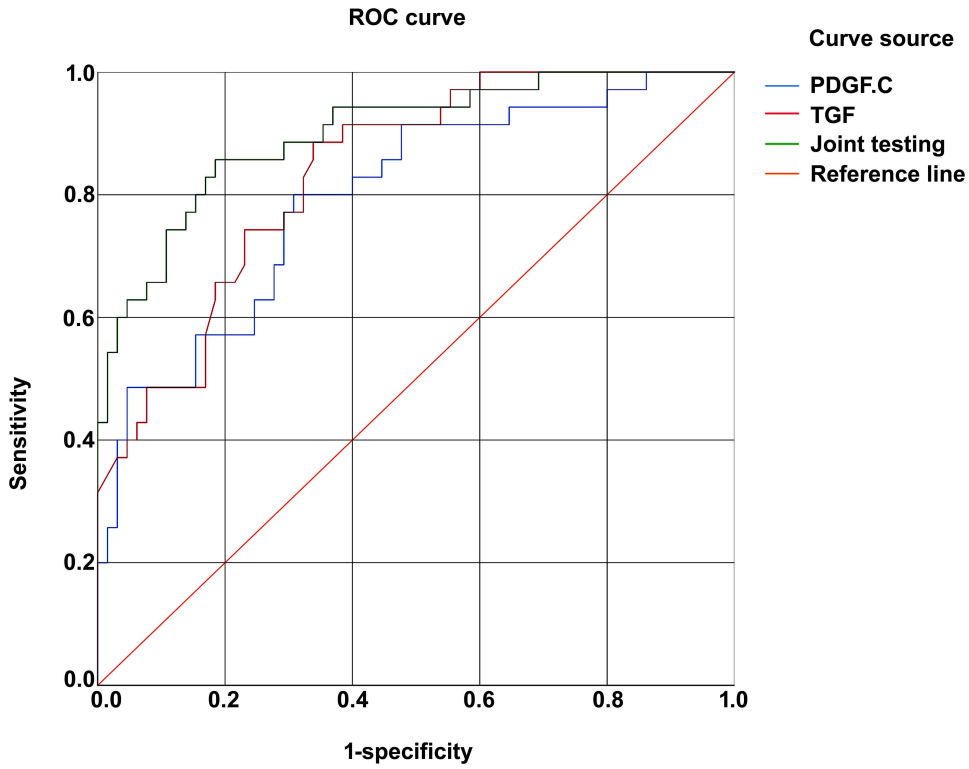


**Figure 3** The predictive value of PDGF-C and TGF-β1 for MACCE after PCI in PCAD patients.
**Abbreviations**: PDGF-C, platelet derived growth factor C; TGF-β1, transforming growth factor β1.

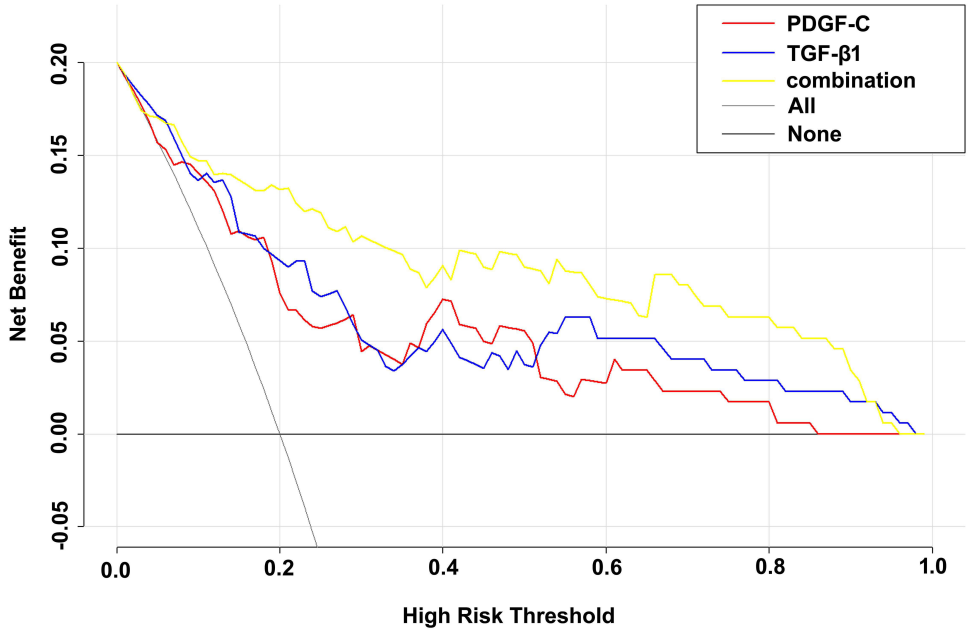


**Figure 4** Decision curve of PDGF-C and TGF-β1 on MACCE occurrence in PCAD patients after PCI.

indicated that PDGF-C and TGF-β1 can predict the risk of MACCE in PCAD patients after PCI, and the net return rate of combined prediction was higher. PDGF-C is a pro-angiogenic factor independent of vascular endothelial growth factor A, which can induce the generation of adventitial neovascularization. PDGF-C increases the blood supply in PCAD plaques, accelerates plaque expansion, and increases the risk of plaque rupture and detachment, which may cause platelet aggregation and thrombosis

again, resulting in vascular obstruction.[8,27] TGF-β1 is a secreted protein belonging to the TGF-β superfamily, which can inhibit the mitosis of vascular smooth muscle cells (VSMCS) from G phase to S phase and reduce the proliferation of VSMCS. Thus, it reduces the risk of atherosclerosis vascular intimal hyperplasia, the severity of PCAD patients, and the risk of MACCE.[28,29] Previous studies have shown that TGF-β1 can help stabilize atherosclerotic plaque, reduce plaque rupture and shedding after PCI, and reduce the risk of MACCE in PCAD patients after PCI.[30,31]

Our study still has certain limitations. For instance, the sample size was limited, the study method was relatively single, the baseline data were less included, the hemogram and glomerular filtration rate were not included, the external verification was not performed, the patients with severe comorbidities were not included, and only middle-aged patients with a narrow BMI range were focused. Thus, the results may not be applicable to the larger PCAD population, which could affect the findings. Moreover, the effects of age, gender, and severity on serum PDGF-C and TGF-β1 were not explored in depth. In the future, large sample, multi-center and multi-mode studies are needed to analyze the value of serum PDGF-C and TGF-β1 in predicting MACCE in PCAD patients after PCI.

## Conclusion

(1) Biomarker trends: The main effect of the number of PDGF-C measurement was significant ($F = 393.071$, $P < 0.001$, bias $\eta 2 = 0.799$). The main effect of the number of TGF-β1 measurement was significant ($F = 151.845$, $P < 0.001$, bias $\eta 2 = 0.605$). Compared with that before operation, the level of serum PDGF-C increased and the level of TGF-β1 decreased successively at 1 year and 2 years after operation, and all reached a significant level ($P < 0.05$). (2) Incidence of MACCE: 100 PCAD patients treated with PCI were divided into MACCE group (n = 35) and non-MACCE group (n = 65). The incidence of MACCE was 35.00%. There were 3 cases (8.57%) of cardiac death, 9 cases (25.71%) of heart failure, 11 cases (31.43%) of recurrent myocardial infarction, and 12 cases (34.29%) of malignant arrhythmia. (3) Predictive value analysis: TGF-β1 was an influencing factor of MACCE in PCAD patients after PCI. The combined detection of PDGF-C and TGF-β1 had a certain predictive value in predicting the occurrence of MACCE in PCAD patients after PCI, and the AUC was 0.900, showing a strong predictive value.

In general, serum PDGF-C levels increased and TGF-β1 levels decreased in PCAD patients after PCI. hs-CRP, MPV and PDGF-C were the influencing factors of MACCE in PCAD patients after PCI. The combined detection of PDGF-C and TGF-β1 had a certain predictive value in predicting the occurrence of MACCE in PCAD patients after PCI, and the results had biological significance. Clinical detection of PDGF-C and TGF-β1 levels can predict the risk of MACCE in PCAD patients after PCI, so as to provide guidance strategies for clinical effective treatment. Drug therapy, diet regulation and other ways to stabilize the levels of PDGF-C and TGF-β1 can reduce the risk of MACCE in PCAD patients after PCI.

## Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Ethical Approval

This study was approved by The Ethics Committee of Guigang City People's Hospital (Approval No: E2023-077-02) and complied with the Declaration of Helsinki. Informed consent was obtained from participants for the participation in the study and all methods were carried out in accordance with relevant guidelines and regulations.

## Funding

This study was funded by Guigang City Self Funded Research Project (GKR2300030).

## Disclosure

Haide Liu and Shanglang Tan are co-first authors and co-corresponding authors. The authors report no conflicts of interest in this work.

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