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The Personality and Psychological Stress Predict Major Adverse Cardiovascular Events in Patients With Coronary Heart Disease After Percutaneous Coronary Intervention for Five Years

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Abstract: To investigate the effects of personality type and psychological stress on the occurrence of major adverse cardiovascular events (MACEs) at 5 years in patients with coronary artery disease (CAD) after percutaneous coronary intervention (PCI).

Two hundred twenty patients with stable angina (SA) or non-ST segment elevation acute coronary syndrome (NSTE-ACS) treated with PCI completed type A behavioral questionnaire, type D personality questionnaire, Self-Rating Depression Scale (SDS), Self-Rating Anxiety Scale (SAS), Trait Coping Style Questionnaire (TCSQ), and Symptom Checklist 90 (SCL-90) at 3 days after PCI operation. Meanwhile, biomedical markers (cTnI, CK-MB, LDH, LDH_1) were assayed. MACEs were monitored over a 5-year follow-up.

NSTE-ACS group had higher ratio of type A behavior, type A/D behavior, and higher single factor scores of type A personality and type D personality than control group and SAP group. NSTE-ACS patients had more anxiety, depression, lower level of mental health ($P < 0.05$; $P < 0.01$), more negative coping styles and less positive coping styles. The plasma levels of biomedical predictors had positive relation with anxiety, depression, and lower level of mental health. Type D patients were at a cumulative increased risk of adverse outcome compared with non-type D patients ($P < 0.05$).

Patients treated with PCI were more likely to have type A and type D personality and this tendency was associated with myocardial injury. They also had obvious anxiety, depression emotion, and lower level of mental health, which were related to personality and coping style. Type D personality was an independent predictor of adverse events.

Abbreviations: CAD = coronary artery disease, CH = competitive hostility, CK-MB = creatine kinase-MB, cTnI = cardiac troponin I, DS14 = type D Personality Scale, HDL-C = high-density lipoprotein cholesterol, LDH = lactic dehydrogenase, LDL-C = low-density lipoprotein cholesterol, MACE = major adverse cardiovascular events, NA = negative affectivity, NC = negative coping, NSTE-ACS = non-ST segment elevation acute coronary syndrome, PC = positive coping, PCI = percutaneous coronary intervention, SA = stable angina, SAS = Self-Rating Anxiety Scale, SCL-90 = Symptom Checklist 90, SDS = Self-Rating Depression Scale, SI = social inhibition, TABP = type A Behavior Pattern Scale, TC = total cholesterol, TCSQ = Trait Coping Style Questionnaire, TG = triglyceride, TH = time hurry.

INTRODUCTION

Cardiovascular diseases have become the leading cause of death in the world, among which coronary artery disease (CAD) stands out due to its high morbidity and mortality. Studies have found that personality type and psychological stress might play great roles in the pathogenesis of CAD. Patients with type A behavior have higher levels of plasma catecholamine and 5-hydroxytryptamine and higher incidence of arrhythmia.[1,2] Apart from personality type, cognitive model, incompetence of using social support and lack of appropriate coping styles can also affect the development and prognosis of CAD.

Percutaneous coronary intervention (PCI) has been widely applied to patients with CAD, but it still carries some possible complications. The possibility of their occurrence is one of the reasons to feel fear and discomfort, affecting the patients' psychological status, emotional response, medical behavior, and rehabilitation.[3] Symptoms of fear and behavioral problems can be detected in CAD patients after PCI relative frequently.[4,5] Meanwhile, the death rate was higher for type D behavior patients and special psychology intervention could reduce this phenomenon.[6–8]

In the present study, we aimed to find out the difference of personality type, negative emotion response, and psychological stress between NSTE-ACS patients and stable angina ones treated with PCI and their impacts on prognosis at 5 years' follow-up.

METHODS

Study Population

Two hundred twenty angiographically documented CAD patients including 89 cases of stable angina (SA) and 131 cases of non-ST segment elevation acute coronary syndrome

(NSTE-ACS) were selected from Qilu Hospital of Shandong University between January 1, 2009 and January 1, 2010. All those patients were performed PCI operation. Thirty normal volunteers were selected as control. Patients with other macrovascular diseases, psychosis history, family history of psychosis, or other serious diseases (such as cancer, renal failure) were excluded. All patients gave their informed consents to this study and the protocol was approved by the Ethics Committee of Qilu Hospital of Shandong University.

Blood Biomarker Measurements

Blood samples from every patient were collected on admission to the hospital. Serum levels of total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C) were measured by enzymatic assays. Levels of biomedical markers (cTnI, CK-MB, LDH, LDH_1) were measured.

Personality Questionnaire

The type A Behavior Pattern Scale (TABP) and type D Personality Scale (DS14) were used to identify type A personality and type D personality, respectively.[9,10] TABP includes time hurry (TH) and competitive hostility (CH) scores. Subjects scoring 37 to 50 were classified as type A personality. DS14 comprises two 7-item subscales: negative affectivity (NA) and social inhibition (SI). The presence of type D personality is defined as having a cut-off score of ≥ 10 on both subscales. Zung's Self-Rating Depression Scale (SDS) and Zung's Self-Rating Anxiety Scale (SAS) were used to access the level of depression and anxiety.[11,12] We examined the coping style by Trait Coping Style Questionnaire (TCSQ) which consists of negative coping (NC) and positive coping (PC).[13] Symptom Checklist 90 (SCL-90), a self-report questionnaire of multidimensional complaints with normative data, was also used.[14]

Clinical End-Points

Recurrent major adverse cardiovascular events including myocardial reinfarction, CCS (Canadian Cardiovascular Society) grades $\geq III$ angina pectoris, revascularization, and death that occurred in the 5 years after PCI were considered primary end-points. Revascularization was defined as PCI or coronary artery bypass grafting. We followed up the patients through office visits and/or telephone interviews.

Statistical Analyses

All analyses involved use of SPSS16.0 software package (SPSS Inc, Chicago, IL). Values were expressed as mean ± SD. ANOVA was used to compare continuous variables and lysergic acid diethylamide test was performed to do post hoc comparisons. We used χ^2 test to compare categorical data. A $P < 0.05$ was considered statistically significant. The cumulative incidence of the primary end-points between the type D patients and the non-type D patients was analyzed by Kaplan–Meier curves.

RESULTS

The Basic Characteristics and Blood Biomarker Measurements

As shown in Table 1, there was no significant difference among the 3 groups regarding age, sex, body weight, lipid profile, smoking history, and family history. Concentrations of cTNI, CK-MB, LDH, and LDH_1 were significantly higher in the NSTE-ACS group than those of SAP and control groups ($P < 0.05$ or $P < 0.01$) (Table 1).

Personality Types

The incidence of type A personality in control group was 3.33% versus 8.99% in SAP patients, 39.69% in NSTE-ACS patients, while that of type D personality of 3 groups did not have significant difference. Patients with both type A and type

TABLE 1. Clinical and Biochemical Characteristics in the 3 Groups

Parameters	NSTE-ACS (n = 131)	Gr SAP (n = 89)	Control (n = 30)
Age, y	59 ± 7	58 ± 6	58 ± 7
Male, %	79 (60.3%)	55 (61.8%)	18 (60.0%)
Systolic blood pressure, mm Hg	137 ± 12	136 ± 11	131 ± 9
Diastolic blood pressure, mm Hg	86 ± 13	84 ± 15	79 ± 11
Body mass index, kg/m^2	26.9 ± 2.2	27.0 ± 2.4	25.1 ± 2.3
Diabetes mellitus	39 (29.8%)	26 (29.2%)	7 (23.3%)
Dyslipidemia	43 (32.8%)	28 (31.5%)	8 (26.7%)
Hypertension	52 (39.7%)	35 (39.3%)	10 (33.3%)
Current smokers	45 (34.4%)	29 (32.6%)	9 (30.0%)
Glucose, mmol/L	6.35 ± 2.00	6.36 ± 1.71	5.80 ± 1.48
Total cholesterol, mmol/L	5.73 ± 1.01	5.59 ± 0.99	5.47 ± 0.76
Low density lipoprotein, mmol/L	4.00 ± 1.00	3.75 ± 0.87	3.37 ± 0.68
High density lipoprotein, mmol/L	1.09 ± 0.15	1.01 ± 0.13	1.12 ± 0.19
cTNI, ng/L	0.69 ± 1.70[*,†]	0.09 ± 0.01	0.01 ± 0.01
CK-MB, u/L	16.50 ± 10.39[*,‡]	12.36 ± 4.89	12.40 ± 4.21
LDH, u/L	212.56 ± 67.17[*,‡]	162.80 ± 0.43	170.83 ± 54.73
LDH_1, u/L	77.22 ± 38.47[*,‡]	45.84 ± 0.33	51.37 ± 7.00

CK-MB = creatine kinase-MB, cTnI = cardiac troponin I, LDH = lactic dehydrogenase.
[*]$P < 0.05$ vs control group.
[†]$P < 0.05$.
[‡]$P < 0.01$ vs SAP group.

TABLE 2. Proportion of Personality Types in the 3 Groups

	NSTE-ACS (n = 131)	SAP (n = 89)	Control (n = 30)
Type A, %	39.69% (52/131)[†,§]	8.99% (8/89)	3.33% (1/30)
Type D, %	40.46% (53/131)	21.35% (19/89)	16.67% (5/30)
Type A/D, %	19.85% (26/131)[*,‡]	0.00% (0/89)	0.00% (0/30)

[*] $P < 0.05$.
[†] $P < 0.01$ vs control group.
[‡] $P < 0.05$.
[§] $P < 0.01$ vs SAP group.

D personality in NSTE-ACS group were 19.85% versus 0% in both control group and SAP group ($P < 0.05$, $P < 0.01$) (Table 2). For the signal factor scores, NSTE-ACS group has higher scores than both control group and SAP group ($P < 0.05$, $P < 0.01$). Accordingly, behavior pattern was significantly related to the pathogenesis of CAD (Table 3).

Negative Emotion, Psychology Health, and Coping Style

With significant higher scores of SDS, SAS, and SCL-90, NSTE-ACS patients tended to have more depression and anxiety ($P < 0.05$; $P < 0.01$) (Table 4). By contrast, patients with NSTE-ACS had higher negative coping score and lower positive coping score than the other 2 groups (Table 5).

Correlates of Biomedical Predictors and Psychology Indicators

Biomedical predictors (cTNI, CK-MB, LDH, LDH$_1$) were positively related to depression, anxiety, psychology health, having no relationship with type D personality or coping styles. LDH was negatively related to type A personality (Table 6). We also found depression, anxiety, psychology health were associated with negative coping style, but negatively related to type D personality, type A personality, and positive coping style (Table 7).

Clinical End-Points

At 5 years' follow-up, there were 53 events in the CAD patients, of which 39 events in NSTE-ACS group and 14 in SAP group. As shown in Table 2, there was total of 98 patients with

TABLE 3. Signal Factor Scores of Personality Types in the 3 Groups

	NSTE-ACS (n = 131)	SAP (n = 89)	Control (n = 30)
Type D	23.80 ± 9.01[*,‡]	15.27 ± 8.39	14.70 ± 7.56
SI	12.02 ± 5.30[*,‡]	9.09 ± 5.09	8.57 ± 3.90
NA	11.78 ± 5.93[*,‡]	6.20 ± 4.07	6.07 ± 4.78
Type A	32.84 ± 7.07[*]	29.53 ± 5.98	25.70 ± 7.53
TH	17.38 ± 3.93[*]	15.78 ± 3.69	13.20 ± 4.80
CH	15.47 ± 4.05[*,†]	13.71 ± 3.55	12.50 ± 3.79

CH = competitive hostility, NA = negative affectivity, SI = social inhibition, TH = time hurry.
[*] $P < 0.01$ vs control group.
[†] $P < 0.05$.
[‡] $P < 0.01$ vs SAP group.

TABLE 4. Negative Emotion and Psychology Health in 3 Groups

	NSTE-ACS (n = 131)	SAP (n = 89)	Control (n = 30)
SAS	50.31 ± 8.36[*,†]	40.76 ± 8.39	39.97 ± 4.60
SDS	55.72 ± 6.62[*,†]	48.14 ± 8.15	44.97 ± 8.77
SCL-90	197.0 ± 45.63[*,†]	138.76 ± 39.19	126.57 ± 26.28

SAS = self-rating anxiety scale, SCL-90 = symptom checklist 90, SDS = self-rating depression scale.
[*] $P < 0.01$ vs Control group.
[†] $P < 0.01$ vs SAP group.

TABLE 5. Coping Styles in 3 Groups

	NSTE-ACS (n = 131)	SAP (n = 89)	Control (n = 30)
Positive coping	33.42 ± 7.75[†]	37.44 ± 7.61	35.60 ± 7.60
Negative coping	34.04 ± 6.23[*,‡]	29.56 ± 9.31	28.57 ± 6.41

[*] $P < 0.01$ vs control group.
[†] $P < 0.05$.
[‡] $P < 0.01$ vs SAP group.

TABLE 6. Correlation of Biomedical Predictors and Psychology Indicators

	SAS	SDS	Type D	Type A	PC	NC	Scl-90
cTNI	0.251[†]	0.183[*]	−0.088	0.045	−0.47	0.039	0.351[†]
CK-MB	0.197[*]	0.250[†]	−0.010	0.042	−0.092	0.112	0.346[†]
LDH	0.292[†]	0.200[†]	0.008	−0.250[†]	−0.043	0.073	0.303[†]
LDH$_1$	0.310[†]	0.310[†]	−0.031	−0.144	−0.077	0.152	0.357[†]

CK-MB = creatine kinase-MB, cTnI = cardiac troponin I, LDH = lactic dehydrogenase, NC = negative coping, PC = positive coping, SAS = self-rating anxiety scale, SCL-90 = symptom checklist 90, SDS = self-rating depression scale.
[*] $P < 0.05$.
[†] $P < 0.01$

TABLE 7. Correlates of Psychology Indicators

	Type D	Type A	PC	NC
SAS	−0.290[†]	−0.236[†]	−0.230[*]	0.365[†]
SDS	−0.273[†]	−0.115	−0.294[†]	0.378[†]
Scl-90	−0.336[†]	−0.160	−0.182[*]	0.349[†]

NC = negative coping, PC = positive coping, SAS = self-rating anxiety scale, SCL-90 = symptom checklist 90, SDS = Self-rating depression scale.

[*] $P < 0.05$.
[†] $P < 0.01$.

TABLE 8. Major Adverse Cardiac Events During 5-Year Follow-Up

	Type D (n = 98)	Non-Type D (n = 122)	P Value
MACE, %	31 (31.6)	22 (18.0)	<0.05
Death	3 (3.1)	2 (1.6)	>0.05
Reinfarction, %	6 (6.1)	4 (3.2)	>0.05
Severe angina pectoris, %	22 (22.4)	16 (13.1)	<0.05
Revascularization, %	8 (8.2)	5 (4.1)	>0.05

MACE = major adverse cardiovascular events.

type D personality (including A/D type) in the 2 CAD groups. Type D patients had higher incidences of MACEs (31.6%) and severe angina pectoris (22.4%) compared with those of non-type D patients (18.0% and 13.1%, respectively; Table 8). Type D patients were at a cumulative increased risk of adverse outcome compared with non-type D patients ($P < 0.05$, Figure 1).

DISCUSSION

In the present study, we found that patients treated with PCI were more likely to have type A and type D personality and this tendency was associated with myocardial injury. The type D personality patients also had obvious anxiety, depression emotion, and lower level of mental health. The patients' psychological responses were related to personality and coping style. Type D personality was an independent predictor of adverse events including nonfatal myocardial reinfarction, severe angina pectoris, revascularization, and death at 5 years' follow-up.

Type A personality refers to the tendency of time urgency, haste, competition, and hostile, which are risk factors of CAD, and are associated with higher incidence of coronary artery evens and sudden death.[2,15] Anger and hostile have been proved to been independent risk factors of CAD.[16] Recent studies found type D personality was also an independent risk factor of CAD. 25% to 28% CAD patients had type D personality, while 38% ACS patients had type D personality.[17–19] In the present study, we found that patients treated with PCI tended to have more anxiety and depression, lower psychology health, more negative coping styles. These findings indicated that psychology intervention may be necessary for those patients. In our study, much more CAD patients treated with PCI, especially the NSTE-ACS patients, had type A personality than control group. Though the ratio of type D personality patients in 3 groups did not have statistical difference, but NSTE-ACS group had higher signal factor scores than the other 2 groups. Hence, we concluded type D personality was associated with CAD.

Previous study showed that ACS patients with type D personality may be associated with disruption of the hypothalamic-pituitary-adrenocortical (HPA) axis function which may contribute to heightened inflammatory responses, influencing prognosis.[20] Type D patients were more likely to smoke more, have higher level of fasting plasma glucose, total cholesterol
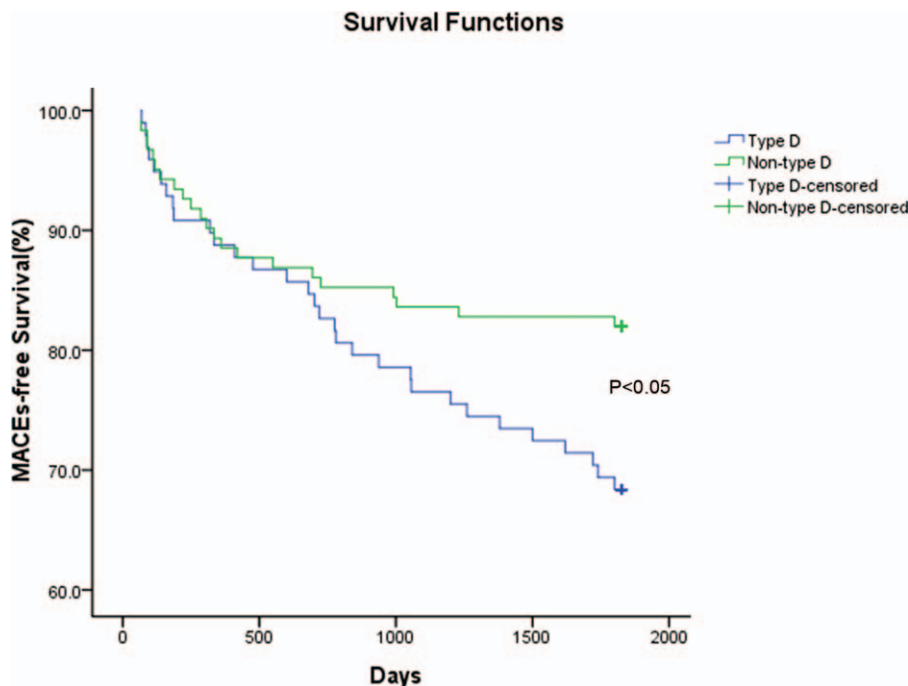

FIGURE 1. Kaplan–Meier curve for the incidence of the primary end-points between Type D group and non-type D group; $P < 0.05$.

and C-reactive protein, indicating that type D personality might promote disease through physiological mechanisms.[19,20] Studies also reported that type D personality is an independent risk factor of depression and anxiety for patients after PCI.[23–26] In the present study, we found that much more NSTE-ACS patients had type D personality and higher level of plasma biomedical predictors, which indicated that personality might be 1 reason of the recurrence of ACS. Our research showed the tendency of higher scores of anxiety and depression and lower psychology health in NSTE-ACS group and the negative relationship between these symptoms and myocardial injury marker. These findings indicated the interaction of persistent myocardial injury, recurrent angina, and negative emotions, which might in turn hinder effective treatment.

Whether type D personality predicts poor prognosis in CAD patients treated with percutaneous coronary intervention, studies come to different conclusions.[16,19,21,22,27–31] Pedersen et al reported that type D patients were at a cumulative increased risk of adverse outcome compared with non-type D patients at 9 months' follow-up.[10] Type D personality remained an independent predictor of adverse outcome adjusting for all other variables, including SES versus bare-stent implantation. Dulfer found that synergistically analyzed type D was not associated with 10-year all-cause mortality in PCI patients whereas dichotomous type D was. However, after adjustment for depression most of the findings had disappeared. Depression played an important role in this. Type D was not associated with 10-year subjective health status. In the present study, we found that after 5 years' follow-up, type D patients had higher incidences of MACEs and severe angina pectoris compared with those of non-type D patients. Type D patients were at a cumulative increased risk of adverse outcome compared with non-type D patients ($P < 0.05$).

An important limitation of the present study was that it was a preliminary single-center study and the patient sample is not large enough. A comprehensive multicenter study involving a larger population with CAD treated by PCI is clearly warranted to assess the relationship of personality with MACEs.

In conclusion, CAD patients treated with PCI were more likely to have type A personality and type D personality, which may be associated with myocardial injury. Type D personality was an independent predictor of adverse events.

ACKNOWLEDGMENT

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