Journal of Psychosomatic Research 108 (2018) 54–60

Contents lists available at ScienceDirect

Journal of Psychosomatic Research

journal homepage: www.elsevier.com/locate/jpsychores

Type D personality and coronary atherosclerotic plaque vulnerability: The potential mediating effect of health behavior

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ARTICLE INFO

Keywords:
Type D personality
Plaque vulnerability
Health behavior
Mediation analysis

ABSTRACT

Objective: The association between type D personality and coronary plaque vulnerability has been suggested. The objective of the study was to evaluate the potential mediating effects of health behavior on the association between type D personality and plaque vulnerability in coronary artery disease (CAD) patients.

Methods: A total of 319 CAD patients were assessed for type D personality and health behavior via self-administered questionnaires. The plaque vulnerability, evaluated according to characteristics, accompaniment, and outcomes of plaque, was assessed by optical coherence tomography.

Results: Regression analysis showed that type D personality was independently associated with lipid plaque (odds ratio [OR] = 2.387, $p = 0.001$), thin cap fibroatheroma (TCFA) (OR = 2.366, $p = 0.001$), rupture (OR = 2.153, $p = 0.002$), and lipid arc ($\beta = -0.291$, $p < 0.001$). Mediation analyses showed that aspects of health behavior were significant mediators of the relationship between type D personality and plaque vulnerability. Psychological stress mediated the relationship between type D and lipid plaque ($p = 0.030$), TCFA ($p = 0.034$), and rupture ($p = 0.013$). Living habits significantly mediated the relationship between type D and lipid plaque ($p = 0.028$), TCFA ($p = 0.036$), but not rupture ($p = 0.066$). Participating in activities was not a significant mediator of the relationship between type D personality and lipid plaque ($p = 0.115$), TCFA ($p = 0.115$), or rupture ($p = 0.077$).

Conclusions: Health behaviors (psychological stress and living habits) may be mediators of the association between type D personality and plaque vulnerability.

1. Introduction

Type D personality is defined by an interaction of high levels of negative affectivity (NA) and social inhibition (SI), and individuals with this personality type have a tendency to experience negative emotions across time and situations and to have inhibited expression of emotions for fear of rejection or judgment from others [1]. The results of many studies have documented the association between type D personality and poor prognosis in coronary artery disease (CAD). A meta-analysis [2] including 12 independent studies indicated that type D personality may be a predictor of poor cardiac prognosis, with an odds ratio (OR) for adverse events of 2.3. Fifteen separate studies showed a positive association between type D personality and risk of major adverse cardiac events (MACEs), whereas a negative association was observed between type D personality and health-related quality of life [3]. A recent study revealed that type D personality is associated with lipid plaque, thin cap fibroatheroma (TCFA), and fibrous cap thickness [4], while NA is closely related to the occurrence and severity of plaque [5]. However, the potential mechanisms underlying the relationship between type D personality and plaque vulnerability remain poorly understood.

Health behavior refers to full engagement in various activities (such as getting enough sleep, eating a balanced diet, getting proper exercise, having a cheerful mood, getting regular check-ups, etc.) in order to enhance physical fitness, maintain and promote physical and mental health, and prevent disease [6]. It is well known that negative emotional and behavioral factors in humans change over time and cluster together in variable ways [7]. Behavior is kept or changed by personality traits through motivation, emotions, beliefs and so on, while the consistency and vulnerability of the personality across time and situations determines the relative vulnerability of an individual's behavior, which makes such behavior a key factor affecting the physical and

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https://doi.org/10.1016/j.jpsychores.2018.02.007
Received 14 October 2017; Received in revised form 12 February 2018; Accepted 17 February 2018

mental health of the individual.

Type D individuals are theorized to engage in more deleterious health behavior and perceptions than those with other personality types, which is due largely to the general susceptibility to psychological distress among individuals with type D personalities [8,9]. Compared to individuals with other personalities, type D individuals more often report anxiety and being distressed [10,11], consuming alcohol [12], smoking cigarettes [13,14], and having poor dietary habits [15,16], while being less likely to report symptoms of disease to health-care professionals [17].

The results of previous studies confirmed that negative health behavior can accelerate the pathogenesis of atherosclerosis and result in significant decreases in fibrous cap thickness and increases in plaque size [18], and individuals with a type D personality have a tendency to engage in unhealthy behaviors. Therefore, the objective of the present study was to explore whether factors of health behavior may mediate the association between type D personality and plaque vulnerability.

2. Methods

2.1. Patients and procedures

This study initially enrolled 340 consecutive CAD patients who underwent optical coherence tomography (OCT) imaging at the Second Affiliated Hospital of Harbin Medical University from May 2016 to January 2017. These patients were aged between 20 and 80 years old. Among them, 5 patients who could not complete the questionnaires, 10 patients for whom OCT image quality was poor, and 6 patients with missing clinical information were excluded. Eventually, 319 CAD patients were included in the study.

These participants were asked to complete the Type D Personality Scale (DS14) and health behavior scale at 2–3 days after OCT examination. Meanwhile, demographic and clinical data were obtained from their medical records and confirmed by patients if necessary. Experienced researchers explained the questionnaires in detail to the included participants. This study was approved by the Ethics Committee of the Second Affiliated Hospital of Harbin Medical University. Informed consent was obtained from all patients, and the acquired data were kept confidential.

2.2. Measures

2.2.1. Type D personality

Type D personality was assessed using the Chinese version of the DS14 scale, which was revised by Tilburg University in The Netherlands, the Chinese University of Hong Kong, and the Chinese Academy of Sciences, Institute of Psychology. The scale includes two dimensions, namely NA, such as: “I take a gloomy view of things”, and SI, such as: “I often feel inhibited in social interactions”, with 7 items in each dimension. When patients scored 10 points or more on the two dimensions, the determination of type D personality could be made. Results for the analyses of the internal consistency and reliability of the two dimensions have indicated the Cronbach's alpha coefficients were 0.832 and 0.720, while the measurement correlation coefficients were 0.794 and 0.794, respectively. This scale has shown good reliability and validity for CAD patients in China.

2.2.2. Health behavior

Health behavior scale, compiled by Yanyang Li of Peking University [19], were used to measure individual health behavior and contain 38 questions. Participants were asked to answer questions on a 5-point Likert scale pertaining to three different domains of their health behavior: psychological stress (e.g., insomnia, anxiety), participation in activities (e.g., having a passion for exercise or participating in physical exercise), and living habits (e.g., noncompliance with medicine or poor eating habits). Among them, a lower score for the domain of participation in activities and higher scores for the other two domains indicated less healthy behavior. Thus, to facilitate analysis, we reversed the score when scoring the dimension of participation in activities. As a result, a higher score overall indicates worse health behavior. Cronbach's alpha coefficients were 0.78, 0.80, and 0.79, respectively, for the three domains.

2.3. Sociodemographic characteristics and clinical data

The following sociodemographic characteristics and clinical data were collected: name, gender, age, cardiac diagnosis (ACS or stable angina pectoris), family history of CAD (confirmed CAD before 50 years old in at least one first-degree relative), hypertension (systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg on two different occasions or if patients were currently taking anti-hypertensive drugs) [20], diabetes mellitus (DM) (a random venous plasma glucose concentration ≥ 1.1 mM, a fasting plasma glucose concentration ≥ 7.0 mM, 2-hour plasma glucose concentration ≥ 11.1 mM after an oral glucose tolerance test, or a combination of any of them) [21], and smoking history (lifetime consumption > 100 cigarettes or 1 cigarette per day) [22]. Biomedical markers included serum total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), fasting blood glucose, and C-reactive protein (CRP).

2.4. OCT data analyses

OCT measures the echo time delay and intensity of light that is reflected or back-scattered from internal structures in tissue to produce cross-sectional images [23]. In the present research, OCT was performed to observe the in vivo morphology of a culprit lesion plaque, and the following measurements were made [24,25]: characteristics of the plaque: lipid plaque by signal-poor regions with diffuse borders, which is considered to be rich in lipid with two or more quadrants [26,27]; thickness of the fibrous cap covering the lipid core at its thinnest part measured in triplicate and presented as the mean value; and lipid arc, which is used to measure the quadrants of a necrotic lipid pool in this research [23]. Regarding the accompaniment of the plaque, calcium was recorded when an area consisted of low backscatter and a sharp border was present [28]; macrophage infiltration was recorded when the signal intensity had heterogeneous backward shadows [29]; and cholesterol crystals were characterized if located in the linear regions of high intensity that existed beside a lipid core [24]. The following indicators of plaque vulnerability were examined: TCFA (which was defined as a plaque with lipid content in ≥2 quadrants and the thinnest part of a fibrous cap measuring ≤65 μm), rupture (which was defined when there was fibrous cap discontinuity with clear cavity formation inside the plaque [23]), and thrombus (characterized by an irregular mass protruding into the lumen of the artery that had a measured diameter at least 250 μm [30]). Two independent experienced observers, both blinded to the sociodemographic and clinical characteristics, analyzed all of the OCT images. A third independent investigator joined to achieve consensus, if there was discordance between the two observers.

2.5. Statistical analysis

All statistical analyses were performed using SPSS version 20.0. p values < 0.05 were considered statistically significant. Normally distributed variables were expressed as mean (standard deviation) and skewed variables as median (interquartile range). For normally distributed variables, *t*-test was applied, whereas for skewed variables, Mann-Whitney *U* test was used. χ^2 test was used for the comparison of qualitative data. In addition, multivariate linear and binary logistic regression analyses were performed to evaluate the association between type D personality and plaque vulnerability. All OCT variables were