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Letter to the Editor

Anger control and cardiovascular outcomes

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The association between coronary artery disease (CAD) and psychological aspects has been emphasized in previous years [1,2]. Anger is one typical manifestation of psychological stress, and higher scores on tests of anger have been associated with a higher chance of cardiovascular events [3]. However, there are still doubts about which aspect of anger is most relevant to risk. We carried out a prospective cohort study to assess the association between specific aspects of anger and angiographically detected CAD as well as the association between these aspects of anger and adverse cardiovascular events.

We included consecutive patients scheduled for coronary angiography to evaluate suspected CAD at our institution between 11/30/2009 and 02/03/2010. All patients enrolled provided written informed consent, and the study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki, as reflected in *a priori* approval by the institution's human research committee. Anger aspects were assessed by Spielberger State-Trait Anger Expression Inventory (STAXI) [4,5], which was developed to be used in a variety of medical conditions. The STAXI instrument separately assesses two major domains using a Likert scale: trait of anger and expression of anger. The trait of anger domain measures individual differences in the disposition to experience anger, and it is divided into temperament and angry reaction. The expression of anger domain provides a general index of the frequency with which anger is experienced, expressed, suppressed or controlled, and is assessed with three subscales: anger-in, when angry feelings are repressed or stored; anger-out, when the individual expresses anger toward other people or objects in the environment; and anger control, which measures the frequency with each individual tries to control the expression of anger.

Coronary angiography procedures were performed by the Judkins technique, and CAD was defined as the presence of a coronary stenosis of at least 50% of luminal area in at least one epicardial coronary artery. The primary cardiovascular event endpoint was a composite of the occurrence of cardiovascular death, myocardial infarction (MI), myocardial revascularization or hospitalization for angina. The sample size was calculated to demonstrate an association between anger and CAD on baseline angiography and an association between anger and one-year cardiovascular events, and this estimation resulted in 520 patients. Multiple logistic regression and Cox proportional hazards multiple regression were used to adjust for potential confounders. Kaplan–Meier curves and the log rank test were used to compare event-free survival between patients with anger control below and above the median of the sample.

During the study period, 523 cases were included. Patients with CAD were older, more frequently men, and had a higher prevalence of dyslipidemia, diabetes mellitus, smoking and previous cardiovascular disease (Table 1). Patients with CAD tended to have greater expression of anger ($P = 0.06$) and anger out ($P = 0.07$), and had significantly lower anger control ($P < 0.01$). The other subscales of the STAXI instrument were similar between groups. In multivariable analysis, anger control, but not other aspects of anger, remained significantly associated with CAD. An increase by one point on the scale of anger control was associated with an 8% decrease in the probability of angiographic CAD, independent of other traditional risk factors for CAD and other subscales of anger (OR 0.92 [95% CI: 0.88–0.98]; $P < 0.01$).

Patients were followed for 16 ± 3 months to verify the occurrence of cardiovascular events. From the initial sample of 523 patients, follow-up information was not available for 14 individuals (2.7%). A cardiovascular event was documented in 207 patients (41%). Compared with patients without cardiovascular events, those with events more frequently had diabetes mellitus (34% vs 24%; $P < 0.01$), previous MI (31% vs 23% $P = 0.02$), and lower anger control (26.31 ± 4.74 vs 27.39 ± 4.17; $P < 0.01$). In multivariable analysis, low anger control

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Table 1
Clinical characteristics of study patients according to the presence of coronary artery disease.

Characteristic	With CAD (n = 302)	Without CAD (n = 221)	*P*
Age, years	61 ± 10	59 ± 10	0.05
Male, %	63	38	<0.01
BMI, U	28 ± 5	29 ± 6	0.25
Hypertension, %	84	80	0.25
Dyslipidemia, %	61	51	0.02
Diabetes mellitus, %	32	22	0.01
Family history of CAD, %	34	31	0.42
Smoking, %	61	15	<0.01
Unstable angina, %	21	23	0.61
Depression, %	27	29	0.29
Medical history			
Myocardial infarction, %	32	18	<0.01
PCI, %	8	0	<0.01
CABG, %	20	10	<0.01
STAXI scales			
Trait, U	21 ± 8	21 ± 8	0.95
Temperament, U	9 ± 4	9 ± 4	0.74
Reaction, U	8 ± 4	8 ± 4	0.77
Anger expression, U	20 ± 10	18 ± 9	0.06
Anger in, U	16 ± 5	17 ± 5	0.59
Anger out, U	14 ± 4	13 ± 4	0.07
Anger control, U	26 ± 5	28 ± 9	<0.01

Abbreviations: BMI, body mass index; CAD, coronary artery disease; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting; STAXI, Spielberger State-Trait Anger Expression Inventory Scale. STAXI scales are expressed by averages and standard deviation. Other data are expressed as percentiles (%).

(HR = 1.41 [CI = 1.07–1.87]; $P = 0.02$) and diabetes mellitus (HR 1.41 [CI = 1.05–1.90], $P = 0.02$) were independently associated with cardiovascular events. The adjusted Kaplan–Meier survival curves for cardiovascular events among patients with high and low anger control demonstrated a separation of the curves favoring those with higher anger control ($P < 0.01$; Fig. 1).

Although the association between positive and negative emotions and cardiovascular disease has been extensively studied, considerably fewer studies have addressed the importance of self-control. Recently, Haukkala et al. evaluated the association of anger and hostility with cardiovascular outcomes in a prospective cohort study with nearly eight thousand individuals followed for 15 years [6]. Low anger control predicted ten-year cardiac events, independent of other relevant variables. The Normative Aging Study evaluated 1122 healthy men with the Minnesota Multiphasic Personality Inventory-2 (MMPI-2) who had follow-up for an average of 13 years [7]. Individuals with higher levels of self-regulation had a 62% lower risk of cardiovascular events, even after adjustment for traditional risk factors. In a small case–control study in Japan, 96 men with acute MI and 77 healthy individuals completed the STAXI and the Cynicism Questionnaires (CQ) [8]. After adjustment for biological risk factors, increasing CQ score was associated with an 11% higher risk of MI, and the anger control score in the STAXI instrument was associated with a 25% lower risk of MI.

The limitations of our study include the lack of lower risk patients, and those with an acute coronary syndrome. During follow-up, many of the cardiovascular events were myocardial revascularization procedures, and the present study does not have power to evaluate the association between anger control and isolated endpoints, such as death or MI. The mechanisms by which low anger control was associated with CAD and cardiovascular events were not specifically addressed in this study.

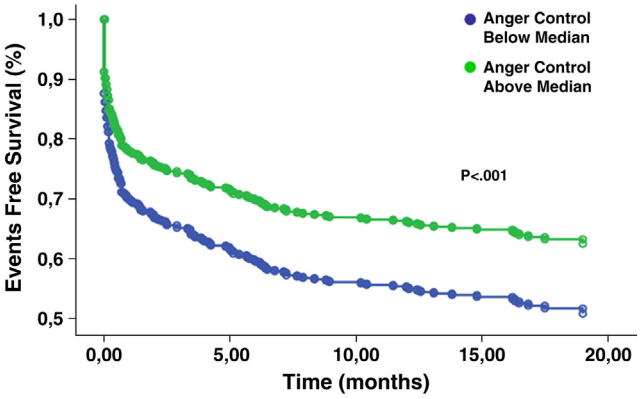

Fig. 1. Kaplan–Meier curves of time to cardiovascular events during follow-up among patients with anger control above and below the median for the population.

This analysis confirms the association between anger control and cardiovascular events, and extends these earlier observations to a population of patients undergoing coronary angiography to evaluate suspected CAD. The use of the STAXI instrument allowed a thorough investigation of several specific aspects of anger, and low anger control was strongly associated with CAD and with higher cardiovascular event rates in this group of patients. Further studies exploring the influence of anger management on the development of CAD and prevention of cardiovascular events are warranted.

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