

ROLE OF PSYCHOLOGICAL STRESS IN CARDIOVASCULAR DISEASE

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ABSTRACT

Cardiovascular disease (CVD) is reported to be the leading cause of death globally. A plethora of risk factors have been identified to explain the high prevalence rates of CVD. Though, several clinical and biochemical risk factors have been identified, the role of psychological factors are also gaining importance during the past few decades. Recent studies suggest that psychological factors could be associated with the occurrence and recurrence of CVD. Emotional stress has been shown to increase sympathetic nerve activity thereby triggering adverse cardiac events. Moreover, psychological factors also affect homeostasis and thrombosis. Though the sequelae of events are still unclear, this review tries to highlight the pathological mechanisms of psychological factors leading to CVD.

KEY WORDS: Cardiovascular disease; Psychological features; Depression; Stress.

INTRODUCTION

Cardiovascular disease (CVD) is fast becoming the commonest cause of death world-wide. According to the Global Burden of Disease Study, during 1994-1997, 30% (15.3 million) deaths were due to CVD. It is also a major cause for premature mortality and morbidity. The contribution of developing countries to the global burden of CVD will soon exceed that of the developed world (1).

Several risk factors have been identified to be associated with CVD which includes *causative risk factors* (hypertension, hyperlipidemia and diabetes), *conditional risk factors* (triglycerides, lipoprotein (a) and homocysteine) and *pre-disposing risk factors* (obesity, physical activity, sex, family history, socio-economic factors, insulin resistance and psychological factors) (2). Impact of psychological stress on CVD has been long debated. This is mainly due to the difficulties in standardization of the measurement of psychological factors. However, evidence from recent studies have shown a strong association of psychological stress with CVD (Table 1) (3-11).

Table 1: Psychological factors and CVD

Author	Year	Relative Risk (95% confidence intervals)
Williams et al (5)	1992	3.3 (1.8 - 6.2)
Kaplan et al (6)	1994	2.0 (1.2 - 3.3)
Barefoot et al (7)	1995	1.6 (1.1 - 2.3)
Moser et al (8)	1996	4.9 (2.1 - 12.2)
Krumholz et al (9)	1998	2.6 (1.0 - 6.6)
Denoilet et al (10)	1998	3.9 (1.2 - 9.6)
Fraser Smith et al (11)	1999	3.2 (1.7 - 6.3)

Studies on experimental models have identified that stress induced "defense reaction" characterized by a marked increase in sympathetic nerve activity may trigger adverse cardiac events (12). It has also been shown that psychological stress may provoke silent myocardial ischaemia (13). With psychological stress, there is an increase in sympathetic response and plasma epinephrine which produce a rapid increase in blood pressure and heart rate (14).

In this article, we review the association of psychological stress, with particular reference to hemostatic factors, in the predisposition to cardiovascular disease.

DEPRESSION AND CVD

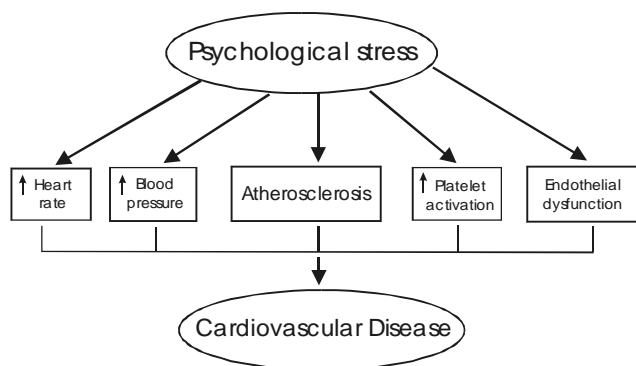
Depression is usually identified by at least four symptoms such as changes in appetite, sleep disturbances, fatigue, feelings of guilt, worthlessness or hopelessness or suicidal thoughts (4). Recent evidence suggests that depression could be an independent predictor of both primary and secondary CVD events (15). Apart from inducing hypercortisolism, heart rate variability and impairment of vagal stimulation, depression also affects platelet function (4). Depression has been reported to enhance platelet activation and release of coagulation products like platelet factor 4 and beta thromboglobulin (16). This in turn could lead to a hypercoagulable state and thus to CVD. Moreover, hypercortisolism may at least partly explain the proatherogenic effect of depression and this has been implicated as one of the mechanisms to explain the link between depression and CVD events.

STRESS AND CVD

A six year prospective study showed that job strain with inherent "tension" at work was associated with a four-fold increase in CVD (17). Type 'A' behavior, described as an individual striving hard to reach poorly defined goals, has been consistently associated with CVD (18). Most studies have focussed on the psychological factors in the month preceding the development of acute myocardial infarction (MI) and have reported stressful life events to be associated with CVD (19). Similarly, acute stress due to natural calamities like earthquake, has also been studied in detail (20). A sharp increase in the number of CVD deaths have been reported after the first missile attack in the Gulf war in Israel, which decreased after a month (21). Acute anger induces sudden CVD deaths. Even recalling an incident of acute anger has also been shown to induce changes in the coronary vasculature (22). The mechanisms by which psychological stress can lead to CVD are summarized in Figure 1.

Fig 1: Link between Stress and CVD

PATHOPHYSIOLOGICAL MECHANISMS INDUCED



BY STRESS

Scientists have tried to study the pathophysiological mechanism induced by stress in experimental models and laboratory induced stress in volunteers (4,5). These studies have demonstrated heart rate and blood pressure elevation and thus an increase in oxygen demand. Another mechanism by which mental stress induces CVD is coronary vasoconstriction (23). In fact in those with known CVD, stress can lead to reoccurrence of clinical events. Psychosocial stress has also been shown to induce endothelial dysfunction and atherosclerosis (24,25). Studies have demonstrated that stress increases the carotid intimal medial thickness of the artery, indicating that it promotes atherosclerosis (24).

PROTHROMBOTIC EFFECTS (EFFECTS ON PLATELET FUNCTION)

Stress can also alter hemostasis and thrombosis. Stress induces hemoconcentration by a decrease in plasma volume, which could lead to increase in blood viscosity (26). A study on subjects before and after a major earthquake revealed an increase in blood viscosity and fibrinogen levels (20). The sequelae of events due to stress are however still unclear. Studies on thrombotic factors in 22 healthy men revealed that acute psychological stress leads to an increase in platelet factor 4, beta thromboglobulin (BTG), platelet activation, hematocrit and total plasma protein (27). Grigani et al (28) studied the effect of emotional stress on coronary artery disease. This study showed that stress induces significant increments in hemodynamic parameters like heart rate, systolic and diastolic blood pressures and increases the platelet aggregation. Further, the effect of the anti-platelet drug dipyridole in stress induced platelet aggregation, revealed a decrease in platelet aggregation demonstrating a direct link between emotional stress and platelet function (29).

STUDIES IN INDIANS ON STRESS AND CVD

CVD is emerging as a major cause of death in India. It has been projected that 15 years from now, India would have the highest CVD deaths compared to any other country (30). Studies on type A behaviour in Indians have demonstrated a strong correlation of stress with angiographically proven coronary artery disease (31). Similar results have been reported in survivors of myocardial infarction (32). A comparative study in Singapore on Indians and Chinese, revealed stronger cardiovascular reactivity to stress among Indians than compared to Chinese men (33).

INTERVENTION AND PREVENTION

Though extensive studies have been carried out on coagulation parameters and stress, the mechanisms by which they are related are still unknown. However, studies have identified drugs like dipyridole and sertraline, attenuate the increased platelet activation seen in stressed and depressed individuals (5,29). Behavioral interventions aimed at reducing these risk factors by relaxation techniques and life style modifications can be of great help to reduce the incidence of future CVD. More prospective epidemiological studies are needed to explore the role of behavioral interventions in preventing CVD. In our country with its wealth of yoga, meditation,

pranayama and other techniques, stress management techniques can certainly be used to reduce the burden of CVD.

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