Libyan International Medical University

Faculty of Basic Medical Science

Effect of depression on heart

Ajnadin Marei

Supervised by: Dr. Mohammed Hamza

Assisted by: Dr. Suzan Elhony

Report Submitted to fulfill the requirements for Scientific Research Activity

Date of Submission: 12/3/2020

Abstract

Depression and heart disease affect millions of people of all ages across all world regions; it is the second leading cause of death in 2030.

Studies have shown that depression is a significant risk factor for heart disease and that it increases morbidity and mortality in patient suffer from previously heart disease

Autonomic nervous system changes are often found in altered mood states and appear to be a central biological substrate linking depression to cardiovascular diseases. Alterations of autonomic nervous system functioning are reflected in reductions of heart rate variability (HRV) and other pathways such as endothelial dysfunction, platelet activity, inflammation and immune dysfunction that connect the depression to cardiac disease.

Introduction

The 3 leading causes of burden of malady in 2030 projected to include acquired immune deficiency syndrome, depressive disorders and ischemic heart disease. Impressively, depression scores second during this seeding and, at present, have a very high prevalence worldwide.(1)

Depressive disorders involve disturbances of feeling that have an effect on somebody's entire mental life. that have 2 major subtypes;

Major Depressive Disorder (MDD), marked by one episode or continual episodes of depression; and dysthymic depression (DD), that involves a chronic disturbance of mood.(2)

Major depressive disorder is among the foremost usually diagnosed mood disorders in youngsters and adolescents.(2)

Criteria for MDD involves essential options of either depressed mood or loss of interest or pleasure over a 2 weeks , experienced nearly daily four or more of the following symptom , experienced nearly each day: "significant weight loss or weight gain or a decrease or increase in appetite; sleep disturbance or hypersomnia; activity agitation or retardation; fatigue or loss of energy; feelings of worthlessness or excessive inappropriate guilt; diminished ability to concentrate or indecisiveness; continual self-destructive mentation or a suicide try" (2)

Depression is an confirmed risk factor for cardiovascular disease (CVD) and mortality.(1)

People with depression are much more possible to suffer coronary artery disease and acute cardiovascular sequelae such as myocardial infarction, congestive heart failure and hypertension(1)

The association between depression and cardiovascular disease is found in individuals both with and without cardiac antecedents, and is independent of traditional cardiovascular risk factors like body mass index, physical activity, hypertension and hypercholesterolemia (1)

Material and Method

The report was performed to discover studies reviewing the effects of depression on the heart. online sites included in this report are PubMed and google scholar. The search terms included "effect of depression" "correlation between heart and depression " and "psychological stress and depression on heart". Mendeley is used for citations and bibliography.

Result

Before talking about the response of our body to stress, the distinction between "healthy" and "unhealthy" stress needs to be created.

"Healthy stress" is an adaptational response to daily stressors, characterized by transient increases in stress hormones and associated physiological reactions to charge up muscular power production. On the other hand, "unhealthy stress" happens once stress is repetitive, usually with non-physical reactivity, and prolonged or perhaps chronic. It is this chronic, uncontrolled stress response, that can render a person progressively susceptible to chronic disease and of particular interest in this research into cardiovascular disease

The body's major physiological responses to stress stimuli are mediated, by two main systems:

The sympathetic-adrenal-medullary (SAM) system and the hypothalamic-pituitary-adrenal axis (HPA-axis)

The first component of the stress response involves the SAM system. In this system, the hypothalamus stimulates the adrenal medulla, which responds by releasing the catecholamines adrenalin and noradrenalin, into the blood.

The autonomic nervous system plays an important role in the control of arterial pressure and in the regulation of blood flow in humans

For example, activation of the sympathetic of the autonomic nervous system, and specifically, adrenergic receptors by adrenaline or noradrenaline in the arteries of the heart, results in vasoconstriction, and thus increased vascular resistance, increased heart rate, increased blood pressure, increased cardiac output, and decreased heart rate variability

The second component involves the HPA axis consists of the hypothalamus, the pituitary gland, and the adrenal glands. In response to a stressor that is still understood as a threat, hypothalamic neurons from the paraventricular nucleus raise the amount of synthesis and release of corticotrophin-releasing hormone and arginine vasopressin.

Corticotrophin-releasing hormone travels to the anterior pituitary gland and stimulates the secretion of adrenocorticotropic hormone. Adrenocorticotropic hormone stimulates the adrenal glands to secrete glucocorticoids and mineralocorticoids.

Glucocorticoids have direct effects on the heart and blood vessels, mediated by both glucocorticoid and mineralocorticoid receptors.

once the perceived stressor has deactivated, feedback loops are triggered at different levels in order to shut the HPA-axis down and return to a set homeostatic point.

However, among people under chronic stress or in people with depression, abnormalities occur in these feedback loops, involving the prefrontal cortex, the amygdala and the HPA-axis are obvious

It is under these situations that a healthy stress response may become an unhealthy damaging response.

The outcomes of these alterations are widespread and in terms of cardiovascular function, may include coagulation alterations, endothelial injury and hypertension

The association between altered mood and cardiovascular dysfunction is found in individuals both with and without cardiac antecedents, and is independent of traditional cardiovascular risk factors like body mass index, physical activity, hypertension and hypercholesterolemia

A number of responsible biological and behavioral mechanisms have been proposed, which may link depression with cardiovascular disease.

Biological mechanism: Dysfunction of the autonomic nervous system and HPA-axis we consider as the controlling or "Master" mediators of the relation between psychology and CVD. their disturbance, in terms of an "unhealthy" stress response, can make localized target tissue effects, to reduce arterial elasticity and decline endothelial function and cause coagulation abnormalities.

Chronic HPA-axis and autonomic nervous system activity can also cause immune dysfunction, as well as include accretion production of pro inflammatory cytokines

Behavioral mechanism: variety of behavioral pathways seem to be included in the relationship between psychological risk factors and CVD. A growing body of evidence suggests that depressed people or those experiencing ongoing psychosocial stress are more likely to show unhealthy behaviors and less likely to be involved in health-promoting behaviors

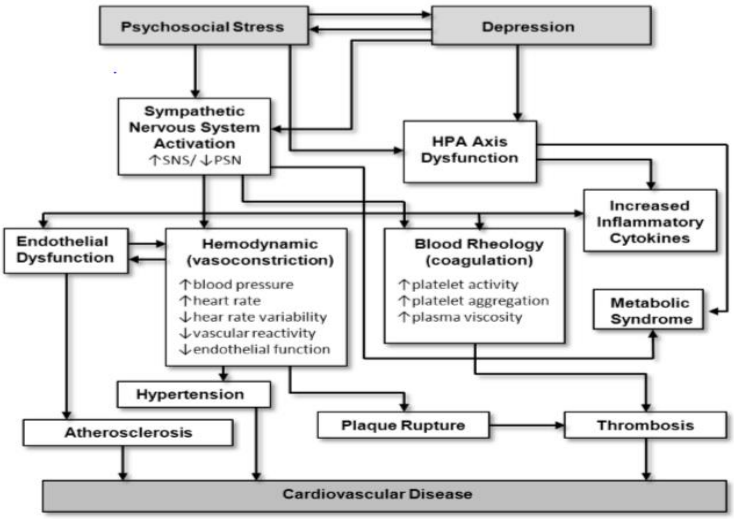

Figure 1. Potential mediating pathways and mechanisms linking psychosocial stress, depression and cardiovascular disease

SNS: Sympathetic nervous system

PSN: parasympathetic nervous system

HPA-Axis: pituitary-adrenal axis

Discussion

chronic stress and depression can cause disruption of autonomic nervous system and HPA-Axis

Firstly, the disruption of autonomic nervous system by hyperactive sympathetic system and a hypoactive parasympathetic system is a characteristic of stressed and depressed individuals(2)

Evidence for a link between psychological distress and autonomic imbalance has largely arisen from investigations involving heart rate variability (HRV).

Heart rate variability, a measure of the beta-to-beat fluctuation in heart rate, and therefore considered to reflect the balance between sympathetic and parasympathetic regulatory(2)

Low HRV is suggestive of excessive cardiac sympathetic modulation, inadequate cardiac parasympathetic modulation, or both, and has been repeatedly documented among depressed individuals. Low HRV is also a known risk factor for a number of clinical cardiac presentations, including ventricular arrhythmias in patients with coronary heart disease and for cardiac sudden death Furthermore, an increased risk of myocardial infarction(2)

An upsurge in chronic sympathetic activity, due to either excessive cardiac sympathetic modulation, inadequate cardiac parasympathetic modulation, or

both, will in turn, elicit a chronically raised concentration of circulating catecholamines(2).

Increased levels of these catecholamines have been seen in individuals exposed to chronic psychosocial stress and among those with depression this chronic increase in sympathetic activity can result in vasoconstriction, platelet activation, hypertension and arrhythmia(2)

Secondly, depression and chronic stress have been associated with dysregulation of the HPA-axis, which can result in hypersecretion of glucocorticoids and subsequent hypercortisolism. This is often demonstrated by assessing circulating cortisol, which is found to be higher among people with depression as are levels of corticotrophin-releasing hormone in cerebrospinal fluid and in the paraventricular nucleus of the hypothalamus(2)

High levels of plasma cortisol have been shown to promote the development of atherosclerosis and hypertension in addition, high plasma cortisol has been shown to accelerate injury to the vascular endothelial cells, leading to endothelial dysfunction through alterations to the nitric oxide (NO) system(2)

In addition to endothelial dysfunction, increased sympathoadrenal activity resulting from increased cortisol may cause vasoconstriction, platelet activation, and elevated heart rate and rhythm disturbances.(2)

The Mechanistic Target Tissue Effects of HPA-Axis and Autonomic Nervous System Disruption shown in:

Firstly, endothelial dysfunction is considered an early marker of cardiovascular dysfunction and a risk factor for the development of CVD

Healthy vascular endothelium can be characterized by vasodilator, anti-adhesive, anti-inflammatory and anti-coagulant properties In contrast, endothelial dysfunction is characterized by reduced dilator function, increased inflammatory cell and platelet adhesion and increased coagulation activity. Chronic stress and depression have been associated with impaired endothelial function, where endothelial dysfunction has been documented in individuals experiencing symptoms of stress and depression who were otherwise healthy people(2)(3)

For example, the increased level of circulating catecholamine associated with an increased sympathetic drive, which is also often seen in depressed patients may contribute to structural changes in the endothelial cells along the arterial wall including the induction of macrophages into the abluminal space(2)

Further to these effects, circulating catecholamines may also increase the uptake of low-density lipoproteins by endothelial cells(2)

Secondly, platelet activity: During acute stress response, catecholamines (adrenaline and noradrenaline) facilitate immediate physical reactions

associated with a preparation for violent muscular action and increased strength and speed in anticipation of fighting or running. These physiological changes include enhanced perspiration and increased blood clotting function of the body speeds up .(2)(3)

SNS activation might contribute to arterial thrombus formation. Several studies have demonstrated that SNS activation induced procoagulant responses in patients with atherosclerotic plaques and endothelial dysfunction. Chronic stimulation of the SNS and concomitant hypercoagulable changes could contribute to gradual fibrin deposition at sites of atherosclerotic lesions (3)(4)

Thirdly, inflammation and immune dysfunction : Several review papers have reported that increases in production and plasma levels of proinflammatory cytokines, particularly interleukin-6 (IL-6) interleukin-1b (IL-1b), C-reactive protein (CRP) and tumor necrosis factor-a (TNF-a) are often seen in depressed subjects (2)

Proinflammatory cytokines have been implicated in the pathogenesis of atherosclerosis. It has also been suggested that atherosclerotic lesions and endothelial damage lead to the increased production and release of proinflammatory cytokines creating a cycle of inflammation. As a result, a sequence of events that eventually lead to thrombus formation and vascular occlusion may be stimulated.(2)

Conclusion

The researches approved that the depression effect on cardiovascular health by several pathways biological and behavioral that increase the risk of heart disease for people without history of cardiovascular disease, and worse the outcomes in the individual with cardiovascular disease.

References

1. Sgoifo A, Carnevali L, Angeles MDL, Alfonso P. Autonomic dysfunction and heart rate variability in depression. 2015;(October).
2. Psychology C. Effects of Psychosocial Stress and Depression on Cardiovascular Health in Youth : A Longitudinal Investigation. 2016;(February).
3. Carney RM, Freedland KE. Depression and coronary heart disease. 2017;(November)
4. Pagano G, Corbi G, Ferrara N. Thromboembolic Diseases Adrenergic Nervous System and Hemostasis. 2014;(Febrary).