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The cerebral consequences of diabetes

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ABSTRACT

Introduction

The number of patients suffering from diabetes mellitus is growing globally. Diabetes is a disease requiring cooperation from the patient. Numerous cases of behavior not satisfying doctor are interpreted as lack of subordination and willingness to adapt to medical recommendations. Problems with adherence to treatment may be a result of decrease in cognitive functions, and associated cerebral diabetes complications as stroke, structural brain changes, depression and diabetic distress.

Aim

The purpose of this study is to present cerebral complications and their consequences depicted in professional literature.

Results

Diabetes has many severe cerebral complications. Patients may experience both ischaemic and haemorrhagic stroke and ensuing disability. Moreover, diabetes is described to be a serious factor contributing development of brain structural changes. There was decrease in of gray and white matter reported to be associated with decline in cognitive functions. Diabetes is also

described as cause of depression and diabetic distress. These two affective problems are very serious reasons influencing everyday activity of patients. Glycaemic control in such individuals is significantly poorer than in people not suffering from these complications.

Conclusions

The cerebral complications of diabetes are frequent, especially in population of elderly people. They have substantial influence on cooperation with patient, treatment adherence and its outcomes. Every situation of doctor`s dissatisfaction with the results of diabetic education, compliance and self-care activities performed by the patient should lead to investigation if he have any diabetes cerebral complications.

Keywords: Diabetes Mellitus, Depression, Stroke

INTRODUCTION

Diabetes is a disease affecting more and more people. The International Diabetes Federation estimated that in 2017, 326.5 million people of working age and 122.8 million people aged 65-99 years had diabetes. The number of patients is expected to rise, to reach the level of 438.2 million diabetes cases in working age group and 253.4 million sufferers in geriatric population in 2045 [1]. One of the genuine problems in clinical management with diabetics is treatment adherence and performance of self-care activities such physical activity and use of proper diet. Numerous cases of behavior not satisfying doctor are interpreted as lack of subordination and willingness to adapt to medical recommendations. Although, such approach may be fallacious. Problems with adherence to treatment may be a result of decrease in cognitive functions, and associated cerebral diabetes complications as stroke, structural brain changes, depression and diabetic distress.

OBJECTIVES

The purpose of this study is to present the cerebral consequences of diabetes, their mechanism and clinical implications.

METHODS

Significant articles describing diabetic cerebral complications and their consequences have been analyzed.

RESULTS

Stroke

Many epidemiologic studies have depicted diabetes as an independent risk factor for ischemic and hemorrhagic stroke [2, 3]. The most popular stoke type in diabetic patients is lacunar infarct.

There are numerous possible mechanisms promoting stroke in diabetes. There can be listed dysfunction of endothelium, chronic systemic inflammation and increased oxidative stress level, impaired vasodilatation, arteries wall stiffness.

Reactivity of vessel walls may be defective due to wall stiffness or flawed nitric oxide-mediated vasodilatation as a result of increased inactivation or reduced nitric oxide reactivity of arteries smooth muscle.

In diabetic patients chronic, smouldering inflammatory process is frequently described, as C-reactive protein, cytokines interleukin-1 and interleukin-6 serum levels are elevated. Inflammation plays an important role in the development of endothelial dysfunction and atherosclerotic plaque.

Moreover, unbalanced oxidant-antioxidant status observed in diabetics with excessive oxidative stress lead to various pathological processes associated with macro- and microvascular complications [4]. Overproduction of reactive oxygen species related to hyperglycaemia results in disturbances in the glycolysis process and accumulation of glycolytic intermediates as well as increased formation of advanced glycation end products leading to endothelial dysfunction. Diabetes-related vasculopathy accelerate atherosclerosis intrinsic to diabetes.

Stroke and vascular risk factors (diabetes, obesity, dyslipidemia, hypertension) have considerable contribution in the development of cognitive impairment and dementia [5,6].

Deterioration of cognitive functions observed after stroke is associated with severe risk of disability and being dependant on caregiver [7]. Stroke-related dementia correlates with decrease of survivors' quality of life of life [8]. Furthermore, diabetic patients are at a higher risk of stroke-related death than patients not suffering from diabetes [9]. Poor intellectual abilities such as thinking, attention and memory contribute to not satisfying level of diabetes control and produce problems with taking care of such patients.

Brain structural changes

There were many studies conducted to analyze structural changes in brain tissue of individuals with diabetes and their clinical consequences. The one of the most recent works in this area is paper by Moheet et al. [10].

They found changes of volume in the right temporal lobe and left occipital lobe, analyzing voxel-based morphometry of individuals with type two and one diabetes. The results showed that the right temporal lobe volumes of white matter in and left occipital lobe volumes of gray matter were significantly lower in the type 2 diabetes mellitus patients than in controls not suffering from diabetes. Authors evaluations revealed that white matter volumes in many brain regions (including both frontal, temporal lobes, the precuneus and limbic lobe) correlated with ankle-brachial index and macrovascular disease, as assessment of ankle-brachial index is the most sensitive and precise method to detect peripheral arterial disease [11].

Although the exact patophysiological mechanism of brain injury related to diabetes mellitus still remains unclear, it is widely proposed that vascular factors play a crucial role in this process [12,13]. Endothelial dysfunction along with atherogenic hyperlipdaemia enhance atherosclerosis development, resulting in peripheral arterial disease. It is mainly connected with lower extremity vascular disease and diabetic foot syndrome but generalized atherosclerosis also affects brain arteries, leading to cerebrovascular disease [14].

However, other studies showed that not only vascular complications correlate with brain structural changes but hyperglycemia (expressed as the level of glycosylated hemoglobin) can be described as one of the causes of this condition [15,16].

Described by Moheet et al. [10], and other authors [17,18] organic brain changes in diabetic patients correlate with lower achievements in Clock Drawing Test and Montreal Cognitive Assessment, suggesting that cognitive dysfunction may be caused by changes in gray and white matter region.

Structural changes of brain in diabetic patients result in cognitive functions deterioration and well-known problems with treatment adherence and self-care activities performance.

Depression

Patients suffering from type 2 diabetes are at two times higher risk of depression development compared to people without diabetes [19].

Formerly, it was proposed depressive disorder in diabetic may have been the effect of the stress and social, everyday problems associated with chronic illness.

However, nowadays it is widely accepted idea that the relation between depression and diabetes is bidirectional.

Depression can be a risk factor for diabetes mellitus, not only as poor self-care behaviors and disadvantageous lifestyle contributes to metabolic changes but also as a result of the depression-related biochemical changes [20]. Mezuk et al. in their metaanalysis have described that depression is associated with significantly, higher risk (even 60%) of incident diabetes [21].

Depression has been proven to be associated with insulin resistance [22]. This affective disorder is connected with visceral obesity, low activity and unfavorable effects of antidepressant drugs on glucose tolerance and its metabolism.

In parallel, diabetes may promote depression incidence.

Initially, there is some evidence that depression and diabetes have vast common area of independent risk factors. These are: genetic predisposition, gender, age, social factors, socioeconomic status, self-care behaviours, diet, physical activity [23]. Cigarette use is associated with depression and diabetes as independent risk factor as well. [24].

Among other mechanisms role of psychosocial aspects of chronic illness is depicted [25].

Moreover, there is accumulating evidence that inflammation and its mediators, pro-inflammatory cytokines such as interleukin 1, 6 and TNF-α are firmly associated with depression [26]. Chronic low-grade inflammation is observed in patients with diabetes.

Effective management of depression in diabetic patients is crucial as it influences on adherence to treatment and self-care activities, resulting in poor glycaemic control and overall clinical outcomes [27], including more aggravating complications of diabetes. Further, global mortality for depressed individuals with diabetes is reported to be significantly higher than for those not suffering from affective disorder [28]. Treatment involving use of antidepressants and cognitive behavioral therapy, supplemented by collaborative care of many healthcare specialists is considered to be efficient, beneficial not only for patients mental condition but also metabolic control and comprehensive health status.

Diabetes distress

Diabetes distress is even two times frequently observed than depressive episodes. Being more persistent over time and associated with such hard-to-modify aspects as diabetes complications, comorbidities and social variables, it becomes a serious problem in clinical proceeding with diabetic patients [29]. Thus, what is diabetes distress and how to manage with it?

Diabetes distress describes an emotional response to an exhausting and constantly progressive disease and general psychosomatic condition [30]. It is classified by many researchers as a part of diabetes spectrum conditions, and should not be viewed as co-morbid psychiatric disorder. Diabetes distress unites worries, fears and concerns of patients as a reaction to substantial burden of chronic disease [31].

Fischer et al. [30] suggested that diabetes-related emotional distress may be caused by three complementary groups of stressors combined together. They listed: (1) distress resulting from tightly diabetes and its treatment (in this area fears of complications, diabetes burnout etc.) (2)

distress resulting from life stressors unrelated to diabetes (family and occupational, financial situation etc.) and (3) distress resulting from such factors as personal characteristics, life history, genetics), stressing that much of the distress is related to diabetes, its treatment, complications and decreased quality of life.

Diabetes distress is a serious clinical problem. It includes sense of hopelessness, lack of motivation to act. Diabetic distress influences on results of treatment. It was described by some scientific reports that diabetic distress even to greater extent than depressive disorder is associated with glycaemic control, diet quality and non-HDL cholesterol levels in diabetic individuals [31].

Therefore, Fischer et al. [30] concisely proposed some ways of dealing with problem of diabetic distress. Thus, managing with diabetic distress should not be performed only when it becomes detected, but education and support should be provided constantly by doctor and other healthcare professionals. Gaining knowledge about prophylaxis of complications, rules and time frames of follow-ups could be beneficial. Patient and his healthcare provider should analyze, identify and anticipate stressors associated with disease. However, the approach of doctor should be much wider than touching only medical issues. He should, in cooperation with patient, recognize how other life stressors can contribute to diabetic distress enhancement. It is crucial to have some social, psychological skills, as these interventions require an efficient communication.

CONCLUSIONS

Diabetes has many severe cerebral complications. Patients may experience both ischaemic and haemorrhagic stroke and ensuing disability and reduced quality of life connected with being dependant from care of relative or professional health assistants. Moreover, diabetes is described to be a serious factor contributing development of brain structural changes. There was decrease in of gray and white matter reported to be associated with decline in cognitive functions, such as thinking, memory and planning, affecting self-care activities and treatment adherence. Moreover, diabetes is described as cause of depression and diabetic distress. These two affective problems are very serious reasons influencing everyday activity of patients. They have reduced inclination to perform physical activity or attend regular follow-ups. Glycaemic control in such individuals is significantly poorer than in people not suffering from these complications.

In summary, it is important to stress that cerebral complications of diabetes are frequent, especially in population of elderly people. They have substantial influence on cooperation with

patient, treatment adherence and its outcomes. Every situation of doctor`s dissatisfaction with the results of diabetic education, compliance and self-care activities performed by the patient should lead to investigation if he have any diabetes cerebral complications.

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