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Close relationship between obesity and type 2 diabetes mellitus (T2DM) and dietary regulation strategies

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ABSTRACT
With the change of lifestyle in modern society, the incidence of obesity and diabetes (T2DM) is increasing year by year, becoming a global health problem. There is a close link between obesity and T2DM, and understanding their relationship and complications is important for the prevention and treatment of diabetes. This paper will explore the association between obesity and T2DM and the important role of dietary management in prevention and treatment.

KEYWORDS
obesity; 2 diabetes mellitus; dietary regulation strategies

1 Introduction

According to the International Diabetes Federation (IDF), the number of diabetes patients worldwide has reached 537 million, 90% of whom are type 2 diabetes (T2DM), and the prevalence is still increasing. Among diabetic patients, the proportion of combined overweight and obese patients was as high as 65.3%. Obesity may not only contribute to the development of T2DM, but may also further increase the risk of cardiovascular disease in patients with T2DM. In China, the number of diabetes patients in 2017-2023 exceeded 100 million, ranking first in the world, with the proportion of overweight, obese and central obesity patients being 41%, 24.3% and 45.4% [1], respectively.

The association between obesity and type 2 diabetes mellitus (T2DM) involves several complex biological mechanisms that can directly affect glucose metabolism and systemic metabolic status while increasing insulin resistance and abnormal insulin secretion. The possible pathogenesis of obesity associated with T2DM include: abnormal fat metabolism, abnormal insulin secretion, abnormal intestinal flora, and abnormal lipid distribution. The occurrence and development of obesity and T2DM are causal and influence each other, forming a vicious circle. A deeper understanding of these pathogenesis mechanisms contributes to the development of more effective prevention and treatment strategies. In addition, obesity is not the only determinant of diabetes, but only a booster of the onset of diabetes, and we will find that there is no necessary relationship between the prevalence of childhood obesity and the incidence of T2DM [2].

2 The relationship between obesity and T2DM

Obesity refers to high body fat that to body mass index (BMI) above the normal range. T2DM, type 2 diabetes, is a chronic metabolic disease due by insulin resistance and / or inadequate insulin secretion. Studies show that obesity is one of the major risk factors for T2DM, with a clear

association between them [3].

First, obesity can lead to insulin resistance. When the body fat content is too high, adipocytes secrete a series of hormones and cytokines, such as leptin and adiponectin, which can interfere with the normal function of insulin, leading to insulin resistance. Insulin resistance is one of the underlying pathophysiological changes occurring in T2DM[4].

Second, obesity can lead to impaired islet β -cell function. The incidence of hyperuricemia is as high as 45% to 75%. Because insulin resistance is a common pathogenic basis for both. Insulin resistance causes increases in both blood glucose and uric acid levels. Not only that, but high uric acid can the complications of diabetes, such as cardiovascular disease and kidney disease. Uate crystals will stimulate vascular wall, cause atherosclerosis, damage islet β cells, cause insulin resistance, further aggravate glucose metabolism disorder, long-term high sugar, high fat diet will make the islet β cells overweight, lead to its function gradually impaired, insufficient insulin secretion, further aggravate the occurrence and development of diabetes.

3 Complications of T2DM

T2DM can cause a variety of complications, including cardiovascular disease, retinopathy, kidney disease and so on. These complications seriously affect the quality of life and prognosis[5]. Diabetes complications more than 100, the disease is the most known. Especially for cardiovascular disease, kidney disease, hyperuricemia, neuropathy, blindness, amputation, dysfunction and so on.

3.1 Cardiovascular diseases

Diabetic patients are often accompanied by cardiovascular disease risk factors such as hypertension and hyperlipidemia, which are easy to cause cardiovascular events such as coronary heart disease and myocardial infarction. Excessive accumulation of visceral fat can increase the risk of cardiovascular disease in patients with T2DM. Arterial stiffness was increased in obese individuals compared to non-obese individuals of the same age. Animal experimental studies have confirmed that obesity increases cardiac output and causes cardiac hypertrophy, and that these cardiac changes significantly increase the risk of heart failure and cardiac arrhythmias. Due to the long-term hyperglycemia in diabetic patients, it will cause persistent damage to blood vessels, leading to a series of lesions such as abnormal vascular endothelial cell function, vascular wall thickening and lumen stenosis. These changes not only increase the risk of atherosclerosis, but also may also lead to the occurrence of serious cardiovascular diseases such as coronary heart disease, myocardial infarction, and heart failure. According to statistics, cardiovascular disease has become the leading cause of death in diabetic patients aged 25-74 years, accounting for about half of the total deaths. According to the 2023 ESC Guidelines for Cardiovascular Disease Management in Diabetes Patients developed by the European Society of Cardiology (ESC), patients with type 2 diabetes (T2DM) have a 2 to 4 times higher risk of cardiovascular disease in their lifetime than individuals without T2DM, and many patients with cardiovascular disease are found to have T2DM when diagnosed.

3.2 Retinopathy

Long-term high blood sugar can damage retinal blood vessels, leading to vision loss or even blindness. In daily clinical work, some patients found that blood glucose was high during unconventional health examination, but were diagnosed with T2DM because of the typical symptoms of diabetes or diabetes complications. Such patients had not been paid attention to for many years, and the probability of diabetic retinopathy was high [6].

3.3 Kidney disease

Diabetes mellitus can cause microangiopathy in the kidney, leading to impaired renal function and even renal failure. Diabetic nephropathy is one of the common complications of diabetes, its main pathological changes is the microvascular lesions of the kidney, the laboratory examination for renal function abnormalities, such as glomerular filtration rate increased or decreased, albuminuria, urea nitrogen, creatinine value, etc., and in the early diabetic kidney lesions, may not appear the decline of glomerular filtration rate and albuminuria [7].

3.4 Polycystic ovary syndrome (PCOS)

PCOS is closely related to diabetes, and they have a common basis. Hyperinsulinemia occurs when the patient develops obesity and leads to insulin resistance. Hyperinsulinemia can stimulate ovarian hyperplasia and secrete more androgens, leading to polycystic ovary syndrome, followed by elevated blood glucose, abnormal glucose tolerance and even diabetic [8].

4 The role of dietary management in the prevention and treatment of T2DM

Dietary management is one of the important measures to prevent and treat T2DM. Reasonable diet structure can control weight, reduce blood sugar, lipids and other indicators, and reduce the occurrence of complications [9].

4.1 Control of total energy intake

Reasonable control of total energy intake is the key to weight control. It is recommended to develop a personalized diet plan based on their height, weight, age and activity. Diet adheres to the principle of "controlling the total amount, reasonable collocation, timing and quantification, eat less and more meals", and the total amount of diet is calculated according to the calories that adults need every day. Reasonable combination includes staple food, meat, fish, beans, vegetables, fruits, and the total amount they need. Timed quantification mainly refers to the rule of insulin secretion and the condition of oral hypoglycemic drugs, every meal. Eat less and more meals, and increase the number of meals under the condition of unchanged daily diet, not only control the sharp rise of blood sugar, but also prevent the occurrence of hypoglycemia [10].

4.2 Low-sugar diet

Limit sugar intake is important to control blood sugar levels. It is recommended to reduce the intake of high-sugar foods such as candy and sweet drinks, and eat more foods rich in dietary fiber such as vegetables and fruits. Mediterranean diet use, which focuses on diet quality, mainly vegetables, fruits, fish, nuts, whole grains, legumes and olive oil. Numerous studies have shown that the Mediterranean diet can promote longevity, improve the quality of life, and help to reduce the risk of T2DM.

4.3 High-fiber diet

Dietary fiber helps control blood sugar and lipid levels, and prevent intestinal problems such as constipation. It is recommended to increase the intake of high-fiber foods such as whole grains, beans and potatoes. The plant-based diet is also a high-fiber diet: the emphasis on less processed plant foods, including grains, fruits, vegetables and legumes, helps reduce the risk of chronic

diseases, including heart disease and T2DM [11].

4.4 Low-fat diet

Reducing the intake of saturated fatty acids and trans fatty acids is helpful to reduce the blood lipid level and prevent the occurrence of cardiovascular disease. It is recommended to choose healthy fats such as olive oil and fish oil.

4.5 A balanced diet

Keeping a balanced diet is very important for maintaining good health. It is recommended to consume appropriate amounts of protein, carbohydrates, fats, vitamins, minerals and other nutrients. Focus on increasing fiber and heart-healthy minerals (such as calcium, potassium and magnesium), while reducing sodium and saturated fatty acids. This dietary style helps to improve cardiovascular health and has positive effects on the management of T2DM [12].

5 Conclusion

There is a close link between obesity and T2DM, and understanding the relationship and complications is important for the prevention and treatment of diabetes. For extremely obese patients, gastrointestinal surgery can be considered to reduce weight and improve insulin resistance, and surgical treatment requires the patient to fully assess the risks and benefits, and to proceed under the guidance of a specialist physician. In addition, it can increase physical activity, aerobic exercise, anaerobic exercise, strength training and other appropriate exercise methods, through the exercise consumption of energy and improve body fat distribution, in order to achieve the effect of weight loss and improve insulin resistance, improve insulin sensitivity.

T2DM and its complications are also a global problem that seriously endangers human health. The treatment of T2DM complications is a complex and systematic process, which requires multiple factors. Treatment includes blood sugar control, dietary adjustment, medication, and special treatment for complications. Among them, dietary management is one of the important measures to prevent and treat T2DM. Through a reasonable dietary structure, it can control body weight, reduce blood sugar, blood lipid and other indicators, and reduce the occurrence of complications. Therefore, it is recommended that patients with T2DM should take reasonable dietary management measures, while strengthening physical exercise and regular examinations to maintain physical health. Controlling diet has multifaceted benefits for the management of T2DM, including glycemic control, weight management, cardiovascular health, blood pressure control, nutritional balance, and improved quality of life. Scientific and reasonable diet control not only helps to control blood sugar, but also can ensure the supply of various nutrients needed by the body. This helps to maintain the normal physiological function of the body and prevent problems such as malnutrition and decreased immunity. However, patients need to pay attention to avoid excess when controlling their diet and conduct personalized dietary planning under professional guidance.

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