Review Article

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TAURINE'S CRUCIAL FUNCTION IN METABOLIC DISEASES

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ABSTRACT

The cluster of risk factors for metabolic syndrome, which includes several diseases like cardiac disease, hypertension, obesity and diabetes, has emerged as a major issue in public health. The majority of mammalian tissues contain taurine, an amino acid that contains sulphur. Although it is possible to produce taurine internally, dietary sources are still the most important. Researchers discovered that taurine has many biological functions, such as reducing blood pressure, protecting cells from ischemia-reperfusion damage, and influencing intracellular calcium concentration. It also has antioxidant, antiatherogenic, and other beneficial benefits. Taurine has effective action to metabolic syndrome, including lowering triglycerides to avoid obesity, according to a lot of research. In this review, we will briefly describe the how taurine in preventing metabolic syndrome, as well as its favourable effects on cardiac, obesity, hyperlipidaemia, diabetes mellitus, and other disorders.

KEYWORDS: Taurine, Metabolic disease, Diabetes, Hypertension, Atherosclerosis.

INTRODUCTION

In recent times, there has been a significant amount of study and public attention focused on the increasing prevalence of metabolic syndrome, which is also referred to as insulin resistance syndrome. There are a number of risk factors for heart attacks that are included in the metabolic syndrome. These risk factors include obesity, insulin resistance, dyslipidaemia, and hypertension. Different clinical criteria for this condition have been created by a variety of expert bodies; however, they are all in agreement that you should take all of these variables into consideration simultaneously(1).

A person is considered to have metabolic syndrome if they have increased BMI value with altered lipid profile, elevated blood pressure, and elevated fasting plasma glucose. Metabolic syndrome is known to raise the chance of getting type 2 diabetes by five times, as well as cardiovascular events by around two times, all-cause mortality by about 1.5 times, and type 2 diabetes by about 1.5 times(2,3).

Almost all mammalian tissues, including the heart, retina, liver, muscles, and platelets, contain the conditionally necessary amino acid taurine (2-aminoethanesulfonic acid), which is abundant in seafood. Before the discovery that preterm newborns given formula could not maintain normal plasma or urinary taurine levels in 1975, it was thought to be a non-essential nutrient for humans. Low taurine levels were also linked to a number of clinical diseases, such as cardiomyopathy, retinal degeneration, growth retardation, and others, according to in vivo investigations. Among taurine's several documented biological and physiological functions are its anti-oxidant and anti-inflammatory qualities, as well as its ability to regulate osmoregulation, stabilise membranes, and modulate cellular calcium levels(4,5).

TAURINE DEMONSTRATED IN CLINICAL AND ANIMAL RESEARCH TYPE 1 DIABETIC MELLITUS

In the various published reports it was found that taurine can help with type 1 diabetes,. who were taking insulin had improved glucose metabolism after 30 days of taking taurine supplements (0.5 g twice daily) (6). Both streptozotocin and alloxan destroy pancreatic beta cells, which is a common complication of type 1 diabetes, and taurine may protect them (5,7).

MECHANISMS OF TAURINE IN HYPOGLYCEMIA

A clinical investigation was conducted on men who were overweight but did not have diabetes. Various

studies reveals, insulin resistance and heparin through the intravenous route, may damage the pancreatic cells while , after a course of therapy consisting of three microgram of taurine per day for a period of two weeks reverse these mechanism (8). In another study on rodent was observed that 2% taurine for a period of thirty days provide better results. Taurine administration resulted in decreased levels of glucose in the blood of mice, and a tyrosine insulin receptor protein phosphorylation in skeletal muscle and liver and regulate the insulin level and stimulation.–(9,10).

IMPACT OF TAURINE ON OBESITY

Nowadays it was found that taurine provide very important and beneficial role in the treatment of obesity, both in animals and in people. In a study conducted in 2004 in a group of approximately 30 people, it was found that, students who did not have diabetes mellitus and had a body mass index (BMI) of 25.0 and who were given taurine, while the other group consisted of fifteen individuals who were given a placebo. Very interesting results they found that in body weight, triglycerides (TG), were decreased significantly in the group that was given either 3 microgram of taurine or a placebo orally at regular intervals for a period of seven weeks. With regard to the prevention of cardiovascular disease in those who are overweight or obese, the data suggest that taurine has the potential to be a game-changer. According to the findings of a study that involved 243 healthy teenage females, researchers discovered that individuals whose urinary taurine excretion was higher had considerably lower serum triglyceride levels than those whose excretion was lower. A diet that is high in taurine may be able to improve serum lipid profile, according to this evidence (12).

ANTIOXIDATION

By promoting insulin resistance and pancreatic β cell dysfunction, oxidative stress adds to the pathophysiology of diabetes, which is caused by the increased production of reactive oxygen species (ROS). The reactive oxygen species and imbalance between oxidant and antioxidant environment inside the cellular system mainly responsible for the Initiation of diabetes (13). Animal models for familial hypercholesterolemia in humans, including apoE-deficient mice and Watanabe heritable hyperlipidemic (WHHL) rabbits, have shown that taurine can inhibit lipid peroxidation. Because of its antioxidant capabilities, taurine improves beta cell dysfunction. Evidence suggests that taurine's antioxidant benefits are mediated through mitochondrial pathways, as it has been demonstrated to reduce mitochondrial superoxide generation in mice. By decreasing taurine levels in mitochondria, in vitro investigations have examined the molecular pathways underlying this action. When mitochondrial taurine synthesis drops, the amount of ND5 and ND6, proteins encoded by mitochondria, drops as well, rendering Complexes I and III useless.(14).

NEUROINFLAMMATION MODULATION

Inflammation in the neurological system can be mitigated by taurine, according to research. Taurine significantly enhanced functional recovery after traumatic brain injury (TBI) in the penumbral region while reducing water content and accumulation of glial fibrillary acidic proteins (15). In a combined study it was found that a week of taurine treatment a significant notable decrease in the levels of various cytokines, Intracellular inflammatory factors, monocyte chemotactic protein-1, and vascular endothelial growth factor (VEGF) (16). Taurine treatment effectively reduced the severity of neuronal damage in serious brain injuries and traumatic brain injury by decreasing cerebral oedema, increasing astrocyte activity, and proinflammatory cytokines. In STZ- and Mn-induced animals, taurine therapy restored choline acetyltransferase and acetylcholinesterase activity, which are important for acetylcholine regulation. Regarding the cholinergic signaling system and Aβ-mediated neurotoxicity, taurine shielded the retinal neurones of chicks in vitro. Glutamate receptors are not involved in the action, however taurine's neuroprotective properties have blocked picrotoxin, a GABAA receptor antagonist. (17).

Beyond the Alzheimer's disease (AD) model, researchers have investigated taurine's neuroprotective benefits in PD models in both cells and animals. Taurine demonstrated a protective effect when tested against neurotoxicity caused by rotenone(16).

THE POTENTIAL OF TAURINE IN COMBATING ATHEROGENESIS

Atherosclerosis, impacting more than 60 million individuals in the United States, has undergone extensive research over the past sixty years. While low-density lipoproteins (LDL) are recognised for their role in plaque development within the arterial wall, oxidised LDL can significantly worsen this process. Rats with high cholesterol that were administered taurine (15 g/kg/day) for a duration of five weeks exhibited a 37% decrease in plasma LDL, a 32% decrease in total cholesterol, and a 43% decrease in triglyceride (TG) levels in comparison to control rats that were fed the same diet without taurine (12,18) Additionally, rats that were provided with a high taurine diet, when compared to those on a cholesterol-

free diet, exhibited a notable reduction in plasma levels of LDL, total cholesterol, and triglycerides. A 43% reduction in hepatic triglycerides and a 77% increase in free fatty acids in the liver were noted. Platelet activation, adhesion, and aggregation at locations of vascular endothelial disruption due to atherosclerosis are critical processes in the formation of arterial thrombus. The influence of taurine on platelet agreeability has been proposed to be substantial. Platelets obtained from taurine-depleted cats exhibited a sensitivity to aggregation that was twice that of platelets from cats supplemented with taurine(19).

ANTI-INFLAMMATORY

Type 1 diabetes, in which pancreatic beta cells die due to inflammatory processes, and type 2 diabetes, in which macrophages migrate into adipose tissue, are both thought to be rooted in inflammation. The anti-inflammatory taurine chloramine is produced when taurine reacts with hypochlorous acid. An important part of inflammatory pathways, taurine chloramine reduced the activity of NF-kB and reduced levels of monocyte chemoattractant protein 1 (MCP-1), in addition to inhibiting TNF-alpha release the prospective mechanism behind it that they directly damage the beta cells or inhibiting ulk-1, beclin-1 macrophage activity in type 2 diabetes. (20,21).While no direct anti-inflammatory role of taurine directly found with taurine treatment in in vivo study on mice.

ARTERIAL PRESSURE

Many research have examined taurine's antihypertensive effects. After 7 days of 6 g taurine, young borderline hypertensive' systolic and diastolic blood pressure dropped significantly. Tibetans were studied for taurine's hypotensive effects. After 2 months of ingesting 3 g of taurine daily, systolic and diastolic blood pressures dropped dramatically. Taurine has been tested for its hypotensive effects in rats with spontaneous hypertension (SHR), deoxycorticosterone acetate (DOCA), and high-fructose diets (22). The hypotensive effects of taurine are linked to renin-angiotensin-aldosterone system. This is the primary pathways which directly involved hypertension conditions. One of the many medications used to manage hypertension is angiotensin II, a crucial hormone in the RAAS. Experimental evidence suggests that taurine can inhibit angiotensin II activity in cell cultures(23).

CONCLUSION

In the conclusion we found that, taurine has been demonstrated to treat metabolic syndrome and diabetes in animals. This study also provide a broad idea regarding the various metabolic pathways and signalling molecules were bused to modulate and regulate the general metabolism of our human body as well as rodent system, and may be beneficial in the treatment of diabetes, obesity, hypertension and cardiac disease. Unfortunately, clinical trial data is lacking. More research is needed to improve clinical studies. This will shed light on taurine as a nutritional supplement for metabolic syndrome and diabetes prevention.

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