Original Article

The Mineral Preparation Dibeston: The Effect on the State of Excretory Kidney Function in Diabetes Mellitus

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Abstract

Diabetes mellitus is one of the most common diseases in modern society, and by 2030, according to the World Health Organization, it may reach the seventh place in the ranking of the main causes of death of the population. To optimize the treatment of diabetes mellitus, various mineral complexes can be used. This scientific article reveals the potential of the action of the new mineral preparation Dibeston on the state of excretory kidney function in alloxan diabetes. An experiment was conducted on 40 white laboratory rats divided into five groups: group 1 - intact; group 2 - controls with alloxan diabetes; group 3 - alloxan diabetes - Dibeston; group 4 - alloxan diabetes + Asparkam; group 5 - alloxan diabetes + selenium preparation. The levels of glycemia, creatinine, polyuria, and proteinuria were studied. It was found that the drug Dibeston has a pronounced beneficial effect in case of impaired kidney function against the background of alloxan diabetes mellitus.

Keywords: Diabetes mellitus, Alloxan diabetes, Excretory kidney function, Asparkam, Selenium, Dibeston

Introduction

According to the International Diabetes Federation, there are about 450 million diabetic patients in the world, and their number doubles every 12-15 years [1, 2]. According to forecasts of the World Health Organization, by 2030 diabetes mellitus will reach the seventh place among the causes of death [3]. The impaired excretory function of the kidneys (diabetic nephropathy) is a frequent complication of diabetes mellitus, leading, along with others, to disability and death of patients [4-6]. Thus, in type 2 diabetes mellitus (at its debut in puberty), the incidence of diabetic nephropathy is about 45% [7].

Typical signs of type 2 diabetes mellitus (DM2), along with weight gain and dyslipidemia, are reduced glucose tolerance, hyperinsulinemia, hyperleptinemia, impaired incretin response to glucose loading, endocrine system dysfunction, including changes in thyroid and sex steroid hormone levels [8-11]. This is due to impaired metabolic processes in tissues, increased oxidative stress and inflammation in them, and dysregulation of the functional activity of the hypothalamic links of the endocrine system [12, 13]. An important role in this regulation is played by insulin and leptin, which enter the central nervous system through the blood-brain barrier using receptor-mediated mechanisms [14, 15]. However, in conditions of prolonged hyperglycemia and insulin and leptin resistance, the transport of insulin and leptin in the central nervous system is disrupted, which leads to their deficiency in the hypothalamus and other parts of the brain in DM2 [16, 17].

The weakening of insulin and leptin signaling in the hypothalamus is one of the primary causes of a decrease in the expression and secretion of hypothalamic-releasing factors – tyroliberin and gonadoliberin, stimulating the release of thyroid-stimulating hormone and gonadotropins by the adenohypophysis [18-20]. A decrease in the activity of insulin and leptin pathways in the hypothalamus and other parts of the brain leads to eating disorders and central regulation of carbohydrate and lipid metabolism [21-23].

To optimize the treatment of diabetes mellitus and prevent the development of severe complications, new medicines are

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being sought, as well as additional elements of antidiabetic therapy. Various vitamin and mineral complexes, antioxidants, and phytopreparations can be used for this purpose [24, 25].

The purpose of this scientific study is to evaluate the effect of a complex of mineral additives consisting of compounds of magnesium, sodium, potassium, and selenium on the level of glycemia and the state of excretory kidney function in rats with alloxan diabetes.

Materials and Methods

The current experiment was performed on laboratory white Wistar rats. All animals were kept in the same optimal conditions: nutrition, wakefulness, and sleep patterns met the standards for these animals [26]. 40 mature male rats weighing 200-250 g were divided into 5 groups: group 1 – intact; group 2 – alloxan diabetes mellitus; group 3 – alloxan diabetes mellitus + Dibeston complex of mineral additives; group 4 - alloxan diabetes mellitus + Asparkam drug; group 5 - alloxan diabetes mellitus + selenium drug.

The model of diabetes mellitus was reproduced by subcutaneous administration of a freshly prepared aqueous 10% solution of alloxanhydrate at a dose of 100 mg /kg against the background of 18-hour starvation of animals.

Dibeston composition: sodium chloride 28%, potassium chloride 22%, potassium citrate 12%, potassium bromide 1%, magnesium sulfate 14%, calcium asparaginate 6%, magnesium asparaginate 8%, glutamic acid 5%. Rats received dibeston in the form of a 1% solution for free drinking.

Rats received the drug Asparkam in the form of a drinking solution in ampoules of 10 ml. The drug was injected through a probe into the stomach (0.1 ml / 100 g) for 10 days before the administration of alloxan.

Selenium preparation (selenopyran) is a selenium compound packaged in 1 g. Selenopyran solution was administered intramuscularly to rats (0.04 mg selenium / 100 g) 3 days before and the next day after alloxan administration.

A 10% aqueous solution of alloxanhydrate was administered subcutaneously at a dose of 100 mg/kg, after which the use of mineral compositions was continued for another 10 days. Then the animals were placed in exchange cages for 24 hours, after which they were slaughtered. Daily diuresis, drinking activity, protein content in urine, glucose, and creatinine in blood and urine were determined, and glomerular filtration rate and water reabsorption were calculated according to standard methods [27-30]. Statistical processing was carried out using the program "Statistics".

Results and Discussion

A significant hypoglycemic effect of Asparkam and selenopyran was established (glycemic levels, respectively, 3.37±0.30 and 4.71±0.35 µmol/l versus 8.0±0.22 µmol/l in group 2 rats); Dibeston did not cause a statistically significant hypoglycemic effect **(Figure 1)**.

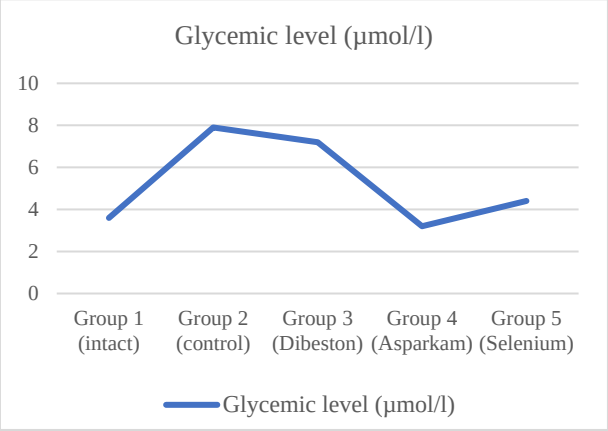

Figure 1. The level of glycemia in rats after administration of mineral supplements

The development of alloxan diabetes was accompanied by renal manifestations: polyuria (7.34±0.60 ml/100 g versus 3.2±0.50 ml/100 g in intact patients), polydipsia, glucosuria, proteinuria, some decrease in glomerular filtration and reabsorption of water, increased blood creatinine (152.80±10.30 µmol/l versus 93.10±2.20 µmol/l in intact rats). The use of mineral additives reduced the severity of polyuria **(Figure 2)**, polydipsia (especially pronounced in the Dibeston and Asparkam groups, in which diuresis was, respectively, 2.00±0.24 ml/100 g and 1.48 ml/100 g), glucosuria. In addition, the use of hyposol led to a significant decrease in proteinuria (protein excretion per day 0.24±0.02 mg/100 g versus 0.75±0.27 mg/100 g in group 2) **(Figure 3)**.

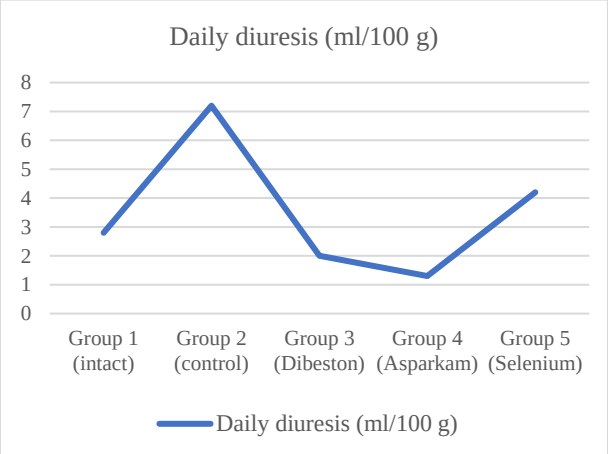

Figure 2. Severity of polyuria in rats after administration of mineral supplements

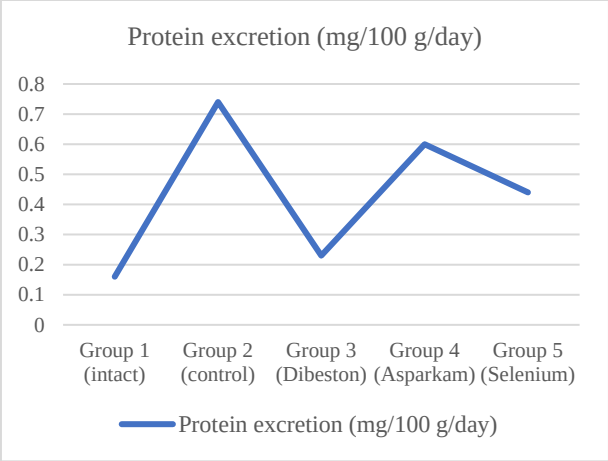

Figure 3. Changes in the level of proteinuria in rats after administration of mineral supplements

The use of hyposol and selenopyran also led to a decrease in blood creatinine concentrations (82.0±1.0 μmol/l and 110.2±5.5 μmol/L, respectively, versus 152.8±9.3 μmol/L without treatment) **(Figure 4)**.

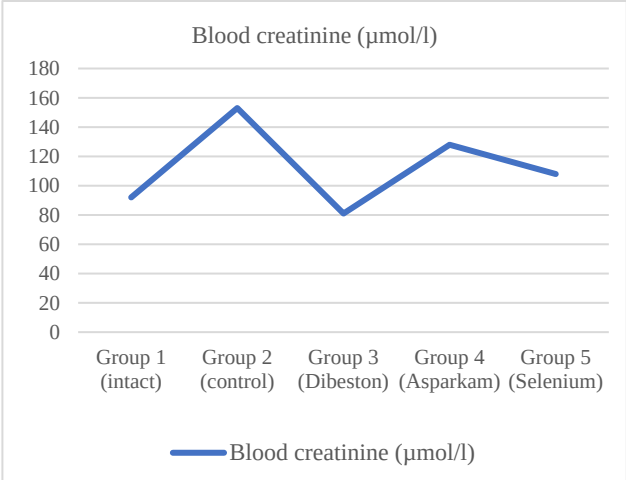

Figure 4. Changes in blood creatinine concentration in rats after administration of mineral supplements

The beneficial effect of the studied compounds on the state of renal excretory function may be partially due to hypoglycemic action (reduction of polyuria, polydipsia, glucosuria when using Asparkam and selenopyran); with pronounced antioxidant activity (selenopyran) [31, 32] and with a decrease in increased activity of the renin-angiotensin-aldosterone system, which leads to a decrease in intraclubular hypertension (Dibeston) [33].

Conclusion

As a result of the experiment, data were obtained on the effect of compounds of various minerals on the state of the excretory function of rats with alloxan diabetes. The studied mineral compounds, especially Dibeston, and selenopyran, have a beneficial effect on impaired renal function against the background of alloxan diabetes mellitus. The identified effects can be used in the development of drugs for the complex treatment of diabetes mellitus, including those accompanied by nephropathy.

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ETHICS STATEMENT: The protocol for experiments with laboratory animals complied with the requirements of the European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes.

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