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DYNAMICS OF HEMODYNAMIC INDICATORS DURING INTENSIVE CARE FOR DIABETIC KETOACIDOSIS

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Abstract
Diabetes mellitus (DM) is one of the most common endocrine diseases worldwide. Severe and dangerous complications of diabetes mellitus are diabetic ketoacidosis and hyperglycemic ketoacidotic coma, which require a special approach, both due to the severity of the course and due to high mortality. High mortality in hyperglycemic ketoacidotic coma is associated with insulin deficiency (1,4,6), tissue hypoxia, endogenous intoxication, water-electrolyte imbalance, metabolic disorders, multiple organ dysfunction (2,3,5). Most clinicians identify, first of all, hypovolemia and accompanying systemic hypoperfusion as one of the leading links in the pathogenesis of systemic and organ failure in patients with diabetic ketoacidosis and hyperglycemic ketoacidotic coma (2,6).

Introduction

The leading role in the correction of hypovolemia is played by infusion therapy, aimed at rapidly increasing the volume of circulating blood, cardiac output, oxygen delivery and its consumption by body tissues. Its optimal choice, along with insulin therapy and other means of pharmacological correction, can prevent the development of critical illness and multiple organ dysfunction in patients with diabetic ketoacidosis and hyperglycemic ketoacidotic coma. All of the above indicates the relevance and clinical significance of the problem under consideration, since timely diagnosis and adequate intensive therapy of diabetic ketoacidosis and hyperglycemic ketoacidotic coma can not only significantly improve treatment results, but also the outcome of the disease as a whole.

The purpose of our work was to study the dynamics of hemodynamic parameters against the background of intensive therapy for diabetic ketoacidosis.

Materials and methods of research

65 patients with diabetes mellitus who were in critical condition due to diabetic ketoacidosis and hyperglycemic ketoacidotic coma were examined. The study included patients aged 35 to 60 years (mean age 55.4±1.2 years). To determine the severity of the patients' condition, parameters of central hemodynamics were studied, volemic indicators , heart rate (heart rate), ADP (average dynamic pressure), SI (stroke index), SPVR (specific peripheral vascular

resistance), CI (cardiac index), CBV (circulating blood volume), CPV (circulating plasma volume), VCRBC (volume circulating red blood cells). To study the effectiveness of infusion therapy, a main and control group of patients were formed. Patients in the study and control groups received standard insulin therapy to correct blood glucose. Rehydration therapy using saline and salt-free solutions was carried out strictly under the control of central venous pressure and hourly diuresis. Patients in the control group received infusion therapy with standard saline solutions: 0.9% sodium chloride solution or Ringer's solution , 0.45% sodium chloride solution were used. Correction of potassium deficiency was carried out using intravenous drip administration of a 0.15% potassium chloride solution. In patients of the main group, Succinasol was used for detoxification purposes . After blood glucose decreased to 14-16 mmol /l, the domestic Cadence solution was included in the infusion .

The results of the study showed that patients who were in critical condition with diabetic ketoacidosis were characterized by significant changes in central hemodynamics upon admission to the intensive care unit. In both groups of patients, there was a decrease in SI and CI compared to the norm by 42.3 and 27.4%, respectively ($p<0.05$), an increase in ADP by 25.6% ($p<0.05$) and SPVR by 27. 5% ($p<0.05$), increase in heart rate by 28.3% ($p<0.05$). The pathogenesis of decreased performance of the cardiovascular system in critically ill patients with diabetic ketoacidosis is due to various manifestations of cellular dehydration. The identified changes in central hemodynamics in patients upon admission indicated a breakdown of the compensatory mechanisms of the circulatory system, a sharp increase in cardiovascular failure caused by a combination of low cardiac output with hypovolemia , as well as manifestations of various types of dehydration. Patients experienced volemic disturbances, such as a decrease in circulating blood volume due to a decrease in the volume of circulating plasma and a decrease in the volume of circulating red blood cells.

Modern intensive care for diabetes mellitus with diabetic ketoacidosis in critically ill patients includes two mandatory components. This is a subsidy of fluid with compensation for its deficiency and correction of current pathological losses of water and electrolyte composition of the blood, as well as insulin therapy.

The results of the study show that in the control group, against the background of traditional infusion therapy, achieving the target glycemic level was accompanied by a significant decrease in this indicator on day 1 to 52.4%, and on day 2 to 48.8%. In patients of the main group, a gradual decrease in glycemia was observed, by 60% and 68%, respectively. During the rehydration program, patients in the main group showed an improvement in blood water and electrolyte balance. In patients of the main group, on day 1 there was an increase in the Na + content in the blood plasma by 8.5 %, and on day 2 by 12.3%. A similar picture was observed with the K^+ concentration in the plasma of the main group of patients, which increased from 3.2±0.1 to 4.4±0.1 mmol/l. And in patients in the control group on days 1 and 2, no significant changes in Na + and K^+ were observed in the blood plasma . This normalization of the electrolyte composition of the blood in patients of the main group led to an improvement in central hemodynamics.

Indicators of circulatory homeostasis in patients of the main and control groups

Table No. 1.

Indicators	On admission		In 24 hours		Through 48 hours	
	CG	MG	CG	MG	CG	MG
Glucose, mmol /l	24.8	26.2	11.3	10.5	12.7	8.3
Heart rate/ min¹	96.2	97.1	99.4	92.2	94.7	74.5 *
ADP, mm Hg. Art.	109	110.4	100.3	95.8 *	104.7	83.7
SI, ml/m²	24.8	27.9	25.3 *	34.7	27.9	39.8 *
CI, l/m²	2.4	2.6	2.5	3.2	2.7	3.4
SPVR, dynes.s.cm-5	2178.4	2190.7	1365.4	936.8 *	1324.7	824.3
CBV, ml/kg	53.63	54.61	61.66	69.41 *	67.2	74.83 *
CPV, ml/kg	24.84	24.84	30.81	39.42 *	37.53	43.84 *
VCRBC, ml/kg	28.2	29.2	29.74	30.71	31.71	31.29

Note. * p< 0.05, compared with the control group.

On the first day in the main group, the values of the main indicators of central hemodynamics improved. This was confirmed by a significant decrease in heart rate by 5% after 1 day, ADP by 13%, an increase in SI by 24%, and CI by 14%. It should be noted that SPVR decreased by more than 50% (Table No. 1) . In patients in the control group, during treatment according to the standard algorithm, the parameters of SI and CI did not differ significantly from the initial values. Heart rate remained at the same level.

According to the data obtained, in patients with hyperglycemic ketoacidosis in critical condition, volemic disturbances associated with a decrease in CBV, CPV, and also a decrease in VCRBC. Despite the therapy carried out during rehydration therapy, in patients in the control group there was an increase in CBV by only 15%, CPV by 24%, and VCRBC did not undergo significant changes. In patients of the main group, there was an increase in CBV by 39% on day 1, and by 60% on day 2, while there was a 2-fold increase in CPV, by 54.5% and 71%, respectively, indicating the effectiveness of the therapy. This made it possible to correct the deficit of CBV, stabilize blood circulation, creating optimal conditions for circulation.

Conclusion

Thus, the proposed option of intensive therapy made it possible to correct the deficit of CBV, stabilize blood circulation, creating optimal conditions for microcirculation in patients in the early stages of treatment. Moreover, this approach reliably helps to reduce the length of stay of patients in the intensive care unit and reduce the mortality rate.

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