Stress-induced hyperglycemia as a predictor of the development of post-stroke seizures

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Abstract. *Stress-induced hyperglycemia is a controversial risk factor for the development of seizures after a stroke. Stress-induced hyperglycemia leads to increased mortality and complications in critically ill patients. The aim of the study was to evaluate the effect of stress-induced hyperglycemia on the development of post-stroke seizures.*

Materials and methods*: 489 patients were included in the case-control study. In patients, the level of stress-induced hyperglycemia was assessed by retrospective data of biochemical analysis. Statistical methods were used to determine the relationship between the level of stress-induced hyperglycemia and the development of post-stroke seizures.*

Results: *according to the results of the study, in 260 cases in the group, the outcome of which was the development of post-stroke seizures was stress-induced hyperglycemia. Stress-induced hyperglycemia was observed 1.193 times more often than normoglycemia. The chance of developing post-stroke seizures in the study group was 1.468. The relationship between the traits was found to be statistically significant.*

Conclusion: *Stress-induced hyperglycemia is associated with the development of post-stroke seizures. Our study confirmed that stress-induced hyperglycemia is one of the predictors of the development of post-stroke seizures.*

Keywords: *stress-induced hyperglycemia, post-stroke seizures, predictor, ischemic stroke*

Introduction

Currently, there is a consistent increase and prevalence of seizures [1]. This is due to an increase in the population of persons of older age groups, as well as an increase in the incidence

of cerebrovascular pathology [2]. About 10% of epilepsies and 55% of newly diagnosed seizures develop after a stroke [3].

Seizures worsen morbidity and mortality rates, prevent active recovery from stroke, and increase the length of hospital stay [4,5]. It has been proven that mortality in patients with post-stroke seizures is at a higher level than in all patients with ischemic stroke [6]. In addition, patients with seizure syndrome have a more pronounced neurological functional deficit in the outcome of stroke than patients without seizures [7].

The management of patients with post-stroke seizures is challenging due to the lack of proven effective treatment guidelines and recommendations. In their practice, neurologists are faced with such problems in treatment as the optimal time to start treatment and an adequate choice of antiepileptic drugs [8].

In the course of a meta-analysis, it is known that hemorrhagic stroke, stroke in the left carotid system, atherothrombotic ischemic stroke, severe neurological deficit according to the NIHSS scale, age over 65 years are the most frequent risk factors for seizures after stroke [9].

In the course of the literature review, there is a single number of studies and ambiguous conclusions about stress-induced hyperglycemia as a risk factor for the development of post-stroke seizures [10,11].

Stress-induced hyperglycemia occurs in up to 50% of stroke cases [12]. Stress hyperglycemia is an independent predictor of disease severity. Practice has shown that stress-induced hyperglycemia in patients with cerebral stroke is associated with an increase in the area of ischemic brain damage and a worsening prognosis [13, 14]. The risk of hospital complications also correlates with the degree of hyperglycemia, with a higher one observed in patients without a history of diabetes mellitus, and improved glycemic control reduces the incidence of complications and mortality [15].

Thus, the growth and prevalence of convulsive seizures against the background of a stroke necessitates a more detailed study. Better knowledge of the risk factors for post-stroke seizures, as well as the possible prediction of seizures after stroke, may have an impact on improving the prevention and treatment of seizures after stroke.

Purpose

The purpose of the study was to evaluate the effect of stress-induced hyperglycemia on the development of post-stroke seizures in patients with ischemic stroke.

Materials and methods

The case-control study was carried out on the basis of a neurological hospital. We retrospectively analyzed 260 case histories of patients with post-stroke seizures in 2015-2020. The study included patients aged 50-79 years, who were divided into two groups. The main group consisted of 260 patients aged 50 to 77 years (141 men and 123 women) with seizures, the control group - 229 patients (119 men and 106 women) 50–73 years old without seizures. Patients of the two groups were comparable in clinical characteristics (blood pressure of 2-3 degrees, points on the NIHSS assessment scale not more than 22), pathogenetic subtype of stroke (atherothrombotic ischemic). The level of stress-induced hyperglycemia was assessed by the results of biochemical analysis in patients upon admission to the hospital, on an empty stomach the next morning, and also during the entire stay of the patient in the hospital. The exclusion criteria were type 1 and type 2 diabetes mellitus and a history of epilepsy, clinically and neuroimaging hematomas with a volume of more than 30-40 ml, accompanied by severe neurological deficit, and patients with intracerebral and subarachnoid hemorrhages. The criterion for confirming stress-induced hyperglycemia was the consultation of respective specialists, exclusion of the diagnosis of diabetes mellitus, blood test for glycated hemoglobin (HbA1c) - less than 6.0%. Statistical processing was carried out using the software package Microsoft Excel, Statistica 6.0., The statistical programming language R version v3.2.0. Spearman's correlation coefficient was used to assess the relationship between the level of stress-induced hyperlycemia and the development of post-stroke seizures. The strength of associations of the analyzed features was determined using the value of the odds ratio and relative risk. The study was approved by the local ethics committee of the medical university.

Results and its discussion

In the course of the study, we found that in patients with post-stroke seizures, an increase in the level of blood pressure to the 3rd degree was more often observed, in percentage terms - 53.85% in the main group. In the control group, patients with grade 2 slightly prevailed - 50.22%. We concluded that no significant differences in blood pressure were found in the two groups. According to the clinical examination, patients with seizures did not have a gross neurological deficit; in the control group, severe neurological disorders were observed (121 cases - 52.84%). As in previous studies, the association of the severity of stroke with the development of seizures was not confirmed [16,17,18]. In our study, seizures developed in the atherothrombotic variant. However, according to the literature, a higher incidence of epileptic seizures after cardioembolic stroke was found in comparison with other subtypes of ischemic stroke [19, 20, 21]. In 115 (44.23%) patients of the main group and 116 (50.66%) of the control group, ischemic stroke developed in the carotid system, in 145 (55.77%) patients of the main

group and 113 (49.34%) of the control group - in the vertebrobasilar pool. Thus, convulsions developed in patients with ischemic stroke in the vertebro-basilar basin. When analyzing and assessing the level of stress-induced hyperglycemia, we divided the patients into 3 groups according to the level of glycemia. The first group, which had normal blood glucose levels, the second group with a stress-glycemic level of 7.8-11.1 mmol/l, and the third group, whose indicators exceeded 11.1 mmol/l. It was revealed that the level of stress-hyperglycemia up to 7.8-11.1 mmol/l was more often observed in two groups, the proportion of patients in the main group was 49.23% and 45.41% in the other group. In the main group, 153 cases of an increase in the level of glycemia were observed, of which, at a level of glycemia of 7.8-11.1 mmol/l, -128 cases, 25 cases with a level of glycemia of more than 11.1 mmol/l. In the control group, there were 116 cases of normoglycemia and 113 cases of hyperglycemia without outcome. According to the results obtained, in stress-induced hyperlycemia, the greatest number of post-stroke convulsive seizures was observed. When analyzing the relationship, it was revealed that in patients with post-stroke seizures, stress-induced hyperglycemia is observed 1.193 times more often than normoglycemia (RR=1.193). The odds ratio was 1.468, thus, the chance of developing post-stroke convulsive seizures in the main group is 1.5 times greater than in the control group (OR=1.468). The correlation coefficient of Spearman's ranks was 0.1. The connection between the signs is assessed as a direct weak one. The relationship was recognized as statistically significant, since the obtained p level (p=0.010617) did not exceed the permissible value (p=0.05). According to clinical phenomenology, 40% developed focal seizures, 34.15% developed simple partial seizures, 21.15% of patients suffered from complex partial seizures, generalized seizures were recorded in 7.69%. According to the results of the study, focal seizures were more often recorded in patients with the development of post-stroke seizures (104 cases). Also, analyzing our own data, we observed that convulsions were more often noted on 3-4 days of hospitalization. As a percentage, on day 3 at 21.92%, on day 4 at 42.31%. According to the classification of G.Barolin and E. Sherzer (1962), seizures that developed 7 days after an acute cerebrovascular accident are early seizures [22].

Conclusion

Based on the results obtained, we came to the conclusion that stress-induced hyperglycemia can be attributed to a predictor of the development of post-stroke seizures. Timely control of the level of stress-induced hyperglycemia and proper patient management will reduce the risk of developing post-stroke seizures.

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