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The Influence of Glucose Load on γ -Glutamyl-Transpeptidase (GGTP) Activity in the Serum of Patients with Acute Disturbances of the Cerebral Circulation

Wpływ obciążenia glukozą na aktywność γ -glutamylotranspeptydazy (GGTP) w surowicy krwi chorych z ostrymi zaburzeniami krążenia mózgowego

The examinations carried out on the patients with the stroke have showed that in the early period of the illness the functions of the vegetative central neurons become defective, and the disturbances of liver functions deserve particular interest (6, 17). One of the most sensitive indicator of liver functions is GGTP activity. GGTP is a membranous enzyme of the hepatic cells which catalyses the transportation reaction of the terminal C-glutamyl acid from γ -glutamyl peptides to other peptides or L-aminoacids. The increase of the plasmatic activity of this enzyme may point to hepatic cells damage (16). GGTP also occurs in the kidneys, pancreas, intestine, heart muscles and in the brain. The histochemical analyses have showed a relatively large concentration of this enzyme in the border range of neuron nuclei and in the cytoplasm of the endothelium plexus, and the brain capillaries (3, 11). The examinations have revealed a quick exchange of labelled aminoacids between the brain and blood. Fast transportation of aminoacids engaged in the γ -glutamyl cycle is an indirect confirmation of capillary participation in the function of the blood-brain barrier. It is thus comprehensible that in the conditions of the brain-blood barrier disfunction as a result of capillary placenta damage, the plasmatic activity of GGTP (both of capillary and cerebral origin) may increase. The change of activity of GGTP in serum and in cerebro-spinal fluid of the patients with acute vascular brain damage has been proved (1, 16). The significant decrease of the glutamic acid contents in the blood of patients with cerebral infarction on the first day of the illness as a result of the intravenous glucose loading test is an additional observation (8). The protective influence of glucose on liver cell function is commonly known. It is also known that brain stroke leads to the disturbances of carbohydrate balance (2, 4, 5, 7, 9, 10, 12, 15).

The aim of this work was to check GGTP activity in the serum of patients with acute disturbances of the cerebral circulation and the influence of the intravenously injected glucose on the activity of the enzyme.

PATIENTS AND METHOD

The control group consisted of 15 patients (9 women and 6 men) with pain radicular syndromes in the term of pain remission. The age of the control people oscillated from 45 to 68 (the average was 54).

The group of patients with the transient cerebral insufficiency consisted of 25 people (15 women and 10 men) at the age of 41—82 (the average age — 63). In all the cases the circulation insufficiency concerned the area which is supplied with blood by vertebral arteries. The diagnosis was based on the clinical pathological symptoms and on the results of subsidiary analyses. All patients left the clinic after the suffering had stopped. 25 patients were examined on the 1st and 3rd day of their stay in the clinic, 21 — on the 7th day, 7 — on the 14th day.

The group of patients with the brain infarction consisted of 30 persons (18 women and 12 men) at the age of 44—86 (the average age — 69). The diagnosis was based on clinical pathological symptoms and on the results of subsidiary analyses. 10 people died. The sectional confirmation was received in the case of 3 patients. In 7 cases the diagnosis was confirmed by the computer tomography, in 1 case

by angiographic analyses. The examinations on the 1st day of the illness were carried out on 30 patients, on the 3rd day — on 27 patients, on the 7th day — on 22 patients, and on the 21st day — on 12 patients.

The group of patients with the cerebral haemorrhage consisted of 11 people (7 women and 4 men) at the age of 54—88 (the average age — 72). The diagnosis was established on the basis of the clinical picture of the illness and the results of subsidiary analyses. The sectional confirmation was received in the case of 2 patients. In 4 cases the diagnosis was confirmed by the computer tomography. The haemorrhagic syndrome in CSF was found in 10 cases. On the 1st day the examinations were conducted on 11 patients, on the 3rd day — 7 patients, on the 7th day — 5 patients, on the 14th day — 3 patients, and on the 21st day — only on 2 patients.

All the examined patients were on the routine hospital diet. The patients in a bad condition were fed parenterally and with help of a probe. The results did not give the basis to recognize any damaged parenchymatous organs and alcohol excess.

The concentration of glucose and GGTP activity labelled in blood taken from thy basilic vein of the patients on an empty stomach and 60 and 120 min after giving 80 ml of 40% glucose solution intravenously.

The concentration of glucose in blood was labelled with a colorimeter o-toluidine method with the help of standard sets Bio-Lachema-Test from Lachema Company (Czechoslovakia). The extinctions were read out with the help of a spectrophotometer Specol type from Karl Zeiss Jena Company — the wave length — 630 μm .

For labelling GGTP activity in blood standard sets from Bio-Lachema Test company (Czechoslovakia) were used. The extinctions were read out with the help of a spectrophotometer Specol type — the wave length — 410 μm . GGTP activity was given in international units per 1 liter (U/l). According to that method appropriate norms equal — for men 15 — 106 U/l and for women 10 — 66 U/l.

The results underwent statistical analysis with the help of Student's *t* test (13).

RESULTS AND DISCUSSION

The intravenous glucose injection to the control people caused the statistically significant increase of the glucose concentration in the 60th min of the loading test and the decrease of glucose contents in the 120th min up to the initial value.

Average GGTP activity in the serum of the control people and its fluctuation range were normal (14, 15). After the intravenous glucose loading the activity of

that enzyme slightly increased in the 60th and 120th min of the test, but in an insignificant way.

The statistically significant increase of glucose in blood in comparison with control value on the 1st and 3rd day of the observation was found in the group of patients with the transient cerebral insufficiency. On the 7th and 14th day since the symptoms of the transient cerebral insufficiency had appeared, the glucose contents in the patients' blood was slightly greater. After the intravenous glucose loading, the concentration of that substratum in patients' blood increased to greater values than in the control group, but the differences were not statistically significant. It appeared that in the 120th min of the glucose loading test statistically significant increase of its concentration in blood maintained on the 1st, 3rd and 7th day since the appearance of transient cerebral insufficiency symptoms. The results pointed to the decreased tolerance of glucose in this group of people.

In the group of patients with the transient cerebral insufficiency who were on an empty stomach GGTP activity in blood turned out to be greater than in the control group but the difference was statistically insignificant. The activity of that enzyme was decreasing gradually between the 1st and the 14th day since the appearance of transient cerebral insufficiency symptoms. The glucose loading test did not change significantly GGTP activity in blood.

In the group of patient with the cerebral infarction the statistically significant increase of the glucose concentrations in blood (before glucose loading) in comparison with the control group was found on the 1st, 3rd, 7th and 14th day of the illness, and in comparison with the group of patients with the transient cerebral insufficiency on the 1st, 3rd and 7th day after the appearance of insufficiency symptoms. After the intravenous glucose loading test its increased concentration in the blood was observed in the case of all the examined patients with the cerebral infarction from the 1st to the 21st day of the illness. In comparison with the control group and the group of patients with the cerebral circulation insufficiency the statistically significant increase concerned the 1st, 3rd, and 7th day of the cerebral infarction. In the 120th min of the glucose loading test the statistically significant increase of glucose concentrations in blood concerned all the examined patients with the cerebral infarction on all days of the conducted examination in comparison with the controls and the patients with cerebral circulation insufficiency. The received results point to a decreased tolerance of glucose in the group with the cerebral infarction in comparison with the controls and the patients with cerebral circulation insufficiency.

GGTP activity in the blood of patients with the cerebral infarction (before glucose loading) on the 1st, 3rd, 7th, 14th, and 21 st day of the illness was greater than the one in the control group and in the group of patients with the transient cerebral insufficiency. The differences, however, were very small and statistically insignificant. After the glucose loading test GGTP activity in the blood of the

patients with the cerebral infarction behaved variably; on the 1st day it was smaller, and it was increasing up to the 120th min of the loading test. On the remaining days of the illness it did not show any significant fluctuations. The differences were statistically insignificant.

The concentrations of glucose in the blood of patients with the cerebral haemorrhage (before glucose loading) on the 1st day were statistically and significantly greater than the ones in the control group, in the group of patients with the transient cerebral insufficiency and in the group of patients with the cerebral infarction. On the 3rd and 7th day of the cerebral haemorrhage they were statistically significant — greater than those in the control group and in the group of patients with the transient cerebral insufficiency. After the glucose loading the glucose concentrations increased in the 60th min of the test and decreased in the 120th min. The received values of the concentration of glucose were significantly greater than those in the control group and in the group with the transient cerebral insufficiency. On the 1st day GGTP activity in the serum of patients with the cerebral haemorrhage was similar to the one in the control group. The activity increased explicitly on the 3rd and 7th day of the cerebral haemorrhage but this increase turned out to be statistically insignificant. After the glucose loading on the 1st day of the cerebral haemorrhage GGTP activity in the blood serum increased slightly in the 60th min of the test. On the 3rd and 7th day there was the decrease of the activity in the 60th min and its increase in the 120th min. of the glucose loading test up to the initial values. The interpretation of the received results of the analyses is difficult because of a small number of patients with the cerebral haemorrhage, especially those whose examination was carried out on the 3rd and 7th day of the illness.

Our examinations show that the transient cerebral insufficiency and the brain stroke are accompanied by the disturbances of glucose tolerance. The harder the clinical course of vascular brain damage, the greater the disturbances of glucose tolerance. The patients with the cerebral haemorrhage are accompanied by the greatest disorders of carbohydrate metabolism. These statements are in agreement with the results of our previous examination (4, 7) and other authors (5, 9).

We did not find any constant and significant relation between glucose concentration and GGTP activity in blood in any of the groups of determinations.

The estimation of the accomplished results is difficult because of a nonunidirectional character of changes as far as the examined correlations are concerned. It is also difficult because of the lack of the statistical significance of many received differences in the behaviour of GGTP activity according to the clinical form of the cerebral stroke, the term of the illness, and the stage of the glucose loading test.

Generally speaking, the activity of this enzyme (which is higher on the 1st and 3rd day of the illness) gradually normalizes starting from the 7th day among the

patients with transient cerebral ischaemia and with cerebral infarctions. But in the group with the cerebral haemorrhage the increase of GGTP activity was showed, and it became greater after several days of the illness. However, a small number of patients with the cerebral haemorrhage makes it impossible to analyze the statistics of these results. One may only point to the analogy between this phenomenon and the "behaviour of the GGTP activity in blood of patients with the heart infarction" (16).

The results presented in this work turned out to be compatible with the previous ones, which served to check liver functions in patients with cerebral stroke (6, 17).

Conclusions

1. There is a statistically insignificant increase of GGTP activity before the glucose loading and there are fluctuations of this activity among the patients with the brain stroke.

2. There is no constant and significant relation between glucose concentrations and GGTP activity in blood among the patients with the stroke.

3. The changes of GGTP activity are greater and they maintain longer among the patients with some more acute forms of the stroke.*

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* The results of statistical analysys are in the authors' possession.

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STRESZCZENIE

Badano wpływ obciążenia glukozą na aktywność GGTP w surowicy krwi na czczo oraz po 60 i 120 min. od dożylnego obciążenia 80 ml 40% glukozy u 15 osób kontrolnych, u 25 osób z przemijającą niewydolnością krążenia mózgowego, u 30 chorych z rozmięknieniem mózgu i u 11 chorych z krwotokiem mózgowym w okresie od I do XXI doby choroby.

Wykazano wzrost aktywności badanego enzymu w surowicy krwi chorych z udarami mózgu na czczo i jej wahania po obciążeniu glukozą. Obserwowano tendencję do normalizacji aktywności GGTP wraz z upływem czasu od zachorowania. Intensywność tych odchyżeń i czas ich utrzymywania się były tym większe, im cięższa była postać udaru. Nie wykazano stałej i istotnej zależności pomiędzy stężeniami glukozy a aktywnością GGTP w surowicy krwi badanych chorych.