EFFECT OF ACUPUNCTURE ON CATECHOLAMINE CONTENT IN THE HYPOTHALAMUS AND BRAIN STEM OF RATS WITH EXPERIMENTAL GASTRIC ULCER

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Neurophysiological investigations have revealed the involvement of the reticular formation, thalamus, hypothalamus, and limbic zones of the brain in the transmission of somatic and visceral signals under normal conditions and in experimental interoceptive pathology [3-5], and also in association with various types of acupuncture procedures [4, 7, 11].

The important role of catecholamine systems of the brain in the mechanisms of acupuncture (AP) also has been studied [1, 2, 7, 10]. However, no investigations have been devoted to the direct study of biogenic amines in visceral pathology against the background of AP.

The aim of this investigation was accordingly to study changes in catecholamine concentrations in the hypothalamus and brain stem in experimental visceral pathology and the effect of AP on these processes.

EXPERIMENTAL METHOD

Experiments were carried out on 30 male albino rats weighing 190-220 g. The animals as a whole were divided into five equal groups. Group 1 (control) consisted of intact animals. In the rats of groups 2, 3, and 4 an experimental gastric ulcer (EGU) was induced by mechanical irritation of the pyloroduodenal region with Pean's forceps for 10 min [6]. Rats of group 5 underwent a mock operation. Animals of groups 3 and 5 received one session of bilateral AP 24 h after the operation for 20 min, in the zone of the Ho-Ku point by steel needles, inserted to a depth of 1-2 mm, 24 h after the operation [10, 11]. Rats of group 4 underwent mock AP, by insertion of needles subcutaneously into the lower third of the limbs where there are no AP points.

Immediately after one session of AP the animals were decapitated and the hypothalamus and brain stem were removed in the cold. The tissue was kept at −25°C for 2-3 days. Concentrations of adrenal in (A), noradrenalin (NA), dopa, and dopamine (DA) were determined spectrofluorometrically [9]. The development of the pathological process in the gastric mucosa was monitored by morphological investigations. The results were analyzed by single-factor dispersion analysis and the significance of differences between the control and experimental groups was estimated by the value of Dunnett's coefficient, whereas the significance of differences between parameters in the experimental groups was estimated by Duncan's method [8].

EXPERIMENTAL RESULTS

Data relating to catecholamine concentrations in the various brain structures studied are given in Table 1.

It will be clear from Table 1 that the NA concentration in the hypothalamus of rats of the experimental groups did not differ significantly from the control ($F_{4,25} = 0.97$, $p > 0.1$). Dispersion and postdispersion analysis of the NA level in the experimental groups showed no

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TABLE 1. Concentrations (in mmoles/g tissue) of NA, A, Dopa, and DA in Hypothalamus and Brain Stem of Rats in Control, with EGU, and Treated by AP (M ± m)

Catecholamines	Control (group 1)	EGU (group 2)	EGU + AP (group 3)	EGU + mock AP (group 4)	Mock EGU + AP (group 5)
			Hypothalamus		
NA	0,76±0,09	0,78±0,08	0,63±0,08	0,65±0,02	0,63±0,06
A	0,12±0,009	0,15±0,007	0,18±0,002*	0,17±0,02*	0,14±0,01
dopa	0,20±0,05	0,23±0,018	0,29±0,05 $p_{3-5}<0,01$	0,24±0,01	0,14±0,03
DA	0,71±0,199	1,86±0,43*	1,36±0,08	1,94±0,06*	1,58±1,5*
			Brain stem		
NA	0,54±0,08	0,53±0,10 $p_{2-3}<0,05$ $p_{2-5}<0,05$	0,32±0,06 $p_{3-4}<0,05$ $p_{3-5}<0,05$	0,55±0,02	0,57±0,03
A	0,04±0,009	0,09±0,01* $p_{2-3}<0,01$	0,15±0,02* $p_{3-4}<0,01$ $p_{3-5}<0,01$	0,08±0,005*	0,09±0,004*
dopa	0,04±0,009	0,11±0,02 $p_{2-3}<0,005$	0,28±0,06* $p_{3-4}<0,005$ $p_{3-5}<0,001$	0,11±0,006	0,06±0,008
DA	0,70±0,04	1,00±0,16	1,15±0,24*	0,80±0,32	0,82±0,69

Legend. Asterisk denotes values for which $p < 0.05$ compared with control (Dunnett's test). In all other cases value of p is shown compared with corresponding procedures (Duncan's test).

difference between them ($F_{3,26} = 1.21$, $p > 0.1$), indicating that the procedures used had no effect.

The level of A increased significantly ($p < 0.05$) in the hypothalamus of rats with EGU after a single session of both true and mock AP.

Analysis of the difference between the mean values of the dopa concentration in the control and experimental groups showed that in animals with EGU the dopa concentration in the hypothalamus after AP was maximal and exceeded the control values by 45%, whereas in rats undergoing the mock operation, under the same conditions the dopa concentration fell by 30%. However, dispersion analysis revealed no significant differences compared with the control ($F_{4,25} = 2.2$, $p > 0.05$), and this must be regarded as evidence of a tendency for this parameter to increase as a result of the experimental procedures.

Meanwhile, postdispersion analysis of data on the dopa concentration in the experimental groups revealed significant differences between them ($F_{3,20} = 3.5$, $p < 0.05$). The dopa level in the hypothalamus of the rats of group 3 was approximately twice as high as in the rats of group 5 ($p < 0.01$).

Comparison of the DA concentration in the hypothalamus revealed a marked and significant rise of its level (by 2-2.5 times compared with the control) in rats of the experimental groups.

Changes in the catecholamine concentrations in the brain stem were as follows. The NA concentration in animals of the experimental groups was virtually identical with that in the control group ($F_{4,25} = 2.53$, $p > 0.05$), although in the rats of group 3 with EGU a tendency was noted for it to fall (by 40%). It is also important to note that the NA level in the animals of this group was significantly ($p < 0.05$) less than that in all the other experimental groups.

Changes in the A and dopa levels in the brain stem also were observed. The A level in groups 2, 4, and 5 was raised by 2-2.5 times ($p < 0.05$) and in group 3 by 4 times ($p < 0.005$) compared with this parameter in the control. Changes in the dopa concentration were more marked still. For instance, in rats with EGU (group 2), against the background of AP the dopa level was significantly increased (by 7 times, $p < 0.005$) compared with the control and was significantly higher than in the other animals. In the other experimental groups, although changes were noted in the parameters studied, they were not significant.

During the investigation of DA in the brain stem of rats with EGU, its concentration after one session was doubled compared with the control group ($p < 0.05$), whereas in other groups its level did not increase significantly.

Different results were obtained in investigations [12] which showed that electrical AP is accompanied by a rise of NA without any change in the DA level in the hypothalamus, cerebellum, pons, and midbrain of intact animals. The disparity between our data and the information cited above can be explained on the grounds that investigations of biochemical parameters were undertaken under different experimental conditions.

The results thus indicate that during simulation of a pathological visceral process a significant increase in the DA concentration is observed in the hypothalamus of the rats, a significant increase of A in the brain stem, and a tendency for concentrations of A and dopa to increase. A session of AP into animals with EGU caused a significant rise of the A level in the hypothalamus and an increase in the concentrations of dopa and, in particular, of DA compared with values in the control group. A clear tendency also was found in the brain stem for levels of A, dopa, and DA to rise in animals with EGU after AP, compared with the control.

A session of AP did not lead to any significant change in the parameter tested in the hypothalamus of animals with EGU compared with the corresponding data for rats undergoing a mock operation. Meanwhile, in the brain stem a significant fall of the NA level and a marked rise of the A and dopa levels were observed in the brain stem after a session of AP, compared with the other experimental conditions.

After a session of mock AP, values of various parameters in animals with EGU were quantitatively similar to data in animals with EGU alone. Consequently, mock AP did not change the catecholamine concentrations in the brain structures studied.

Levels of NA, A, dopa, and DA in rats undergoing the mock operation, after a session of AP were in most cases within the control limits.

To conclude, when visceral afferentation from the gastrointestinal tract is intensified, restructuring of the functional state of the central catecholaminergic systems of the brain takes place. Acupuncture stimulation against the background of the pathological process has a significant effect on the activity of these systems.

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