they permit it to be recommended for the treatment of diseases in which the use of neuroleptics is undesirable, for example, in children with neurological diseases or to terminate L-dopa-induced hyperkinesias without the risk of aggravating the basic symptoms of Parkinsonism.

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SYSTEMIC AND REGIONAL HEMODYNAMICS DURING AUDIOGENIC CONVULSIONS IN RATS GENETICALLY PREDISPOSED TO EPILEPSY

M. N. Ivashev, O. S. Medvedev, V. B. Koshelev, and T. V. Ryasina

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Experiments on Krushinskii-Molodkina (KM) rats have shown that during a convulsion induced by interrupted acoustic stimulation the animals developed subdural and subarachnoidal hemorrhages [1, 2, 9]. The mechanism of onset of these hemorrhages is not yet clear. In our view, changes in the systemic blood pressure (BP) during a convulsion may be the cause of hemorrhage into the brain.

The aim of this investigation was to study changes in BP, the heart rate (HR), and the blood flow in the brain, heart, liver, kidneys, and other organs during convulsions.

EXPERIMENTAL METHOD

Experiments were carried out on six KM rats, bred in the Faculty of Biology, Moscow State University. The rats, weighing 250-300 g, were anesthetized with pentobarbital (30-40 mg/kg) for insertion of polyethylene catheters: through the right carotid artery into the left ventricle and through the femoral artery into the abdominal aorta.

Laboratory of Experimental Pharmacology, Institute of Experimental Cardiology, All-Union Cardiologic Scientific Center, Academy of Medical Sciences of the USSR. Department of Human and Animal Physiology, Faculty of Biology, M. V. Lomonosov State University, Moscow. Laboratory of Pathological Anatomy, Research Institute of Neurology, Academy of Medical Sciences of the USSR.

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TABLE 1. Parameters of Systemic and Regional Hemodynamics before and after Convulsions (M ± m)

Parameter	Initial data	Parameters after convulsion
BP, mm Hg	103±5,4	93±11,1
HR, beats/min	409±24,4	292±21,1*
Ci, ml/min/100 g	27,9±1,4	32,6±3,7
TPVR, mm Hg/ml/min/100g	3,7±0,18	2,9±0,39
Regional blood flow, ml/min/g tissue		
Brain, left hemisphere	1,11±0,18	1,82±0,2
Brain, right hemisphere	0,92±0,13	1,53±0,4
Cerebrum	1,46±0,19	1,73±0,34
Brain stem	0,68±0,13	1,05±0,19
Heart	5,13±0,52	7,32±1,62
Adrenals	3,92±0,42	3,82±1,14
Kidneys	4,62±0,86	2,54±1,23
Liver	0,13±0,05	0,23±0,07
Spleen	2,16±0,46	0,66±0,4*
Small intestine	2,58±0,34	2,12±0,56
Pancreas	1,46±0,3	0,49±0,23
Skeletal muscles	0,10±0,03	0,05±0,02

Legend. *$p < 0.05$ Compared with initial data.

The peripheral ends of the catheters were led out subcutaneously on the dorsal region and fixed in the interscapular region: the experiment was started 24-48 h after the operation, when the animals were awake. BP and HR were recorded by means of a type SP-01 electromanometer (USA) and amplifiers of types 566 and 567 (Hugo Sachs, Germany) and led to a type Mark VII recorder (Graphtec, Japan). The cardiac ejection and blood flow in 13 zones of the body were determined with the aid of microspheres, 15 μ in diameter, and labeled with Sc-46, Sr-85, Co-57, and Sn-113 (MEN, USA), The microspheres were introduced before, during, and 20 min after the convulsion [4]. After the experiments the rats were killed by injection of pentobarbital, and samples of the organs and tissues were weighed and placed in plastic test tubes. The number of microspheres in the specimens was determined on a 1282 CompuGamma gamma-counter (LKB Wallac, Finland). The cardiac index (CI) was calculated in ml/min/100 g and the blood flow in ml/min/g tissue by standard equations, using a SuperCalc-2 program and Labtam 3015 microcomputer (Australia) [5]. Convulsions were induced by acoustic stimulation with an intensity of 80-120 dB [1]. The results were subjected to statistical analysis by Student's t test.

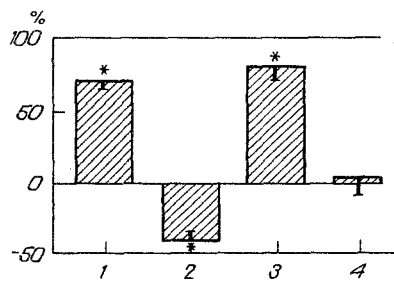
EXPERIMENTAL RESULTS

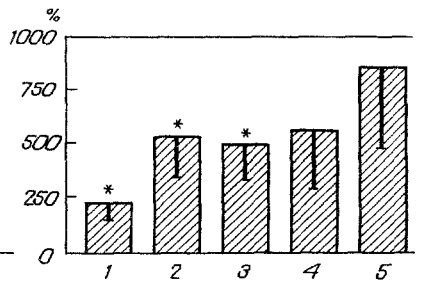
The hemodynamic parameters before and after induced audiogenic convulsions are shown in Table 1. Occluding the right carotid artery by the left-ventricular catheter was accompanied by reduction of the cerebral blood flow in the corresponding half of the brain (Table 1).

During acoustic stimulation marked changes appeared in the systemic hemodynamics BP rose on average by 73%, HR fell by 42%, the total peripheral vascular resistance (TPVR) did not change significantly, and the cardiac index (CI) rose on average by 80% (Fig. 1). After the convulsion (on termination of acoustic stimulation) the values of BP, CI, and TPVR did not differ significantly from the initial level, whereas HR was on average 27% lower (Table 1).

During convulsions a marked increase in the blood flow in the brain and heart was observed in the KM rats: in the left and right hemispheres flow rates of 6.58 ml/min/g and 5.26 ml/min/g were observed, with 8.90 ml/min/g in the cerebellum, 5.04 ml/min/g in the brain stem, and 15.32 ml/min/g in the heart (Fig. 2). The blood flow in these organs remained increased after the convulsions also (Table 1).

Vascular tone in the adrenals, kidneys, liver, spleen, intestine, pancreas, and skeletal muscles was increased, and this led to a decrease in the blood flow in these organs. After audiogenic convulsions the blood supply of these organs was not completely restored, and only in the liver was the initial level exceeded (Fig. 3; Table 1).





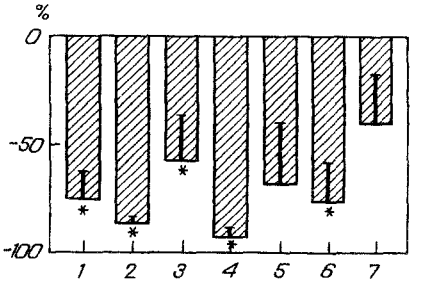


Fig. 1 Fig. 2 Fig. 3

Fig. 1. Changes in systemic hemodynamics (in % of initial level) during audiogenic convulsions in conscious KM rats: 1) BP, 2) HR, 3) CI, 4) TPVR. Here and in Figs. 2 and 3: *$p < 0.05$ compared with initial level.

Fig. 2. Changes in organ blood flow (in % of initial level) during audiogenic convulsions in conscious KM rats: 1) heart, 2) left cerebral hemisphere, 3) right cerebral hemisphere, 4) cerebellum, 5) brain stem.

Fig. 3. Changes in organ blood flow (in % of initial level) during audiogenic convulsions in conscious KM rats. 1) Adrenals, 2) kidneys, 3) liver, 4) spleen, 5) intestine, 6) pancreas, 7) skeletal muscles.

The results indicated that audiogenic convulsions in conscious KM rats are accompanied by a marked pressor response of BP and CI and a fall of HR. Recording the cerebral blood flow and the blood flow in the heart revealed a significant increase in the blood supply in the brain and heart during the period of raised BP, this may have been the cause of hemorrhages into the brain structure. Other investigations [6, 7] have shown that rupture of cerebral venules is a frequent cause of hemorrhages into the brain when there is a sharp rise of BP. One of the factors facilitating disturbance of the integrity of the cerebral vessels during convulsions may be a sharp increase in the cerebral blood flow. There is evidence [10] that convulsions caused by injection of bicuculline (1 mg/kg) in normotensive Wistar–Kyoto rats are accompanied by an increase in the cerebral blood flow from 0.6 to 3.07 ml/min/g. Maximal dilatation of the cerebral vessels also was demonstrated in other investigations [8]. In KM rats during exposure to acoustic stimulation (80-120 dB) peripheral paralyses develop [3]. Elevation of BP combined with an increase in cerebral blood flow leads to a rise of intravascular pressure in the brain, which may be the cause of hemorrhages leading to paralyses after convulsions. The increase of vascular tone in the internal organs leads to centralization of the blood flow, when the blood circulates around the heart–brain system, and this also may be a cause of developing pathology of the cerebral circulation.

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