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Title **THE STATE OF FREE-RADICAL OXIDATION OF LIPIDS IN EXPERIMENTAL MYOCARDIAL INFARCTION IN RATS**

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HEMORRHAGIC STROKE IN PEDIATRIC PRACTICE.

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Author presented evaluation data of the computer brain neurosonography results and hemodynamic monitoring of the 56 newborns with hemorrhagic insult. At newborns with hemorrhagic insult were identified significant changes of the hemodynamic not only in the brain, but also of the whole organism, which is not always manifested in the clinical symptoms. It must be taken into account when treating newborns with hemorrhagic insult, especially during surgical interventions.

Key words: hemorrhagic stroke, neurosonography, minute volume of blood, stroke volume, pulse pressure.

Acute disorders of cerebral circulation are the most important medical and social problem [1,6,9]. The problem of strokes in infancy has acquired the greatest relevance due to the increase in their prevalence, high mortality and severe neurological outcomes leading to early childhood neurological disability [2,10,13]. The results of epidemiological studies in recent years regarding the incidence of strokes in newborns are different, but in most studies it is 2–3 / 100,000 per year. According to the literature, most authors believe that hemorrhagic stroke in young children is polyetiological in nature [5,8,12]. In this regard, the main problem of neonatology, the prevention of hemorrhagic complications, requires the mobilization of the efforts of specialists of a number of profiles (neonatologists, neurosurgeons, hepatologists, pediatricians, ophthalmologists, obstetricians - gynecologists, neuropathologists, infectious disease specialists). The problem of ensuring the perioperative management of children with non-traumatic cerebral hemorrhage - surgical removal of the hematoma remains acute [3,4,7,11].

The clinical manifestations of stroke in newborns are very diverse, its diagnosis is

significantly difficult due to the lack of clear identification and description of the patient's sensations. The clinical symptoms and signs of stroke described in the literature are insufficient to detect stroke in newborns. As a result, stroke in newborns in most cases is diagnosed late or not at all, and the clinical manifestations of the disease are explained by other reasons. In many cases, treatment and prophylactic care is late, which leads to the development of irreversible consequences and an increase in the number of disabled children, although in many cases this can be avoided. **Purpose of the study:** to study the state of the hemodynamic picture in hemorrhagic stroke in newborns.

Material and methods: A total of 56 newborns with hemorrhagic stroke were examined: boys - 32, girls - 24. The non-operated group (group 1) included children who received only conservative therapy (8 children), which included compensation for BCC deficiency (blood plasma transfusion), decongestant, anti-inflammatory correction. In infants of this group, small volumes of hematoma were revealed that did not require surgical removal or hard-to-reach localization of hemorrhage; positive dynamics were noted during conservative therapy. These newborns

showed insignificant deviations in homeostasis. After improvement of the condition, 42 newborns were discharged, 8 of them without surgery, before (14 patients - group 2) and after surgery to remove hematoma (20 children - group 3). 8 patients died (group 4), and 4 - on the first day, 1 patient on days 2, 3 and 9 after the operation performed on the 2nd day of stay in the clinic, 1 child died on the 160th day of artificial lung ventilation (ALV) after 2 operations performed on the 1st and 3rd day of admission to the clinic. Newborns of the 4 groups differed in extremely serious condition upon admission.

The diagnosis was confirmed by computed tomography (CT). Concomitant infection - herpes, cytomegalovirus, chlamydia, pneumonia was detected in 25 newborns, 25 had a negative test result, the remaining 6 were not tested for TORCH infection. Functional liver immaturity was found in 6 newborns.

The state of central hemodynamic was assessed by monitoring the following parameters: minute blood volume (MBV), stroke volume (SV), indicators of systolic (SBP), pulse (PAP), mean (MAP), diastolic (DBP) blood pressure, total peripheral vascular resistance (OPSR), heart rate (HR), an indicator of myocardial oxygen consumption (MOC).

The dynamics of sympathetic tone was assessed by the index of the minute blood volume (QV_m). The method for calculating the minute volume of blood circulation

(MCV) and total peripheral vascular resistance (OPSR) was borrowed from the materials of clinical and functional results of studies of adult cardiologists [127]. The monitoring was carried out by devices 1 - Nihon Kohden (Japan), Datex Ohmedia (Spain), Oxypal Neo (Japan).

Statistical processing of the results was carried out on a computer using Microsoft Excel programs. To compare the mean values, the Student's t test was used. For a comparative assessment of the results and identification of possible interrelated events, the pairwise correlation method was used.

Results and discussion: On the first day of treatment, the average daily SBP in newborns of group 1 was increased by 23% with a normal level of diastolic blood pressure. That is, a hyper dynamic type of blood circulation was revealed, which was also expressed in an increase in PAP, a tendency to an increase in mean blood pressure to 58.8 ± 6.2 mm Hg, which caused an increase in myocardial oxygen consumption by 20% ($p < 0.05$), an increase in the minute volume of blood circulation by 78%, with a normal average daily heart rate, an oxygen saturation indicator. The revealed changes in hemodynamics in the group of non-operated newborns characterize the formation of a hyperdynamic type of blood circulation caused by a stress hypersympathotonic reaction to cerebral hemorrhage. Confirmation is an increase in the level of sympathetic tone in 1 day by 20% under conditions of normal body temperature (table 1).

Table 1
Average daily hemodynamic parameters of non-operated newborns (group 1)

Treat ment days	SBP mm. mercury column.	DBP mm. mercury column.	PAP mm. mercury column.	MAP mm. mercury column	HR blows. \ min.	SpO ₂ %	MOC O ₂ , un	MBV l / min	QV m,un	SV, ml	OPSR дин*с*см ⁻⁵ М
1	86,6 ±6,7	44,9 ±6,2	42,3 ±3,1	58,8 ±6,2	138, 6 ±12,	97,8 ±1,2	120,0 ±0,8	892,0 ±58,3	1,2 ±0,0	6,4 ±0,8	777 ±91

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2	82,7 ±6,1	42,3 ±5,3	41,8 ±0,4	53,9 ±6,3	143, 3 ±6,7	97,0 ±1,3	118,5 ±0,4	957,9 ±5,2	1,2 ±0,0 1	6,7 ±0,8	690 ±93
3	80,6 ±7,0	42,9 ±3,8	40,3 ±0,9	54,9 ±4,7	141, 7 ±5,8	97,3 ±1,0	114,2 ±0,4	926,0 ±9,2	1,2 ±0,0 1	6,5 ±0,6	696 ±60
4	83,9 ±5,7	43,2 ±4,1	37,7 ±3,2	55,3 ±5,8	133, 1 ±5,1	96,9 ±1,2	111,6 ±0,3	790,1 ±32,7	1,1 ±0,0 1	5,9 ±0,5	849 ±139
5	86,8 ±3,3	44,3 ±4,7	40,7 ±1,6	57,1 ±4,5	134, 2 ±5,9	97,4 ±0,5	116,5 ±0,2	833,0 ±23,5	1,1 ±0,0 1	6,2 ±0,4	834 ±112
6	86,9 ±3,2	45,7 ±3,3	41,0 ±1,9	59,7 ±3,2	132, 1 ±4,6	97,3 ±0,7	114,8 ±0,1	816,9 ±27,3	1,1 ±0,0 1	6,2 ±0,6	851 ±93
7	88,3 ±3,1	45,6 ±2,1	41,5 ±1,6	58,1 ±2,3	129, 5 ±2,8	97,5 ±0,9	114,4 ±0,1	803,2 ±17,8	1,1 ±0,0 1	6,2 ±0,3	880 ±87
8	88,2 ±4,8	46,1 ±3,7	41,7 ±1,8	59,6 ±4,5	136, 1 ±4,3	97,4 ±0,5	120,0 ±0,2	846,1 ±18,1	1,2 ±0,0 1	6,2 ±0,2	834 ±112
9	90,2 ±3,4	47,4 ±2,4	42,3 ±0,8	61,0 ±2,0	130, 1 ±4,8	97,7 ±0,4	117,4 ±0,2	800,0 ±13,5	1,1 ±0,0 1	6,2 ±0,8	902 ±87
10	87,5 ±2,0	42,3 ±1,8	44,6 ±1,3	56,5 ±2,9	125, 9 ±6,5	97,5 ±0,5	110,2 ±0,1	865,4 ±46,0	1,2 ±0,0 1	6,9 ±0,7	809 ±68
11	89,7 ±1,6	43,4 ±0,5	46,3 ±1,3	58,9 ±0,8	131, 4 ±11, 8	97,7 ±0,3	117,9 ±0,2	914,1 ±145,1	1,3 ±0,0 1	7,0 ±0,3	785 ±88
12	86,7 ±4,4	44,0 ±4,0	42,7 ±0,5	58,3 ±4,1	127, 6 ±2,1	98,0 ±0,4	110,6 ±0,1	832,4 ±2,7	1,1 ±0,0 1	6,5 ±0,3	833 ±111
13	87,0 ±5,1	43,6 ±2,8	43,4 ±2,3	58,1 ±3,6	125, 2 ±4,7	97,6 ±0,1	108,9 ±0,2	831,0 ±27,7	1,1 ±0,0 1	6,6 ±0,9	838 ±98

The compensatory nature of the hyperdynamic type of hemodynamics

throughout the treatment period was confirmed by a stable level of the average

daily oxygen saturation. The indicator of oxygen consumption by the myocardium remained elevated relative to the norm throughout the observation period, with a tendency to decrease by 10% at 10, 12, 13 days. The steadily increased cardiac output was due to hypersympathotonia. The hyperdynamic type of blood circulation found in this group of newborns was most likely of an adaptive nature and the restructuring of hemodynamics was aimed at maintaining the required level of intracranial blood circulation in response to cerebral hemorrhage in newborns. However, the vasoactive effect of drug correction (barbiturates, lidocaine, magnesium sulfate), as evidenced by the tendency to decrease total peripheral vascular resistance throughout the observation period, had a stress-limiting effect, reducing tissue oxygen demand, improving tissue perfusion in the ischemic brain area, and anti-edema effect. Before the operation, the hemodynamic parameters of 14 newborns (group 2) were studied, after medical preparation all of them were operated on. In the postoperative period, 8 of them were transferred to the neurosurgical department on the 2nd day after the operation, the remaining 6 - on the 4-6th day after the operation.

In the preoperative period, the average daily parameters of hemodynamics, heart rate, CVP, RR, oxygen saturation were within normal physiological values. On day 1, an increase in myocardial oxygen consumption by 11%, an increase in IOC by 70% in the absence of signs of hypersympathicotonia ($Q_{Vm} = 1.05 \pm 0.01$) was revealed. Thus, in newborns, compensatory mechanisms were revealed that, under conditions of blood transfusion therapy (increase in IOC), made it possible to maintain stable indicators of SBP, DBP, AVP, and CVP.

The tendency of the functional activity of hemodynamics to hyperdynamia in group 2 was the result not only of intracerebral hemorrhage, but also the reaction of the cardiovascular system to blood transfusion, carried out in all newborns during preparation for surgery. Compensation of the BCC deficiency determined the stability of the average daily hemodynamic parameters in both groups, neurological symptoms on admission corresponded to the underlying disease. The introduction of erythrocyte mass and FFP upon admission restored not only the BCC, gas transport function, blood oxygen capacity, but also oncotic pressure, rheological properties, compensation for the deficiency of coagulation factors, hemostasis. The comparatively smaller number of hemo- and plasma transfusions in the postoperative period (group 3) is due to the fact that children went to the operation with the BCC already recovered in pre-operative preparation and insignificant intraoperative blood loss. In the following days of observation, the need for repeated hemo- and plasma transfusion arose in isolated cases. On the first day after surgery (Table 2.), the indices of body temperature, SBP, DBP, Avg AP, CVP, HR, RR, oxygen saturation index, sympathetic tone index were within normal limits. However, myocardial oxygen consumption was increased by 17%, IOC - by 70% ($p < 0.05$).

On days 2-4 of the postoperative period, the tendency to increase the temperature to subfebrile numbers (37.2 ± 0.16 °) caused an increase in the effect of sympathetic tone on the heart rate by 21% on day 2, without increasing myocardial oxygen consumption, IOC (table 2).

Table 2.
Average daily hemodynamic parameters in newborns after surgery
(group 3)

Days	SBP mm. merc ury colu mn.	DBP mm. merc ury colu mn.	PAP mm. merc ury colum n.	MAP mm. merc ury colum n	CVP mm. merc ury colu mn	RR in min	HR blows. \ min.	SpO ₂ %	MOC O ₂ , un	MBV l / min	QV m.un	SV, ml	OP SR дин *с* sm ⁻ ⁵ М
1	81,8 ±4,7	44,4 ±3,5	35,9 ±2,5	46,4 ±4,2	54,9 ±2,5	36,5 ±3,3	143,4 ±5,8	98,7 ±0,6	117,4 ±0,3	817,4 ±36,1	1,09 ±0,03	5,7 ±0,2	801 ±10 5
2	81,5 ±4,7	41,8 ±3,3	39,3 ±4,8	42,4 ±5,8	58,6 ±3,8	41,1 ±6,3	145,2 ±10,2	98,0 ±1,1	118,4 ±0,5	927,8 ±124, 3	1,2 ±0,01	6,4 ±0,2	703 ±12 0
3	84,1 ±6,0	42,7 ±3,5	38,6 ±3,2	45,9 ±3,8	48,8 ±3,4	40,0 ±5,7	140,4 ±6,9	97,9 ±1,0	118,1 ±0,4	855,7 ±47,9	1,19 ±0,01	6,1 ±0,9	786 ±99
4	85,9 ±2,	46,0 ±2,8	34,3 ±6,5	44,7 ±4,8	56,5 ±6,1	39,1 ±6,5	139,6 ±11,4	97,5 ±0,9	120,0 ±0,3	726,9 ±267, 7	1,01 ±0,01	5,2 ±0,4	945 ±82
5	84,1 ±6,1	45,2 ±4,3	38,1 ±3,2	51,7 ±2,4	46,1 ±5,3	41,1 ±2,5	138,8 ±11,5	97,1 ±1,1	116,8 ±0,7	817,8 ±71,4	1,10 ±0,01	5,9 ±0,2	823 ±92
6	79,8 ±3,5	43,9 ±3,5	33,6 ±2,9	40,8 ±4,3	57,2 ±6,2	43,0 ±1,8	135,8 ±6,9	98,2 ±0,7	108,4 ±0,2	739,1 ±57,1	0,9 ±0,01	5,4 ±0,3	864 ±86
7	84,1 ±3,7	42,1 ±0,7	34,1 ±7,1	36,3 ±6,7	52,1 ±6,5	42,2 ±2,6	136,5 ±5,1	97,5 ±0,8	114,9 ±0,2	739,4 ±160, 8	0,9 ±0,01	5,4 ±0,4	910 ±18 8
8	85,4 ±4,4	44,0 ±2,3	37,5 ±4,1	40,3 ±2,6	63,9 ±7.1	41,9 ±3,4	141,3 ±7,9	97,1 ±0,5	120,8 ±0,4	819,1 ±95,9	1,1 ±0,01	5,8 ±0,1	834 ±74
9	84,1 ±0,1	43,7 ±1,5	33,3 ±4,3	47,8 ±8,7	61.5 ±5,9	40,4 ±3,4	141,6 ±4,3	97,6 ±0,2	119,2 ±0,3	738,7 ±225, 3	1,0 ±0,01	5,2 ±0,8	911 ±87
10	81,7 ±2,1	43,00 ±2,57	29,3 ±2,04	43,3 ±7,85	60,0 8,00	41,6 ±2,87	137,6 ±12,81	98,1 ±0,44	112,5 ±0,3	648,1 ±111, 1	0,8 ±0,01	4,7 ±0,7	100 9 ±15 3

Noteworthy is the high SBP (95.3 ± 1.4 mm/Hg) on the day of admission to the clinic, which was increased by 28% ($p < 0.05$), with a tendency to decrease to 78.6 ± 9 mm/Hg for 10 days. DBP in the first 9 days didn't differ significantly from the norm, on the 10th day it decreased by 30% ($p < 0.05$), despite the vasopressor support of hemodynamics in the 4th group of newborns. The average daily level of pulse and mean arterial pressure in children of group 4 was characterized by an increase throughout the observation period. The average daily CVP was closer to the upper limit of the permissible norm, starting from the second day, amounting to 70-80 cm of water st. The dynamics of the average daily heart rate level occurred within the permissible values. The oxygen saturation index against the background of constant oxygen insufflation tended to decrease. At the same time, the average daily rate of oxygen consumption by the myocardium, an increase of 31% on the first day, remained increased up to 8 days in the following days. Moderate hypersympathotonia (1.18 ± 0.01) in the first two days began to increase to maximum values on the 5th day (1.25 ± 0.01), in the following days it showed a tendency to a slight decrease to 1.14 ± 0.02 units for 10 days. The severity of the condition of patients in group 4 was due to a large volume of hemorrhage in 2 with a dislocation of the brain by 1-1.5 cm, concomitant infection - pneumonia in 3 newborns. On the remaining days of observation, no significant differences in indicators were found, which indicated an effective correction of hemodynamics. However, excessive brain damage and the severity of associated factors led to a negative outcome.

The compensatory value of the activity of the respiratory system (tachypnea) during hyperthermia is known, aimed at an adequate increase in heat transfer under conditions of hypermetabolism with a systemic inflammatory response of the

body. The average daily body temperature in patients of group 4 on the first day was significantly lower than in the first. That is, in group 1, a subfebrile level of body temperature was revealed, and in the fourth, with a relatively more severe stress state, the average daily body temperature was "normal". In group 1, the average daily body temperature gradually decreased to normal on the 5th day, remaining at this level and the subsequent days of observation. While in patients of group 4 on 8 and subsequent days, the average daily temperature level increased to subfebrile figures (37.1 ± 0.1 °) against the background of an increase in clinical and laboratory signs of the inflammatory response of the newborn's body. Initial subfebrile condition in group 1 at admission was most likely associated with a stress response of the body to an intracerebral hematoma.

Conclusions. 1. In the group of unoperated newborns, a hyperdynamic type of blood circulation of an adaptive nature and signs of hemodynamic restructuring aimed at maintaining the required level of intracranial blood circulation in response to cerebral hemorrhage in newborns were revealed.

2. In newborns after surgery (group 3), there was a tendency towards stress mobilization of hemodynamics, characteristic of the adaptive mobilization of compensatory mechanisms in the postoperative period. In order to stabilize the achieved results of surgical treatment, it is advisable to increase the duration of drug correction by 2-3 days (up to 10 days after surgery).

3. With hemorrhagic stroke in newborns, pronounced changes in hemodynamics are noted not only in the brain, but also in the whole organism, which does not always manifest itself in clinical symptoms. This must be taken into account when carrying out intensive care of newborns with hemorrhagic stroke, especially during surgical interventions.

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