The results do not contradict the hypothesis of the regulatory role of enderpines in relation to catecholamine metabolism [3]. It is well known that sudden changes in the structure of emotions are accompanied by the liberation of adrenalin into the blood stream. This hypothesis is confirmed by experiments in which water and adrenalin were given. Subcutaneous injection of water invariably makes it necessary to increase the pool of free endogenous adrenalin in the myocardium on account of emotional and pain stress in the experimental animals and the concentrations of all three types of enderpines are reduced compared with their level in the experiment with injection of water (Fig. 1B).

Consequently, the mechanisms connected with metabolism of the enderpines and their function are connected with changes in the free adrenalin (and, probably, of other catecholamines also) level and they respond to this level by a feedback mechanism, i.e., they carry out the homeostasis which we postulated previously [3].

The action of α-methyldopamine (an inhibitor of catecholamine synthesis) also can evidently be explained similarly. This substance probably induces a compensatory increase in the concentration of one fraction of enderpines (RP3) in response to a fall in the catecholamine level produced by that substance.

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ENERGY METABOLISM IN THE LIVER AND KIDNEYS DURING THE FIRST DAY AFTER ACUTE BLOOD LOSS IN RATS

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UDC 616-005.1-036.11-092.9-07:
[616.61+616.36]-092:612.013.7

KEY WORDS: blood loss; hemodynamics; energy metabolism.

Experimental investigations of energy metabolism in different organs during shock and after blood loss, published in the literature, describe its changes during the first 3-4 h after the beginning of development of the pathological process. However, in patients with third-degree traumatic shock the period of unstable hemodynamics lasts much longer (according to data given by the I. I. Dzhanelidze Emergency Aid Research Institute, up to 16 h). Accordingly it was decided to study the dynamics of changes in energy metabolism during the 24-h period after acute blood loss in the liver and kidneys, the functions of which are disturbed very significantly in this process.

EXPERIMENTAL METHOD

Fifty male rats weighing 220-320 g were used. The animals were fixed to a frame, pentobarbital was injected (40 mg/100 g intraperitoneally), and the femoral artery was catheterized to measure the arterial blood pressure (BP). Bleeding (2.5% of body weight) was carried out for 10 min. Anesthesia was maintained throughout the experiment. The fixation of the rats was subsequently released somewhat. Heparin was injected in fractional doses (total dose not more than 500 units) into the femoral artery. Depending on the course of the posthemorrhagic period the animals were divided into four groups. In the rats of group 1, BP fell immediately after blood loss on average to 9 mm Hg, after which it became stabilized at between 40 and 60 mm Hg (in 50% of the animals it did not exceed 45 mm Hg), after which it again fell progressively. Energy metabolism was investigated 3.6 h after blood loss, when the mean value of BP was 39 mm Hg. In the animals of groups 2, 3 and

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Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 89, No. 7, pp. 30-31, July, 1980. Original article submitted August 14, 1979.

0007-4888/80/8907-0894$07.50

TABLE 1. Concentrations of Energy Metabolites (in μmoles/g wet weight of tissue) in Liver and Kidney of Rats after Acute Blood Loss

Group of animals	Experimental conditions	Statistical index	Liver										Kidney									
			ATP	ADP	AMP	total adenine nucleotides	energy potential	lactate	pyruvate	lactate/ pyruvate	glucose	glycogen	ATP	ADP	AMP	total adenine nucleotides	energy potential	lactate	pyruvate	lactate/ pyruvate	glucose	glycogen
1	Control	M	3,39	0,50	0,12	4,01	0,908	1,45	0,262	5,69	27,39	73,12	2,57	0,41	0,16	3,14	0,877	1,05	0,150	7,67	4,63	4,60
		$\pm m$	0,11	0,07	0,02	0,13	0,011	0,29	0,051	0,69	4,41	10,16	0,26	0,03	0,02	0,27	0,012	0,12	0,015	1,30	0,51	0,37
		n	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	Blood loss	M	2,99	0,76	0,26	4,02	0,840	1,83	0,196	9,24	5,83	3,75	2,38	0,44	0,19	3,01	0,863	2,35	0,192	12,11	4,37	3,30
		$\pm m$	0,30	0,10	0,03	0,34	0,015	0,36	0,016	1,31	1,21	0,39	0,21	0,05	0,04	0,22	0,022	0,47	0,014	2,00	0,47	0,29
		n	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
		P_2			<0,0027		<0,01			<0,05	<0,0027	<0,0027						<0,02				<0,02
2	Control	M	3,49	0,71	0,18	4,38	0,875	1,35	0,219	6,20	18,17	53,24	2,54	0,55	0,19	3,28	0,857	1,12	0,151	7,82	5,58	4,46
		$\pm m$	0,06	0,08	0,01	0,06	0,005	0,21	0,018	0,86	4,22	13,09	0,15	0,06	0,02	0,15	0,015	0,18	0,016	1,60	1,78	0,26
		n	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		P_1			<0,02	<0,05	<0,02															
	Blood loss	M	3,80	0,61	0,17	4,57	0,896	1,37	0,215	6,37	11,08	9,16	2,31	0,46	0,14	2,91	0,869	1,32	0,175	7,47	5,03	4,31
		$\pm m$	0,14	0,10	0,01	0,23	0,011	0,20	0,010	0,88	3,69	1,58	0,20	0,06	0,01	0,21	0,009	0,15	0,013	0,66	0,84	0,83
		n	6	6	6	6	6	6	6	6	6	5	6	6	6	6	6	6	6	6	6	6
		P_2										<0,01										
3	Control	M	3,45	0,85	0,23	4,53	0,854	0,95	0,145	6,48	6,09	16,94	2,47	0,58	0,22	3,26	0,846	1,03	0,117	9,25	3,25	2,32
		$\pm m$	0,13	0,12	0,01	0,15	0,014	0,18	0,021	0,59	1,86	5,10	0,06	0,09	0,03	0,14	0,016	0,06	0,012	0,91	0,20	0,16
		n	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		P_1		<0,05	<0,0027	<0,05	<0,02				<0,0027	<0,0027									<0,05	<0,0027
	Blood loss	M	3,42	0,94	0,28	4,65	0,835	1,59	0,153	10,40	4,00	4,74	2,40	0,51	0,19	3,11	0,854	1,81	0,145	12,57	4,11	3,11
		$\pm m$	0,24	0,10	0,04	0,18	0,021	0,34	0,022	1,57	0,58	1,13	0,19	0,05	0,01	0,16	0,012	0,22	0,014	1,38	0,53	0,41
		n	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		P_2								<0,05		<0,05						0,01				
4	Control	M	3,22	0,78	0,23	4,22	0,859	1,20	0,135	9,16	3,30	5,57	2,24	0,47	0,22	2,93	0,848	1,36	0,138	9,98	2,94	2,75
		$\pm m$	0,24	0,17	0,03	0,43	0,016	0,17	0,016	1,56	0,79	1,02	0,14	0,08	0,03	0,22	0,013	0,28	0,020	1,24	0,51	0,28
		n	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		P_1			<0,01		<0,05		<0,05		<0,0027	<0,0027									<0,05	<0,0027
	Blood loss	M	2,97	1,02	0,37	4,36	0,791	1,65	0,161	9,73	3,32	4,04	1,94	0,61	0,33	2,87	0,778	2,26	0,176	11,66	2,13	3,11
		$\pm m$	0,74	0,23	0,11	0,84	0,042	0,46	0,021	2,29	0,87	0,57	0,28	0,07	0,09	0,28	0,041	0,73	0,024	2,28	0,29	0,29
		n	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		P_2																				

Legend. P_1) Level of significance of changes due to restraint; P_2) level of significance of changes under the influence of blood loss.

4 BP after blood loss averaged 18, 23, and 24 mm Hg respectively and it became stabilized at the level of 50-80 mm Hg. Tissues were taken for analysis after 7.2, 16.6, and 24 h respectively. Simultaneously with the experimental animals, four groups of control restrained rats were studied, which were sacrificed when the mean value of their BP was 87, 97, 64, and 68 mm Hg respectively. The energy potential of the cells was calculated by Atkinson's method [2].

EXPERIMENTAL RESULTS

Fixation of the animals caused no significant changes in the concentration of energy metabolites in the liver and kidneys, with the exception of a decrease in glucose and glycogen (Table 1). The system of adenine nucleotides and the redox state of the cells of these organs were resistant to acute blood loss. In the rats of group 1 with the severest course of the posthemorrhagic period, in which energy metabolism was investigated in the stage of decompensation of the circulation when BP was 35-40 mm Hg, after temporary stabilization at the level of 40-60 mm Hg no significant changes were observed in the indices studied other than exhaustion of the glycogen reserves. In animals with less marked disturbances of the hemodynamics and with stabilization of BP at the level of 50-80 mm Hg (groups 2, 3, and 4), a sufficiently high level of adenine nucleotides remained in the liver and kidneys during the 24-h period after blood loss, and in the liver there was even a small increase in their total reserves.

Disturbances of energy metabolism in the liver and kidneys of rats after a single blood loss has been described in the literature [6, 10], but they are difficult to compare with the results of the present experiments, for the authors cited did not measure BP or the extent of the blood loss. The effect of blood loss on the content of adenine nucleotides in the liver [4, 5, 7-9] and kidneys [4] has been studied mainly on the model of hemorrhagic shock suggested by Wiggers, with the blood pressure stabilized at 30 or 40 mm Hg. Marked changes in the concentration of these metabolites were found as early as after 1-2 h in the case of "reversible" shock and they reached high levels of severity after 2-3 h in the case of "irreversible" shock, when the ATP concentration fell to 15-20% of the initial level, and the lactate/pyruvate ratio was increased.

The absence of significant changes in the concentrations of metabolites studied in the liver and kidneys of rats in the present experiments, by contrast with the results cited above, may be attributed to differences in the method of producing the blood loss and other factors.

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