noted in the kidneys. The mild nature and reversible character of most of the changes discovered point to preservation of functional homeostatis of the lungs and kidneys.

Under conditions of acute respiratory failure, extracorporeal oxygenation of the blood by the veno-venous method is thus preferable to the veno-arterial method as regards compensation of the gas-exchange function of the lungs, the working conditions of the heart (in the absence of cardiac decompensation and severe pulmonary hypertension), and maintenance of the oxygen transport in the body.

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EFFECT OF HYPOTHALAMIC ELECTRICAL STIMULATION ON PROTEIN SYNTHESIS IN ORGANS OF ADULT AND OLD RATS

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In the modern view the mechanisms of aging at the organismal level are largely determined by age-related disturbances of hypothalamic function, but at the subcellular and cellular levels they are reflected in disturbances of regulation of genome expression [3]. Previously the writers discovered important age differences in the effect of hypothalamic electrical stimulation on transcription of different classes of RNA and induction of certain key enzymes in the rat liver [5].

Age differences in hypothalamic regulation of total protein synthesis in different organs and also of liver chromatin proteins were compared in the investigation described below.

EXPERIMENTAL METHOD

Adult (aged 11 months) and old (aged 23-24 months) Wistar rats were used. Electrical stimulation of the hypothalamus was applied on unrestrained animals by a bipolar technique between symmetrically placed electrodes, inserted into the medial hypothalamus 2-3 weeks before sacrifice of the rats, in accordance with coordinates of a sterotaxic atlas with corrections for age [5]. The parameters of stimulation were: a continuous series of pulses 1 msec in duration and with a frequency of 100 Hz, duration of stimulation 15 min. The strength

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of the stimulating current was close to the threshold for motor manifestation of the behavioral response.

The intensity of protein synthesis was judged from the relative specific radioactivity (RSR), which was determined as the ratio of the specific radioactivities of acid-insoluble and acid-soluble materials, separated by means of nitrocellulose membrane filters [1]. Liver chromatin was fractionated by the method in [4]. Protein was determined by two-wave spectrophotometry [6]. The radioactivity of all samples was measured on a Mark III radiospectrometer (USA). The significance of differences was assessed by the t-test or two-factor dispersion analysis. In the latter case, besides estimating the effect of age factors (F_A), hypothalamic electrical stimulation (F_B), and their combined action (F_{AB}), the strength of the effects of these factors also was determined in relation to the corresponding criteria h_A^2, h_B^2, h_{AB}^2 [2].

EXPERIMENTAL RESULTS

Considering the generalized character and possible nonsynchronization of age changes in hypothalamic regulation, and also the specific structural and functional characteristics of peripheral tissues, it was decided to study the effect of hypothalamic electrical stimulation on the intensity of protein synthesis in five different organs, differing both in type of cell differentiation and in the degree of direct functional control by the hypothalamus: in muscle, myocardium, liver, and adrenal and thyroid glands. The investigations showed that in old age there is a marked decrease in the stimulating effect of the hypothalamus on protein synthesis in most of the tissues studied. For instance, 3 h after stimulation of the hypothalamus, judging by the value of RSR, the intensity of protein synthesis in skeletal muscle of adult rats was raised by 29% ($P < 0.05$), whereas in old animals it was reduced by about the same amount (30%). According to the results of two-factor dispersion analysis the intensity of protein synthesis in the muscles depends significantly on age factors ($F_A = 4.5$; $P < 0.05$) with strength of effect $h_A^2 = 0.07$. Age differences in hypothalamic stimulation also were statistically significant ($F_{AB} = 10.2$; $P < 0.01$) with $h_{AB}^2 = 0.35$. In old age the stimulating effect of the hypothalamus on protein synthesis in the left ventricular myocardium was considerably weakened. In adult rats RSR of protein was increased by 100% ($P < 0.01$), but in old rats by only 9% (Fig. 1). The effect of hypothalamic electrical stimulation in the myocardium ($F_B = 7.31$; $P < 0.01$) with $h_B^2 = 0.15$, and also age differences in the effect of hypothalamic electrical stimulation ($F_{AB} = 4.0$; $P < 0.05$) with $h_{AB}^2 = 0.14$, were significant. Rather different results were obtained for tissues of contracting type. In them, hypothalamic stimulation caused more substantial changes in adult rats than in old animals. For instance, in the adrenals of old rats RSR of protein was increased after electrical stimulation by 88% ($P < 0.05$), but in old rats by only 2% (Fig. 2). Changes in RSR in the thyroid gland of adult and old rats were 31 and 11%, respectively. Of all the organs studied, approximately the same age trend of protein RSR was observed only in the liver, where in adult and old rats it was increased by 67 and 59%, respectively ($P < 0.05$, Fig. 2). The effect of hypothalamic electrical stimulation also was significant in this organ ($F_B = 12.3$; $P < 0.01$) with $h_B^2 = 0.33$. An essential role in the mechanisms of the age changes in hypothalamic control of protein synthesis was played by differences in chromatin protein turnover. Our investigations showed that hypothalamic electrical stimulation causes a marked increase in ^{3}H-leucine incorporation into protein of active and inactive liver chromatin. For instance, with an unchanged protein/DNA ratio, RSR of proteins of inactive chromatin was increased by 220% ($P < 0.02$) and of active chromatin by 14% ($P < 0.05$). In old animals these values were maintained virtually at the control level.

In old age there is thus a marked decline in the stimulating effect of the hypothalamus on the intensity of protein synthesis. In adult rats the increase in RSR of protein was much higher in all the organs studied than in old animals. Evidence of the age-related narrowing of the range of hypothalamic regulatory influences on the genome of peripheral tissues was given by the significant fall in the coefficient of variation of protein RSR in old rats. For instance, the coefficient of variation in different organs of adult experimental rats varied from 0.37 to 0.71, but in old rats from 0.27 to 0.48.

When age differences in the effect of hypothalamic electrical stimulation on the intensity of translation in peripheral tissues are discussed, it cannot fail to be noted that, compared with intact rats, the control animals used in these investigations, with implanted electrodes (but without stimulation) were distinguished by a somewhat different age dynamics of RSR. Protein RSR did not differ significantly in the organs studied from intact rats of different ages, and it was somewhat higher in adult animals, whereas in rats with electrodes im-

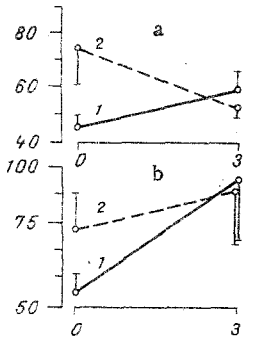

Fig. 1

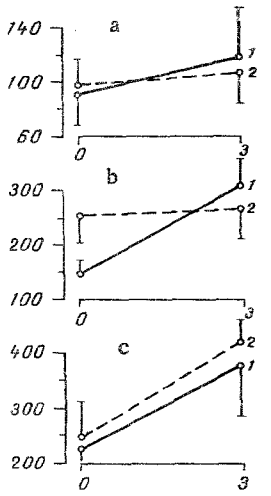

Fig. 3

Fig. 1. Effect of hypothalamic electrical stimulation on intensity of protein synthesis in tissues of contractile type from adult (1) and old (2) rats. Abscissa, time after stimulation (in h); ordinate, RSR ($\times 10^3$): a) Skeletal muscle, b) left ventricular myocardium.

Fig. 2. Effect of hypothalamic electrical stimulation on intensity of protein synthesis in tissues of secretory type in adult (1) and old (2) rats: a) Thyroid gland. b) adrenal gland, c) liver. Remainder of legend as to Fig. 1.

planted into the hypothalamus, RSR rose with age. This could have a significant effect on the course of adaptive reactions of the body in old age, in which the hypothalamus and the protein-synthesizing apparatus participate. In old age regulation of function is disturbed and the reliability of hypothalamic control is reduced [3]. That is why insertion of an electrode gives rise to more marked changes in the state of the hypothalamus in old animals.

Hypothalamic electrical stimulation in adult rats thus leads to a more marked increase in the intensity of protein synthesis than in old animals.

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