EFFECT OF HYPOKINESIA ON THE STATE OF THE THYROID GLAND IN RATS PREVIOUSLY ADAPTED TO HYPOXIA

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Thyroid function is sharply inhibited in rats during hypokinesia for 50 days. Adaptation to hypoxia for 80 days leads to moderate hypofunction of the thyroid gland with no pathological changes in its parenchyma. Adaptation to hypoxia starting 1 month before hypokinesia has a prophylactic action and reduces the pathological effect of hypokinesia on thyroid function.

KEY WORDS: adaptation to hypoxia; hypokinesia; thyroid gland.

A previous investigation [2] showed that adaptation of rats to hypoxia substantially weakens the action of hypokinesia on various functional indices.

In this investigation, the state of the thyroid gland in rats was evaluated in analogous experiments.

EXPERIMENTAL METHOD

Experiments were carried out on sexually mature male rats divided into four groups: 1) control; 2) hypokinesia: The animals of this group were kept for 24 h daily for 50 days in small individual box cages, greatly reducing their mobility; 3) adaptation to hypoxia: The rats of this group were kept for 5 h daily except on Sundays for 1 month in a pressure chamber at an "altitude" of up to 7500 m, and for the next 50 days at an "altitude" of 6500 m for 3 h daily on alternate days; 4) adaptation to hypoxia + hypokinesia: In the animals of this group the second (50-day) period of adaptation to hypoxia was combined with hypokinesia. The thyroid glands were removed immediately after decapitation of the rats and fixed in Bouin's fluid. Paraffin sections 5 μ in thickness were stained with hematoxylin–eosin. Thyroid morphology and function were assessed from the height of the follicular epithelial cells, the quantitative ratio between epithelium, colloid, and connective tissue, the density of the colloid, and the presence of "zones of resorption."

EXPERIMENTAL RESULTS AND DISCUSSION

The results are given in Table 1. Hypokinesia led to marked inhibition of thyroid function. The follicular epithelium in the rats of this group was flattened; the follicles were large and distended with dense, folded colloid, with no zones of resorption. In some cases their walls were ruptured so that the follicles were joined together to form extensive cavities. The structure of the gland showed subdivision into lobules, due to the pathological overgrowth of connective-tissue bands.

After prolonged (80 days) adaptation to hypoxia the thyroid glands contained small follicles with liquid colloid, numerous zones of resorption were seen, and the follicular epithelial cells were high. These changes indicate active synthesis and liberation of hormones. By contrast with the picture observed after more rigorous adaptation to hypoxia [1, 4], under the present experimental conditions no sclerotic changes were observed in the structure of the gland. On the whole, although adaptation to hypoxia was accompanied by some features of reduced thyroid function, the degree of the reduction was relatively small.

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TABLE 1. Morphological and Functional State of the Thyroid in Rats (M ± m)

Group of rats	Height of cells of follicular epithelium, μ	Relative proportion (in %)		
		epithelium	colloid	connective tissue
1	13,3± 0,57	80,6± 0,79	8,9± 1,4	10,5± 1,0
2	9,9± 0,15	58,0± 1,6	28,8± 1,3	13,2± 1,0
3	12,9± 0,12	69,0± 1,2	21,6± 1,0	9,4± 0,7
4				
subgroup 1	11,4± 0,42	68,9± 1,7	18,6± 1,1	12,5± 1,4
2	9,6± 0,15	55,8± 1,0	32,3± 1,0	11,9± 1,0

In the animals of group 4 two types of response of the thyroid gland were found. In 11 of the 21 rats (subgroup 1) the changes were practically the same as in the rats of group 3. The presence of comparatively small follicles with high thyroid epithelium, zones of resorption, and liquefaction of the colloid in some follicles pointed to very slight inhibition of gland function. However, in 10 rats (subgroup 2) the changes resembled those found in the animals of group 2. The morphological picture of the gland in these groups could not be distinguished, whereas the indices of the morphological and functional state of the thyroid in the rats of the two subgroups differed significantly from each other ($P < 0.001$). In the glands of the animals of subgroup 2 of group 4 a marked decrease in height of the follicular epithelium was observed; the nuclei were flattened and compressed, with dense chromatin; the follicles were mainly large, with dense colloid and without zones of resorption; the walls of the follicles were ruptured and the follicles themselves joined together. Meanwhile in the rats of this subgroup no hypertrophy of the connective-tissue bands in the thyroid gland could be observed, as was characteristic of the animals with hypokinesia. Against the background of marked hypofunction, individual follicles were nevertheless found with evidence of high functional activity. This is evidence that the gland was less severely affected by exposure to hypokinesia in animals previously adapted to hypoxia than in animals not so adapted.

It was emphasized previously [2], on the basis of an assessment of the general state of the animal, that the prophylactic effect of preliminary adaptation to hypoxia (with continuation of adaptation procedures during exposure to hypokinesia) is stronger than in the case of simultaneous exposure to hypokinesia and hypoxia [3]. The results of the present experiments indicate that preliminary adaptation to hypoxia also protects the thyroid gland against the unfavorable action of hypokinesia.

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