Effect of Hydrocortisone on Amine Content in the Thymus

V. E. Sergeeva, R. I. Klyasheva, N. V. Aleksandrova, and S. A. Porfir'eva

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 123, No. 6, pp. 677-679, June, 1997
Original article submitted April 10, 1996

Intraperitoneal injection of 2.5% hydrocortisone suspension (0.5 ml) changes the content of biogenic amines in different lobule zones and thymocytes of high animals. The content of norepinephrine and serotonin increases in luminescent cells of the subcapsular and premedullary zones and decreases in mast cells.

Key Words: *hydrocortisone; thymus; subcapsular and premedullary zones; mast cells; serotonin;*

Hydrocortisone (cortisol, HC) is the most potent natural glucocorticoid in animals and men [1,4,9,11].

The reticuloendothelial system (thymus, spleen, lymph nodes, etc.), muscular, bone, and connective tissue are the targets for glucocorticoids.

Glucocorticoids (cortisol, cortisone, etc.) exhibit anti-inflammatory, antishock, antiallergic, and immunosuppressive activities, which are of importance in tissue and organ transplantation for prevention of their rejection. An important role in these processes is played by the thymus [5-8].

Hydrocortisone exerts an antimitotic effect on cortical lymphocytes of the thymic lobules and induces a dose-dependent involution of the thymus [5]. This is accompanied by a 50% reduction of organ weight and its DNA content, inhibition of lymphocyte differentiation, and intensification of destructive processes.

Numerous aspects of the molecular effect of steroid hormones on the cell and its nucleus have been extensively studied: transport into the cell, binding to receptor proteins, and formation of glucocorticoid-protein complexes followed by binding to specific DNA regions near the transcription initiation sites [1-3].

However, little is known on the effect of HC on the content of biogenic amines in different thymic zones and cells [7,8].

Department of Medical Biology and Histology, Department of Pharmacology, Medical Institute of I. N. Ul'yanov State University, Cheboksary

The aim of the present study was to investigate the effect of HC on the contents of norepinephrine and serotonin in different structures of the thymus in high animals.

MATERIALS AND METHODS

Thymuses from 50 albino male rats aging 1.5-2 month and weighing 130±20 g were used.

The animals were divided into 3 groups: group 1 were intact controls, rats of groups 2 and 3 were intraperitoneally injected with 0.5 ml physiological saline and 0.5 ml 2.5% HC (suspension hydrocortisone acetate, Bacterial Preparation Plant, Kharkov), respectively, for 4 days.

The preparation was injected in the afternoon, when the endogenous HC level decreases to minimal values [3].

Experiments were carried out in the fall. In all experimental series, the thymus was obtained under deep ether narcosis according to the Helsinki declaration.

Cryostat sections of the thymus were processed by the Falck—Hillarp luminescent-histochemical method allowing visualization of biogenic amines in different thymic structures.

The method is based on the condensation of norepinephrine with formaldehyde yielding 1,2,3,4-tetrahydroisoquinoline, which undergoes dehydration and forms 2,3-dihydroisoquinoline characterized by intense fluorescence in a short-wave range. These

0007-4888/97/0006-0588$18.00

products form luminescent complexes with bright green fluorescence.

Carbolines formed in the same reaction from serotonin are characterized by white and yellow fluorescence.

Cryostat sections were treated in a paraformaldehyde chamber at 80°C for 1 h and examined under a LYuMAM-1A luminescent microscope.

The data were summarized and the content of biogenic amines presented as distribution diagrams. The significance of differences was assessed using the Student's t test at $p<0.05$.

RESULTS

In HC-treated animals (group 3), the content of luminescent cells in different thymic lobes and zones increased in comparison with control groups 1 and 2. Moreover, the aminoabsorbing cells of the subcapsular zone were larger than in the control. Bright premedullary cells were found in the corticomedullary zone. Some thymic lobes had no distinct boundaries between the cortical and medullary zones due to abundant amino-positive cells. Emerald-green varicose adrenergic nerve endings were found near blood vessels. In other thymic lobes, epithelial reticular stroma was seen.

Thus, 2 types of thymic lobes were found in HC-treated rats: depleted lobes with naked delicate stroma and lobes with multiple amines-positive structures and yellow luminescence. The medulla of the control animals had few luminescent cells and adrenergic endings; no Hassall bodies were found.

Spectrophotometry of luminescent structures showed that HC treatment enhanced the intensity of luminescence in subcapsular and premedullary thymic cells and in adrenergic nerve endings (Fig. 1).

Moreover, enhanced luminescence was observed in cortical and medullary thymic lymphocytes. The content of norepinephrine in cells of the corticomedullary zone remained unchanged, while in mast cells it was considerably decreased. Nerve endings with emerald-green luminescence were clearly outlined; spectrophotometry revealed a considerable increase in the norepinephrine content. Thus, HC changes the content of biogenic amines in amino-containing structures of the thymus. The content of biogenic amines increases in luminescent cells of the subcapsular and premedullary zones (Figs. 1 and 2), while the content of norepinephrine and serotonin in mast cells decreases (Fig. 2).

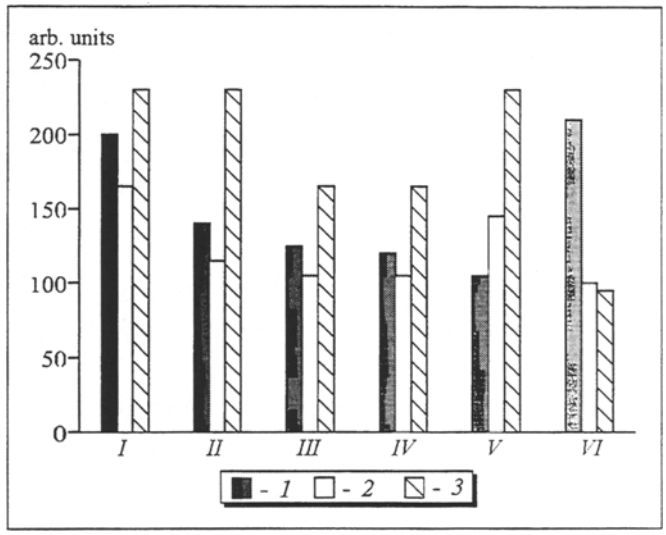

Fig. 1. Norepinephrine distribution in amin-containing thymic structures in the control (*1*) and after injection of physiological saline (*2*) and hydrocortisone (*3*). Here and in Fig. 2: premedullary (*I*) and subcapsular (*II*) cells; cortex (*III*) and medulla (*IV*); *V*: adrenergic nerve endings; *VI*: mast cells.

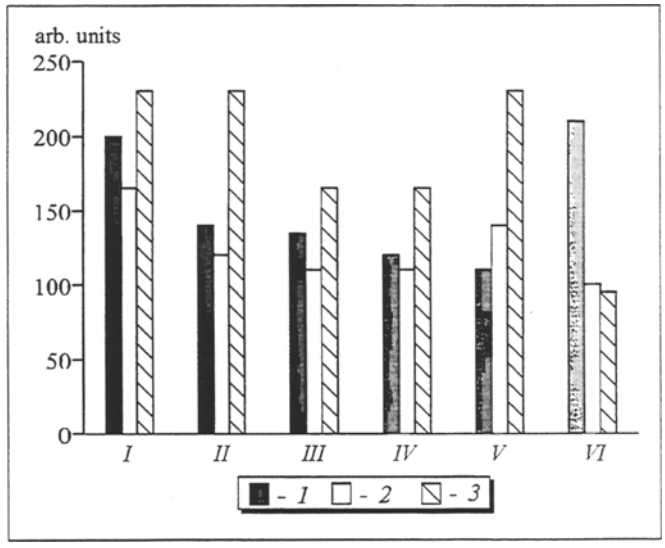

Fig. 2. Serotonin distribution in amin-containing thymic structures in the control (*1*) and after injection of physiological saline (*2*) and hydrocortisone (*3*).

REFERENCES

1. B. Alberts, D. Brey, G. Lewis, *et al.*, in: *Molecular Biology of the Cell* [Russian translation], Moscow (1994), pp. 349-353.
2. E. N. Zhavoronkova and B. F. Vanyushin, *Biokhimiya*, **52**, No. 5, 870-877 (1987).
3. R. Marry, D. Grenner, P. Meyes, and V. Rodwell, in: *Human Biochemistry* [Russian translation] (1993).
4. Yu. A. Ovchinnikov, in: *Bioorganic Chemistry* [in Russian], Moscow (1987), pp. 707-708.
5. E. T. Ostroushko, *Byull. Eksp. Biol. Med.*, **69**, No. 6, 84-87 (1970).
6. V. E. Sergeeva and D. S. Gordon, *Luminescent-Histochemical Characteristics of the Early Response of Monoamine-Containing Thymic Structures to Antigen Stimulation* [in Russian], Cheboksary (1992).
7. V. E. Torbek, *Morfologiya*, **102**, No. 3, 103-104 (1992).
8. N. A. Yurina and A. Ya. Tamakhina, *Byull. Eksp. Biol. Med.*, **122**, No. 10, 461-464 (1996).
9. J. B. Baxter and P. H. Forsham, *Am J. Med.*, **53**, 573 (1972).
10. D. K. Cranner, *Glucocorticoid Hormone Action*, J. D. Baxter and G. G. Rousseau (Eds.), Springer-Verlag (1979).
11. U. Gehring, *Trends Biochem. Sci.*, **12**, 399-402 (1987).
12. S. H. Snyder, *Sci. Am.*, **254**, No. 4, 132-140 (1984).