4. W. E. Lands, P. R. Letellier, and L. H. Rome, Adv. Biosci., 9, 15 (1973).
5. J. C. McGiff et al., Circ. Res., 31, 36 (1972).
6. I. H. Mills and P. E. Ward, J. Physiol. (London), 239, 123 (1974).
7. L. R. Willis, J. H. Ludens, and J. B. Hook, Am. J. Physiol., 217, 1 (1969).

DISTRIBUTION OF RADIOACTIVE CORTISOL IN THE TISSUES AND MEDIA OF THE EYE

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Incorporation of cortisol-^{3}H and the dynamics of its accumulation in the tissues and media of the eye (sclera, ciliary body, cornea, iris, capsule of the lens, aqueous humor, vitreous body) were investigated. The intensity of incorporation of cortisol into the tissues and media of the eye and also the rate of its elimination from them were shown to differ. The sclera, cornea, ciliary body, and the capsule of the lens were shown to be target tissues for cortisol.

KEY WORDS: *target tissues for hormones; specific receptors; cortisol; eye.*

Hormones regulate the activity of the organs and tissues and affect the biochemical indices and processes in cells and subcellular structures [6-8]. Certain hormones have target tissues and organs in the body, which respond specifically to their action by changes in the activity of their metabolic enzymes. Evidence has recently been published on the effect of corticosteroids on the enzyme activity of some tissues of the eye [1-3] and of the incorporation of labeled steroid hormones into the retina [4, 5, 10] and lens [9].

The distribution, dynamics of accumulation and elimination, and also the specificity of the binding of cortisol-^{3}H in the various tissues of the eye were studied in the investigation described below in order to determine whether they are target tissues for the action of this hormone. The incorporation of the hormone into the sclera, cornea, ciliary body, iris, capsule of the lens, aqueous humor, and vitreous body was determined.

EXPERIMENTAL METHOD

Experiments were carried out on 50 male chinchilla rabbits weighing 1-2.5 kg. In experiments *in vivo* cortisol was injected intraperitoneally in a dose of $0.13 \cdot 10^{-3}$ mole/kg (60 μCi/kg). The animals were killed at various times (5 and 10 min; 1, 2, 4, and 24 h) after injection of the hormone. The tissues were removed in the cold and homogenized in 85% formic acid during heating (except the vitreous body and aqueous humor). Samples (0.2 ml) of the homogenates were taken and added to special flasks containing 5 ml of toluene–alcohol scintillator. The radioactivity in the sample was counted by means of the Mul'tim-212 liquid scintillation counter.

Accumulation of the hormone in the tissues and media of the eye was expressed in counts/min/g tissue.

In the experiments *in vitro* the tissues were incubated in medium containing $2.5 \cdot 10^{-6}$ M cortisol-^{3}H and 0.001 M EDTA (pH 7.4) at 37°C. The same manipulations were then carried out with the tissues as in the experiments *in vivo*, and they were homogenized after incubation for various times (from 5 min to 24 h).

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TABLE 1. Incorporation of Cortisol-^{3}H into Tissues of Rabbit's Eye *in vivo* (in counts/min/g)

Tissue	Time after injection of cortisol-^{3}H					
	5 min	10 min	1 h	2 h	4 h	24 h
Sclera	0	2300	750	1360	986	0
Cornea	0	3500	460*	1100	460	0
Ciliary body	0	12 980	15 300	850	1546	0
Iris	0	2490	1190*	4275	2472*	0
Capsule of lens	0	1510	1420	1120	670	0

Legend. Results shown in Table 1 are statistically significant except where marked by asterisk.

EXPERIMENTAL RESULTS

Experiments on rabbits of different ages showed that the dynamics of incorporation and the character of accumulation of cortisol were similar in the groups of sexually mature and sexually immature rabbits. The only difference between the groups was the more intensive incorporation of the hormone into certain tissues of sexually mature rabbits.

Target tissues are known to be characterized by rapid incorporation [4] and slow elimination of the hormone [7], by the presence of specific receptors, and by changes in the metabolic activity of the enzymes [11].

Cortisol-^{3}H was found to be incorporated into many tissues and media of the eye as early as 7-10 min after injection (Table 1). Incorporation of the label in the experiments *in vivo* reached a maximum for most tissues (sclera, cornea, capsule of the lens) after 10 min, for the ciliary body after 1 h, and for the iris after 2 h. A similar pattern of cortisol incorporation also was found for the tissues in the experiments *in vitro*. The most intensive incorporation of the hormone in the experiments *in vitro* was found into the ciliary body, rather less into the cornea, and, in order of decreasing intensity, into the iris, sclera, and capsule of the lens.

The results indicate that the various tissues of the eye evidently differ in their number of receptors for binding cortisol. However, the difference in the intensity of accumulation of the hormone may also depend on differences in the blood supply to these tissues.

The rate of elimination of the hormone, reflecting the degree of specificity of its binding with the tissue, was low for most tissues of the eye. The slowest elimination of the hormone took place from the capsule of the lens, followed in increasing order by the aqueous humor, sclera, vitreous body, ciliary body, and iris. All the cortisol was eliminated from the tissues and media of the eye 24 h after its injection. A parallel was found between elimination of the hormone and the restoration of normal glycosidase activity, when modified as a result of the action of the hormone [1-3]. Similar correlation also was found between activation of the enzymes and assimilation of the hormone by the tissue of the retina in experiments *in vitro* [5]. This fact confirms the hypothesis that the binding of cortisol by the tissues of the eye is specific.

To discover whether specific receptors exist in the tissues of the eye experiments were carried out to determine the competitive binding of cortisol-^{3}H, i.e., experiments with incorporation of the labeled hormone after administration of nonradioactive cortisol. Incorporation of the radioactive hormone after saturation with the nonradioactive hormone was found to be reduced in the sclera, cornea, ciliary body, and capsule of the lens. This suggests that these tissues of the eye contain specific receptors for binding with cortisol. The other tissues studied probably bind cortisol through nonspecific receptors or accumulate it diffusely.

Similar patterns of behavior were found for the tissues of the human eye. The only difference was in the more intensive incorporation of the hormone. The number of specific

receptors for binding with cortisol is evidently a species difference for the eye tissues. The sclera, cornea, ciliary body, capsule of the lens (and, according to data in the literature, the lens itself and the retina) are evidently target tissues and the eye is an effector organ for the action of cortisol.

The tissues of the eye are known to be highly sensitive to the action not only of cortisol, but also of several hormones with a different spectrum of action [1]. It can therefore be postulated that the eye is a target organ not only for cortisol, but also for some other hormones.

LITERATURE CITED

1. B. S. Kasavina, V. M. Dronova, and N. I. Kislyakova, Dokl. Akad. Nauk SSSR, 218, 230 (1974).
2. B. S. Kasavina, P. V. Sergeev, and N. B. Chesnokova, Byull. Éksp. Biol. Med., No. 9 47 (1972).
3. B. S. Kasavina, T. V. Ukhina, and T. K. Demina, Dokl. Akad. Nauk SSSR, 22. 236 (1975).
4. G. J. Chader, J. Neurochem., 21, 1525 (1973).
5. L. S. Dietrich, Biochem. Pharmacol., 14, 467 (1965).
6. T. D. Gelehrter, Metabolism, 22, 85 (1973).
7. M. Görlich, Arch. Geschwulstforsch., 37, 161 (1971).
8. A. A. Moskona and R. Piggington, Science, 158, 496 (1967).
9. S. Ono, H. Hirano, and K. Obara, Exp. Eye Res., 16, 517 (1973).
10. L. Reif-Lehrer and G. J. Chader, Biochim. Biophys. Acta, 192, 310 (1969).
11. C. A. Villee, The Molecular Control of Cellular Activity, New York (1962), pp. 297-318.