

THE EFFECT OF MECHANICAL INJURIES OF THE CEREBRAL CORTEX ON THE FORMATION OF ADRENOCORTICOTROPIC HORMONE BY THE HYPOPHYSIS

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The investigations of B. V. Aleshin [1, 2] and S. P. Nikolaichuk [7, 8] have shown that the relationship between the peripheral endocrine glands and the hypophysis is altered by disturbances in the normal state of the cerebral cortex. Endroczi and Lissak [10] established that stimulation of the reticular formation and the posterior division of the hypothalamus leads to a general intensification of hormonopoiesis in the adrenal cortex. In this case, changes occur which are analogous to those observed in this gland after administration of adrenocorticotrophic hormone (ACTH), with retention of the relationship between the hormonal fractions that is noted in intact animals.

Inasmuch as the work of the subcortex is coordinated with higher divisions of the central nervous system, it is reasonable to postulate that disruption of the normal state of the cerebral cortex would cause a change in the activity of the subcortex, which in turn may effect the processes of hormone formation and hormone secretion from the adrenal cortex.

In one of our previous works [9] on male rabbits, we studied the effect of mechanical injury of the cerebral cortex on adrenocorticotrophic function of the anterior lobe of the hypophysis 10 days after operation. In those cases where silver disks were placed in the anterior region of the cortex of both hemispheres, the concentration of ACTH in the hypophysis fell markedly in comparison with its level in intact rabbit-donors, which may be regarded as a sign of decreasing production of this hormone. The same procedure, performed on the posterior region, did not cause manifest changes in the concentration of ACTH in the hypophysis.

In this work, we attempted to elucidate how the adrenocorticotrophic function of the hypophysis is altered in dogs, following the application of gauze tampons to the premotor and occipital regions of the cortex of both cerebral hemispheres, at more prolonged intervals of time (13 and 30 days) after the operation.

Our previous observations [6] showed that the concentration of corticosteroids in the adrenal cortices and in the blood of dogs may not only be altered depending on the site of action in any portion of the cerebral cortex, but also on the duration of the action. The concentration of ACTH in the experimental donors was established by the level of androgens in the adrenal cortices of hypophysectomized rat-recipients which received an extract of the hypophysis under study.

EXPERIMENTAL METHOD

Male dogs were used as the donors. In these animals, gauze tampons were applied to the premotor or occipital area of the cortex of both cerebral hemispheres, under the dura mater.

To avoid changes in the hormonopoiesis of the hypophysis caused by narcosis, the donors were sacrificed with an electrical current 13 or 30 days after the operation, and the concentration of ACTH in their hypophyses was determined. An adrenocorticotrophic extract from the hypophysis of the experimental and intact donors was obtained by a method which we developed earlier [4]. The extract was tested by the method of G. Sayers and M. Sayers [11], on hypophysectomized rats 24 hours after removal of the hypophysis.

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The concentration of ACTH in the hypophysis of the dog-donors was established by the change in the level of androgens present in the right adrenal of the hypophysectomized rat-recipients 1½ hours after they were injected intraperitoneally with the hypophyseal extract. Determination of the androgens in the investigated adrenals was performed by the method which we published [5], utilizing Zimmermann's color reaction [12]. The initial level of androgens in the adrenals of the recipients was established by the concentration of these hormones in the left adrenal, which was removed prior to the injection of the extract.

EXPERIMENTAL RESULTS

Before beginning the determination of the ACTH concentration in the hypophysis of the donors that underwent the procedure described above, we established the level of this hormone in the hypophysis of intact donors. We found that the extract from the hypophysis of intact donors, injected into the recipients, caused a marked increase in the concentration of androgens in the adrenal cortices of the latter animals. Thus, before injection of the extract, the left adrenal contained an average of 93.6 micrograms % of androgens, while after the injection, its amount increased to 485.2 micrograms %, i.e., by more than 5 times (by 420%). The amount of androgens encountered in the adrenals of the recipients served as the control (see table).

Injection of the recipients with the adrenocorticotrophic extract from the hypophysis of the donors, 13 days after application of the tampons to the premotor area of the cerebral cortex, markedly lowered the concentration of endrogens in the adrenal cortex of the recipients. While prior to injection of the extract, the left adrenal of the recipients contained approximately the same amount of androgens as in the control animals (an average of 82.4 micrograms %), after injection of the extract the amount of these hormones in the right adrenal fell to 60.5 micrograms % (by 26.7% in comparison with the starting level).

Therefore, application of gauze tampons to the premotor area of the donors lowers the adrenocorticotrophic function of the hypophysis within 13 days.

More prolonged action on the premotor region of the cerebral cortex left the adrenocorticotrophic function almost unchanged: the concentration of adrenal cortex of the recipients, 30 days after the operation, remained approximately the same as after 13 days. Before injection of the extract, the left adrenal contained an average of 78 micrograms % of androgens, while after injection the amount of these hormones in the right adrenal fell to 56.6 micrograms % (by 27%).

Thus, disturbing the normal state of the premotor region of the cerebral cortex in animals clearly depresses the adrenocorticotrophic function of the hypophysis.

In order to compare the effect obtained after mechanical injury of the premotor region with the effect caused by disrupting the normal state of other parts of the cerebral cortex, analogous experiments were carried out on the occipital region. In the following 2 series of experiments we studied the effect of applying gauze tampons to the occipital region of the cerebral cortex on the production of ACTH by the hypophysis, 13 and 30 days after the operation.

The extract from the hypophysis of donors, in whom the tampons were applied to the occipital region, did not change the concentration of androgens in the adrenal cortex of the recipients. While prior to injection of the extract the androgens in the left adrenal of the recipients were equal to an average of 86.3 micrograms %, after injection of the extract their concentration in the right adrenal fell to 79.6 micrograms % (by 7.4%).

Approximately the same results were obtained after injection of the extract from the hypophysis of donors, in whom the tampons were applied to the occipital region, over the course of a longer period of time (30 days after the operation). Prior to injection of the extract, the concentration of androgens in the left adrenal was equal to an average of 81.5 micrograms %, while in the right adrenal, after injection of the extract, it fell to 79.7 micrograms % (by 2%).

The results of the first 2 series of experiments justify concluding that application of gauze tampons to the premotor region of the cerebral cortex in dogs markedly lowers the concentration of ACTH in the hypophysis by the 13th day after the operation, and that the level remains approximately the same as late as 30 days after the time of the procedure.

Analysis of the subsequent 2 series of experiments shows that after a similar procedure is performed on the occipital region, and the same observation intervals are used (13 and 30 days), the concentration of ACTH in the

premotor region.

We are convinced that in intact animals the brain has a stimulatory influence on adrenocorticotrophic function of the hypophysis. In those cases where the normal state of the premotor or occipital regions of the cortex of both cerebral hemispheres is disturbed in dogs, the adrenocorticotrophic functioning of the hypophysis clearly weakens.

It is important to note that the results of the experiments performed on dogs confirm the data which we obtained earlier [9] in determinations of the capacity of the hypophysis to produce ACTH in rabbits; in this latter case, silver disks were implanted in the premotor region of the cerebral cortex of both hemispheres for ten days. However, studying the dynamics of the hormone production by the hypophysis in rabbits which underwent the procedure only on the posterior portion of their cortex showed that the concentration of ACTH in them rose to the level observed in the intact animals.

Thus, our experiments showed that mechanical injury to the premotor region of the cerebral cortex of both hemispheres in rabbits and dogs causes a clear depression in the adrenocorticotrophic functioning of the hypophysis. An analogous procedure on the occipital region of dogs results in a different effect on the adrenocorticotrophic functioning of the hypophysis in dogs than it does in rabbits.

SUMMARY

A study was made of the effect produced by mechanical injury of the brain cortex (application of gauze tampons to the premotor and occipital areas under the dura mater of both hemispheres) on the adrenocorticotrophic function in dogs. Changes in the latter function were assessed by the shifts in the androgen level in the adrenal cortex of hypophysectomized rats-recipients to which an extract of hypophysis of intact and experimental donor-dogs was administered. The initial androgen level in the recipient's adrenal glands was determined (for comparison) by its content in the left adrenal gland excised prior to the injection of the extract.

Administration of hypophysis extract of donors with bilateral injury of the premotor area of the brain cortex led to a marked reduction of the androgen content in the recipient's adrenal cortex pointing to a manifest reduction of the adrenocorticotrophic function in donors. Analogous action on the occipital area of dogs (as distinct from rabbits) had no effect on the adrenocorticotrophic function of the hypophysis.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.

*As in original — However data seems to indicate the opposite — Publisher's note.