

DEVELOPMENT OF THE ADRENAL CORTEX IN OFFSPRING OF TOTALLY IRRADIATED RABBITS

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Differentiation and formation of the zones of the adrenal cortex are retarded in rabbits born from irradiated females crossed with healthy males. The regular cell pattern is disturbed and foci of sclerosis and micronecrosis are observed, with a decrease in the content of lipids, RNA, and ascorbic acid in the cell cytoplasm.

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In the offspring of irradiated animals the permeability of the tissue-blood barriers is disturbed [8], the threshold of excitation of nerve cells is lowered [9], posttraumatic regeneration of bone is depressed [4-6], the thyroid gland undergoes hyperplasia, and malformations may arise [3]. No data concerning the state of the endocrine glands in the offspring of irradiated parents could be found, yet the study of this problem is of considerable interest.

The object of the present investigation was to study changes in the adrenal cortex in the offspring of irradiated females.

EXPERIMENTAL METHOD

A study was made of the adrenals of 18 rabbits whose mothers had been irradiated in a single dose of 150 R 4-6 months before mating with healthy males. The rabbits were sacrificed 1, 3, 10, 15, 21, and 30 days after birth. The offspring of unirradiated females (21 rabbits) were investigated at the same times.

The adrenals were fixed in 10% neutral formalin, Becker's calcium-formol, and Carnoy's fluid. The material was stained with hematoxylin-eosin, Sudan black B, by Brachet's method with extraction of nucleic acids with 5% TCA, and by the Feulgen and Giroud-Leblond methods. The greatest diameter of the nuclei was measured in the cells of each zone. The results were treated by statistical methods.

EXPERIMENTAL RESULTS

On the first day after birth zonal differentiation of the adrenal cortex was absent in the experimental animals and the zona glomerulosa had not formed. The cortex consisted of uniform cells with intensely stained cytoplasm rich in RNA, and a strongly pyroninophilic nucleolus. Giant cells containing 3 or 4 nuclei and with much RNA in their cytoplasm were found. The presence of giant cells in the adrenal cortex is characteristic of the embryonic period of development [1]; in rats and man these cells are found in the first week of extrauterine development also [7]. In the rabbits of the control group no such cells could be found. The cell nuclei of the adrenal cortex were fairly large, and they differed in size from the cell nuclei of the undifferentiated zone (located internally to the zona glomerulosa) of the control animals.

Differentiation into zones still had not taken place on the 3rd day: the zona glomerulosa had not formed and no traces of formation of the zona fasciculata were evident. In all parts of the cortex the lipid content was lower than in the control animals; in some parts lipids were completely absent.

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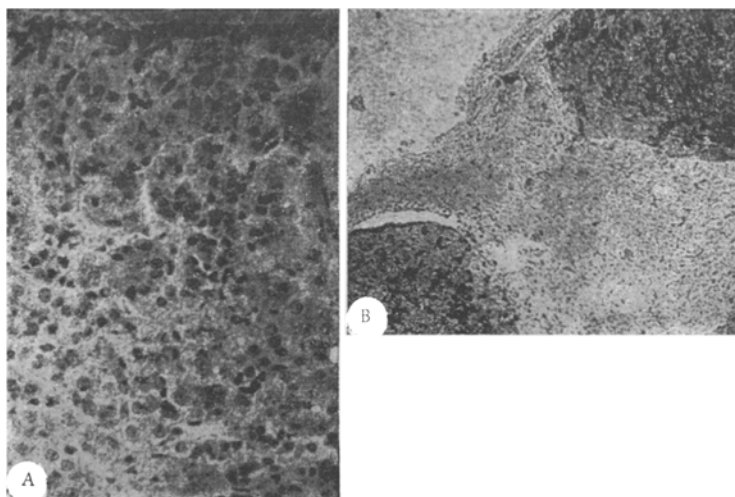


Fig. 1. Offspring of irradiated female (15 days). A) Mingling of cells of zona glomerulosa with zona fasciculata, absence of characteristic cell pattern in zones. Hematoxylin-eosin 250 \times ; B) area of delipidization of adrenal cortex. Sudan black B., 75 \times .

The zona glomerulosa was formed in the control rabbits on the first day after birth, but in the offspring of irradiated females not until the 10th day; the formation of Koelliker's columns in these animals was also delayed. The lipid content in the cytoplasm was lowered in the cells of all zones.

Disturbance of the regular pattern of cells in the adrenal cortex was found in two rabbits sacrificed on the 15th day. The zonal structure was disturbed, and elements of the zona glomerulosa were mixed irregularly with the zona fasciculata (Fig. 1A). Areas of proliferation of connective tissue in the cortical parenchyma were present. The distribution of lipids was extremely irregular; small and also massive areas of delipidization were seen (Fig. 1B). Lipids also had disappeared from the islets of adrenocortical cells in the medulla. A high content of RNA was still maintained in the cytoplasm of cells in the zona glomerulosa and zona fasciculata. Vacuolation, lysis of chromatin, displacement of DNA toward the nuclear membrane, and fragmentation of the nuclei were seen in the cells especially in the zona fasciculata.

In many cells the nuclei were large, much larger than the average for this zone. The increase in size of the nuclei was not accompanied by an increase in the DNA content in the nucleus and RNA content in the nucleolus and cytoplasm. This increase in size of the nuclei has been considered [2] to be not connected with polyploidization. After the 15th day, a zona reticularis was found in both the control and the experimental animals.

On the 21st day the zones of the adrenal cortex were well differentiated, the zona fasciculata consisting principally of pale cells. The distribution of lipids varied from one part to another, and the RNA content was lower than in the control. The changes described above in nuclear structure persisted and were more marked in the zona fasciculata and zona reticularis.

Focal fibrosis and mucous swelling of the connective-tissue fibers of the capsule were observed in the experimental animals on the 30th day. Small areas of micronecrosis and proliferation of connective tissue, producing deformation of the zone, were present in the zona fasciculata. The content of RNA, lipids, and ascorbic acid in the cell cytoplasm was reduced, especially in the zona fasciculata.

The changes described above can probably be attributed to the effects of the irradiated mother on the offspring, although a direct action of radiation on the ovum cannot be ruled out.

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