

ELECTRON MICROSCOPIC STUDY OF THE ULTRASTRUCTURE
OF THYMUS CELLS IN C75BL MICE WITH RADIATION LEUKEMIA

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Experimental leukemia in the mouse produced by ionizing radiation has been extensively treated from many aspects in the literature, but a more detailed acquaintance reveals that the majority of this work has been performed on a light microscopic level whereas few papers deal with submicroscopic changes.

In the study of x-ray produced experimental leukemia, mice of the C57BL strain are frequently used. These characteristically develop a lymphatic leukemia with thymic enlargement. In the literature [3, 4, 5] 2 forms of leukemia are united under one designation: generalized leukemia with thymic involvement (rarely without) and isolated malignant formations of the thymus which are given various designations in the literature (thymic lymphoma, thymic reticulosarcoma, thymoma, thymic lymphosarcoma, etc).

The aim of this paper was the electron microscopic investigation of the changes in mouse thymus cells in leukemia produced after irradiation.



Fig. 1. Thymus cells of mouse exposed to radiation.
Magnification 20,400 \times .

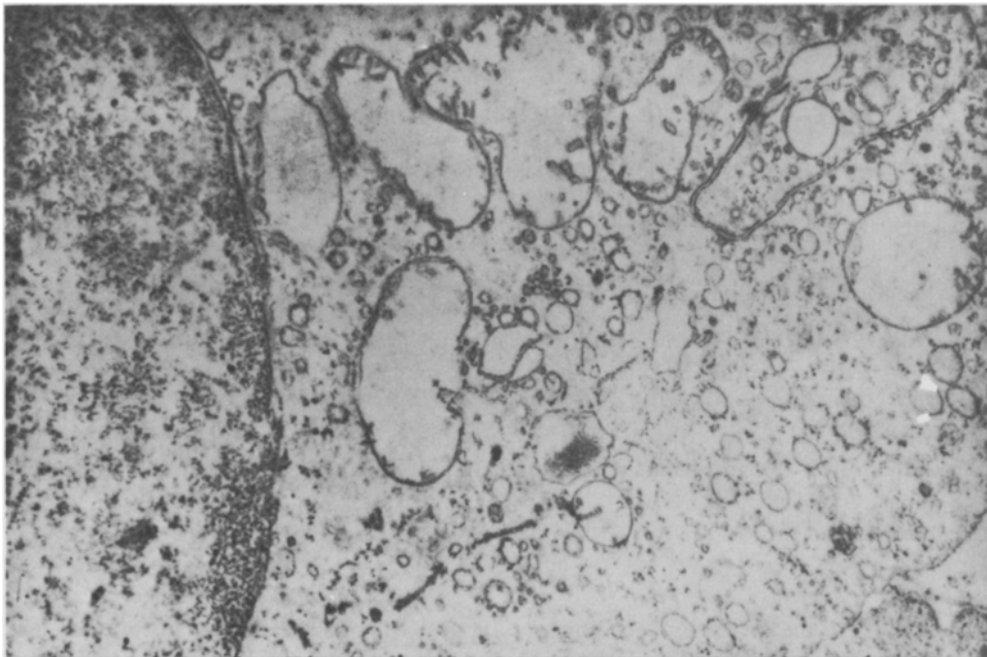


Fig. 2. Thymus cells of mouse exposed to radiation.
Magnification 35,500 \times .



Fig. 3. Section of thymus cells of control mouse.
Magnification 45,000 \times .

METHODS

Mice of the C57BL strain of both sexes were taken at one week of age. They were irradiated with a total dose of 900 R (in 6 sessions at weekly intervals) using an RUM-11 X-ray apparatus (voltage 180 kv, current 10 ma, skin focus distance 40 cm, filters 1 mm Al and 0.5 mm Cu, power dose 22 R/min, single dose 150 R). One week after the end of the irradiation the mice were removed from their parents, separating males and females. They were observed right up to the appearance of signs of illness (ruffled hair, lethargy, dyspnea, axillary and sometimes inguinal lymphadenopathy), which developed at 4-6 months after the end of irradiation. The sick mice were killed (by decapitation) and the tissue material fixed in a 1.5% solution of osmic acid in physiologic solution buffered to pH 7.4.

Then the material was embedded in a mixture of methyl-butyl methacrylate (1:8). Polymerization took place under ultraviolet light. Ultrathin sections made on a "Ultratome" LKB-make ultramicrotome were studied in an IEM-6s electron microscope. The material taken from 6 mice with leukemia and thymic lymphoma and from 3 non-irradiated mice of the same age was studied in this manner.

RESULTS

In smears stained by the Pappenheim method the leukemic cells appear round and large (about 12-17 microns in diameter) with large round nuclei. The nuclear structure is delicate and friable but the chromatin is not distributed entirely evenly. Sometimes nucleoli are clearly defined. The cells usually have a narrow rim of a sharply basophilic protoplasm which gives positive staining by the Brachet method. Often this rim is so thin that it is almost invisible ("naked nucleus").

With electron microscopic study it may be seen that the nucleus of the leukemic cells which comprise the main mass of thymus tissue, usually have oval or round shapes, although sometimes extensive bulging of the nuclear envelope occurs (Fig. 1). The chromatin, as a rule, is evenly distributed within the nuclei. The endoplasmic reticulum is very scant in the cytoplasm of these cells. Granules of RNA lie free in the cytoplasm. Even at this magnification disruption of the structure of the mitochondria may be seen, indicated by their swelling. Changes in the mitochondria appear more clearly at greater magnification, where inflated, swollen mitochondria with remnants of cristae are seen (Fig. 2). Sometimes lipid inclusions may be detected in the cytoplasm.

Upon careful examination of the preparations we did not once detect viral inclusion in the cells that were studied. Such inclusions were observed during studies of lymphocytic leukemia in mice of the AKR strain.

Mitochondria in the thymic lymphoid tissues of mice which were not subjected to irradiation (controls) have a normal structure (Fig. 3). In these mice bulging of the nuclear envelope was not observed.

Thus, in mice of the C57BL strain after X-ray irradiation, with the development of leukemia, changes are observed in the mitochondria (vacuolization, emptiness) of the leukemic thymic cysts and sometimes an increase in the nuclear surface because of bulging of the membrane. No viral inclusions were found in the leukemic cells which corresponds to data from other authors [1, 2].

SUMMARY

A study was made by electron microscopy on the thymus cells in 6 mice of the C57BL strain with leukemia and thymus lymphoma caused by fractional irradiation in a total dose of 900 R, as well as thymus cells of 3 non-irradiated (control) mice of the same age. In leukemia, changes are observed in mitochondrias (vacuolization and emptiness) and sometimes an increase in the area of nuclei due to the bulging of the coat. No virus inclusions were found in leukemic cells. No changes were observed in the mitochondrias and nuclei in non-irradiated mice.

LITERATURE CITED

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