The Effect of X-Ray Irradiation upon the Epithelial Melanin Unit of the Hair Bulb in Hooded Rat*

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Summary. A marked increase in the quantity of pigment in the upper bulb, penetration of melanosomes into the papillae and vacuolisation of the bulb keratinocytes occurred as early as 4–6 h after irradiation with a dose 600–1200 R. Afterwards considerable hyperpigmentations appeared in the proximal segments of dystrophic and catagen hairs and melanin was found in the catagen columns and beyond them.

In most animals within 4–6 h after irradiation occurred a distinct vacuolisation of the Malpighian layer and the granular layer became more prominent.

The melanocyte-epidermal unit [1] includes a melanocyte and neighbouring keratinocytes, which are morphologically and functionally interconnected. In this unit keratinocytes receive the pigment from melanocytes. It seems, that the presence of keratinocytes is necessary for melanogenesis, because neither ultraviolet nor X-rays stimulate melanogenesis in the melanocytes in vitro [2, 3].

The relationship between keratinocytes of the hair bulb and melanocytes seems a peculiar one. Disturbances in hair growth due to various agents are often accompanied by changes in pigmentation. The changes occur in almost all anagen follicles after X-ray irradiation [9] and in cases of thallium poisoning [10]. Hyperpigmentation

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caused by melanin deposits [7, 11] in the hair is observed on some cases of alopecia due to cytostatic drugs [5], alopecia due to inflammatory conditions [6], alopecia areata [4], and in other alopecias.

In humans changes in the melanocytes were observed within 24 h of irradiation of the scalp with an epilating dose of X-rays [9]. The dendritic processes of melanocytes lateral to the dermal papillae became beaded in appearance, from the aggregation of melanosomes. Melanosomes in cells of the upper part of the bulb formed coarse aggregates. After irradiation pigment appeared in the cells of the inner sheath and in the outer sheath, both normally free of pigment.

The first abnormalities in the epidermis observed in a light microscope occurred on the 3rd day after irradiation. Guinea pigs irradiated with a dose of 4000 R (50 kV, 2 mA, 4. 2 FSD, 1 mm Al) showed in the basal layer abnormal mitoses and pyknotic nuclei; in the prickle cell layer oedema of the cytoplasm, and hypergranulosis [8].

The aim of the experiment was to find out when, after irradiation with various doses of X-rays, abnormalities perceptible in a light microscope begin to occur in keratinocytes and melanocytes of the hair follicles and epidermis in hooded rats i.e. animals with a synchronised hair cycle.

Material and Methods

The experiment was conducted with 100 inbred hooded rats (weight approx 200 g). The anagen (growing) stage of the hair cycle was induced by plucking black hair from an area of 7 cm² on the

Fig. 1. 4 h after the irradiation with 1200 R. Hyperpigmentation of the upper hairbulb; penetration of melanosomes into the papilla. Unstained 350×