

PIGMENTARY CHANGES IN SKIN SENESCENCE

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Synopsis

Numerous pigmentary changes occur during aging, physiological variations as well as changes associated with disease. In sun-protected areas, the number of melanocytes decreases by about 10% per decade. The effect of UV radiation may partially offset the effect of aging on melanocytes and explain why some elderly subjects have few melanocytes although their skin is dark. Sunlight may cause an uneven accumulation of pigment cells and of melanin in keratinocytes, resulting in blotchy appearance of the skin. This is probably due to reactive hyperplasia of melanocytes in some foci adjacent to regions where they have a decreased ability to transfer pigment to adjacent keratinocytes.

It is proposed that other cutaneous disorders associated with pigmentary changes be classified as follows: epidermal hyperpigmentation with keratinocytic hyperplasia; atypical epithelial neoplasms with melanocytic hyperplasia; atypical melanocytes neoplasms; post-inflammatory melanosis and metabolic pigmentation.

Riassunto

Con l'invecchiamento si verificano numerosi cambiamenti a livello del pigmento cutaneo provocati sia da cause fisiologiche che patologiche. Nelle aree protette il numero dei melanociti si riduce di circa il 10% ogni dieci anni. L'azione svolta dagli U.V. può parzialmente compensare gli effetti provocati dall'invecchiamento sui melanociti per cui alcuni soggetti anziani presentano la pelle scura pur possedendo pochi melanociti. La luce del sole può causare un accumulo irregolare di cellule pigmentogene e di melanina nei cheratinociti, dando luogo a formazione di "macchie" cutanee.

Questo fenomeno è probabilmente provocato da una iperplasia dei melanociti presenti in alcune zone adiacenti alle regioni che presentano una ridotta abilità a trasferire il pigmento ai cheratinociti adiacenti. Altri disordini cutanei associati a variazioni della pigmentazione possono essere classificati come segue: iperpigmentazione epidermica con iperplasia dei cheratinociti, neoplasma epiteliale atipico con iperplasia dei melanociti, neoplasma melanocitico atipico; melanosi e pigmentazione metabolica post-infiammatoria.

INTRODUCTION

Skin colour is normally produced by the pigments which are melanin, carotenoids and oxygenated or reduced hemoglobin. Other pigments may be also involved at variable degrees in some diseases such as icterus, ochronosis, haemochromatosis (15), chromhidrosis, xanthomas, pseudoxanthoma elasticum, solar elastosis, ...

Of these pigments, melanin is responsible for most of the physiological variations in skin colour. The number, size, type, and distribution of melanosomes in keratinocytes are in truth, the major determinants of the normal pigmentation.

Melanocytes are normally sandwiched between tightly packed basal keratinocytes. Each melanocyte is associated with about forty keratinocytes to which they transfer melanosomes (23, 24). This entity, which has been called the epidermal melanin unit, is responsible for the genetically determined constitutive skin colour. The facultative inducible skin colour depends on a complex relationship between hormones (1), paraneoplastic influences, nutritional deficiencies, intake of various drugs, light, and other environmental factors such as heat and mechanical stimuli (fig. 1, 2). In these conditions, both the number and the metabolic activity of melanocytes can be altered. In par-



FIGURE 1

Fig. 1: Spotty pigmentation corresponding to lentigenes related to photoaging.



FIGURE 2

Fig. 2: Reticulated pigmentation induced by heat (erythema ab igne). The pattern of pigmentation is different from that seen in fig. 1.

ticular, melanocyte division is of importance in amplifying the population of functional melanocytes in UV-irradiated skin (6,8).

Primary pigmentary changes during aging

Pigmentary changes are numerous during aging (13). The main group of diseases concerns the fate of melanocytes during intrinsic aging and photoaging. In sun-protected areas, the number of melanocytes decreases about 10% per decade after the third decade of life (5, 10, 22). However chronic exposure to sunlight may increase the population of melanocytes as well as their activity (6, 8). The effect of ultraviolet light seems therefore partially to offset the effects of chronologic aging of melanocytes, and this may explain why some elderly individuals have dark skin. These modifications related to photoaging are usually uneven and the clinical presentation is that of spotty hyperpigmentation (fig. 1). A conspicuous feature of these pigmented macules is that their size is limited in relation to the large range that would seem possible (fig. 3).

Most of the largest macules result from confluence of smaller spots. It may be supposed that the skin initially contains a continuous sheet of approximately identical normal

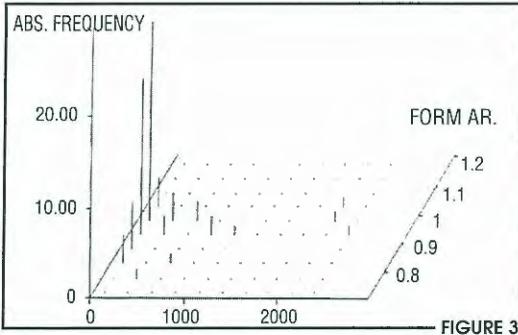


Fig. 3. Relationship between the area, the shape (Form Ar.) and the number (Abs. frequency) of pigmented macules seen in fig. 1. Form Ar. is close to 1 when the shape is rounded, and its value decreases when the outline is irregular. Most of the macules are small and rounded. Larger lesions are few and result from the confluence of smaller macules

melanocytes. Under the influence of a homogeneous ultraviolet irradiation, some groups or clones of melanocytes are stimulated while others are suppressed. Such features of photoaging recall the eruptions of ephelides in youth, the lentiginos occurring during photochemotherapy (12, 14) and genetically induced lentigo macules (26). They depend on the interaction between melanocytes and keratinocytes (17, 18), the rate of melanogenesis in melano-

cytes, the rate of transfer of melanosomes from melanocytes into keratinocytes, and the fate of melanosomes in keratinocytes (fig. 4 a, b).



FIGURE 4a



FIGURE 4b

Fig. 4a, b: Variations in the melanin distribution within keratinocytes of lentiginos.

Table I

Chromametry of the forehead

Groups			L		a		b	
Origin	N.	Photo type	Novem 88	June 89	Novem 88	June 89	Novem 88	June 89
Belgian	8	II	71,3±3,3	54,1±4,3	11,5±2,3	15,2±2,1	11,8±2,3	13,2±1,2
Belgian	16	III	69,5±2,1	59,5±3,1	9,3±0,9	12,4±0,3	16,3±0,9	17,1±1,1
Arabs	12	IV	61,5±2,3	58,3±4,1	5,6±1,1	12±3,4	17,3±1,8	16,7±2
Vietnamese	8	IV	65,1±3,1	64,5±3,2	5,4±0,8	10,2±0,5	15,4±1,1	15,8±1
S. Americ.	12	IV	63,5±2,6	60,3±2,6	6,8±1,6	11,2±1,1	14,9±1,1	15,6±0,9
Black Africans	8	VI	37,6±1,3	36,7±2,1	6,9±1,4	8,8±2	10,7±2,3	10,6±2,3

Non invasive evaluation of the skin pigmentation

It is possible to measure accurately the skin pigmentation by the technique of chromametry (Chromameter Minolta CR200). Three types of information are gained in the standard CIE Lab, including the luminance (L ranging from 0 for black to 100 for white), the spectrum of green to red (with a value "a" increasing when red predominates) and the spectrum of blue to yellow (with a value "b" increasing when yellow predominates).

We compared 6 groups of volunteers aged 31-49 having different ethnic origins and phototypes. Measurements were made on the forehead during the cloudy autumn of 1988 and during the sunny season of 1989 (table I). We found, as expected, significant changes in the parameters "L" and "a" for the different groups of volunteers. Phototypes, UV-induced redness and tanning influenced the data.

We also evaluated skin pigmentation according to age. This study was conducted in winter in families of outdoor workers with Belgian ancestry and phototype III. Measurements were made on a sun-exposed area of the forearm in 12 young adults aged 18-27 and in one of their grand-parents aged 61-79. With aging, we found a significant reduction of 20% in the "L" value and of 12% in the "a" value. A moderate increase of 5% was found for the "b" value. This could be interpreted as the result of decreased vascularity associated with increased pigmentation in the elderly individuals.

Complex pigmentary changes during aging

One of the main alterations found during intrinsic and photoaging is the loss of the orderly structural and functional association between

melanocytes and keratinocytes. This leads to various clinical presentations associating epidermal hyperpigmentation and hyperplasia of keratinocytes. These include among others pigmented seborrheic keratoses (Fig. 5), lichen



FIGURE 5

Fig. 5: Pigmented seborrheic keratoses of variable size and shape.

planus-like keratosis, melanoacanthomas and pigmented sebaceous hyperplasias (7, 9, 11, 19-21).

An abnormal pigmentation may also be found in atypical epithelial neoplasms such as solar keratosis, basal cell carcinomas, pigmented porocarcinomas (fig. 6) and breast carcinomas abutted to the epidermis (3, 4, 16). These neoplasms have to be distinguished from true atypical melanocytes neoplasms represented by lentigo maligna and lentigo maligna melanoma (fig. 7).

The last group of the melanin related

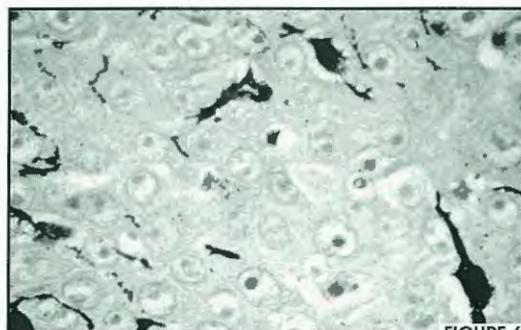


FIGURE 6

Fig. 6: Melanocytes dispersed within a pigmented porocarcinoma.



FIGURE 7

Fig. 7: *Lentigo maligna melanoma with an irregular pigmentation.*

dyschromias, include poikilodermas, Civatte and Riehl's type and inflammatory pigmentations (fig. 8). In these disorders melanin can be



FIGURE 8

Fig. 8: *Post-inflammatory pigmentation.*

found in Fact XIIIa and OKM 5 positive dendrocytes of the dermis acting as activated phagocytic cells (2, 25). These dendrocytes are more numerous in photoaged skin than in sun-protected areas. Tretinoin increases their number and size in the superficial dermis (fig. 9).

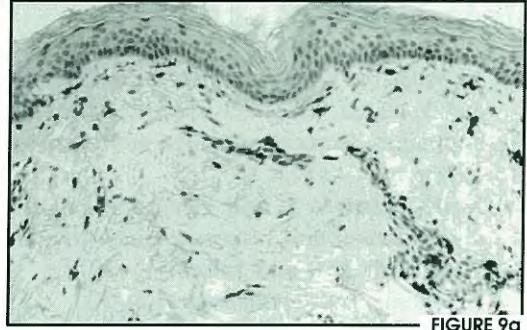


FIGURE 9a



FIGURE 9b

Fig. 9: *Fact XIIIa positive dendrocytes in the superficial dermis recruited in large numbers in aged skin treated by tretinoin. a: before, b: after 6 months of treatment.*

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