Abstract
Chronic ultraviolet (UV) light exposure of skin leads to typical effects: changes in the collagen and elastic tissue matrix is considered the characteristic histological finding in aged skin, followed by visible wrinkling and pigmentary changes. Changes in the epidermis include thinning to atrophy, hyperplasia of melanocytes, and disturbances in the texture of keratinocytes. Assessment of the degrees of photoaging by a grading system with low interobserver coefficient of variation seems to be of special interest. Different clinical methods have been proposed including descriptive grading clinical scales, visual analog scales, and photographic grading scales (J Cosmet Dermatol 3:23–5, 2004). Some of these methods like “skin surface topography grading” (Photodermatol Photoimmunol Photomed 22:39–45, 2006) were compared with histological changes like actinic elastosis. Other studies used histological scoring of dermal aging independent of a noninvasive scoring system. The following approaches were used: quantification of elastic tissue (Dermatol Surg 31:855–60, 2005), type III procollagen, type III to type I procollagen ratio, quantification of the grenz zone (a wide band of eosinophilic material just beneath the epidermis, devoid of oxytalan fibers) (Skin Pharmacol Physiol 18:81–7, 2005), activated fibroblasts with positive procollagen staining (J Cosmet Laser Ther 3:129–36), acid
mucopolysaccharides, improved quality of elastic fibers, and increased density of collagen (J Am Acad Dermatol 34:187–95), quantification of changes in the epidermis (thinning of the stratum corneum, granular layer enhancement, and epidermal thickening) (Dermatol Surg 22:455–60). One disadvantage of most of these methods is that actinic and intrinsic aging cannot be distinguished from one another.

Introduction

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Bhawan et al. [8] systematically investigated histological effects of photoaging. The following features proved to be significantly changed in photoaged skin: increase in melanocytes, increase in melanocytic atypia and epidermal melanin, reduced epidermal thickness, more compact stratum corneum, increased granular layer thickness, increased solar elastosis, dermal elastic tissue, melanophages, perivascular inflammation, and perifollicular fibrosis but no change in the number of mast cells or dermal mucin in the photoexposed skin. Of these, actinic elastosis (basophilic degeneration of the dermis) was the single most reliable factor. Basophilic degeneration is very consistent with the clinical sign of wrinkling and with dermal microvascular aging (see Chap. 2, “Histology of Microvascular Aging of Human Skin”). Thus, a single-factor scoring system of dermal aging regarding dermal basophilic degeneration (DBD) was developed. It should be mentioned that the knowledge of dermal fiber degeneration is not new and the use of a scoring system is the result of previous work [9,10].

After first experiments with a five-level system, it was found that best interobserver agreement was obtainable with a three-level model (Table 1) together with a histological atlas of the different levels (Fig. 1).

This model was tested in 120 biopsies from normal skin of 87 patients (42 females, 45 males, 27.9 ± 23.7 years [mean ± SD]) from surplus areas (i.e., Burow’s triangle) of routinely excised and histologically controlled benign nevus cell nevi of normal skin. Each specimen was characterized by a set of clinical data: age,

### Table 1  Histological scoring of dermal basophilic degeneration (DBD) [11]

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<tr>
<th>No actinic damage (Level 0): No fiber degeneration (Fig. 1a, b).</th>
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<tr>
<td>Moderate actinic damage (Level 1): Fragmentation of fibers of the upper dermis and presence of single basophilic fibers (Fig. 1c, d).</td>
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<tr>
<td>High actinic damage (Level 2): Spotted or band-like basophilic degeneration with conglomerates of basophilic masses in the upper and/or mid-dermis (Fig. 1e, f).</td>
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sex of the patient, and body location of the biopsy with regard to typically solar-exposed skin areas.

The interobserver reliability (agreement among four independent observers) of this technique was 92.2 ± 4.6 % in all biopsies. There was no disagreement of more than one level between the investigators. Correlations were found between DBD and the age of the patient (Spearman $r = 0.662, p < 0.001$) as well as DBD and body regions with typical chronic solar exposure (Spearman $r = 0.244, p = 0.005$). Sixty-eight biopsies revealed no visible DBD (37 from female, 31 from male patients; age: 19.8 ± 18.4 years), 36 biopsies showed moderate “level 1” DBD (28 females, 10 males, 39.9 ± 19 years), and 16 had a high “level 2” DBD (6 females, 10 males, 64.4 ± 11.9 years). DBD was not observable in patients younger than 15 years.

Fig. 1 Scoring of dermal basophilic degeneration (DBD). (a, b) No fiber degeneration (DBD level = 0). (c, d) Fragmentation of fibers (arrows) of the upper dermis and presence of single basophilic fibers (DBD level = 1). (e, f) Spotted (e) or band-like (f) basophilic degeneration (arrows) with conglomerates of basophilic masses in the upper and mid-dermis (DBD level = 2). Scale bar: a, c–f = 200 μm, b = 100 μm (Helmbold et al. [11]. Reprinted with permission of J Invest Dermatol)
Conclusion

The advantages of this approach are easy application, use of HE-stained routine sections, fast determination, and sure results with high interobserver agreement. Disadvantages are that this approach cannot “measure” minimal differences and that it reflects only the dermal component of photoaging. Thus, the mean application fields are the studies that need reliable classification if there is actinic degeneration (or not). On the other hand, this approach is not suitable for quantification of the effects of an antiaging product or similar studies.

Cross-references

▶ Histology of Microvascular Aging of Human Skin

References