Acta Dermatovener (Stockholm) 61: 101–106, 1981

THE ULTRASTRUCTURE OF THE DERMO–EPIDERMAL JUNCTION IN LICHEN PLANUS

Jørgen Clausen, Johan Kjærgaard and Franz Bierring

The Winslow Institute of Human Anatomy and Department of Dermatology, Odense University Hospital, Denmark

Abstract. The ultrastructure of the dermo–epidermal junctional area in biopsy material from 5 patients suffering from lichen planus has been studied during treatment with steroids. Tannic acid was used on the tissue blocks in order to provide high and diversified contrast for electron microscopy. The changes observed in the basal cells consisted mainly of degeneration of the mitochondria and disorganization of the tonofilaments. No ultrastructural changes were seen in the basal lamina, apart from occasional gaps, whose significance for pigment incontinence in old lichen planus lesions is discussed. Cellular infiltration was seen in the dermis, while the ultrastructure of the collagen fibrils of the papillary layer was normal. It is suggested that degeneration of mitochondria with subsequent disturbance of the organization and fixation of tonofilaments are events in the pathogenesis of the condition.

Key words: Lichen planus; Ultrastructure; Dermo–epidermal junction; Basal lamina; Mitochondria; Pigment incontinence

The dermo–epidermal junction in cases of lichen planus has been described in a number of ultrastructural studies in recent years (5, 6, 11). These have reported degeneration of basal epidermocytes into colloid bodies and thickening, as well as irregularity of and gaps in the basal lamina (12). Furthermore, cells have been observed penetrating these gaps from the dermis into the epidermis. In addition, duplication and multiplication of the basement lamina have been seen. Separation of the basement lamina from the basal cells has also been reported, as well as destruction of and reduction in the number of half-desmosomes (10, 13).

The object of the present study has been to reinvestigate the changes taking place in the dermo–epidermal junctional area during the healing of lichen planus lesions. In contrast to the above-mentioned studies, the present investigation has made use of low molecular weight galloyl-glucoses (14), which permit a more detailed contrast in the elements of the dermo–epidermal junction.

MATERIAL AND METHODS

Material for the studies was obtained from 5 patients suffering from lichen planus, 2 women and 3 men, whose ages ranged from 18 to 63 years. The condition had been present for some months, before the patients were referred to a dermatologist. The treatment was topical steroids in 2 cases and topical and systemic steroids in the other 3. Treatment was maintained for an average of approximately 6 months.

A total of 20 skin biopsies were taken, under local anaesthesia, injected in such a manner so that no damage was done to the subsequent biopsies. The biopsy sites were the back, the gluteal region, the ankle, the posterior aspect of the lower leg and the anterior aspect of the forearm. The initial biopsies were taken on the occasion of the patient's first visit to the Department (5 biopsies), intermediate biopsies when healing seemed to have started (4 biopsies) and the final biopsies when the lesions clinically were completely healed (5 biopsies). Biopsies taken from the contralateral, clinically normal region served as controls (6 biopsies).

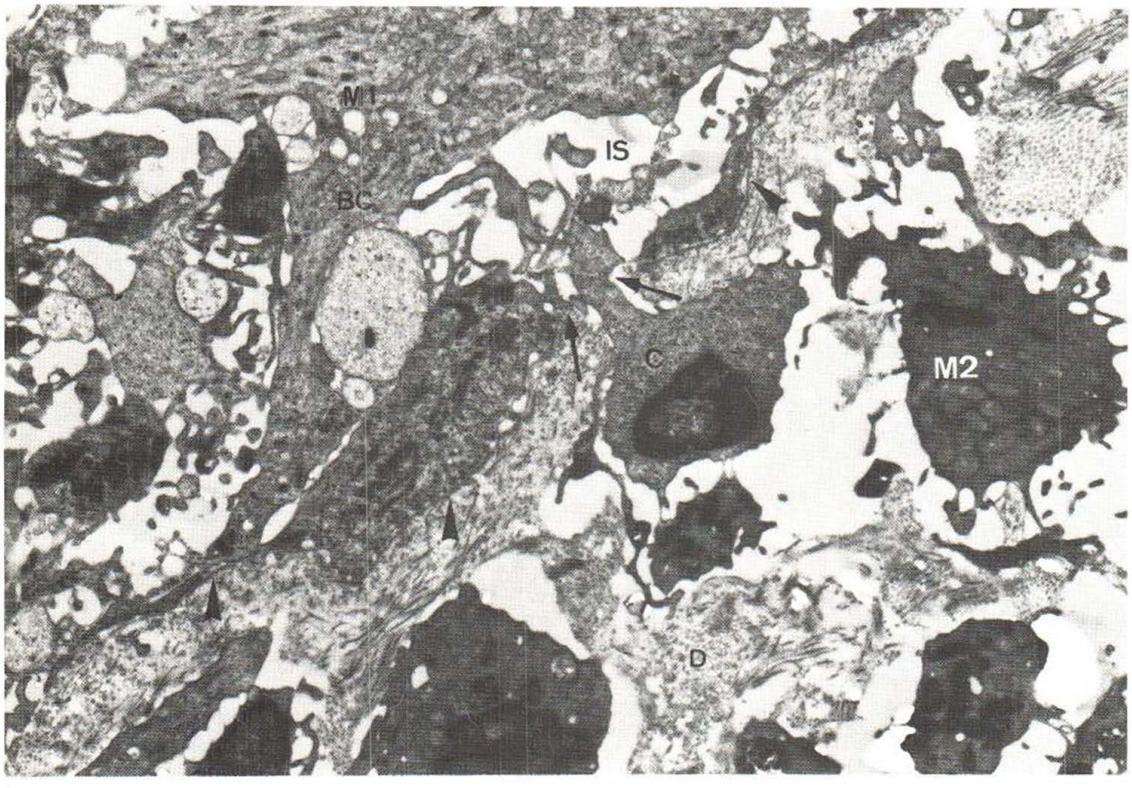
The biopsies were fixed in 2.5% glutaraldehyde in 0.1 M cacodylate buffer, pH 7.2, for one week at 4°C. They were post-fixed in 1% osmium tetroxide in the same buffer for one hour at room temperature. The tissue blocks were treated according to the method of Simionescu & Simionescu (14) with low molecular weight galloyl-glucoses (tannic acid) in order to produce high and diversified contrast, dehydrated in graded series of acetone and embedded in Araldite. Semi-thin sections were stained with basic toluidine blue. These were used for orientation. Areas showing blistering, degeneration and acantholysis—but not distinct necrosis or colloid bodies—were selected for further study by electron microscopy.

The ultra-thin sections taken from these areas were double-contrasted with zinc uranyl acetate and lead citrate and studied in a JEM 100 CX electron microscope using an accelerating voltage of 80 kV.

RESULTS

Initial biopsies

Basal layer of epidermal cells. Intercellular spaces were dilated and the typical palisade arrangement of the basal cells had been lost in a number of areas (Fig. 1). Cytoplasmic processes could be seen ex-


M1
IS
BC
C
M2
D


IS
BC
D

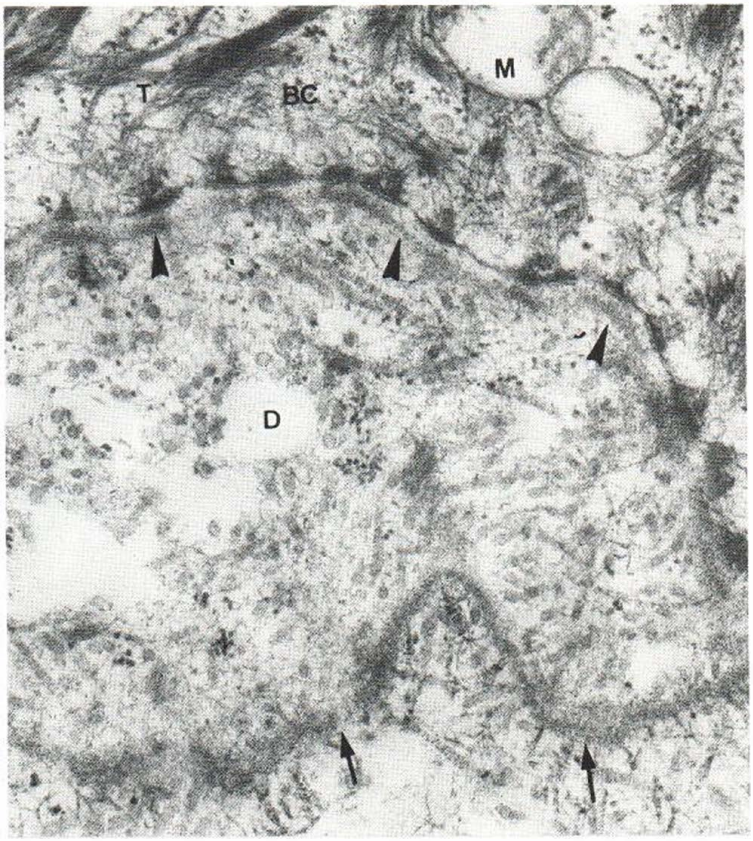


Fig. 3. Initial biopsy. Basal epidermocytes (*BC*) with swollen mitochondria (*M*) and tonofilaments (*T*). Dermis (*D*). Duplication of the basal lamina is present (arrowheads and arrows). ×40 000.

tending into the intercellular spaces. The number of desmosomes was reduced. So too was the number of tonofilaments, the remainder being arranged in bundles in concentric rings around the nucleus, rather than arising from the remaining desmosomes. In most of the cells the mitochondria were swollen and the cristae considerably reduced in number (Fig. 3). Apart from these changes, no alterations were observed in the structure of the cells; this applied to the nucleus, the Golgi apparatus, the endoplasmic reticulum and the ribosomes.

Fig. 1. Initial biopsy. Enlarged intercellular space (*IS*) between the basal epidermocytes (*BC*). In the dermis (*D*) a cellular infiltrate is seen (*C*, M_2). Cell diapedesis via a gap (arrows) in the basal lamina (arrowheads). Dilated mitochondria (M_1) in the epidermocytes as compared with those in the dermal cells (M_2). ×4 000.

Fig. 2. Early intermediate biopsy. The palisade arrangement of the basal epidermocytes (*BC*) is present. Intercellular spaces (*IS*). Tonofilaments in bundles (*T*). Basal lamina (arrowheads). Dermis (*D*). Melanin granules (arrows) in the cytoplasm of the basal cells. ×5 000.

Basal lamina. In some regions gaps were observed in the basal lamina, with macrophages and lymphocytes migrating through the gaps from the dermis to the epidermis (Fig. 1). Two layers of basal lamina were often seen, in a single region even up to five layers (Fig. 3). Despite this, the fine structure of the basal lamina was normal (Fig. 4). The anchoring fibrils from the basal lamina to the dermis were also normal. The anchoring filaments terminating in the junction plate of the half-desmosomes were intact. The structure of the attachment plaque, located on the inner leaflet of the basal cell membrane, was also normal as was the number of half-desmosomes.

Dermis. Lymphocytes and macrophages could be seen in the dermis, especially in the neighbourhood of the gaps in the basal lamina (Fig. 1). Pseudopodia of a macrophage with lysosome-like structures containing melanin were seen protruding through a gap in the basal lamina into the epidermis (Fig. 6). The collagen fibrils of the stratum papillare showed normal axial periodicity (Figs. 3, 4).

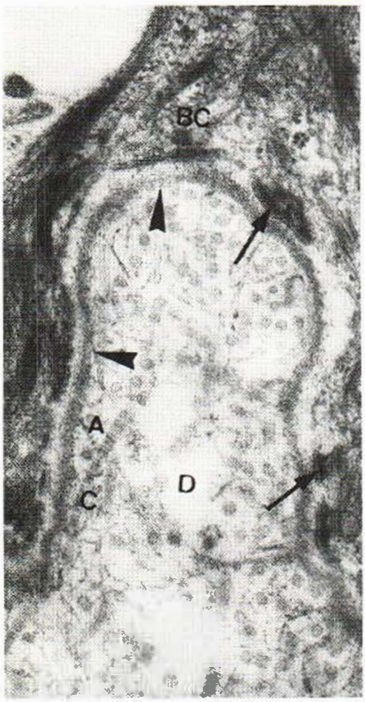


Fig. 4. Initial biopsy. Basal lamina (arrowheads). Half-desmosomes (arrows). Collagen fibrils (*C*) and anchoring fibrils (*A*) in dermis (*D*). ×40 000.

Intermediate biopsies

Basal layer of epidermal cells. The palisade arrangement was restored (Fig. 2), the intercellular spaces had decreased in width, and the number and length of the cytoplasmic processes had increased, the latter connecting neighbouring cells via the increased number of desmosomes. The tonofilaments, which had previously been situated in concentric rings around the nucleus, had increased in number and now radiated out towards the desmosomes and half-desmosomes (Fig. 5). Endocytotic vesicles could now be observed in the basal plasma membrane of the epidermocytes. The mitochondria had a normal appearance (Fig. 5), and melanin granules could be seen in the cytoplasm (Fig. 2).

Basal lamina. No gaps could be observed, whereas duplications could still be occasionally seen.

Dermis. The cellular infiltrations had disappeared from the dermis.

Final and control biopsies

No differences could be observed between the final and control biopsies, both of which appeared normal.

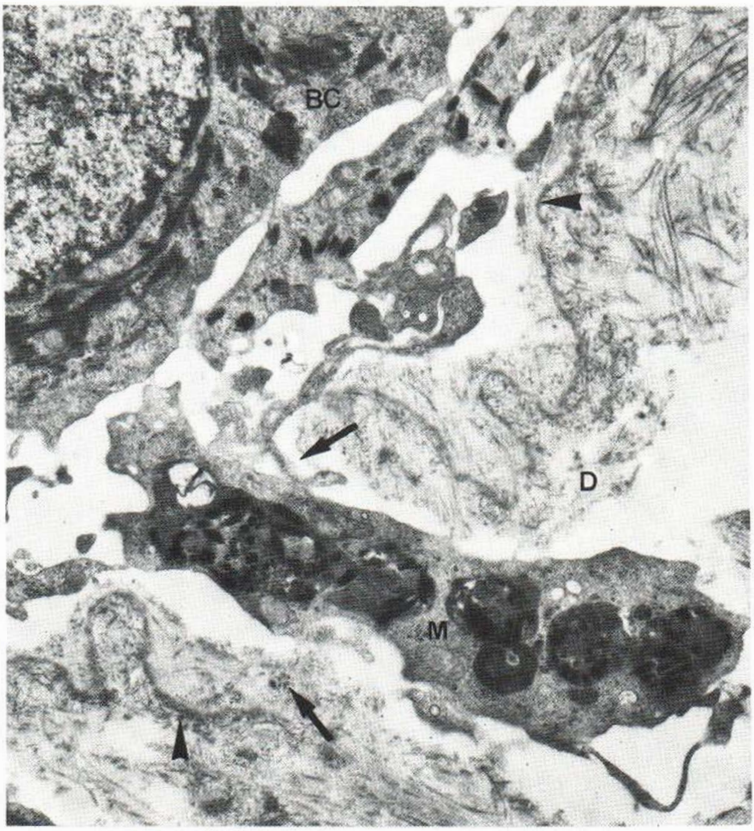


Fig. 6. Initial biopsy. A melanin-containing macrophage (*M*) is passing a gap (arrows) in the basal lamina (arrowheads). Basal epidermocyte (*BC*). Dermis (*D*). ×10 000.

DISCUSSION

The changes observed in the present investigation support the recently expressed view that the primary pathology of the conditions must be sought in the basal cells (2, 3).

Gaps were observed in the basal lamina in the present study, as reported in some previous investigations (7, 10). The reason why these gaps appear is not known, but one possible explanation may be that the enlargement of intercellular spaces between the cells of the basal layer causes tension, thus producing tearing of the basal lamina. This assumption is supported by the observation of an abnormal distribution of fibronectin (8), a compound having adhesional properties, which when incorrectly distributed produces loss of connective tissue stability.

Fig. 5. Late intermediate biopsy. Basal epidermocyte (*BC*) containing mitochondria (*M*) and tonofilaments (*T*) arranged perpendicularly to the basal plasma membrane. Basal lamina (arrowheads). Half-desmosomes (arrow). Dermis (*D*). ×40 000.

Following a lichen planus the skin often presents a rather dirty, reticular appearance, which is due to the deposition of melanin in the dermis, expressing pigment incontinence through the gaps in the basal lamina. This may be due to drop-out through gaps in the basal lamina and, according to Fig. 6, macrophages containing melanin are seen passing such a gap. It is reasonable to believe that melanocytes may escape by the same route, depositing melanin granules in the dermis.

It has been postulated that destruction of the half-desmosomes is the primary alteration in lichen planus (13). Further, that multiplicated basal lamina have no anchoring fibrils (12) and that the connective tissue of the papillary layer is completely dissolved (5, 12). However, the present study has shown no changes in the fine structures of these components, and therefore provides no support for these theories regarding the primary alterations. This might be due to the highly diversified contrast, particularly of membranes and connective tissue.

The present investigation has demonstrated a

mitochondrial swelling in the early stages of the disease, probably indicating a non-specific cellular response to injury (10). On the other hand, this may be of importance with regard to the pathogenesis of lichen planus. This observation may explain the biochemical reports of a marked depression of the respiratory enzyme activity in the lower part of the epidermis in lichen planus (3, 4, 9).

It would be reasonable on the basis of these findings to suggest the hypothesis that, due to a lack of energy, the production by the basal cells of sufficient tonofilaments with a normal orientation and fixation in desmosomes is impaired, thus giving rise to a loss of ability to maintain cell shape and adhesion between the basal cells (1).

ACKNOWLEDGEMENT

The authors are grateful to Ulla Hauschild-Ottesen for expert technical assistance.

REFERENCES

1. Anderton, B.: Intermediate filament cycles. Nature *283:* 716, 1980.
2. Black, M. M.: The pathogenesis of lichen planus. Br J Dermatol *86:* 302, 1972.
3. — What is going on in lichen planus? Clin Exp Dermatol *2:* 303, 1977.
4. Black, M. M. & Wilson Jones, E.: The role of the epidermis in the histopathogenesis of lichen planus. Arch Dermatol *105:* 81, 1972.
5. Brody, I.: The ultrastructure of the epidermis in lichen ruber planus as revealed by electron microscopy. J Ultrastruct Res *28:* 161, 1969.
6. Ebner, H. & Gebhart, W.: Die Ultrastruktur der Epidermis-Cutis-Grenze beim Lichen ruber planus. Arch Dermatol Forsch *245:* 285, 1972.
7. — Epidermal changes in lichen planus. J Cutan Pathol *3:* 167, 1976.
8. Fyrand, O.: Studies on fibronectin in the skin. Acta Dermatovener (Stockholm) *59:* 487, 1979.
9. Hammar, H.: Studies on the energy metabolism in lichen planus. Br J Dermatol *93:* 667, 1975.
10. Johnson, F. R. & Fry, L.: Ultrastructural observations on lichen planus. Arch Dermatol *95:* 596, 1967.
11. Medenica, M. & Lorincz, A.: Lichen planus: An ultrastructural study. Acta Dermatovener (Stockholm) *57:* 55, 1977.
12. Sarkany, I. & Gaylarde, P. M.: Ultrastructural and light microscopic changes of the epidermo-dermal junction. Trans St John's Hosp Dermatol Soc *57:* 139, 1971.
13. Shklar, G., Flynn, E. & Szabo, G.: Basement membrane alterations in oral lichen planus. J Invest Dermatol *70:* 45, 1978.
14. Simionescu, N. & Simionescu, M.: Galloylglucoses of low molecular weight as mordant in electron microscopy. J Cell Biol *70:* 608, 1976.

Received August 18, 1980

Johan Kjærgaard, M.D.
Gardes Alle 9
DK-2900 Hellerup
Denmark