Migratory Ichthyosiform Dermatosis With Type 2 Diabetes Mellitus and Insulin Resistance

Gil Yosipovitch, MD; Baruch Mevorah, MD; Michael David, MD; Maora Feinmesser, MD; Emmilia Hodak, MD; Boaz Gabay, MD; Jamal Ammash, MD; Peter M. Elias, MD

Background: In addition to the well-defined hereditary primary ichthyoses, many sporadic or less well-defined keratinization disorders with or without systemic manifestations have been reported. Herein we describe ichthyosiform dermatosis associated with type 2 diabetes mellitus.

Observations: The patients were members of a large Arab family with heavy consanguinity. Eighteen members were affected with a variously severe scaly disorder. They showed migratory polycyclic keratotic scaly plaques evolving into diffuse generalized scaling or complete remission. Acanthosis nigricans–like lesions were also noted, and there was an association with type 2 diabetes mellitus. A scarcity of intercornocyte lamellae and reduction in lamellar body contents were observed.

Conclusions: We could not find a report of a similar dermatosis. Furthermore, an association between ichthyosis and diabetes has not been documented. Therefore, we believe that this may constitute a new entity.

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IN ADDITION to the well-defined groups of hereditary primary ichthyoses, many sporadic or familial ichthyosiform disorders have been described. In the latter group of less well-defined ichthyoses, there may be extracutaneous manifestations. Whereas excessively dry skin of the shins with mild ichthyosiform skin changes has been associated with diabetes,1 true ichthyosis has not been reported, and, to the best of our knowledge, hereditary ichthyosiform dermatosis has not been associated with diabetes.

Herein described is a heavily consanguineous Arab family, originating in Africa, that displays a unique form of migratory ichthyosiform dermatosis as well as type 2 diabetes mellitus, probably representing a new entity.

REPORT OF CASES

CASE 1

The proband, a 44-year-old man (II-7 in Figure 1) was seen several times for evaluation of a severely itching ichthyosiform dermatosis, which had appeared in early childhood and become worse at the age of 17 years. His mother did not recall the presence of any skin lesions at birth. The patient had type 2 diabetes mellitus that had been diagnosed 10 years previously and was taking glyburide (an oral hypoglycemic). He also had mild (untreated) hypertension and a past and present history of heavy alcohol consumption.

Skin changes included generalized ichthyosis, sparing the palms, soles, and scalp. On the thighs, buttocks, and lower extremities there were migratory oval keratotic plaques coalescing to form circinate lesions of various sizes (Figure 2). In addition, the face showed a diffuse thickening with slight erythema, and marked hyperkeratosis superimposed on lichenification was seen on the anterior aspect of the ankles, on the knuckles, and on the dorsal aspects of the hands. All lesions were migratory within days.

During 3 years of follow-up we observed a cyclical course of the dermatosis; at times migratory lesions predominated, and at other times there was a generalized dermatosis consisting of small and medium-sized scales covering the whole body (Figure 3). Hair, nails, teeth, and mucous membranes were normal.

Complete blood cell count and results of blood smear were within normal limits (ie, no intracellular lipid droplets were present). Fasting blood glucose level was 13.2 mmol/L (238 mg/dL) (reference range, 3.3–5.6 mmol/L [60–100 mg/dL]); glycosylated hemoglobin concen-
tration, 0.08 (reference range, 0.04-0.06); creatine kinase level, 313 U/L (reference range, 24-203 U/L); aspartate aminotransferase level, 33 U/L (reference range, 7-40 U/L); alanine aminotransferase level, 48 U/L (reference range, 7-40 U/L); and γ-glutamyltransferase level, 118 U/L (reference range, 11-50 U/L). Radiographic studies of the thorax were normal, while abdominal ultrasound disclosed a fatty liver. There was diabetic retinopathy. Neurologic and otologic function were normal.

CASE 2

A 19-year-old, mentally retarded man (patient III-9) had suffered from an itchy ichthyosiform dermatosis from early childhood. There had been no bullae nor a collodion membrane at birth. Thereafter he had a localized migratory scaly ichthyosiform dermatosis. A year before the current examination, new lesions had appeared, involving most of the body. Physical examination showed a generalized symmetrical ichthyosiform dermatosis. Lesions started with tiny keratotic papules that slowly spread centrifugally, forming large polycyclic keratotic and scaly plaques, as in the proband (Figure 4). The large circinate plaques had a raised erythematos, crusted, and scaly border. These lesions migrated within weeks, and any area of the integument could be involved at various times. Ankles and knuckles showed marked hyperkeratosis superimposed on lichenification. Hyperkeratosis was also noted on the soles but not on the palms. Diffuse scaling covered the scalp, without hair involvement. Nails were normal. Oral examination disclosed multiple dental caries. No mucous membrane, ocular, or genital organ abnormalities were noted. Serum creatine kinase level was markedly elevated at 643 U/L, but all other biochemical measures, including results of blood chemistry studies; levels of glycosylated hemoglobin, cholesterol, triglycerides, and thyrotropin; and complete blood cell count and blood smear, were within normal limits. Fasting blood glucose level was normal, but fasting blood insulin level was significantly elevated at 534 pmol/L (reference range, 62-118 pmol/L).

CASE 3

The 49-year-old brother of the proband (patient II-9) displayed a localized and migratory pruritic scaly dermatosis.
sis, aggravated in winter, that first appeared in childhood. The patient also suffered from type 2 diabetes mellitus, well controlled with oral hypoglycemics. The physical examination showed erythematous keratotic and scaly areas on both buttocks, similar to those described above, and hyperkeratosis resembling lichenification on the hands and elbows (Figure 5). Laboratory tests showed the fasting blood glucose level to be 15.2 mmol/L (273 mg/dL), with a glycosylated hemoglobin concentration of 0.09. Complete blood cell count, results of liver function tests, and lipid profile were within the normal range.

CASE 4

The 15-year-old daughter of the proband’s cousin (patient III-26) displayed keratotic and scaly migratory lesions similar to the ones present on the proband (Figure 3).

RESULTS

Similar changes of varying severity and extent were seen in several affected members of this kindred. Those with generalized ichthyosis suffered from severe generalized pruritus unrelieved by antihistamines, while others with milder forms or during periods of spontaneous regression had only minimal itch.

Acanthosis nigricans–like lesions were present in the axillae, palms, and inguinal regions in 9 affected members and in 4 without skin lesions. In 2 of the patients there were achromia-like pigmented changes and, in 1, papules resembling seborrheic keratosis on the shins, neither of which was seen in unaffected members of the family.

The general physical examination disclosed moderate obesity in many of the family members without other anomalies. Hair, nails, teeth, mucous membranes, and genital organs (in males) were normal, and there was no hepatosplenomegaly or lymphadenopathy.

Type 2 diabetes mellitus was documented in 7 (38%) of the 18 family members with ichthyosiform dermatosis (see Figure 1). After the age of 43 years, all subjects with ichthyosis also had diagnosed diabetes. Subjects considered to have diabetes were those with diagnosed diabetes according to World Health Organization criteria and treated with oral hypoglycemic agents, insulin, or a specific diet. Most of the other patients with ichthyosis were still too young to manifest type 2 diabetes mellitus. Only 1 member of the kindred had diabetes but not ichthyosis.

Other associated findings included mental retardation in 3 of 18 individuals with ichthyosis, as opposed to only 1 of the 60 subjects without ichthyosis. One patient with ichthyosis had undergone surgery for cranioopharyngioma.

CLINICAL LABORATORY FINDINGS

Complete blood cell count, blood smears, glucose level, glycosylated hemoglobin concentration, results of liver function tests, and levels of thyrotropin, creatine kinase, cholesterol, and triglycerides were determined in 12 patients with ichthyosis. Five affected members had elevated serum creatine kinase values ranging from 227 to 654 U/L (reference range, 24-203 U/L) without suffering from any symptomatic myopathy or hypothyroidism. Analysis of isoenzymes showed that the elevations reflected increased muscle enzymes. In the proband, serial measurements of creatine kinase showed waxing and waning unrelated to drug intake or physical condition, skin disease, or diabetes control. A mild elevation in liver enzyme levels was noted in 5 patients, 1 of whom was an alcoholic. Fasting blood insulin levels were determined in 5 nondiabetic patients who had ichthyosis with acanthosis nigricans, by means of enzyme-linked immu-
nosorbent assay (Boehringer Mannheim, Penzberg, Germany). Four of the subjects had elevated fasting blood insulin levels, suggesting insulin resistance.

Several potassium hydroxide preparations and cultures (at least 2 in each member) from circinate polycyclic lesions repeatedly yielded no evidence of fungal infection.

**LIGHT MICROSCOPY**

Biopsy specimens from full-blown cases showed acanthosis, papillomatosis, hyperkeratosis, and focal parakeratosis of the epidermis, and focal hypogranulosis (hematoxylin-eosin, original magnification ×50) (Figure 6).

Ultrastructure of a hyperkeratotic plaque from the same patient showed a similar appearance, ie, decreased quantities of extracellular lamellae in the stratum corneum. In addition, granular cells in keratotic lesions showed an apparent reduction in the content of keratohyaline granules and keratin filament bundles with abnormal lamellar body contents.

**ELECTRON MICROSCOPY**

The biopsy specimen from a papular lesion on the shoulder of a patient with a full-blown case was examined by electron microscopy. The specimen showed both a scarcity of lamellar membrane structures and marked reduction in secreted lamellar body contents, as well as abnormal secreted contents (Figure 7).

Ultrastructure of a hyperkeratotic plaque from the same patient showed a similar appearance, ie, decreased quantities of extracellular lamellae in the stratum corneum. In addition, granular cells in keratotic lesions showed an apparent reduction in the content of keratohyaline granules and keratin filament bundles with abnormal lamellar body contents.

**BASELINE TRANSEPIDERMAL WATER LOSS AND STRATUM CORNEUM HYDRATION**

Measurements were performed with a combined transepidermal water loss (TEWL) and stratum corneum hydration device (Tewameter and Corneometer CM825; Courage & Khazaka, Köln, Germany) in 4 members with generalized lesions and compared with those in 4 age- and sex-matched unaffected family members, as well as with normative laboratory data from 20 normal controls of similar age (Table 1). Measurements for all family members were done in the same room after an acclimatization period of 20 minutes; measurements were taken in the ventral part of the shin, flexor part of the forearm, and the midabdomen above the umbilicus. The TEWL measurements of patients with ichthyosis did not significantly differ from those of unaffected family members and normative values, suggesting that their barrier function was competent. However, stratum corneum hydration values of subjects with ichthyosis were 2-fold lower than those of unaffected family members and controls.

<table>
<thead>
<tr>
<th>Table 1. TEWL and Stratum Corneum Hydration in Patients With Generalized Ichthyosiform Dermatosis vs Healthy Family Members and Healthy Controls in 3 Body Areas*</th>
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<tr>
<td><strong>Body Site</strong></td>
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<tr>
<td><strong>TEWL Values, g/m² per Hour</strong></td>
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<td><strong>Stratum Corneum Hydration, AU</strong></td>
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*TEWL indicates transepidermal water loss; AU, arbitrary units.
†Normative data from our laboratory from a similar age group.

Figure 6. Light microscopy of hyperkeratotic plaque demonstrating acanthosis, papillomatosis, hyperkeratosis with focal parakeratosis of the epidermis, and focal hypogranulosis (hematoxylin-eosin, original magnification ×50).

Figure 7. Electron microscopy showing ultrastructure of papular lesion. Top, Stratum corneum, postfixed with ruthenium tetroxide, shows both a scarcity of lamellar membrane structure (solid arrows; white arrow shows normal-appearing lamellae) and multiple areas of phase separation (asterisks) (original magnification ×110 000). Bottom, Stratum granulosum (SG) shows marked reduction in secreted lamellar body contents at the SG–stratum corneum (SC) interface (arrows). Keratohyaline and fibrillar contents of SG cytosol are reduced, and most lamellar bodies display abnormal contents (inset, arrowheads) (osmium tetroxide, original magnification ×30 000; inset, original magnification ×85 000).
lower in comparison with unaffected members and historical controls on all body sites, suggesting that skin hydration is very low in this disease.

**RESPONSE TO TREATMENT AND CLINICAL COURSE**

Topical emollients containing urea and/or lactic acid were applied, with no beneficial effect. Systemic retinoids were not prescribed because of abnormal liver function tests in the proband; moreover, patients refused to take other systemic medications and declined further medical follow-up.

**COMMENT**

The ichthyosiform dermatosis in this family presents the following salient features: (1) onset in early childhood with aggravation in adolescence; (2) more or less pronounced itching; (3) migratory skin lesions, beginning as erythematokeratotic papules that evolve peripherally to form small plaques with a grayish brown scale or crust at the margin and fine scales in the center; the small plaques tend to coalesce, forming large polycyclic lesions; (4) a clearly cyclical course with polycyclic lesions evolving into diffuse generalized scaling or complete remission, only to reappear later (5) acanthosis nigricans–like lesions in flexures; (6) high rate of association with type 2 diabetes mellitus and insulin resistance; (7) high degree of consanguinity; (8) elevated creatine kinase levels with no muscle symptoms; (9) light microscopic findings of lesions characterized by marked hyperkeratosis with focal parakeratosis, presence of granular layer, acanthosis, and papillomatosis; and (10) ultrastructural findings of a scarcity of intercorneocyte lamellae and a reduction in lamellar body contents.

Analysis of the pedigree shows 2 possible modes of inheritance: an autosomal dominant mode with incomplete penetrance as well as an autosomal recessive mode with incomplete penetrance. When there is a fourth generation, it may be possible to be more precise about the mode of inheritance.

We have not encountered any keratinization disorder similar to that present in our kindred, nor any association between ichthyosis and type 2 diabetes mellitus. Table 2 summarizes dermatoses that should be considered in the differential diagnosis of our cases. Our patients’ disorder differed from erythrokeratodermia vari-
1.2- to 1.4-fold increase in TEWL level in a cohort of pa-

From et al with an annular epidermolytic ichthyosis, but histologically and ultrastructurally none of our cases had epidermolytic hyperkeratosis. Another congeni-
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eliciting studies of this dermatosis should measure the barrier kinetics, which may be a more accu-
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Reprints: Gil Yosipovitch, MD, National Skin Center,
1 Mandalay Rd, Singapore 308205 (e-mail: gilyos
@sinenet.com.sg).

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