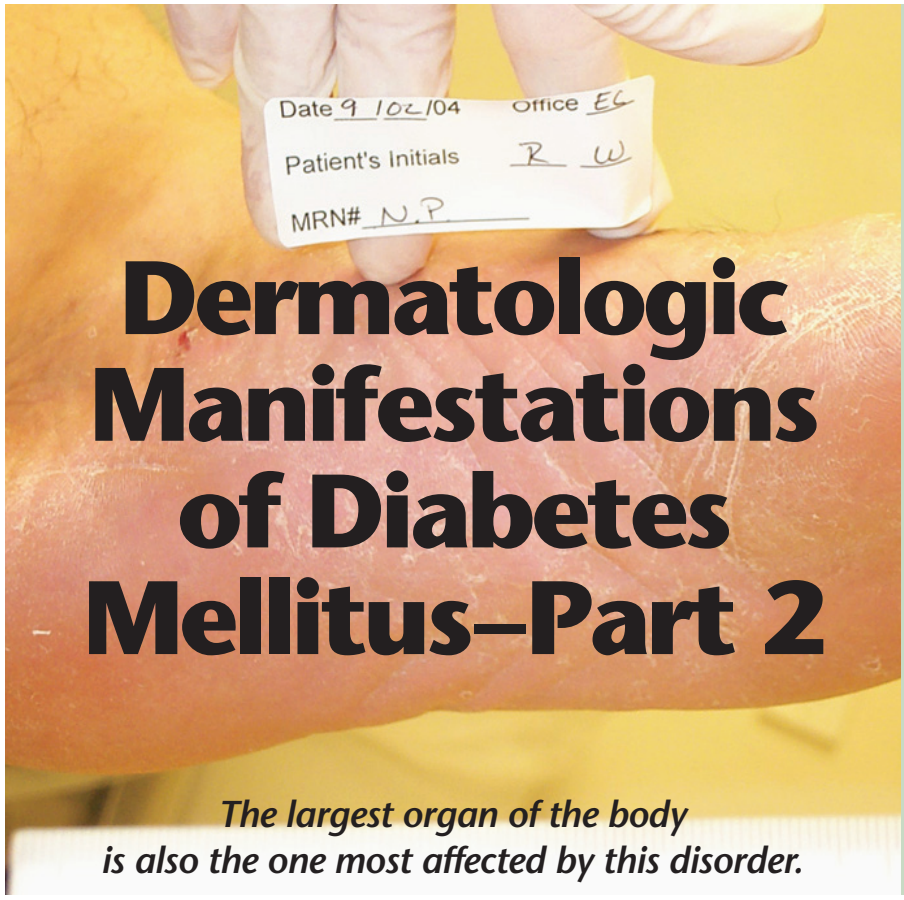

Dermatologic Manifestations of Diabetes Mellitus–Part 2

The largest organ of the body is also the one most affected by this disorder.

Goals and Objectives

1) To clarify the clinical dermatologic manifestations of diabetes mellitus.

2) To understand the vascular changes that affect the skin in diabetes mellitus.

3) To appreciate the role of microangiopathy vs. macroangiopathy on the skin of persons with diabetes mellitus

4) To explain the relationship of dermatologic entities in diabetes and abnormal foot biomechanics.

5) To identify the neuropathic changes that affect the skin in the diabetic patient.

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*Following this article, an answer sheet and full set of instructions are provided (p. 142).—**Editor***

By Kenneth B. Rehm, DPM

Editor's Note: This is the second part of a CME. The first part appeared in the November/December issue of PM.

Skin Thickening

In general, the presence of diabetes mellitus is associated with thickened skin, demonstrated by pulsed ultrasound measurement of skin in the extremities; and in particular, the forearm and the dorsum of the hands and fingers, with pebbling at the tops of the interphalangeal joint and metacarpal phalangeal joint areas, and the dorsum of the feet. It is inconclusive as to whether the skin is thickened in other areas of the body or if it is, in fact, a universal finding with diabetes. Contrary to what occurs in non-dia-

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Diabetes Mellitus...

betics, skin thickness may increase with age and the length of time the diabetes exists.

At least 30 percent of diabetic patients have demonstrable involvement of the dorsum of the hands and/or feet. Often, these changes are clinically unapparent and go unnoticed by patients and physicians. There are, however, clinical signs that suggest a thickening of the skin. These include difficulty in tenting the skin, pebbled or rough skin on top of the interphalangeal joints or in the periungual region, and decreased wrinkling of the skin following immersion in water. (Figure 1)

Although the finding of thick skin (also called digital sclerosis) may seem clinically insignificant, when the skin is very thick, the literature suggests that this is a marker for retinal microvascular disease.

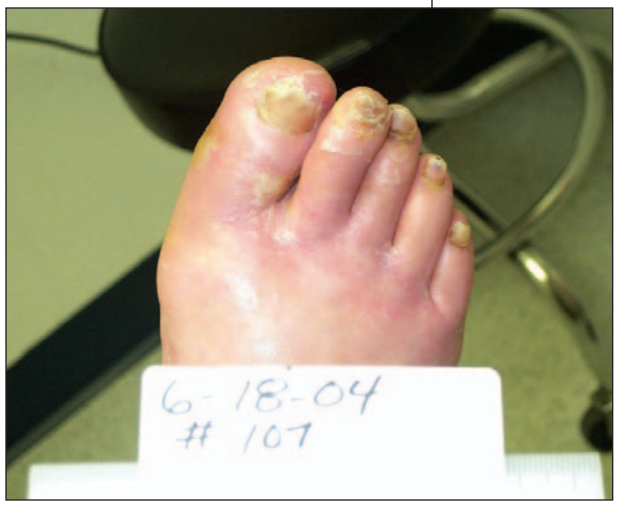

Figure 1: Diabetic thick skin on dorsum of foot

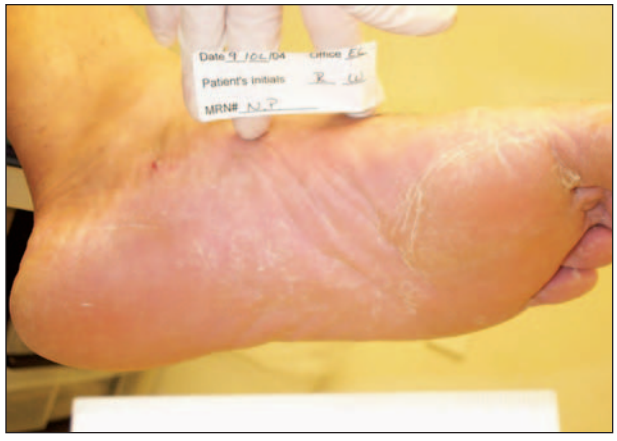

Figure 2 Diabetic yellow skin

Diabetic Scleredema (Scleredema Adultorum of Diabetes)

Diabetic scleredema (DS) is characterized by a marked increase in dermal thickness on the upper neck or posterior back. It is found mostly in overweight, middle aged, poorly controlled type II diabetics, its prevalence being around 2.5 percent of all patients with Type II diabetes. There is no known correlation, as confirmed by ultrasound measurements, between hand and foot skin thickness or digital sclerosis and DS. Histologically, in DS there is a thickened dermis with large collagen bundles that are separated by wide, clear spaces. Increased numbers of mast cells and/or an abnormal amount of glycosaminoglycans (GAG's) in the dermis may be present in affected individuals.

Contrary to what occurs in non-diabetics, skin thickness may increase with age and the length of time the diabetes exists.

One study suggests that tight control of blood sugar helps reduce the severity of these thick skin syndromes.

Yellow Discoloration of Skin And Nails

A yellow discoloration of the skin is a common finding in patients with diabetes mellitus. This is traditionally thought to be carotenemia, but recent evaluations indicate that there is no elevation in serum carotene levels. The yellow skin is most noticeable on the palms and soles of the feet. This probably relates to the sparse competition with melanocytic pigment in these areas.

The accumulation of non-enzymatic glycosylation end products, some of which have a distinctly yellow hue, is a likely cause of the yellow skin. Diabetics are particularly subject to this process, but in general, when proteins that have a long turnover time (e.g., dermal collagen), undergo glycosylation and these end products become abundant, the skin becomes yellow. (Figure 2)

Most diabetic patients have some degree of yellowing of the nails on the hands and/or feet. The degree of discoloration can vary. Minimal involvement could consist of the distal yellowing or a yellow-brown discoloration of the nail plate, most commonly that of the great toe. Marked involvement could entail canary yellow discoloration of all the nails on the hands and feet. Similar to the yellow color observed in diabetic skin, yellowing of the nails probably represents glycosylation end products or could be related to impaired microcirculation to the nail bed and matrix.

Yellowing of the nails is not specific to diabetes, as it could occur as part of normal aging, onychomycosis, or secondary to lymphedema praecox. (Figure 3)

Diabetic Bullosis

The spontaneous onset of multiple bullae on the extremities, usually on the tips and dorsal aspect of the fingers and toes, or less commonly on the dorsal or lateral surface of the feet, legs, hands or forearms, is characteristic of diabetic bullosis. These lesions are not the result of trauma or infection.

On the basis of cleavage level, three different types of diabetic bullae may occur. The most common type occurs spontaneously without any antecedent report of trauma to the area. They present with an erythematous periphery and are not

Continued on page 133

Diabetes Mellitus...

hemorrhagic, but contain clear, sterile fluid. They usually heal spontaneously within a few weeks without any scarring or atrophy. Patients with this condition are usually between the ages of 40 and 75 with long-standing diabetes mellitus. These patients were reported to have good circulation to the affected area as well as diabetic neuropathy. There may be recurrence of the blisters for a number of years. (Figure 4)

The second type of diabetic bullae differs from the first type in that the bullae heal with scarring and slight atrophy. These blisters can be hemorrhagic and an inflammatory base is present. The reported cleavage plane is below the dermo-epidermal junction. (Figure 5)

The third type of diabetic bullae consists of multiple tender non-scarring blisters on sun-exposed and deeply tanned areas of the skin. Immunoflorescence and porphyrin studies were negative. The cleavage plane, as documented through electron microscopy, is at the lamina lucida. (Figure 6)

In all cases, protection of the blisters is recommended. Tense bullae should be aspirated and if not secondarily infected, the roof of the blister should be left intact to act as a natural dressing that supports healing.

Necrobiosis Lipoidica Diabeticorum (NLD)

NLD is a dermatologic condition commonly associated with diabetes mellitus. Its etiology is unknown and occurs almost exclusively in whites.

80% of those that have NLD are female, most commonly between the second and fifth decade of life; but occurrence at any age is possible.

NLD is not pathognomonic for diabetes mellitus, as more than one-third of those that who have this entity do not have diabetes.

This condition may appear years before clinical onset of diabetes mellitus. Certainly any patient who presents with NLD should be evaluated for diabetes.

Between 60 and 65% of people with this disease have diabetes mellitus at the time of the diagnosis. About 25% of those with NLD have some type of glucose tolerance test abnormality or a family history of diabetes. Only 10% of those with this condition have no known connection with diabetes mellitus. NLD has been seen in Ehler's-Danlos Syndrome, type VIII as well as Ataxia-Telangiectasia.

Most diabetic patients have some degree of yellowing of the nails on the hands and/or feet.

It is interesting to note that most patients with diabetes mellitus do not develop NLD, the incidence being .3%.

The anterior shin, pretibial, medial malleolar and dorsal aspect of the feet are the most common locations that NLD involves. Lesions occasionally occur on the thighs and the popliteal regions. Other sites are involved in addition to the lower extremities about 15% of the time. These sites may include the abdomen, upper extremities (especially the hands and forearms), the face, including the eyelids and nose, and the scalp, where NLD may cause alopecia and atrophy of the skin. NLD has also been noted on the heels, the penis, in scars and at sites of scleroderma and BCG vaccinations. It is well to note that even when other parts of the body are involved, the lower extremities are also involved. The patient is less likely to have diabetes mellitus when NLD occurs in areas other than the lower extremities.

The initial lesions are well circumscribed, small, firm, oval, volacious, dusky red to red, erythematous plaques with a fine scale. There is an advancing red border that is slightly elevated with adjoining skin that is reddish-blue. The central area is a yellow brown color indicating lipid accumulation. This central area may have a waxy feel and undergo atrophic changes with increasing telangiectasias. As these lesions undergo slow enlargement or coalescence, they form indurated plaques that are round or oblong when small and develop an irregular geographic configuration when larger. The size of the lesion may vary from a few millimeters to sev-

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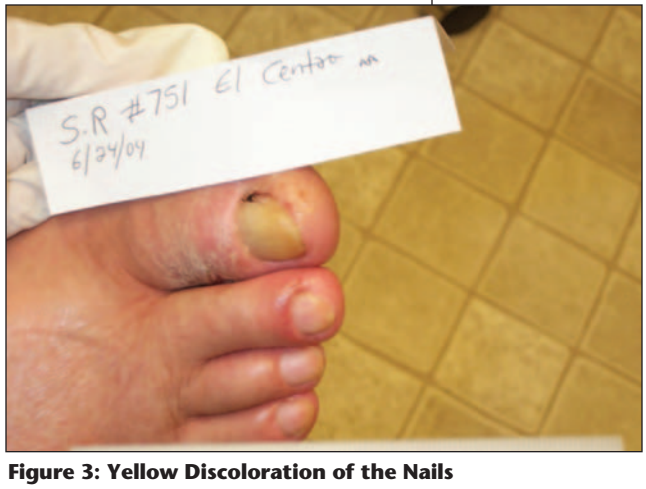

Figure 3: Yellow Discoloration of the Nails

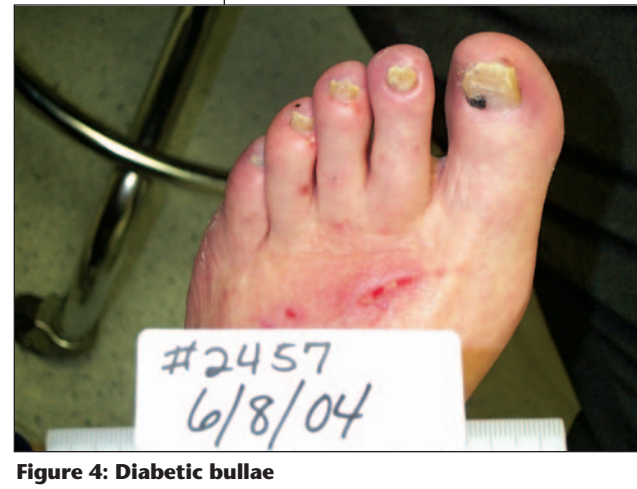

Figure 4: Diabetic bullae

eral centimeters. Ulcerations occur in approximately 1/3 of the NLD patients, whether they are diabetic or not, and start at the central zone, especially after trauma. They are more common in larger and lower extremity lesions. (Figure 7)

Once the inflammatory process subsides, it assumes its chronic, most commonly recognized state: the sharply demarcated sclerotic plaque that is reminiscent of glazed porcelain. The glossy atrophic area softens and becomes entirely brown, through which multiple telangiectasias and underlying blood vessels can be seen. As lesions mature, they may become thicker and more violaceous appearing. The scale may remain fine or become more prominent and collodin-like, particularly if ulceration is imminent. (Figure 8)

The papules and plaques are generally asymptomatic unless they become ulcerated, at which time these lesions frequently become painful. Some patients report pruritis, burning, tenderness, or even partial or complete anesthesia of the affected sites, suggesting local nerve dysfunction. (Figure 9)

Histologically, the lesions start out as a neutrophilic necrotizing vasculitis. The progression of the disease involves collagen degeneration and the destruction of adnexal structures. Lesions evolve with granulomatous and sclerotic changes. Most of the sclerosis occurs in the lower reticular dermis. The upper dermis contains the fatty deposits that give the lesions their yellow appearance. Electron microscopy shows marked changes in the dermal blood vessels as well. These changes consist of focal degeneration of the endothelial cells lining the microvascular. These endothelial cells lose their intracellular organelles and develop electron lucency.

As many as one in five lesions will resolve spontaneously—the time required varies from three to four years for resolution or improvement. This process is independent of glycemic control. As the NLD process improves the lesions are localized to the lower part of the legs. This is important to realize and stress in the treatment protocol.

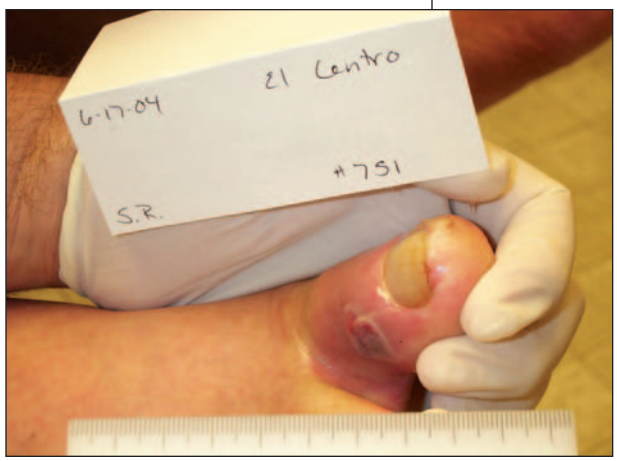

Figure 5: Diabetic bullosis

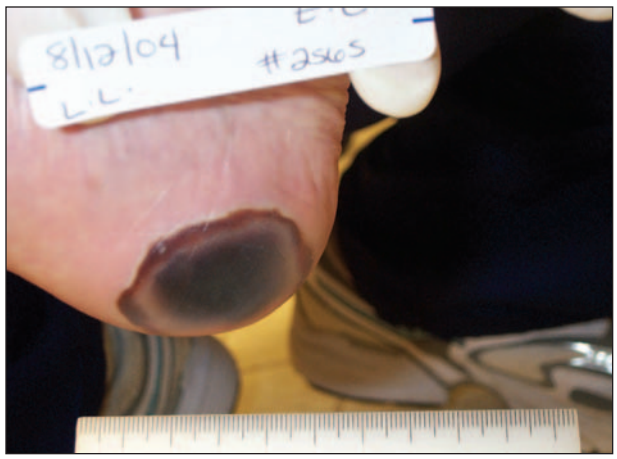

Figure 6: Diabetic bullae at the heel

There is no specific treatment but management should be geared to arresting the progression of the disease and to provide symptomatic relief. Treatment goals should include minimizing infection, recognizing malignant degeneration, allowing spontaneous resolution and well as medical and nutritional stabilization and strict control of the diabetes. The areas affected should be protected from any type of trauma or skin tear, shear or friction.

NLD is not pathognomonic for diabetes mellitus, as more than one-third of those that who have this entity do not have diabetes.

The use of topical steroids and the injection of intralesional steroids into the active margin have been used, but are as yet an unproven remedy. They are used to decrease the inflammation but with topical steroids, the atrophic dermal changes can increase; and with intra-lesional steroids, the diabetic control may be compromised.

Currently, the most impressive therapeutic option may be oral corticosteroids. It is reported that five weeks of oral corticosteroid treatment in six patients resulted in complete cessation of the condition.

It is difficult to design a rational and effective therapy for this problem as the pathophysiology of NLD is not well understood.

Granuloma Annulare

Granuloma annulare is a benign, usually self-limiting, and generally asymptomatic dermatosis. There are several forms of this condition that are all histologically identical and the cause is unknown. Most patients with the classic, more common localized form, however, do not demonstrate any clinical or laboratory evidence of diabetes. This condition is characterized by a distinctive skin eruption consisting of a ring of firm, well-defined, small, pink to red, annular or arciform lesions with papular borders and flat centers. This eruption that occurs most often in children and young adults has a predilection for the back of

Continued on page 135

the hands and fingers, as well as over the lateral and dorsal aspects of the feet, ankles, and legs. The lesions may be singular or become arranged in large annular or serpiginous patterns. These annular lesions may range from 0.5 to 5.0 cm. in diameter and may last for many years or may slowly undergo spontaneous involution without scarring.

Less common varieties include disseminated generalized, multiple, perforating, and subcutaneous forms. The generalized disseminated form of granuloma annulare is found in as many as 33 % of patients with diabetes mellitus. This form consists of multiple classic lesions or numerous, disseminated, flesh-colored papules that are symmetrically distributed on the arms, neck, and upper half of the trunk and less often on the legs. Lesions, however, may be present over the entire body. Disseminated granuloma annulare occurs in adults, and the papules may be accentuated in sun-exposed areas.

Eruptive Xanthomas

These lesions are characterized by a sudden onset of firm, non-tender, yellow papules or nodules that have pink or red areolae or an erythematous halo that surround each individual lesion. They tend to appear in crops. They are common on the knees, elbows, back buttocks, trunk and heels. Eruptive xanthomas are associated with Type I hyperlipidemia, hyperglycemia, and glycosuria. They may appear when serum triglycerides rise to high levels. The majority of those who have this condition are people whose diabetes is in poor control.

Acquired Perforating Dermatoses

Other acquired cutaneous disorders that are thought to have an association with abnormal glucose metabolism include those that have the common histologic denominator of trans-epidermal elimination of degenerative material, chiefly collagen and elastic fibers. These are termed "acquired perforating dermatoses". Although these dermatoses have been reported independent of associated internal problems, many are in patients with chronic renal failure who are also diabetic. They are characterized by multiple umbilicated keratotic papules that have a tendency to form in a linear configuration and favor the extensor surface of the trunk and extremities. They are often very itchy and usually don't undergo spontaneous resolution. Improvement has been noted with topical use of retinoic acid and protection from scratching, combined with diabetic control and ultraviolet therapy.

Granuloma annulare is a benign, usually self-limiting, and generally asymptomatic dermatosis.

Other dermatoses that are reported to be occur more frequently in diabetics include lichen planus, vitiligo, Kaposi's sarcoma, glucagonoma, and Werner's syndrome.

Vascular Changes That Affect the Skin

The vascular changes that take place in the person with diabetes are due to both large vessel disease (atherosclerosis or macroangiopathy) and small vessel disease (microangiopathy). The effects that large vessel disease has on the lower extremity includes alterations in the temperature, texture, turgor, color, elasticity, pigmentation and hair growth, with the skin becoming thin, shiny, dry, atrophic, stiff, cool, and progressively diminishing hair growth. There may be dependent rubor, cyanosis, clubbing of the toenails and elevation pallor. The toenails are thickened and dystrophic.

Microangiopathy plays a prominent role in the skin changes of the diabetic patient. The histology of effected diabetic tissue reveals a PAS positive, thickened capillary basement membrane. These structural changes which occur in the microcirculation do not account for all of the manifestations of small vessel disease. It is interesting to note that some patients with apparent small vessel disease, like gangrene of the

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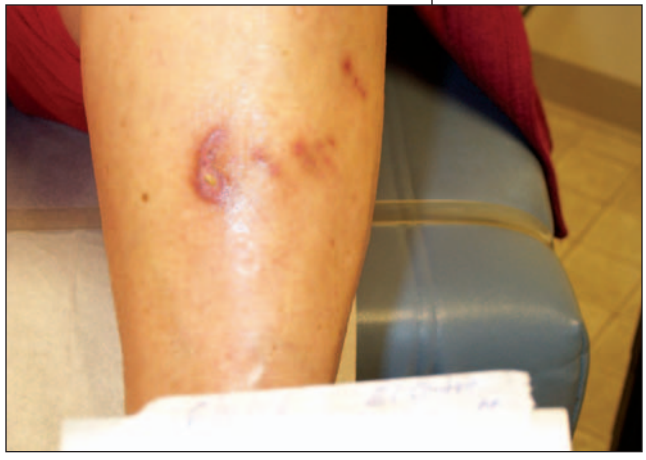

Figure 7: Necrobiosis lipoidica diabeticorum on the shin

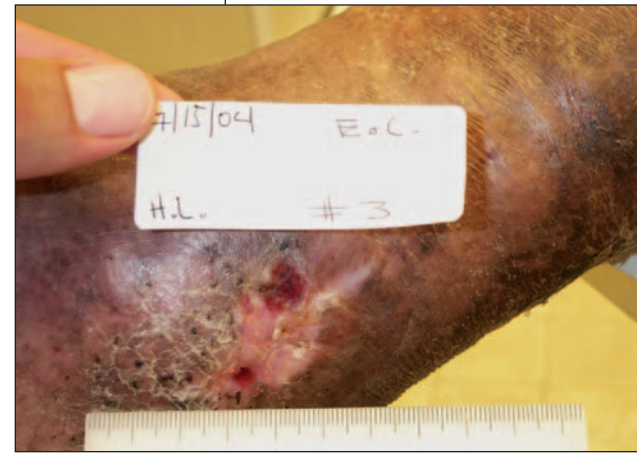

Figure 8: Necrobiosis lipoidica diabeticorum

toes, have shown normal capillaries with skin and skeletal muscle biopsy. (Figure 10)

The concept of functional microangiopathy (FM), or sluggish microcirculation, therefore has to be entertained. This sluggish microcirculation results in micro-venular dilatation and is considered to be functional because it can be reversed with improved control of the diabetes. Red face and periungual telangiectasia are two conditions that tend to improve with better control of the diabetes and might represent examples of functional microangiopathy.

FM could be a result of nonenzymatic glycosylation which affects many components of the blood, such as hemoglobin, the red blood cell membrane, fibronectin, fibrinogen, and platelets. Glycosylation of the red blood cell inhibits the cell pliability and therefore decreases the ability of this cell to pass through pores smaller than 7 microns. The lumen of some capillaries could be as narrow as 3 microns and red blood cells need to elongate into a sausage-like configuration to pass through. In addition, the stiffened membrane associated with the glycosylation process adds an additional challenge to blood flow within the capillary.

In diabetics, there is an increased plasma concentration of fibrinogen and capillary leakage of albumen and water. There is also an increased tendency for platelets to aggregate. The end result is increased viscosity of the blood and sluggish microcirculation.

In small vessel disease, the renal vasculature is affected and is responsible for the kidney failure seen in diabetic patients. Failure of the kidney to thrive is associated with an accumulation of glycoxidation and lipoxidation products in skin collagen. Collagen glycoxidation products appear to quench the activity of nitric oxide, potentially causing impairment of endothelium-mediated vasodilation, abnormalities in vascular tone, flow dynamics, perfusion and blood pressure, all of which contributes to the health status of the skin. Glycoxidation and Lipoxidation products both alter the products of collagen produced and might be associated with a decrease in the ability of the skin to heal. More advanced microangiopathy is associated with hemorrhages, exudates and some devascularized areas on the skin.

Skin Manifestations of Microangiopathy

Diabetic Dermopathy

Diabetic dermopathy is the development of atrophic hyperpigmented maculo-papular eruptions on the shin, sometimes termed "shin spots." This entity is considered one of the most common skin problems associated with diabetes mellitus. The lesions are asymptomatic, well-circumscribed, shallow, irregularly shaped, round to oval, flat-topped, red, scaly papules that may become eroded or ulcerated in the central areas. They vary in number from few to many. They are usually bilateral but not symmetrically distributed. They may clear

The vascular changes that take place in the person with diabetes are due to both large vessel disease (atherosclerosis or macroangiopathy) and small vessel disease (microangiopathy).

with time, leaving areas of epidermal atrophy or post-inflammatory hyper-pigmentation. Sometimes these lesions resemble a superficial dermatophyte infection. (Figure 11)

These lesions are often overlooked, either because they are asymptomatic or because many patients attribute these lesions to antecedent local trauma to the area. Sometimes the patients present with a mild pyoderma, such as a folliculitis which could have initiated the dermopathy. In fact, diabetic dermopathy probably represents post-traumatic atrophy of the skin along with the post-inflammatory hyperpigmentation in poorly vascularized skin. Based on histologic studies this also appears to be a cutaneous manifestation of structural and functional microangiopathy. (Figure 12)

When a diabetic has four or more lesions, as is the case in 14% of the diabetic patients studied, there is a high correlation with

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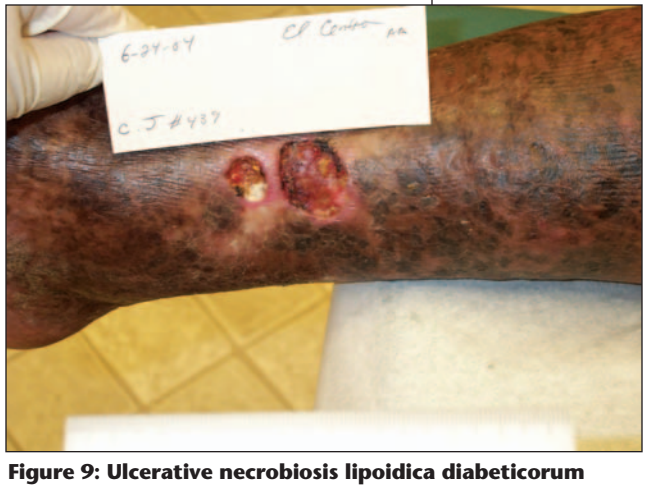

Figure 9: Ulcerative necrobiosis lipoidica diabeticorum

Figure 10: Gangrene of the great toe

Diabetes Mellitus...

retinovascular disease. This condition may precede diabetes by many years and should alert the physician to the possibility of early diabetes.

Pigmented Purpura

Pigmented purpuric dermatosis is characterized by a salt and pepper distribution of multiple tan to reddish small macules, also known as "cayenne-pepper" spots, which coalesce into orange, brown to yellow-tan larger patches of hyperpigmentation. These discolorations occur in the absence of atrophy and are a common finding in elderly diabetics, although patients need not be diabetic to demonstrate these findings.

This condition results from the deposition of red blood cells into the skin that have extravasated from the superficial vascular plexus. These petechiae commonly occur on the lower legs and often extend down to the ankles and dorsum of the feet. It is estimated that about one-half of persons with this condition also have diabetic dermopathy. Except for the frequent association with diabetic dermopathy, this condition appears to be clinically consistent with progressive pigmented purpuric dematosis of Schamberg. There is not a clear understanding of the pathophysiology of this condition, but it does appear to be a marker for structural microangiopathy and in most of these patients, cardiac decompensation with edema of the lower extremities was determined to be a precipitating factor. (Figure 13)

Rubeosis Facei and Red Skin

The engorgement of the superficial venous plexus due to functional microangiopathy causes a variable intensity of red coloration in one's complexion. The prototypical involvement is facial and is called rubeosis facei. This functional microangiopathy is set into motion by hyperglycemia predisposing a person to a sluggish circulation. This becomes clinically evident by the presence of venous dilatation which can be demonstrated in the skin and also in the eye grounds. The vascular engorgement may resolve if the blood sugar returns to normal. This condition may be evident in newly diagnosed diabetics. In a recent study of patients admitted to the hospital with a diagnosis of diabetes mellitus, 59% had markedly red faces.

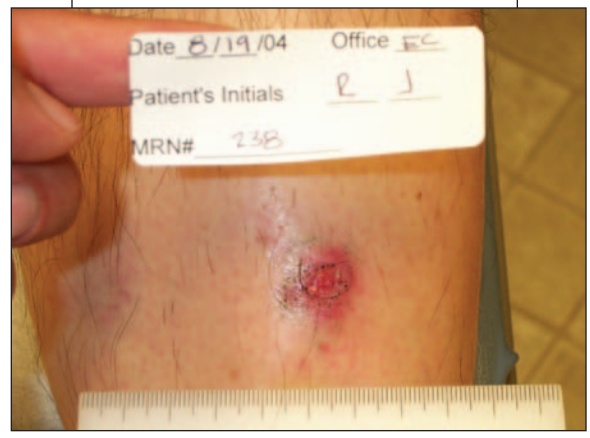

Figure 11: Typical diabetic dermopathy

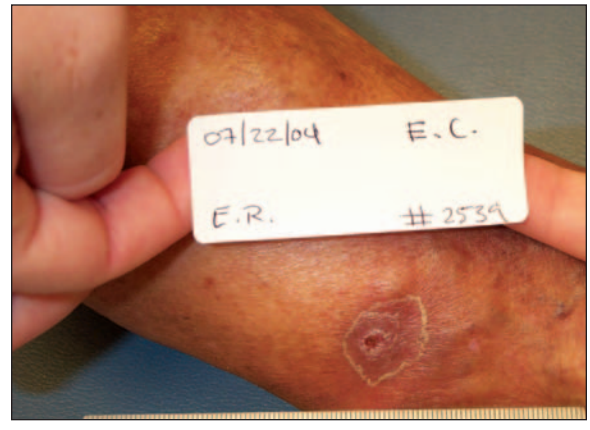

Figure 12: Diabetic dermopathy

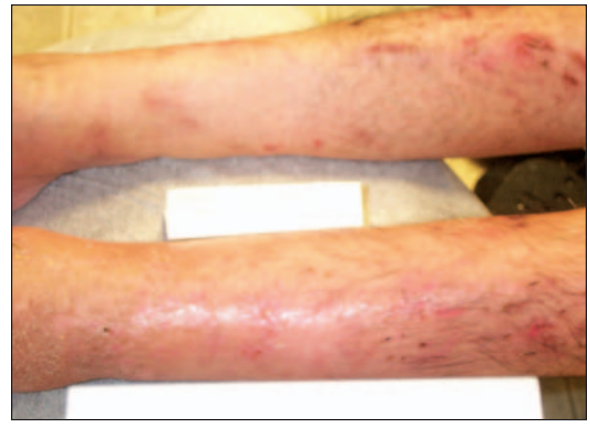

Figure 13: Diabetic dermopathy and pigmented purpura

Periungual Telangiectasia

Nail fold capillary loops are in a horizontal axis relative to the skin surface and lie directly beneath the superficial layer of skin. This arrangement offers an excellent opportunity to view the entire microvascular loop. One study found that 49% of diabetic patients were found to have venous capillary dilatation in this area, as compared with 10% of non-diabetics. Periungual vessel changes may also be associated with various connective tissue disorders, but in connective tissue disease, the patterns of these changes involve irregularly enlarged loops and/or mega-capillaries. In diabetes, one sees homogeneous engorgement of the venular limbs of the capillaries. This venous dilatation appears to be an excellent indicator of functional microangiopathy. Structural microangiopathy may be present as well, but shows up as venous tortuosity.

Practically speaking, it is important to note that a newly diagnosed diabetic is likely to have simple capillary loops, but with a dilated venous portion. A long-term diabetic who has had prolonged poor control of his/her blood sugar, but now has excellent control, may demonstrate venous tortuosity without a dilated venous portion. Small hemorrhages and areas of microcirculatory obliteration are indications of more extensive microangiopathy.

Erysipelas-Like Erythema

A condition of microangiopathy localized to an area of macrocirculatory compromise may become evident by the development of well demarcated erythema on the lower leg, ankle or dorsum of the foot. This correlates with underlying bone destruction and early gangrene. The erythema of erysipelas must be ruled out. Without Erysipelas, there is no associated pyrexia, leucocytosis or elevated ery-

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throcyte sedimentation rate, unless there is an underlying osteomyelitis. (Figure 14)

Limited Joint Mobility and Waxy Skin Syndrome (LJMAWSS)

Originally described in 1974 in insulin-dependent adolescent diabetics, this is considered a relatively new syndrome that can also affect adult non-insulin-dependent diabetic patients. Both components of this syndrome have been described in non-diabetic controls; however, this condition is related to and much commoner in diabetics. It appears to be the earliest clinically detectable complication of childhood and adolescent diabetics.

The incidence of this syndrome is estimated to be as high as 50% of all diabetics. It is not a painful condition and aside from the functional limitations of mobility, primarily of the small joints of the hands and thickening and stiffness of the skin that occurs mostly on the dorsum of the fingers, is basically asymptomatic. This probably explains why, even though it is evidently so common, the condition has only recently been officially delineated.

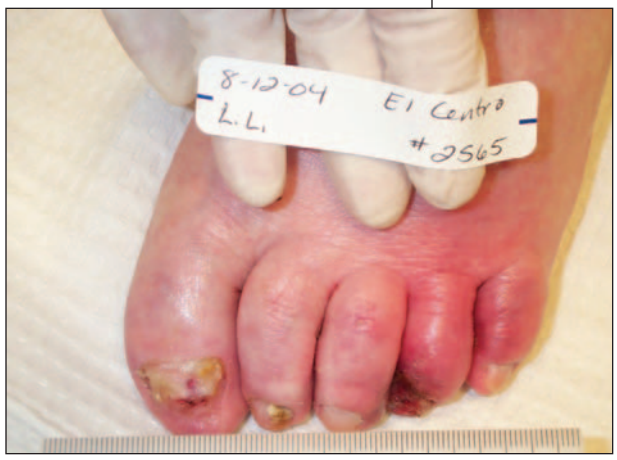

Figure 14: Microangiopathic erythema

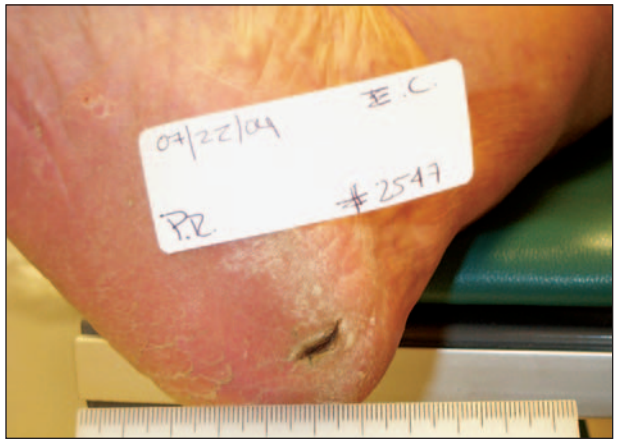

Figure 15: Dry skin associated with autonomic neuropathy

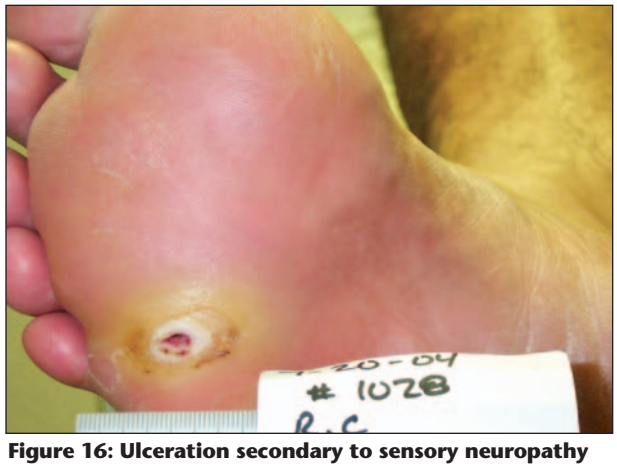

Figure 16: Ulceration secondary to sensory neuropathy

Recently, this syndrome with limited joint mobility has become acknowledged as an important contributor to the abnormal biomechanics seen in the diabetic foot. In the majority of patients that also have diabetic neuropathy, the abnormal pressures developed during gait, lead to ulceration. Patients who have limited joint mobility without neuropathy also demonstrate abnormal foot pressures but usually fail to develop ulcerations. Although contractures of the joints seem related to the duration of hyperglycemia, it is likely that if a person is going to develop this complication, he or she will do so within the first ten years of the disease. There is less certainty about the role that blood sugar control has on the development of this condition.

Diabetic dermopathy is the development of atrophic hyperpigmented maculo-papular eruptions on the shin, sometimes termed "shin spots."

There are studies, however, that do correlate strict glycemic control with diminished thickness of the skin and a decrease in skin collagen glycation. Maintaining strict control of one's diabetes could potentially, therefore, limit subsequent long-term skin damage.

Approximately one third of all patients with limited joint mobility, usually in the more severe cases, also demonstrate abnormal waxiness with abnormal thickening of the skin. This is unrelated to the thick skin that most diabetics develop during the course of their disease. Clinically, this skin manifestation bears a striking resemblance to scleroderma, but it is excluded by the absence of:

1) Raynaud's phenomenon

2) Ulcerative lesions where there are no abnormal pressure points

3) Tapering and calcinosis of the fingers

4) Visceral involvement.

Histologically, this waxy skin is marked by a thickening of the dermal collagen and by a marked scarcity of elastic fibers.

The pathogenesis of the both the skin and the joint mobility complications of this syndrome seem interrelated. The joints themselves are not directly involved but the defect apparently involves the collagen of the peri-articular tissues. The abnormal collagen of both the skin and peri-articular tissues may be a reflection of non-en-

Continued on page 139

zymatic glycosylation of protein, an outcome related to persistent hyperglycemia, although tissue glycosylation is not greater in diabetics with this syndrome than in those without. The condition appears to be unrelated to vascular disease, as this syndrome often occurs in young patients.

Neuropathic Changes That Affect the Skin

Three types of neuropathy contribute to skin changes in the person with diabetes.

1) Autonomic neuropathy
2) Sensory neuropathy
3) Motor neuropathy

Skin Manifestations of Autonomic Neuropathy

Autonomic neuropathy involves the non-myelinated nerve fibers of the autonomic nervous system. This system may be the first nervous tissue affected in diabetics. This autonomic neuropathy, which correlates well with the occurrence of sensory neuropathy, manifests itself by the disturbance of the sweating mechanism, usually resulting in anhydrosis, but hyperhydrosis can occur as a compensatory mechanism for loss of the ability to regulate temperature in the involved area.

Clinically, the symptoms of autonomic neuropathy include complaints that the feet are abnormally cold, burning, or pruritic. Patients can also present with excess sweating or more commonly, the absence of sweating. These complaints are problematic particularly when they involve the feet. Perspiration on the feet maintains hydration of the stratum corneum. Calluses without hydration become thick and brittle. They may fissure and provide a nidus for infection. Too much perspiration may lead to problems with dermatitis and fungal and/or bacterial infections.

In summary, neuropathic patients lose eccrine gland function that most often results in decreased skin moisture, dryness and fissuring of the skin, resulting in an infection portal. Another consequence of autonomic neuropathy is loss of sympathetic control, which will result in vasodilation, arteriovenous shunting and edema. Consequently, there are prominent varicosities and telangiectasias that develop in the feet along with the resultant effects of edema and venous insufficiency on the skin.

Autonomic neuropathy involves the non-myelinated nerve fibers of the autonomic nervous system.

When there are signs of sensory and/or autonomic neuropathy, it is important to be proactive when it comes to the care of the feet and the skin. Appropriate pH-sensitive cleaning and conditioning of the skin with moisturizing emollients made with the diabetic foot in mind are essential elements in maintaining good foot health and preventing the ravages of autonomic neuropathy. (Figure 15)

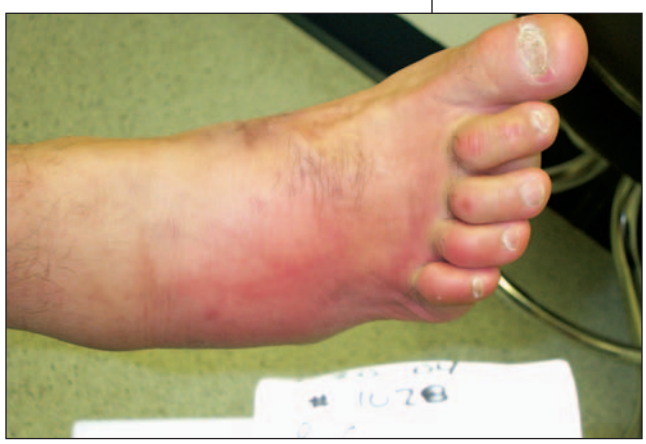

Figure 17: Charcot deformity of hammertoe, motor and sensory

Skin Manifestations of Sensory Neuropathy

Sensory neuropathy is manifest by the loss of adequate sensation in the feet. This loss of sensation in the feet allows the person suffering to withstand pressure and trauma that would not ordinarily be tolerated. Direct shearing and friction pressures on the feet are not felt. This can lead to skin breakdown, ulcerations, infections and Charcot fractures of the foot that usually involve the weight bearing surfaces and bones. (Figure 16)

Typically, the tips of the toes, the plantar aspects of the metatarsal heads and the tarsal areas are involved. Temperature sensation is affected as well, leading to potential burns and injuries from temperature extremes. It is absolutely essential, then, to:

1) Inspect the feet daily for untoward results of having this type of nerve damage.

2) Protect the feet from damaging pressures by using appropriate shoes and shoe inserts.

3) Inspect the shoes to be used everyday for any foreign object that might cause even the smallest amount of damage, which could be devastating for the diabetic.

4) Soften the skin, making it less stiff and more resilient through the use of a low friction diabetic foot cream.

Skin Manifestations of Motor Neuropathy

Motor neuropathy has its greatest effect on the feet. Most commonly, initially the small intrinsic muscles, such as the interossei, begin to atrophy due to a loss of motor innervation. The loss of the stabilizing effect they provide in gait becomes evident as the overpowering of the long flexors and extensors leads to contracted digits (Figure 17) and the retrograde forces being put directly on the metatarsal heads while the plantar fat pad is shifted distally.

There is therefore increased callous that builds up beneath the metatarsal heads. The quality and the quantity of callus tissue are distorted because of the neuropathy. There is increased buildup of thickened, dry and more brittle callous tissue. An imbalance is created between the leg extensors and flexors

Continued on page 140

as the anterior tibial muscles tend to weaken and the gastrocnemius muscles tend to contract.

The most significant net effect of motor neuropathy is an altered walking pattern, a steppage gait that is apropulsive, which leads to abnormal biomechanics of the lower extremity, lack of shock absorption of direct pressures, and increased shear and friction forces delivered to the feet. To avoid the severe effect that motor neuropathy has on the skin of the feet, one must be diligent in providing appropriate shoes and shoe inserts and keeping the skin healthy with proper skin care products made for the diabetic foot.

Pruritis

Itching of the lower extremities is a common event. Once thought to be related to hyperglycemia and sensory neuropathy, it is now stated to be associated with dry skin and xerosis. Skin conditioning products that are made for diabetics and/or low potency corticosteroid creams usually suffice to control these symptoms.

Venous Insufficiency and Edemavascular Changes That Affect the Skin

Venous insufficiency and its associated consequences, such as the edema, ulcerations, dermatitis, and dry skin, may all be associated with diabetes, the common link being the arteriovenous shunting that occurs in the lower extremity. Nevertheless, many diabetics do have this set of problems. Graduated support hose that do not compromise arterial blood flow or irritate the skin surface is an essential element in controlling the edema associated with venous insufficiency. Skin conditioning products that are made for diabetics and neutral soaps should be used to prevent potential skin problems. (Figure 18)

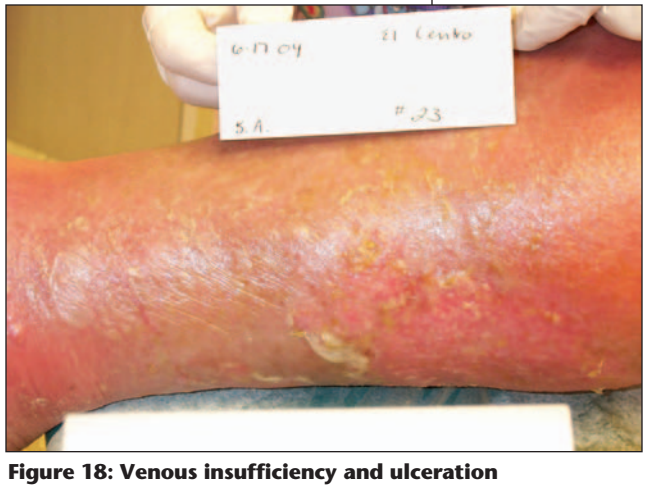

Figure 18: Venous insufficiency and ulceration

Summary

This paper attempts to clarify some of the dermatologic entities associated with diabetes mellitus. It is by no means exhaustive, but the goal is to have the reader take away an overview of the cutaneous pathology of the lower extremity in the diabetic; identify etiological trends in pathology; and to facilitate easier recognition and appropriate treatment of these conditions by the practitioner.

Dermatologic disease is a breakdown in only one system, but is subject to the same diabetic stressors all the other systems are subject to. Each works in concert with the other systems but particular importance is placed upon the interdependence of the neurological, cardiovascular, immunologic, psychological and the metabolic status of the patient. One must keep in mind that dermatologic disease, as in most, has a genetic component and is influenced tremendously by lifestyle and strict control of one's diabetes.

Certainly, there is a portion of the disease process patients can not control. Nevertheless, people have significant power over the status of their own health. Paying attention to the proper mechanics of the foot by using appropriate shoes and inserts designed to relieve pressure from at risk areas, controlling edema with appropriate compression stockings, protecting the skin by avoiding allergic and injurious materials, paying attention to the mechanics of blood flow through proper exercise and edema control using appropriate compression stockings, pampering the skin with neutral soaps and conditioning oils and creams, and liking yourself enough to be ambitiously compliant are all key fundamentals to be used by the person with diabetes to protect the largest protective organ in the body, the skin. ■

References

1. Dockery GL, Crawford ME. Cutaneous Disorders of the Lower Extremity Text W.B. Saunders Company Pages 178-183.
2. Bowker JH, Pfeifer MH Levin and O'Neals THE DIABETIC FOOT sixth edition Text Mosby Pages 197-208.
3. Chakrabarty A, Norman RA, Phillips TJ Cutaneous Manifestations of Diabetes. Wounds 14(8): 267-274, 2002.
4. Sibald GR, et al. Skin and diabetes. Endocrinol Metab Clin North Am 1996; 25:463-72.
5. Miller F III. Management of diabetic foot ulcers. J Cut Med Surg 1998;3(suppl 1):13-7
6. Caputo M, Cavanagh P, Ulbrecht J, et al. Assessment and management of foot disease in patients with diabetes. N Eng J Med 1994; 331:854-60.
7. Meurer M, Szeimies RM. Diabetes mellitus and skin diseases. Curr Probl 1991;20:11-23.
8. Fitzpatrick TB, Johnson RA, Wolff K (eds). Color Atlas and Synopsis of Clinical Dermatology, Fourth Edition. McGraw-Hill, 2001:120-22.
9. Drugge R, Dunn HA. The Electronic Textbood of Dermatology The Internet Dermatology Society Incorporated, 1995-2000.
10. West KM: Epidemiology of diabetes and its vascular lesions. New York, 1978, Elsevier North-Holland Inc., p 353.
11. Haroon TS: Diabetes and skin—a review. Scott Med J 19:257-267, 1974
12. Bernstein JE: Cutaneous manifestations of diabetes mellitus. Curr Concepts Skin Disord 1:3, 1980.

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EXAMINATION

Continuing Medical Education

See answer sheet on page 143.

1) In general, the presence of diabetes mellitus is most likely to be associated with the following skin condition:
- A) Vasculitic ulcerations
- B) Thin skin
- C) Hirsuitism
- D) Digital sclerosis

2) When the skin is very thick in a diabetic, the literature suggests that this is a marker for the following:
- A) Morbid obesity
- B) Parasympathic nervous system disorder
- C) Retinal microvascular disease
- D) Tinea versicolor

3) Diabetic scleredema is associated with all of the following except:
- A) A marked increase in dermal thickness on the upper neck or posterior back
- B) People that are overweight and middle aged with poorly controlled type II diabetes mellitus
- C) Digital sclerosis
- D) An abnormal amount of GAG's in the dermis

4) All of the following are associated with the yellow discoloration of the skin and nails that occurs in diabetes mellitus except:
- A) An elevation in serum carotene levels
- B) Most noticeable discoloration on the palms and soles of the feet
- C) The accumulation of non-enzymatic glycosylation end products
- D) An abundance of proteins with a long turnover time

5) The following is not true concerning diabetic bullosis:
- A) It is a spontaneous onset of multiple bullae
- B) These lesions usually occur subsequent to trauma
- C) Most commonly it occurs on the tips and dorsal aspects of the fingers and toes
- D) Three different types may occur

6) Necrobiosis lipoidica diabeticorum (NLD) is most commonly associated with the following:
- A) A well-documented etiology
- B) A low prevalence in caucasians
- C) Females between the second and fifth decade of life
- D) Most patients with diabetes mellitus develop some form of NLD

7) The most common locations that are affected by NLD include the following:
- A) The anterior shin, pre-tibial, medial malleolar and dorsal aspect of the feet
- B) The buttocks, lower back and inguinal area
- C) Subungual, interdigital and mid-arch areas of the foot
- D) The shoulders, back of the neck, above the eyebrows and behind the ears

8) The patient is most likely to have diabetes mellitus if NLD occurs in the following location:
- A) Face
- B) Shoulders
- C) Hands
- D) Lower extremities

9) The percentage of patients with diabetes that develop NLD is approximately
- A) .3%
- B) 3%
- C) 30%
- D) 90%

10) Which statement best describes the condition of granuloma annulare?
- A) It is a malignant, progressive, very painful dermatosis
- B) There are several forms of this condition that are all histologically identical
- C) Most patients with the classic form have brittle Type I diabetes
- D) It occurs most often in the elderly population

11) The generalized disseminated form of granuloma annulare is found approximately in the following percent of persons with diabetes
- A) .33%
- B) 3.3%
- C) 33%
- D) 67%

12) Eruptive xanthomas are associated with all of the following except
- A) Type I hyperlipidemia
- B) Hansen's disease*
- C) Hyperglycemia
- D) Glycosuria

13) Acquired cutaneous disorders that are thought to have an association with abnormal glucose metabolism include all of the following except:
- A) Those that are characterized by trans-epidermal elimination of degenerative material
- B) Acquired perforating dermatoses
- C) Those patients who are diabetic and also in renal failure
- D) Collagen vasculitis

14) The vascular changes that take place in the person with diabetes are most commonly due to:
- A) Large vessel disease only
- B) Small vessel disease only
- C) Both large and small vessel disease
- D) Autoimmune inflammatory response

Continued on page 142

Continuing Medical Education

EXAMINATION

(cont'd)

15) The histology of affected diabetic tissue reveals the following changes:
- **A) A PAS positive, thickened capillary basement membrane**
- **B) A PAS positive, thin and weakened capillary basement membrane**
- **C) A PAS negative thickened capillary basement membrane**
- **D) A PAS negative thin and weakened capillary basement membrane**

16) Functional microangiopathy is:
- **A) Evidenced by abnormal capillaries with skin and skeletal muscle biopsy**
- **B) Irreversible microcirculatory vasoconstriction**
- **C) Sluggish microcirculation**
- **D) Does not respond to improved control of diabetes**

17) Examples of functional microangiopathy include all of the following except:
- **A) Rubeosis facei**
- **B) Onycholysis**
- **C) Periungual telangiectasia**
- **D) Gangrene of the toes**

18) Failure of the kidney to thrive is associated with the following changes in the skin:
- **A) Accumulation of glycoxidation and lipoxidation products in skin collagen**
- **B) Accumulation of glycoxidation and lipoxidation products in subcutaneous adipose tissue**
- **C) Elimination of glycoxidation and lipoxidation products in skin collagen**
- **D) Elimination of glycoxidation and lipoxidation products in subcutaneous adipose tissue**

19) Diabetic dermopathy is usually associated with the development of:
- **A) Shin spots**
- **B) Hypopigmented papular eruptions**
- **C) Hypertrophic macular eruptions**
- **D) Painful bilaterally symmetrical ulcerations**

20) Periungual telangiectasias are present in the following approximate percentage of diabetic patients:
- **A) .49%**
- **B) 4.9%**
- **C) 49%**
- **D) 10%**

See answer sheet on page 143.

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(Rehm)

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2.	**A**	**B**	**C**	**D**	**12.**	**A**	**B**	**C**	**D**
3.	**A**	**B**	**C**	**D**	**13.**	**A**	**B**	**C**	**D**
4.	**A**	**B**	**C**	**D**	**14.**	**A**	**B**	**C**	**D**
5.	**A**	**B**	**C**	**D**	**15.**	**A**	**B**	**C**	**D**
6.	**A**	**B**	**C**	**D**	**16.**	**A**	**B**	**C**	**D**
7.	**A**	**B**	**C**	**D**	**17.**	**A**	**B**	**C**	**D**
8.	**A**	**B**	**C**	**D**	**18.**	**A**	**B**	**C**	**D**
9.	**A**	**B**	**C**	**D**	**19.**	**A**	**B**	**C**	**D**
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