

An Observational Study of the Spectrum of Mucocutaneous Manifestations of Diabetes Mellitus in Mumbai, India

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Abstract

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Introduction: The skin manifestations of diabetes mellitus (DM) are important, to prevent cutaneous complications, and to detect diabetes based upon the suspicion raised from certain dermatoses. *Methods:* In this hospital-based, non-interventional, observational study, 250 diabetic patients of either gender were evaluated for cutaneous manifestations of diabetes. Patients were categorized into obese and non-obese, and the percentages of various dermatoses in the study population was calculated and compared with similar Indian published studies. *Results:* The proportion of men was higher, and the peak incidence of DM with cutaneous manifestation was in 40-70 years of age (72.8%). Of the total cases, 66 (26.4%) were obese. Majority of cutaneous manifestations associated with DM were infections, seen in 110 patients (44%), with fungal infections being most common (65 cases, 26%), followed by bacterial infections (36 cases, 14.4%). Cutaneous markers of metabolic syndrome including acanthosis nigricans, and xanthelasma palpebrarum were also seen. Disorders of immune dysregulation such as psoriasis, lichen planus, alopecia areata, and vitiligo were seen in a substantial number of cases. However, specific diabetes-associated skin disorders were sparingly encountered; necrobiosis lipoidica diabetorum, and scleroderma diabetorum were not seen. Diabetic foot ulcers were seen in 13 cases (5.2%). *Conclusion:* In view of the high incidence of cutaneous infections in diabetics, they must be closely monitored for the same for early treatment. The association of psoriasis, lichen planus, vitiligo, alopecia areata etc. can be explained on the common pathogenetic involvement of a dysregulated immunity. Complications like foot ulcers are common and need early intervention.

Keywords: Cutaneous; Skin; Diabetes; Infections; Ulcer.

Introduction

Diabetes mellitus (DM) is the most common endocrine disorder characterized by the abnormalities of insulin levels and elevated blood glucose level leading to metabolic, vascular, neurological and immunological abnormalities. Affected organs include the cardiovascular, renal and nervous system, eyes and the skin [1]. This chronic disease affects 11 million individuals in the United States, of these 90% have type II, non-insulin dependent whereas 10% have insulin dependent type I [2]. Diabetes has emerged as a major healthcare problem in India. According to Diabetes Atlas published by International Diabetes Federation (IDF), there were an estimated 40 million persons with diabetes in India in 2007 and this number is predicted to rise to almost 70 million people by 2025 [3].

Diabetes has been classified into various types; however, the two primary forms are type 1 diabetes mellitus or T1DM (formerly called insulin dependent diabetes mellitus or IDDM) and type 2 diabetes mellitus or T2DM (formerly called non-insulin dependent diabetes mellitus or NIDDM), the latter constituting almost 85% of the total global patient population of DM. Other major subsets of the spectrum of DM include maturity onset diabetes of the young (MODY), gestational diabetes (GDM), drug-induced hyperglycemia, pre-diabetes, impaired glucose tolerance (IGT), amongst others.

Cutaneous manifestations described in diabetes mellitus may vary from trivial to life threatening. However none is absolutely pathognomonic of the disease. However, certain cutaneous markers are readily recognizable as diabetic markers and are considered as virtually diagnostic of diabetes

mellitus; e.g. Necrobiosis lipoidica diabetorum (NLD), bullous diabetorum, waxy skin syndrome and diabetic dermopathy [4]. Cutaneous manifestations in diabetes have been reported to have an incidence ranging from 30-40% [2,5]. The clinical manifestations and complications of skin disease are frequently more severe in the setting of diabetes. The literature abounds with studies that attempt to identify and understand the pathophysiology of cutaneous disorder in the diabetes patients. A systematic classification of cutaneous manifestations of diabetes mellitus has been attempted by A C Huntley, detailed in Box 1 [6].

Dermatologists, diabetologists and clinicians often neglect the dermatoses associated with diabetes mellitus. Moreover conflicting and overlapping nomenclature have added to the confusion. Thus, an early recognition of these cutaneous manifestations provide an important "window of opportunity" for the early diagnosis and treatment of diabetes mellitus and consequently reduce the morbidity caused by the associated systemic complication of untreated hyperglycaemia. Thus, this study was undertaken to study the spectrum of dermatoses associated with diabetes mellitus and estimate their proportions in Indian population.

Methodology

This was a hospital-based, non-interventional, observational study of cutaneous manifestations in Indian patients with diabetes mellitus. The study was conducted in the Department of Dermatology, Venereology & Leprology in K. J. Somaiya Hospital & Research Centre, Mumbai, India. It was approved by the institutional ethics committee.

All patients with diabetes mellitus, visiting the Department of Dermatology and Venereology (outpatient and inpatient) of the study centre, during the period of 2 years from April 2008 to April 2010 were included in the study and 250 sequentially presenting cases were examined. Patients of all ages and both sexes diagnosed to have diabetes mellitus with cutaneous manifestations were included. Patients with any other disease causing an immunocompromised state, and those on immunosuppressive medication were excluded from the study. A written consent of for enrolment in the study was taken from all patients and clinical photographs were maintained.

A detailed history was taken as per a specially designed clinical record form (CRF) with particular reference to cutaneous complaints, any other

significant systemic association and treatment modality, if any. A thorough clinical examination was done with special emphasis on examination of the entire integumentary system, including the skin, hair, nails, oral mucous membrane, genital mucosa, and perianal areas. Body mass index (BMI) was calculated for each patient. In the present study, BMI was calculated using the Quetelet's index ($BMI = \text{weight in kg} / \text{height in m}^2$); $BMI \geq 30$ for males and $BMI \geq 28.6$ for females was used as a cut-off value to define obesity.

Patient investigations included a complete blood count (CBC) with erythrocyte sedimentation rate (ESR), fasting blood sugar (FBS) and post-prandial blood sugar (BS-PP), urine examination (routine and microscopy). The other investigations were tailored as per the cutaneous lesions found in the patients (Box 2).

Data analysis was done by calculating proportions and percentages of various dermatoses in the study population (i.e. 250 diabetics with cutaneous manifestations) and was compared with similar Indian and International studies.

Results

Demography and Patient Profile

A total of 250 cases were included in this study that comprised of 139 male patients (55.6%) and 111 female patients (44.4%). The age of patients ranged from 18 years to 90 years old [Figure 1]. The peak incidence of DM with cutaneous manifestation was in 40-70 years of age (72.8%). The incidence was less in young patients and after 80 years. Of the included patients, 249 (99.6%) had T2DM and only 1 (0.4%) had IDDM. A positive family history of diabetes was elicited in 28% of cases (36 male and 34 female patients). Based on the BMI, 184 cases (73.6%) were found to be non-obese whereas remaining 66 (26.4%) were diagnosed to be obese, comprising of 29 male and 37 female patients [Figure 2].

Cutaneous Manifestations [Figure 3]

Majority of cutaneous manifestations associated with DM were infections, seen in 110 patients (44%), of which fungal infections were detected in 65 cases (26%), bacterial infections in 36 cases (14.4%), and viral infections in 9 cases. Infestations like scabies were seen in 4 cases (1.6%).

Cutaneous markers of metabolic syndrome were seen in few cases; acanthosis nigricans (AN) in six

cases (2.4%), and xanthelasma palebrarum (XP) in 4 cases (1.6%). Disorders of dysregulated immunity were encountered as follows: psoriasis in 16 cases (6.5%), lichen planus (LP) in 11 cases (4.4%), alopecia areata in 9 cases (3.6%), and vitiligo in eight cases (3.2%). Specific diabetes-associated skin disorders were sparingly encountered; 13 cases (5.2%) of diabetic ulcer of the foot, and one case each (0.4%) of diabetic hand syndrome and granuloma annulare (GA). No case of NLD or scleroderma diabeticorum was observed.

Cutaneous Infections

Out of 36 patients (14.4%), who were diagnosed with bacterial infections [Table 1], pyoderma were present in 27 patients (10.8%) and erythrasma in two patients (0.8%) followed by leprosy in seven patients (2.8%). The pyodermas detected during the study included furunculosis (14 cases, 5.6%), folliculitis (4 cases, 1.6%), carbuncle (4 cases, 1.6%), cellulitis (3 cases, 1.2%), ecthyma (1 case, 0.4%) and erysipela (1 case, 0.4%). Carbuncles, are clusters of contiguous furuncles interconnected subcutaneously resulting in edematous and abscess-like swelling with a perforated surface giving a "sieve-like" appearance, and typically located over the neck region [Figure 4]. Out of the 29 cases of bacterial infections (excluding 7 cases of leprosy), 18 (62.1%) showed positive gram staining from the collected specimen. Majority of these gram stain positive cases revealed gram positive cocci arranged in clusters, confirmed to be *Staphylococcus aureus*. Out of the seven cases of leprosy encountered in the study, one patient of lepromatous leprosy (LL) had concomitant severe erythema nodosum leprosum with necrotic lesions [Figure 5].

Analysis of different types of fungal infections [Table 2] showed that tinea cruris and corporis were the commonest forms, accounting for 31 cases (12.4%) closely followed by tinea pedis in four cases (1.6%) and tinea faciei in two cases (0.8%) only. Candidal infections including vulvovaginitis, balanoposthitis, intertrigo, and paronychia were encountered in 15 cases (6%). Toe intertrigo involved multiple toe clefts and revealed hyperkeratotic adherent white membrane. Pityriasis versicolor was seen in five cases (2%), and onychomycosis in 7 cases (2.8%). Onychomycosis typically involved multiple nails with toe > finger nail involvement; the most common morphological type being total dystrophic onychomycosis [Figure 6]. A single case (0.4%) of pulmonary and cutaneous cryptococcosis was observed in the study; with clinical features of two umbilicated nodules [Figure 7], and a 3cm nodule in right upper lung field detected on chest X-ray. This

patient was seronegative for HIV infection. Fungal elements were detected on 10% KOH mount and positivity was detected in 48/65 (78.4%) cases of mycoses. Of the 9 cases with viral infections, four had herpes labialis (1.6%), two had herpes zoster (0.8%), two had verruca vulgaris (0.8%), and one patient (0.4%) was detected with herpes progenitalis. Scabies was detected in 4 cases (1.6%).

Cutaneous Markers of Metabolic Syndrome

Acanthosis nigricans was observed in six cases (2.4%), all being obese. The characteristic 'hills and valley' morphology of AN in all the 6 cases involved the neck as well as the axillae [Figure 8]. All these patients also had AN-associated acrochordons (skin tags). Additionally, acrochordons as a stand-alone skin finding was seen in two diabetic patients (0.8%). Yellow soft papules of XP over the eyelids were observed in 4 cases (1.6%).

Papulosquamous Disorders

Apart from psoriasis (16 cases, 6.5%) and LP (11 cases, 4.4%), 10 cases of eczema were found in this study. The lesions were hyperpigmented scaly plaques with or without discharge. The morphological variants included – lichen simplex chronicus (LSC), stasis dermatitis, contact dermatitis and nutritional dermatitis. Of the 11 cases with LP, two cases had additional ulcerative lesions of LP involving the buccal mucosa. Seven cases of LP were confirmed histopathologically.

Lichen amyloidosis with multiple, discrete, pruritic, popular lesions over the anterior aspect of both lower legs was detected in 4 cases (1.6%). Seven cases (2.8%) of acquired ichthyosis were observed in this study. The lesional skin was dry with fine, fissured scales that appeared 'posted-on' the body surface. The lesions were more prominent on the extensor aspect of the lower extremities.

Specific DM-Associated Skin Disorders

Specific diabetes-associated skin disorders were sparingly encountered; 13 cases (5.2%) of diabetic ulcer of the foot [Figure 9], and one case each (0.4%) of diabetic hand syndrome and granuloma annulare (GA).

The patient with diabetic hand syndrome displayed limited mobility of phalanges, and severe contraction of proximal and distal interphalangeal joints resulting in the inability to approximate the palms with fingers fanned out (Prayer sign). No case of NLD or scleroderma diabeticorum was observed.

Miscellaneous Dermatoses

Six cases of urticaria were diagnosed in non-obese NIDDM patients. Lesions consisted of multiple transient, erythematous papules and oedematous plaques and wheals distributed all over the body. Etiology of the same could not be established by detailed history, clinical examination and relevant investigation. Five patients (2%) were detected with Schamberg's purpura. Rosacea was found in 3 patients (1.2%). Three cases of multiple seborrhoeic

keratosis (SK) were detected. Three cases (1.2%) of Kyrle's disease were detected. The lesions presented predominantly over the distal extensor aspect of the extremities and consisted of discrete perifollicular as well as interfollicular hyperkeratotic papules with adherent keratotic plugs [Figure 10]. Koebner's phenomenon was seen on the trunk in two of these patients. One case each of pangeria, burning feet syndrome, stucco keratosis, and prurigo simplex were diagnosed.

Box 1: Classification of cutaneous manifestations of diabetes mellitus⁶

A) Infections

- a) Bacterial
 - i. Pyoderma (especially from *Staphylococcus aureus*)
 - ii. Malignant external otitis (*Pseudomonas aeruginosa*)
 - iii. Necrotizing fasciitis (Gram-positive and Gram-negative and anaerobic mixed infection)
 - iv. Erythrasma
- b) Mycotic
 - i. Superficial – Dermatophytosis / candidiasis
 - ii. Deep – Mucomycosis

B) Skin changes thought to be related to microangiopathy

- a) Punched-out skin ulcer on lower legs.
- b) Necrobiosis lipoidica diabetorum
- c) Diabetic dermopathy (Shin spots)
- d) Bullous eruption of diabetes
- e) Rubeosis

C) Skin changes thought to be related to neuropathy

- a) Neurotrophic ulcer (mal perforans)
- b) Charcot joints

D) Skin changes thought to be related to macrovascular insufficiency

- a) Ischemic skin ulcers and digital gangrene
- b) Erysipelas-like erythema

E) Skin changes related to lipodystrophy

- a) Lipodystrophy at insulin injection sites
- b) Syndromes of lipodystrophy and diabetes
 - i. Seip-Berardinelli syndrome [Congenital Generalized Lipodystrophy (CGS)]
 - ii. Acquired lipodystrophy

F) Other skin diseases that may be associated with diabetes

- a) Granuloma annulare
- b) Scleredema diabeticorum (adulorum)
- c) Eruptive xanthomas
- d) Perforating cutaneous diseases (of diabetes)
- e) Pruritus
- f) Vitiligo
- g) Acanthosis nigricans

G) Drug reactions

- a) Insulin reaction – local wheal, urticaria
- b) Oral hypoglycemic reaction.
Can cause unpleasant flushing reaction after alcohol ingestion and can cause hyponatraemia by increasing action of ADH.

According to S.D.D. Griffiths⁷, cutaneous manifestations of diabetes mellitus are classified as:

- a) **Well defined link to diabetes**
 - Pigmented pretibial patches
 - Necrobiosis lipoidica diabetorum

- Granuloma annulare
- Neuropathic ulcer
- Decreased sweating
- Atherosclerosis
- Skin infections
- Lipoatrophic diabetes
- Carotenaemia
- Secondary xanthomas
- Anogenital itching and vulvodinia
- Limited joint mobility and waxy skin syndrome

b) **Possible link to diabetes**

- Vitiligo
- Alopecia areata
- Idiopathic bulla
- Rubeosis faciei (red face)
- Generalized itching
- Dupuytren's contracture
- Scleredema diabeticorum

b) **Doubtful link to diabetes**

- Psoriasis
- Campbell de Morgan spots

According to Chilukuri Sreedevi, Ivana Palvic, Renar et al, cutaneous manifestation in diabetes mellitus are classified as¹⁵:

I) Dermatologic lesions and associations which are specific for diabetes mellitus.

- a) Pruritus
- b) Necrobiosis lipodica diabeticorum
- c) Granuloma annulare
- d) Diabetic dermopathy
- e) Scleroderma diabeticorum
- f) Acanthosis nigricans
- g) Diabetic bullae

II) Skin alterations due to diabetic complications

- a) Diabetic foot
 - b) Cutaneous infections associated with diabetes
- Bacterial skin infections:
 - Furunculosis
 - Carbuncle
 - Pyodermas
 - Candidiasis
 - Dermatophytosis
 - c) Erythrasma
 - d) Xanthomatosis
 - e) Xanthelesma
 - f) Limited joint morbidity and waxy skin syndrome
 - g) Malignant otitis media

III) Dermatologic changes associated with neurovascular complication

- a) Macroangiopathy
- b) Microangiopathy
- c) Diabetic neuropathy

IV) Dermatologic complication of diabetes treatment

- a) With oral hypoglycemic drugs
- b) Insulin induced disorders

V) Endocrine syndromes with skin alterations and diabetes mellitus

Necrolytic migratory erythema in glucagonoma syndrome

VI) Dermatoses those are more common in diabetes mellitus

- a) Perforating dermatosis
- b) Lichen planus
- c) Eruptive xanthomas
- d) Kaposi's sarcoma
- e) Bullous pemphigoid
- f) Dermatitis herpetiformis
- g) Psoriasis.

Box 2: Special investigations undertaken in study patients as per the cutaneous features

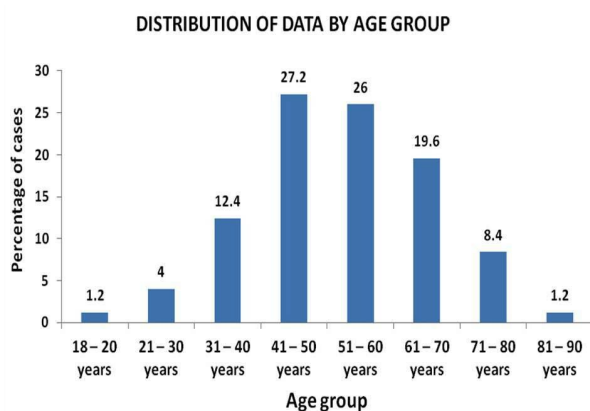
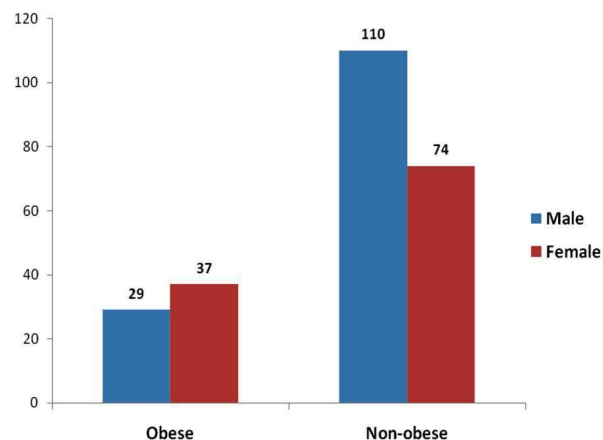
- Wood's lamp examination
- Skin scraping and 10% KOH (potassium hydroxide) mount for fungal study
- Gram stain from skin swab/cutaneous discharge
- Fungal culture for speciation – skin scraping/nail clipping/hair follicle
- Tzanck smear
- Skin biopsy (hematoxylin & eosin, and special stains when required)
- Lipid profile
- VDRL test
- Serology for HIV-1 and HIV-II

Table 1: Incidence of different bacterial infections in 250 patients of diabetes mellitus

Fungal infections	No. of cases	Percentage
Tinea cruris	16	6.4
Tinea corporis	15	6
Tinea pedis	04	1.6
Tinea faciei	02	0.8
Candidal balanoposthitis	04	1.6
Candidal intertrigo	04	1.6
Onychomycosis	07	2.8
Pityriasis versicolor	05	2.0
Vulvovaginal candidiasis	06	2.4
Paronychia	01	0.4
Cryptococcosis	01	0.4
Total	65	25.6

Table 2: Incidence of different fungal infections in 250 patients of diabetes mellitus

Bacterial infections	No. of cases	Percentage
Furunculosis	14	5.6
Folliculitis	04	1.6
Carbuncle	04	1.6
Cellulitis	03	1.2
Ecthyma	01	0.4
Erysipelas	01	0.4
Erythrasma	02	0.8
Leprosy	07	2.8
Total	36	14.4

**Fig. 1:** Age distribution of the study patients**Fig. 2:** Gender-wise distribution of study patients with diabetes mellitus with/without obesity

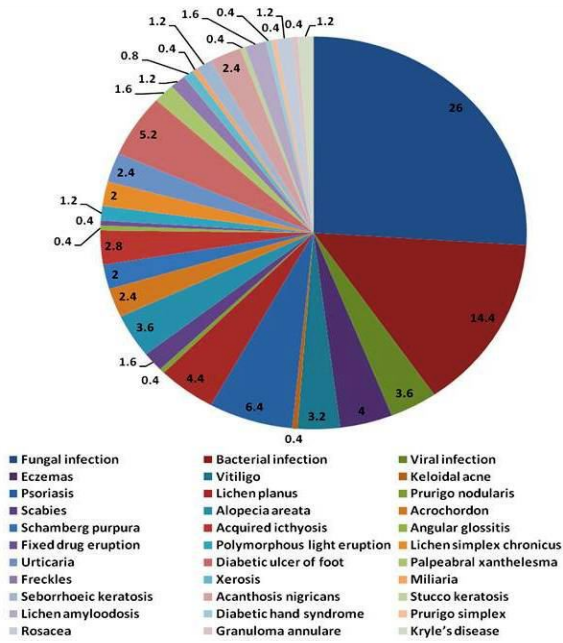


Fig. 3: The incidence of cutaneous manifestations observed in 250 patients with diabetes mellitus in the study



Fig. 6: Total dystrophic onychomycosis involving all toe nails in a 55-year old man with uncontrolled type 2 diabetes mellitus



Fig. 4: Carbuncles over the neck of a 42-year old diabetic man; note the inflamed ulcer with a 'sieve-like' appearance with pus points



Fig. 7: Hyperkeratotic umbilicated nodule over the posterior aspect of the right arm of a 34-year old seronegative diabetic patient, confirmed to be cutaneous cryptococcosis on histopathology and fungal stains.



Fig. 5: Necrotic lesions of erythema nodosum leprosum (ENL) in a 60-year-old diabetic patient with lepromatous leprosy



Fig. 8: Brown-colored hyperkeratotic coalescent velvety plaques of acanthosis nigricans with acrochordons over the neck of a 35-year old man with diabetes.



Fig. 9: Diabetic foot ulcer over the sole of a 50-year old man



Fig. 10: Kyrle's disease; multiple perifollicular as well as interfollicular hyperkeratotic papules with adherent keratotic plugs over both legs, in a patient with type 2 diabetes mellitus with nephropathy

Discussion

Skin lesions in diabetes mellitus are sometimes a mirror to an underlying disease process and they may be the first expression of the disease. In the present study, 250 diabetics with cutaneous manifestations were included. The majority of the patients (53.2%) were over 50 years of age; a finding comparable to that of the study by Thomas George, who reported 68% of the study patients being above 40 years of age [7]. The gender difference with more men with DM and cutaneous manifestations observed in this study is also similar to the previously reported results⁷

In the present study, 66 patients i.e. 26.4% were obese. Bernstein reported an incidence of 39% in his study [8]. The present study failed to demonstrate obesity as a significant factor for developing diabetes

mellitus.

Twenty-seven (10.8%) cases of pyodermas were found in this study. The incidence of bacterial infections reported in previous studies has ranged from 14-20% [7,9]. It has been suggested that examination of the urine and blood for sugar should be carried out in all patients who have recurrent or chronic bacterial skin infections. Similar to the findings of this study, Greenwood *et al* also reported a high incidence of staphylococcal skin infections among diabetic patients [10]. Although recurrent folliculitis and furunculosis are indicators of diabetes, carbuncles are highly suggestive. The largest group of cutaneous disorders in the present study was constituted by fungal infections, detected in 65 patients (26%) with dermatophytosis in 17.6%, and candidiasis in 5.6%. Similarly high incidence of mycoses has been previously reported with dermatophytosis constituting 30-40% of the total cutaneous disease burden in diabetics [7,10]. A predominance of foot involvement and affliction of intertriginous regions has been reported [10]. Whether diabetes mellitus plays a role in the dermatophyte infection remains debatable. While Rothman Kohn found no such association, in a relatively more recent study by Jolly *et al* involving 29 consecutive patients with recurrent *Trichophyton rubrum* infections, a significant proportion had elevated glucose tolerance curves [11,12].

The incidence of candidal infections was found to be lower in this study (6%) compared to higher rates reported by other workers. Mucocutaneous candidiasis was found in 14% cases in the study of Thomas George [7]. Anand reported that 25% of the patients with candidial intertrigo had diabetes mellitus [9]. Hence a prompt search should be made for the presence of diabetes mellitus in non-pregnant females who have vulval pruritus and elderly men with balanoposthitis. Further, the high success rate in the detection of fungus by microscopy of KOH mount observed in this study reaffirms the importance of 10% KOH preparation as a simple and reliable tool for this purpose in diabetic patients.

The incidence of viral infections in the current study was low. A high incidence of association between herpes zoster and DM has been previously reported. Calandra and Lissi reported 52.9% of the patients with zoster had diabetes mellitus [13]. Sezia *et al* found 3.9% of the patients with diabetes developed herpes zoster [14]. Although, in the present study, patients with post herpetic neuralgia (PHN) were not encountered, the risk of PHN and other complications of zoster is well known to be higher in diabetics and seems to be dependent on the

extent of glycemic control [15].

Lichen planus has been reported to be associated with diabetes. In the study of Thomas George, 2% patients of DM had extensive lichen planus [7]. Abnormal glucose tolerance test (GTT) has been reported in 36-80% cases with LP [16-18]. In the present study, 16 cases of DM (6.4%) had psoriasis vulgaris. Anand and Aschner *et al* reported DM in 8.88% and 5.7% of psoriasis patients respectively [9,19]. The association of psoriasis with diabetes mellitus remains controversial. While Lynch showed no more than chance association between psoriasis and diabetes, others have reported strong association between the two [20-22]. Hajini *et al* and Pranesh Nigam *et al*, reported abnormal GTT in 14.3% and 27.7% of psoriasis patients respectively [21,22].

In this study, AN was detected in 2.4% of the diabetic patients. AN is a well-established cutaneous marker of the metabolic syndrome, which is characterized by insulin resistance. In the PRIME Net study of Kong *et al*, the rate of AN was 22% among those with significant risk factors for T2DM.

Further, patients with AN were twice as likely as those without AN to have type 2 diabetes (35.4% vs 17.6%; $P < .001$) [23]. The incidence of acrochordons found in the current study was much lower than other studies. The reported percentage of patients with multiple skin tags having DM has ranged upto 72.3% [24].

Autoimmune disorders like vitiligo and alopecia areata have a plausible association with diabetes. Late onset vitiligo after the age of 40 years appears to have a close association with diabetes mellitus. Dawber reported 4.8% patients of maturity onset of diabetes mellitus to have concomitant vitiligo [25]. While there is a paucity of specific studies linking these alopecia areata with DM, their association may be explained by the common autoimmune etiology of both disorders. Although the incidence of lichen amyloidosis in diabetic patients was observed to be low (1.6%) in this study, higher incidence has been reported by others like Weyers *et al* [26]. They attributed generalized pruritus to be the causative factors for lichen amyloidosis in diabetics. Similarly, although we found just 3 cases of rosacea in the study population, the association of rubeosis faciei (red face) and diabetics has been reported to be strong. Paron and Lambert reported upto 59% of patients with "red face" to be diabetics [27].

The association of acquired perforating dermatosis (APD) including Kyrle's disease with DM and related or unrelated renal and/or hepatic insufficiency is well known. In their study of 25

patients with APD, Akoglu *et al* reported that diabetes constituted the highest risk for the development of APD (48%), although only one of the 25 patients had Kyrle's disease [28]. Further, owing to the presence of concomitant systemic morbidities in patients with Kyrle's disease, a direct link between diabetic nephropathy and Kyrle's disease warrants further substantial investigations.

In the present study, 13 cases (5.2%) of diabetic ulcer of foot were encountered in longstanding patients with T2DM. The ulcers were present at the sites of high mechanical pressure on the plantar surface of feet. A new term, diabetic foot disease (DFD) better describes the spectrum of feet complications arising from complications of diabetes. DFD occurs in all types of diabetes showing higher prevalence among males and in patients more than 60 years old [29]. The lifetime risk for the development of a diabetic foot ulcer in patients with diabetes ranges from 15% to as high as 25% [30,31]. The burden of diabetic foot disease (DFD) is expected to increase in the future. Diabetic peripheral neuropathy (DPN) is a major risk factor for foot ulceration. DPN leads to loss of protective sensation resulting in continuous unconscious traumas. Patient education and early detection of high risk foot are essential for the prevention of foot ulceration and amputation [29].

Diabetic stiff hand syndrome, also known as diabetic cheiroarthropathy, is a disorder in which finger joint mobility becomes restricted as the hands become waxy and thickened [32]. It has been described in both T1DM as well as T2DM. A single case of diabetic hand syndrome in a patient with T2DM was seen in this study. Collier *et al* reported the incidence of diabetic hand syndrome in patients with DM to be 4.2% [33]. Poor glycemic control-associated enhanced protein glycosylation resulting in collagen deposition has been postulated to be the main etiological factor behind this syndrome. Diabetic microangiopathy and neuropathy contribute additionally [34].

The cutaneous manifestations and complication of DM seem to be multifactorial in origin. Acute metabolic derangements, insulin resistance cascade, chronic degenerative afflictions, impaired ability to handle infection due to altered cell-mediated immunity, abnormal carbohydrate metabolism, formation of advanced glycosylation end (AGE) products, diabetic neuropathy and microangiopathy, and complications of anti-diabetic medications, all contribute to the pathogenesis of cutaneous as well as other systemic morbidity of diabetes mellitus [35]. Early detection of the disease, early recognition of cutaneous complications and timely intervention

hold the key to successful management of these patients.

Conclusion

The results and deductions from the current study suggest that patients with diabetes mellitus are highly susceptible to development of cutaneous infections, and must be closely monitored for the same for early treatment. By corollary, any individual with recurrent bacterial and/or fungal infections should be screened for DM. Although other disorders of dysregulated immunity such as psoriasis, lichen planus, vitiligo, alopecia areata etc. are frequently encountered in diabetics, they do not seem to pose a huge threat to the overall morbidity. Although, we did not detect any diabetes-specific cutaneous disorders like NLD, complications like foot ulcers were commonly encountered. Judicious use of investigations like KOH mount, gram staining, fungal culture, and skin biopsy can render diagnosis and treatment more prompt and definitive. The shortcomings of the study include, lack of correlation between the glycemic control and cutaneous manifestations, and non-monitoring of improvement of skin disorders with successful treatment.

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