



ORIGINAL RESEARCH ARTICLE

Prevalence and Spectrum of Cutaneous Manifestations in Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study

Chirag Jayantibhai Vamja 

¹Assistant Professor, Department of Dermatology, Shantabaa Medical College, Amreli

Abstract

Introduction: Diabetes mellitus type 2 is one of the chronic diseases related to many skin problems owing to high blood sugar, immune system dysregulation, and vascular problems. Skin findings may act as markers for the onset of metabolic disorders. The study aimed to focus on the evaluation of the aspects of cutaneous findings in diabetic patients.

Method: The study was a cross-sectional observational study conducted among 110 patients of Type 2 Diabetes Mellitus in a tertiary healthcare centre. Clinical examination, medical history, and laboratory investigation were conducted. The parameters of blood, bacterial culture, gram staining, KOH mount, and fungal culture were analysed in order to diagnose the skin manifestations and infection.

Results: Out of 110 diabetic patients studied, acrochordons (21.8%), candidal balanoposthitis (19.1%), and furunculosis (18.2%) constituted the highest frequencies of dermatosis. Infective dermatosis was the most frequent, with 69 cases of bacterial infection and 79 cases of fungal infection noted. Microbiological study revealed that there were 30 cases of bacterial cultures and 37 cases of fungal cultures. Infective dermatosis was mainly observed among patients with diabetes for less than 5 years.

Conclusion: The study concluded that the cutaneous manifestations are mostly common among Type 2 diabetic patients, with infectious dermatoses. Early dermatological evaluation and the microbiological evaluation can aid in improvement of the diagnosis, management and the prevention of the diabetes-related skin complications.

Keywords: Type 2 Diabetes Mellitus, Cutaneous Manifestations, Dermatoses, Fungal Infection, Bacterial Infection

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1 | INTRODUCTION

Type 2 diabetes mellitus is an exponentially growing chronic metabolic disease in developing countries. According to the international diabetes federation, 382 million people suffered from diabetes in 2013 and were expected to be 592 million in 2035, and 80% of diabetes cases are in developing countries. (1) It was estimated that the Global Burden of Disease (GBD) Study 2010 showed an increase in mortality due to diabetes from 16.3 to 19.5 per 1 Lakh people, when adjusted for age (2). The prevalence of diabetes has increased dramatically in the last few decades, and according to the World Health Organisation's Global Report on Diabetes 2016, today the disease affects more than 400 million people worldwide, causing a significant burden of disease throughout the world. The basic pathological features of T2DM are chronic insulin resistance and gradual loss of pancreatic beta-cell function, which lead to sustained hyperglycemia in the systemic circulation. Excessive blood glucose levels start a chain of complicated pathways, one of which is the generation of advanced glycation end-products (AGEs). These systemic changes lead to changes in the structure of the components of the extracellular matrix, with the crosslinking of essential components of the dermal matrix (collagen and elastin) affecting the normal mechanical and structural integrity of peripheral tissues. (3) The lifelong effects of chronic hyperglycemia, characterised by widespread microvascular and macrovascular damage which eventually leads to end-organ dysfunction in multiple organ systems, as defined by the landmark UK Prospective Diabetes Study (UKPDS) Group (1998), make good metabolic control so important. (4)

The skin is a metabolically active organ and represents the direct reflection of the internal metabolic balance and is, therefore, very sensitive to the pathological disturbances of T2DM. In systemic hyperglycemic states, there are several different pathways that disrupt the architecture of the skin. Structural abnormalities are severe in the dermal vessels due to the microangiopathy, which results in thickening of the endothelial basement membrane and a decrease in the localised tissue perfusion. (5) It was shown that

these changes have a significant effect on the micro-circulatory function of the skin, reducing its ability to withstand slight skin injuries. At the same time, eccrine sweat glands are also affected by autonomic neuropathy, resulting in very dry skin and reduced viscoelastic properties of the skin. (6) So the skin lesions one sees in the clinic are quite varied and can be classified as clear cases. These dermatological signs can be grouped into four categories: Cutaneous infections, both bacterial and fungal; Non-infectious dermatoses strongly associated with diabetes (Acanthosis Nigricans, Necrobiosis Lipoidica, Diabetic Dermopathy); Manifestations secondary to severe microvascular or macrovascular disease (ischemic changes, neurotrophic foot ulcers); Cutaneous side effects resulting from oral hypoglycemic agents or insulin therapies. (7) Epidemiological studies have shown that at some point in the course of their disease, up to one-third of all diabetes patients develop some form of skin involvement, and certain lesions serve as good surrogate markers for unrecognised internal metabolic derangements. (5, 7) Although it is known that there are pathophysiological correlations, skin involvement is often underestimated or disregarded in routine clinical assessment, which is often driven by the routine assessment of the more serious renal, retinal or cardiovascular complications. But any skin problem is frequently the first noticed sign of sub-optimal glycemic control or advancing microvascular damage. The prevalence and clinical presentation of these diseases may be greatly affected by geographic variations in climate, personal hygiene, and medical services.

This cross-sectional study aimed to investigate the prevalence, to define the different clinical spectrum of the skin manifestations and to mathematically correlate these with the objective metabolic parameters, Glycated Haemoglobin (HbA1c) levels and the overall duration of diagnosed T2DM in our local

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Assistant Professor ,Department of Dermatology
,Shantabaa Medical College, Amreli

patient population.

2 | METHOD

Research design

The study was a cross sectional study which to evaluate the prevalence and the Spectrum of Cutaneous Manifestations among patients with diabetes. The study was conducted in the Department of Dermatology and Diabetic Clinic of a Tertiary Care Centre Hospital. The study included 110 patients those who were diagnosed with the Type 2 Diabetes Mellitus. The patients were analysed for several dermatological manifestation like clinical assessment, medical history, duration of diabetes, family history and laboratory analysis. The ethical approval was taken from the Institutional Ethics Committee. Both written and informed consent were taken for the study. Selection of patient was done under certain predefined inclusion and exclusion criteria.

Inclusion criteria

- Those who were diagnosed with the Type 2 Diabetes Mellitus (T2DM) were selected for the study.
- Those who were presented with the dermatological signs and/or symptoms were included
- Both written and verbal consent required for the study.

Exclusion criteria

- Patients of age below 30 years of age were excluded.
- Those who were diagnosed with the impaired glucose tolerance without the presence of diabetes were excluded.
- Gestational diabetes or those who were diagnosed with Type 1 Diabetes Mellitus were excluded.
- Unwilling candidates were not selected.

Procedure

Patients with informed consent taken for the study and the 110 selected participants were analysed with the demographic parameters, duration of diabetes, history of treatment, glycemic status, family history of diabetes and other dermatological complaints. All

of the patients were underwent with the clinical assessment with focus on identification and documentation of several cutaneous manifestations related with the Type 2 Diabetes Mellitus. The dermatological findings were recorded on the basis of the clinical presentation and were categorized into infective and non-infective dermatoses. Laboratory analysis was done and 5 ml blood samples were collected from veins and were stored under aseptic conditions. Sample analysis was done for the blood glucose levels, complete blood count (CBC), liver function tests (LFT), and renal function tests (RFT) for evaluating the metabolic and systemic status. Those who were presented with the infective dermatoses, samples were collected for the microbiological assessment. The bacterial infections were evaluated by the use of Gram staining and bacterial culture for organism identification. The fungal infections were assessed by the potassium hydroxide (KOH) mount examination, and gram staining procedure for candida detection and the fungal culture. The clinical and laboratory findings were evaluated to determine the rate of prevalence, distribution and the spectrum of cutaneous disorder among diabetic patients.

Statistical analysis

Data analysis was done by the use of SPSS software of version 27. The categorical variables were represented in the form of frequency and percentage. The rate of prevalence and the distribution of the cutaneous manifestations were analysed among the diabetic patients. Several statistical tests were performed to evaluate the association between the dermatoses and clinical factors like the duration of diabetes and family history. The p-value <0.05 was considered for maintaining the statistical significance.

3 | RESULTS

The table 1 showed that the distribution of the dermatological manifestations noted among 110 patients. Out of all recorded dermatoses, the acrochordons were the most commonly observed condition, among 24 patients, 21.8% which was followed by the candidal balanoposthitis among 21 patients and furunculosis among 20 patients. Some of the common

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fungal infections include the tinea corporis among 19 patients, generalized pruritus among 15 patients, and 13 each in lichen planus and vitiligo. Some infective conditions like cellulitis (10%), folliculitis (8.2%), pyogenic ulcer (8.2%), and candidal vulvovaginitis (8.2%) were also noted. Some of the rare conditions were reported, which include the erythrasma (1.8%), candidal intertrigo (2.7%), carbuncle (2.7%), and tinea manum (2.7%). Also the infective dermatoses showed high rate of occurrence rather than the individual non-infective manifestations.

The table 2 showed the distribution of the methodological evaluation of the bacterial dermatoses among diabetic patients. Out of total 69 patients with bacteria skin problem, 43 cases were used for microscopy and culture. Also 30 samples showed Gram-positive organisms, while no Gram-negative organisms were noted. The most common bacterial dermatosis was Furunculosis, which affected among 20 patients, and 12 samples were analysed and 8 cases showed Gram staining and culture growth. The second condition was the Pyogenic ulcer, with 6 culture positive cases noted among 8 samples. Ecthyma, folliculitis, and pyogenic abscess showed the growth of bacteria. 30 cases showed culture positivity, while 13 cases were noted with no growth of microbes.

emonstrated the mycological assessment of the fungal dermatoses observed among diabetic patients. Out of total 79 patients with fungal disorder, about 61 samples were analysed by microscopy and culture, 46 cases showed the positive finding regarding the KOH samples and 37 samples showed fungal growth on culture. 40 patients showed Candidal infections, where the most common presentation was the candidal balanoposthitis among 21 cases, which was followed by the vulvovaginitis, paronychia, and intertrigo. Among other infections of dermatophyte, the tinea corporis was the most predominant condition noted among 19 cases, which was followed by the tinea pedis and onychomycosis. High rate of KOH and the positive culture indicated the involvement of fungus among diabetic patients, which highlighted the significance of the laboratory diagnosis for accurate investigation and antifungal management.

tated the distribution of infective and non-infective dermatoses on the basis of the duration

of diabetes among 110 patients. Out of the total population of study, 62 patients showed the infective dermatoses, while 48 patients showed the non-infective dermatoses. 80 patients had diabetes of less than 5 years, while infective dermatoses was noted among 50 patients, with 30 patient showed the non-infective manifestations. 30 patient showed the duration of duration as more than 5 years, 12 patients showed infective dermatoses and non-infective dermatoses was observed among 18 patients. The most frequently observed was the infective dermatoses, among patients with short duration of diabetes.

howed the association between the family history of diabetes mellitus and the rate of occurrence of the dermatoses among diabetic patients. Out of 110 patients, 51 patients showed positive family history for diabetes mellitus, while 59 patients had no history of diabetes. The Dermatoses preceded with the identification of diabetes among 36 patients, which included the 20 patients with the family history of diabetes and 16 patients with no family history. Contrastingly, dermatoses did not preceded the diagnosis of diabetes among 74 patients, which showed that 31 patients with family history and 43 patients without family history. Thus, high proportion of patients showed dermatoses after the diagnosis of diabetes, which indicated the relationship of the cutaneous manifestations with diabetes.

4 | DISCUSSION

In this cross-sectional study of the study group, the prevalence of skin conditions was high among patients with T2DM. This is likely to be comparable to that found in the literature from previous clinical experience, where skin architecture is remarkably spared in chronic hyperinsulinaemic and hyperglucose states. The overall prevalence is comparable with that reported by Rahul Ragunatha et al. (2011), who reported up to 91.2% of the assessed diabetic population having cutaneous findings. (8) This is a very high rate, which means that the skin very clearly reflects internal metabolic stress. In our results, we found that variables such as age progression, male

TABLE 1: Distribution of Various Dermatoses among Diabetic Patients

Dermatoses	No. of Patients (n = 110)	Percentage (%)
Acanthosis Nigricans	10	9.1
Acrochordons	24	21.8
Candidal balanoposthitis	21	19.1
Candidal intertrigo	3	2.7
Candidal paronychia	7	6.4
Candidal vulvovaginitis	9	8.2
Carbuncle	3	2.7
Cellulitis	11	10
Diabetic dermopathy	5	4.5
Diabetic neuropathy	6	5.5
Necrobiosis lipoidica diabetorum	4	3.6
Ecthyma	5	4.5
Erysipelas	5	4.5
Erythrasma	2	1.8
Folliculitis	9	8.2
Furunculosis	20	18.2
Bullosis diabetorum	5	4.5
Generalized pruritus	15	13.6
Lichen planus	13	11.8
Onychomycosis	7	6.4
Perforating dermatoses	6	5.5
Pyogenic abscess	5	4.5
Pyogenic ulcer	9	8.2
Tinea corporis	19	17.3
Tinea manum	3	2.7
Tinea pedis	10	9.1
Vitiligo	13	11.8
Xanthelasma	11	10

gender, etc., are related to different groups of lesions when considering the demographic variables. This is in line with the baseline characteristics of demographic characteristics observed by Mahajan et al. (2003), which indicated age differences in skin morphology and occupational environmental exposures as a possible explanation for differences in non-infectious versus infectious cutaneous profiles. (9) The recorded clinical spectrum can be broken down easily into three groups: metabolic, infectious and vascular. Non-infectious lesions, such as Acanthosis Nigricans, were present in many of our patients. The biochemical cause of this condition is the direct stimulation of the insulin-like growth factor-1 (IGF-1) receptor on dermal fibroblasts and

keratinocytes by high serum insulin. It causes abnormal proliferation of the epidermis and clinically visible hyperpigmented plaques. (10) On the other hand, infectious expressions such as superficial fungal infections (Tinea pedis and candidiasis) made up a large proportion of our data. This has been noted by Gupta et al. (2003) as the overgrowth of fungal species such as opportunistic dermatophytic and yeast species in the presence of high glucose concentration in local sweat and local tissues, and a weak barrier function in the dermis. The main result achieved by this study is the existence of a great correlation between metabolic dysfunction and the existence of skin manifestations, both in their severity and duration. There was a significantly higher

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TABLE 2: Microbiological Evaluation of Bacterial Dermatoses among Diabetic Patients

Clinical Entity	No. of Patients	Sampled for Microscopy & Culture	Gram Stain (+ Organism)	Gram Stain (– Organism)	No. of Cases with Growth on Culture	No Results
Furunculosis	20	12	8	–	8	4
Pyogenic ulcer	9	8	6	–	6	2
Ecthyma	5	5	4	–	4	1
Folliculitis	9	6	4	–	4	2
Pyogenic abscess	5	5	4	–	4	1
Erysipelas	5	–	–	–	–	–
Carbuncle	3	3	2	–	2	1
Cellulitis	11	4	2	–	2	2
Erythrasma	2	–	–	–	–	–
Total	69	43	30	–	30	13

TABLE 3: Mycological Evaluation of Fungal Dermatoses among Diabetic Patients

Clinical Entity	No. of Patients	Sample for Microscopy and Culture	KOH Mount Positive	Positive for Culture
Candidal infections				
Candidal balanoposthitis	21	16	12	10
Candidal vulvovaginitis	9	6	4	3
Candidal paronychia	7	5	4	3
Candidal intertrigo	3	2	1	1
Total (Candidal infections)	40	29	21	17
Dermatophyte infections				
Tinea corporis	19	15	12	9
Tinea pedis	10	8	6	5
Tinea manum	3	3	2	2
Onychomycosis (Tinea unguium)	7	6	5	4
Total (Dermatophyte infections)	39	32	25	20
Overall Total	79	61	46	37

TABLE 4: Association of Pattern of Dermatoses with Duration of Diabetes Mellitus Among Diabetic Patients

Pattern of Dermatoses	Duration of Diabetes Mellitus		Total
	< 5 Years	> 5 Years	
Infective dermatoses	50	12	62
Non-infective dermatoses	30	18	48
Total	80	30	110

TABLE 5: Association Between Family History of Diabetes Mellitus and Onset of Dermatoses Among Diabetic Patients

History of DM	Dermatoses preceded the detection of DM	Dermatoses did not precede the detection of DM	Total
Family history of DM	20	31	51
No family history of DM	16	43	59
Total	36	74	110

relative risk of acute cutaneous infections in cases with poor glycemic control (HbA1C profiles). (11) This clinical correlation is supported by the studies of Goyal et al (2010) on the effect of poorly controlled hyperglycemia on the function of PMNs, which include impaired chemotaxis and phagocytosis, thus increasing the risk of a patient being attacked by recurrent bacterial and fungal infections. In contrast, microvascular markers of the skin—including diabetic dermopathy (shin spots) and significant cutaneous xerosis—had stronger associations with the total time spent in T2DM than with current HbA1c levels. (12) This is a time-dependent relationship, which is similar to observations of Pavlović et al. (2007, which demonstrate that structural end-organ microangiopathy occurs gradually, and only after chronic exposure to systemic metabolic stress. (13)

Sustained, comprehensive, routine visual skin screening as part of routine diabetes management is essential to finding peripheral issues at an early stage, since symptoms such as xerosis or fungal infections could herald more serious complications such as ulcers or gangrene. Although no cause-and-effect relationship can be ruled out with this cross-sectional study design, the high prevalence of these conditions means these are good non-invasive markers of metabolic instability and microvascular damage. According to the study analysis, endocrine

and metabolic disorders are the top clinical groups that have secondary dermatological changes at the highest frequencies. (14) These results support the need for regular dermatological evaluations to complement an interdisciplinary approach to complication prevention and better outcomes for the patient, which is recommended in the American Diabetes Association (2015) Standards of Care (15). Periodic, preventive skin examinations help to treat the skin before microvascular problems become serious and/or threaten the limbs.

5 | CONCLUSION

This study concluded that diabetes mellitus is correlated with many forms of cutaneous manifestations, especially infectious types, in which infective dermatoses predominate. The most common were acrochordons, candidal balanoposthitis, furunculosis, and tinea corporis. The study found high risk of cutaneous complications for diabetic patients. The microbiological analysis showed the predominance of Gram-positive bacteria in such disorders as furunculosis and pyogenic ulcers, and mycological examination indicated the presence of *Candida* species and dermatophytes. The study found that infective dermatoses were more common in patients with a

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short period of diabetes, while non-infectious skin disorders occurred in patients with chronic diabetes. The positive family history of diabetes was found to be correlated with the early occurrence of dermatoses prior the diagnosis of diabetes.

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