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A study on pattern of skin manifestations in diabetes mellitus and correlation with glycosylated hemoglobin levels

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Abstract

Involvement of skin is a key component in diabetes mellitus to the extent of 79.2% of the diabetics. This study was conducted among the patients with diabetes mellitus attending the Department of DVL. Current study assessed the clinical pattern of cutaneous manifestations in patients of Diabetes mellitus and its correlation with glycosylated haemoglobin levels. 37.5% of the study subjects had diabetes since 1-5 years and 40% had since 5-10 years. 8.3% of the cases in this study had family history of diabetes. Hypertension was main co morbidity and present in 10% of the study subjects. 40.6% of the study subjects had cutaneous infections, 32.6% had cutaneous manifestations which are not specific to diabetes mellitus. Strong to weak association of cutaneous manifestations to diabetes mellitus was present in 24.6% of the cases. 21.7% of the patients in this study had fungal infections, 15.2% had bacterial infections and 3.6% had viral infections. Among the fungal infections, Candidal balanoposthitis, Candidal vulvovaginitis, Intertrigo, Onychomycosis, Tinea corporis, Tinea cruris and Tinea manuum were common. In the bacterial infections, folliculitis, furuncle, erythrasma, Pitted keratolysis, Paronychia, cellulitis and carbuncle were common. Herpes zoster was the common viral infection which was present in 2.9% of the patients and verruca vulgaris was present in 0.7% of the study subjects. In the cutaneous manifestations which had strong to weak association with diabetes mellitus, vitiligo, Diabetic dermopathy, Acanthosis nigricans, Lichenplanus, Xanthoma, Granuloma annulare, Kyrle's disease, Scleroderma of Buschke and Bullosis diabeticorum were present in this study. Insulin lipodystrophy was present in 0.7% of the cases. Among the cutaneous manifestations which were not specific to diabetes mellitus, generalized xerosis, Acrochordans, Psoriasis, Dermatosis papulosa nigra, Cherry angiomas and Schamberg's Disease were present. Seborrheic keratosis and Idiopathic guttate hypomelanosis were also seen. Hyperkeratotic eczema, Macular amyloidosis, Exfoliative dermatitis, Urticaria, Pityriasis rosea, Lichen simplex chronicus, Acquired ichthyosis, Polymorphic light eruptions, and Melasma. Leucocytoclastic vasculitis, Porokeratosis, Contact dermatitis, keloids and Lipodystrophy were the other non-specific manifestations. The mean random blood sugar levels among was 250.6±82.1 mg/dl, fasting blood sugar level was 175.2±52.6 mg/dl and post prandial blood sugar level was 242.4±81.4 mg/dl. The HbA1c level was normal in 7.5% of the study subjects, 12.5% had good control, 41.7% had fair control and 38.3% had poor control. 35.7% of the study subjects aged between 41 – 50 years had cutaneous infections, 31.3% had lesions which are not specific to DM and 35.3% had lesions with strong to weak association with DM. This difference was not statistically significant. Majority of patients with cutaneous manifestations (80.5%) were seen in patients with fair to poor control of diabetes mellitus. There was a statistical significance ($p < 0.000$) between cutaneous infections and glycosylated hemoglobin. 42.9% cutaneous infections, 20.0% with non-specific lesions to DM and 47.1% with strong to weak associations with DM had poor glucose control. 57.1% of the patients with cutaneous infections, 35.6% of the patients with lesions not specific to diabetes mellitus, 32.4% with strong to weak association to DM and 66.7% of the patients with complications of diabetes mellitus had fair control of diabetes mellitus as per HbA1c levels. 40.4% of the patients with cutaneous infections, 35.7% of patients with lesions not specific of diabetes mellitus and 48.4% of patients with strong to weak association of diabetes mellitus had diabetes since 5– 10 years. Poorly controlled sugar levels were the main cause for most of the cutaneous manifestations as evident in this study. A good glycemic control reduces the incidence and severity of the cutaneous disorders. However, several nonspecific cutaneous disorders that occur in diabetic patients can increase the likelihood of exposure to infectious organisms and contact allergens, resulting in chronic and recurrent infections and eczemas. Early detection of potentially grave or predisposing conditions and providing a comprehensive diabetic care to the patients is strongly advocated.

Keywords: Glycemic control, eczemas, cutaneous disorders, diabetes mellitus

Introduction

Diabetes mellitus (DM) is a major lifestyle disorder, which is fast gaining the status of a potential epidemic in India and World. It is a most common endocrine disorder across the

world. It is a heterogenous condition characterized by hyperglycemia as a consequence of defects in insulin secretion and variable degrees of insulin resistance [1]. Diabetes mellitus is an “Iceberg disease” affecting 422 million people worldwide and set to increase to 592 million by the year 2035. It is the commonest endocrine disease with every fifth diabetic in the world lives in India. Diabetes mellitus is an established risk factor for morbidity and mortality [2]. Diabetes Mellitus may be accompanied by other biochemical disturbances and the presence of progressive diabetic tissue damage with microvascular complications including retinopathy, neuropathy and nephropathy and macrovascular complications including cardiovascular, cerebrovascular and peripheral vascular diseases [3]. DM can be further characterized into type 1 Diabetes mellitus (T1DM) and type 2 Diabetes mellitus (T2DM). T1DM is a chronic immune mediated disease that is characterized by selective loss of insulin producing β cells in the pancreatic islet. T2DM is characterized by reduced insulin signaling and/or insulin production with subsequent β – cell dysfunction.

Involvement of skin is a key component in Diabetes mellitus. The data available shows that, skin disorders will be present in 79.2% of people with diabetes [4]. Skin is particularly important in diabetics because it does get involved in one way or other. The prevalence of cutaneous infections is more in DM type 2 whereas autoimmune conditions are commonly associated with DM type 1 [5]. It has been observed that at least 43-66% of patients with diabetes mellitus have some type of cutaneous involvement during the course of their chronic disease, and 20-55% of these patients have uncontrolled diabetes. Uncontrolled diabetes increases the risk of development of microangiopathy and related complications [6].

There are many skin manifestations in DM, which may vary from trivial to life threatening but none of them are pathognomonic of the disease. Some cutaneous manifestations in diabetes mellitus are relatively specific “markers” of the condition, usually caused by the metabolic changes in diabetes or associated with endocrine disorders that cause diabetes. Other skin conditions develop as manifestations of chronic diabetic complications, particularly vascular changes and peripheral neuropathy. Skin infections are more common in people with poorly controlled diabetes, but not specific for the condition. Cutaneous side effects of drug treatment for diabetes may occur, although these are less common with current therapies [7].

The cutaneous manifestations include number of conditions which may be specific and much more common in people with diabetes than general population (e.g., necrobiosis lipoidica). The cause of many of these conditions remains obscure, although some may be related to the process of non-enzymatic glycation of cutaneous structural proteins, particularly collagens or changes in microvascular structural proteins. A number of cutaneous conditions were previously thought to have an increased incidence in diabetes, but subsequent studies have not substantiated these links (e.g., generalized pruritus) [8]. The evidence that granuloma annulare is associated with diabetes is inconclusive [9].

Glycosylated (Or glycated) hemoglobin (*HbA1c*) is a form of hemoglobin used primarily to identify the average plasma glucose concentration over prolonged periods of time. It is a parameter of checking blood glucose control in diabetics

over the past 3 months. The reference range (That found in healthy persons), is about 5%-7%. A diabetic person with good glucose control has Hb A1c level that is close to or within the reference range [10].

The present study is significant in view of the increasing prevalence of diabetes mellitus in the present scenario of a sedentary life style in the general population. A study of this kind will help in knowing the pattern of mucocutaneous manifestations in Diabetic patients in this region and also the association of these mucocutaneous manifestations with the control of Diabetes as the study includes assessment of glycosylated haemoglobin.

Aim: To assess the clinical pattern of cutaneous manifestations in patients of Diabetes mellitus and its correlation with Glycosylated haemoglobin levels.

Materials and Methods

A cross sectional study was conducted among the patients with diabetes mellitus attending the Department of DVL. About 120 patients attending the outpatient department during the study period constituted the study sample.

Inclusion criteria: All confirmed (Old and new) cases of Diabetes Mellitus with mucocutaneous manifestations irrespective of age, sex, duration of illness and associated diseases, willing to participate in the study.

Exclusion criteria: Patients with chronic renal failure, Pregnancy, Retropositive Patients, Serum electrolyte abnormalities, and Non complying patients who do not consent to participate in the study.

Procedure: All the patients who were diagnosed to have Diabetes mellitus according to the revised ADA criteria were subjected for a detailed history with regards to the cutaneous complaints, duration, family history and treatment of diabetes mellitus were noted.

All the patients were subjected for complete cutaneous and systemic examination under good lighting conditions.

Relevant investigations including Fasting blood sugar (FBS), random blood sugar (RBS), post prandial blood sugar (PPBS), glycosylated hemoglobin (HbA1c) were done.

Investigations like Gram’s staining, Potassium hydroxide (KOH) mount, Wood’s lamp, Skin biopsy and Tzanck smear were done in relevant cases to diagnose cutaneous manifestations associated with DM.

Gram’s staining: It is a bacteriological laboratory technique. The specimen obtained is smeared onto a clean dry glass slide and is heat fixed. Then, the smear is stained with crystal violet for one minute and later Gram’s iodine is added and kept for one minute. After this, the smear is washed with tap water and is decolorized with acetone for 30 seconds. After washing with tap water, it is counter stained with Carbol fuchsin for 30 seconds. The smear is then dried and was examined under oil immersion lens.

Potassium hydroxide (KOH) mount: For skin lesions, material is scraped with a flat edge of a sterile scalpel blade. The skin above the site should be pulled up with one hand and the scalpel edge moved across the edge of the lesion with the other.

For vaginal mucous membrane, a speculum examination is done and vaginal discharge is collected from the posterior fornix using a sterile swab. From the glans penis, the specimen is collected using a sterile swab after retracting the prepuce.

In cases of nail involvement, the deeper keratinous material from the nail bed and the nail clippings were collected. In cases of paronychia, the specimen is collected by expressing the pus from below the nail folds.

Mounting of specimen: The specimen is placed on a clean dry glass slide and 10% potassium hydroxide is added for skin and mucous membrane specimens. It is then covered by a cover slip and gently preheated before examining for fungi. In case of nail specimens, 20% potassium hydroxide is taken in a test tube and clippings were kept in it overnight. The specimen is then examined the next day. Initial examination is with low power (10x) magnification, followed by high power (40x) magnification to study the morphology of the fungus. The patient is examined in dark room. Ideally the lamp is allowed to warm for about one minute. The lamp is held 4-5 inches from the lesion. In case of erythrasma, a coral red fluorescence is observed and in tinea versicolor, a golden yellow fluorescence is observed.

Skin biopsy: A punch biopsy is performed from the lesional skin in conditions such as psoriasis, lichen planus, diabetic dermopathy, Kyrle's disease and granuloma annulare. After an informed consent, the selected site is cleaned with spirit and is infiltrated with 2% lignocaine. A skin biopsy punch of suitable size is held perpendicular to the skin surface with the right hand whereas the left hand is used to make the skin tight by stretching perpendicular to relaxed skin tension lines. The punch is firmly pushed against the skin and rotated between the thumb and forefinger, so as to carry the punch up to the subcutaneous fat. The punch is then slowly withdrawn and specimen is elevated and cut at its base using a curved iris scissor and is placed in a container with 10% formalin and sent for histopathological examination.

Tzanck smear: For viral infections, samples are taken from a fresh vesicle. The vesicle is unroofed and the base is scraped with a scalpel. The material is transferred to a clean glass slide. The specimen was fixed using formalin and is stained using giemsa stain. The giemsa stain is poured onto the slide and kept for 15 minutes and is then washed off with water and is examined under the microscope with an oil immersion objective. The presence of multi-nucleated giant cells are characteristic. The data collected was analyzed using the Statistical Package for Social Services. The categorical data was presented as frequencies and percentages. Chi square test was used as the test of significance. The quantitative variables were presented as measures of central tendency and dispersion.

Results

About 7 (5.8%) of the study subjects had diabetes mellitus since less than 1 year, 45 (37.5%) of the study subjects had diabetes since 1 – 5 years, 48 (40%) had since 5 – 10 years, 12 (10%) had diabetes since more than 10 years and 8 (6.7%) of the study subjects were newly diagnosed. Hypertension was the main comorbidity and present in 12 (10%) of the study subjects, hypercholesterolemia was present in 7 (5.8%) of the study group and hypertriglyceridemia was present in 6 (5%) of the study

subjects. This study had shown that, about 56 (40.6%) of the study subjects had cutaneous infections, 45 (32.6%) had cutaneous manifestations which are not specific to diabetes mellitus. Strong to weak association of cutaneous manifestations to diabetes mellitus was present in 34 (24.6%) of the cases and 3 (2.2%) patients had cutaneous lesions which are the complications of DM.

Out of 56 (40.6%) of patients with cutaneous infections in the study subjects, 30 (21.7%) had fungal infections, 21 (15.2%) had bacterial infections and 5 (3.6%) had viral infections.

Among the total of 30 study subjects with fungal infections, 7 (5.1%) had intertrigo, 1 (0.7%) had candidal vulvovaginitis, 7 (5.1%) had candidal balanoposthitis, 2 (1.4%) had onychomycosis, 3 (2.2%) had Tinea corporis, 2 (1.4%) had Tinea cruris and 1 (0.7%) had Tinea mannum, 2 (1.4%) had Tinea pedis and 4 (2.9%) had Tinea versicolor.

The distribution of bacterial infections among 21 study subjects had shown that, about 6 (4.3%) of the study subjects had folliculitis, 6 (4.3%) had furuncle, 2 (1.4%) each had erythrasma, pitted keratolysis, paronychia, cellulitis and 1 (0.7%) had carbuncle.

Herpes zoster was the common viral infection which was present in 2.9% of the patients and verruca vulgaris was present in 0.7% of the study subjects.

In the cutaneous manifestations which had strong to weak association with diabetes mellitus, vitiligo was present in 7 (5.1%) of the study subjects, diabetic dermopathy was present in 6 (4.3%) of the cases, Acanthosis nigricans was present in 6 (4.3%) of the cases, Lichen planus was present in 5 (3.6%) of the cases, Xanthoma was present in 3 (2.2%) of the cases, 2 (1.4%) of the cases had Granuloma annulare, Kyrle's disease, Scleroderma of Buschke and 1 (0.7%) case had Bullosis diabeticorum.

Among the cutaneous manifestations which were not specific to diabetes mellitus, 9 (6.5%) had generalized xerosis, 6 (4.3%) had Acrochordans, 3 (2.2%) each had Psoriasis, Dermatitis papulosa nigra, Cherry angioma and Schamberg's Disease. About 2 (1.4%) of the cases in this study had Seborrheic keratosis and Idiopathic guttate hypomelanosis. 1 (0.7%) each of the cases had Hyperkeratotic eczema, Macular amyloidosis, Exfoliative dermatitis, Urticaria, Pityriasis rosea, Lichen simplex chronicus, Acquired ichthyosis, Polymorphic light eruptions, Melasma, Leucocytoclastic vasculitis, Porokeratosis, Contact dermatitis, Keloids and Lipodystrophy. The mean random blood sugar levels among the study group was 250.6 ± 82.1 mg/dl, fasting blood sugar level was 175.2 ± 52.6 mg/dl and post prandial blood sugar level was 242.4 ± 81.4 mg/dl.

HbA1c was done of which 9 (7.5%) of the study subjects had normal values, 15 (12.5%) had good control, 50 (41.7%) had fair control and 46 (38.3%) had poor control.

The cutaneous lesions were more common among the patients with poor glucose control as per HbA1c levels. About 24 (42.9%) of patients with cutaneous infections, 9 (20.0%) with lesions not specific to diabetes mellitus, 16 (47.1%) with strong to weak associations and 2 (66.7%) of the patients with complications of diabetes mellitus, had poor glucose control. About 32 (57.1%) of the patients with cutaneous infections, 16 (35.6%) of the patients with lesions not specific to diabetes mellitus, 11 (32.4%) with strong to weak association and 1 (33.3%) case with complications of diabetes mellitus had fair control of diabetes mellitus as per HbA1c levels. Majority of the patients 71 (55.5%) with cutaneous manifestations had diabetes mellitus for a duration of 5 years and above and 57 (44.5%) of patients

had diabetes of less than 5 years duration. About 21 (40.4%) of the patients with cutaneous infections, 15 (35.7%) with non-specific lesions of diabetes mellitus and 15 (48.4%) with strong to weak association of diabetes and 3 (100%)

cases with complications of DM had diabetes since 5 – 10 years. This difference in duration of diabetes mellitus was not statistically significant between the different types of lesions and cutaneous manifestations.

Table 1: Distribution of patients

	Number of cases	Percentage
Age in years		
≤ 20	2	1.7
21 – 30	4	3.3
31 – 40	9	7.5
41 – 50	45	37.5
51 – 60	35	29.2
> 60	25	20.8
Sex		
Male	74	61.7
Female	46	38.3
Type of DM		
T1 DM	6	5.0
T2 DM	114	95.0
Status of diabetes		
Known diabetic	112	93.3
Newly diagnosed (Incidental)	8	6.7
Duration of diabetes mellitus		
Less than 1 years	7	5.8
1 – 5 years	45	37.5
5 – 10 years	48	40.0
More than 10 years	12	10.0
Newly diagnosed	8	6.7
Family history of diabetes mellitus		
Yes	10	8.3
No	110	91.7
Systemic associations		
Absent	106	88.3
Present	14	11.7
Co morbidities		
Hypercholesterolemia	7	5.8
Hypertriglyceridemia	6	5.0
Cutaneous manifestations		
Cutaneous infections	56	40.6
Not specific to diabetes mellitus	45	32.6
Strong to weak association	34	24.6
Complication of diabetes mellitus	3	2.2
Cutaneous infections		
Fungal infections	30	21.7
Bacterial infections	21	15.2
Viral infections	5	3.6

Table 2: Distribution of study group according to fungal infections

	Number of cases	Percentage
Intertrigo	7	5.1
Candidal vulvovaginitis	1	0.7
Candidal balanoposthitis	7	5.1
Onychomycosis	2	1.4
Tinea corporis	3	2.2
Tinea Cruris	2	1.4
Tinea mannum	1	0.7
Tinea pedis	2	1.4
Tinea versicolor	4	2.9
Bacterial infections		
Folliculitis	6	4.3
Furuncle	6	4.3
Erythrasma	2	1.4
Pitted Keratolysis	2	1.4
Paronychia	2	1.4
Cellulitis	2	1.4
Carbuncle	1	0.7
Viral infections		
Herpes Zoster	4	2.9
Verruca vulgaris	1	0.7

Table 3: Distribution of study group according to strong to weak association with DM and distribution of study group according to cutaneous manifestations not specific to DM

	No of cases	Percent
Strong to weak association with DM		
Vitiligo	7	5.1
Diabetic dermopathy	6	4.3
Acanthosis nigricans	6	4.3
Lichen planus	5	3.6
Xanthoma	3	2.2
Granuloma annulare	2	1.4
Kyrle's disease	2	1.4
Scleredema of buschke	2	1.4
Bullosis diabeticorum	1	0.7
Non-specific to DM		
Generalized xerosis	9	6.5
Acrochordans	6	4.3
Psoriasis	3	2.2
Dermatosis papulosa nigra	3	2.2
Cherry angioma	3	2.2
Schamberg's Disease	3	2.2
Seborrheic keratosis	2	1.4
Idiopathic guttate hypomelanosis	2	1.4
Hyperkeratotic eczema	1	0.7
Macular amyloidosis	1	0.7
Exfoliative dermatitis	1	0.7
Urticaria	1	0.7
Pityriasis rosea	1	0.7
Lichen simplex chronicus	1	0.7
Acquired ichthyosis	1	0.7
Polymorphic light eruptions	1	0.7
Melasma	1	0.7
Leucocytoclastic vasculitis	1	0.7
Porokeratosis	1	0.7
Contact dermatitis	1	0.7
Keloids	1	0.7
Lipodytropy	1	0.7

Table 4: Distribution of study group according to blood sugar levels & glycosylated hemoglobin levels

	No of cases	Mean± S.D	Minimum-maximum
RBS	120	250.6±82.1	130-497
FBS	120	175.2±52.6	105-403
PPBS	120	242.4±81.4	127-497
HbA1c Control	No of cases	Percent	
Normal (< 6%)	9	7.5	
Good control (6.01 – 7%)	15	12.5	
Fair control (7.01- 8%)	50	41.7	
Poor control (> 8%)	46	38.3	

Table 5: Distribution of study group according to cutaneous manifestations and hba1c levels

Spectrum of cutaneous manifestations	Normal (%)	Good control (%)	Fair control (%)	Poor control (%)
Cutaneous infections	0	0	32 (57.1)	24 (42.9)
Not specific to diabetes mellitus	6 (13.3)	14 (31.1)	16 (35.6)	9 (20.0)
Strong to weak association	3 (8.8)	4 (11.8)	11 (32.4)	16 (47.1)
Complications of diabetes mellitus	0	0	1 (33.3)	2 (66.7)
Total	9 (6.5)	18 (13.0)	60 (43.5)	51 (37.0)

χ² value=36.104, p value< 0.0001

Table 6: Distribution of study group according to cutaneous manifestations and duration of diabetes mellitus

Spectrum of cutaneous manifestations	< 1 year N (%)	1 – 5 years N (%)	5 – 10 years N (%)	> 10 years N (%)
Cutaneous infections	5 (9.6)	22 (21.0)	21 (40.4)	4 (7.7)
Not specific to diabetes mellitus	1 (0.7)	19 (45.2)	15 (35.7)	7 (16.7)
Strong to weak association	2 (6.5)	8 (25.8)	15 (48.4)	6 (19.4)
Complications of diabetes mellitus	0	0	3 (100.0)	0
Total	8 (6.2)	49 (38.3)	54 (42.2)	17 (13.3)

Discussion

The mean age of the subjects in the present study is 52.11 years. Majority of them are above 40 yrs, the range between 41-50 years constituting 37.5%, followed by 29.2% in the range of 51-60 years and 20.8% above the age of 60 years.

A study by Sandeepthi *et al.* had shown similar results as noticed in this study^[16].

As age increases, the duration of diabetes also increases and hence one can notice large number of cutaneous manifestations in old diabetics than newly diagnosed diabetics. Chronic hyperglycemia may lead to damage of all organs including skin. The patients may be exposed to ill effects of asymptomatic hyperglycemia for many years before DM is detected.

Most of the patients with diabetes mellitus having cutaneous manifestations were males in this study (61.7%) and females accounted for 38.3%.

Sandeepthi *et al.* also noticed similar results where males outnumbered females. Kadam *et al.* have noticed that, about 62% of the cases were males and 38% were females. Galdeano *et al.* also noticed the same^[12, 13].

About 95% of the cases with cutaneous manifestations in this study had type 2 DM.

The mean duration of type 1 diabetes mellitus was 47.2 years and type 2 diabetes mellitus was 26.83 years. About 40% of the cases had diabetes mellitus since 5 – 10 years. These results were similar to the study conducted by Timshina *et al.*^[14]

About 8.3% of the cases in this study had family history of diabetes.

In the present study out of 120 patients, 25 (20.83%) had associated comorbidities. Hypertension was the main comorbidity and present in 10% of the study subjects (48%), hypercholesterolemia was present in 5.8% of the study group (28%) and hypertriglyceridemia was present in 5% of the study subjects (24%).

Bhat *et al.* noted that the hypertension was present in 46.4% of the cases^[15].

This study had shown that, about 40.6% of the study subjects had cutaneous infections, 32.6% had cutaneous manifestations which are not specific to diabetes mellitus. Strong to weak association of cutaneous manifestations to diabetes mellitus was present in 24.6% of the cases and 2.2% of the patients had cutaneous lesions which are the complications of diabetes mellitus.

This study had shown that, 40.6% of the study subjects had cutaneous infections. Of them 21.7% had fungal infections, 15.2% had bacterial infections and 3.6% had viral infections.

The cutaneous infections occur in 20 – 50% of the diabetic subjects with poorly controlled sugar levels especially in type 2 DM. The poor controlled status might be the cause or consequence of the concurrent infections. The increased incidence of cutaneous infections in patients with diabetes mellitus can be attributed to the abnormal microcirculation, hypohidrosis, peripheral vascular diseases, diabetic neuropathy, decreased phagocytosis, impaired leucocyte adherence and delayed chemotaxis.

In the present study 56 patients had cutaneous infections out of which, fungal infections were seen in 30 (53.57%) patients which formed the majority. The fungal infections accounted for 21.7% of the total cases with cutaneous manifestations. Candidal balanoposthitis (5.1%), intertrigo (5.1%), onychomycosis (1.4%), tinea corporis (2.2%), tinea

cruris (1.4%), candidal vulvovaginitis (0.7%), tinea pedis (1.7%), tinea manuum (0.7%), tinea versicolor (2.9%) were the common fungal infections noticed in this study.

The distribution of bacterial infections had shown that, about 4.3% of the study subjects had folliculitis, 4.3% had furuncle, 1.4% had erythrasma, 1.4% each had pitted keratolysis, paronychia, cellulitis and 0.7% had carbuncle in the present study.

In a study by Kadam *et al.*, 8% had Folliculitis, 2% had furuncle, 2% had carbuncle, 1% had palmar abscess. The common organisms isolated were *Staphylococcus aureus* and *Staph epidermidis*.

Herpes zoster was the common viral infection which was present in 2.9% of the patients and verruca vulgaris was present in 0.7% of the study subjects.

In a study by Sandeepthi *et al.*, Herpes zoster was present in 1.5% of the cases and verruca vulgaris was present in 2% of the cases. In a study by Kadam *et al.*, Herpes simplex was present in 1% of the cases and herpes zoster was present in 1% of the cases.

In the cutaneous manifestations which had strong to weak association with diabetes mellitus, vitiligo was present in 5.1% of the study subjects, diabetic dermopathy was present in 4.3% of the cases, Acanthosis nigricans was present in 4.3% of the cases, Lichen planus was present in 3.6% of the cases, Xanthoma was present in 2.2% of the cases, 1.4% of each cases had Granuloma annulare, Kyrle's disease, Scleroderma of Buschke and 0.7% had Bullosis diabeticorum.

In a study by Sandeepthi *et al.*, Bullous diabeticorum was present in 3% of the cases, diabetic dermopathy was noticed in 2% of the cases, diabetic rubeosis in 1% of the cases and necrobiosis was present in 0.5% of the cases. Xanthesma was noticed in 1.5% of the cases and Eruptive xanthomas were present in 0.5% of the cases.

Mahajan *et al.* found diabetic dermopathy in 6% of patients, bullosis diabeticorum in 2% and granuloma annulare in 1% of them, which is similar to the findings in the present study^[16].

The presence of lichen planus in patients who were newly diagnosed to have diabetes have been revealed by the studies. Vitiligo had shown a close association with the diabetes mellitus. It has been proposed that the insulin at high concentrations may stimulate stimulate insulin like growth factor receptors on keratinocytes, thereby promoting epidermal cell proliferation. So, every patient of acanthosis nigricans should be investigated for DM and every patient of DM should be screened for acanthosis nigricans.

Generalized xerosis (5.1%), Acrochordans (4.3%), Psoriasis (2.2%), Dermatosi papulosa nigra, Cherry angioma and Schamberg's Disease (2.2%) were common skin lesions. About 1.4% of the cases in this study had Seborrheic keratosis and Idiopathic guttate hypomelanosis. About 0.5% of the cases had Hyperkeratotic eczema, Macular amyloidosis, Exfoliative dermatitis, Urticaria, Pityriasis rosea, Lichen simplex chronicus, Acquired ichthyosis, Polymorphic light eruptions, Melasma, Leucocytoclastic vasculitis, Porokeratosis, Contact dermatitis, keloids and Lipodys trophy.

The mean random blood sugar levels was 250.6 (\pm 82.1) mg/dl, fasting blood sugar level was 175.2 (\pm 52.6) mg/dl and post prandial blood sugar level was 242.4 (\pm 81.4) mmg/dl. In the present study about 43.33% of patients with cutaneous manifestations had fasting sugar levels between

70-150 mg/dl, 34.16% had fasting sugar levels between 150-200 mg/dl and 22.5% had fasting sugar levels of more than 200mg/dl.

In a study by Sandeepthi *et al.*, about 14% of the patients with cutaneous manifestations had sugar level between 70 – 150 mg/dl, 44% had sugar levels between 151 – 200 mg/dl and 42% had sugar levels of more than 200 mg/dl.

In the present study, 37% of patients had poor control, 43.5% had fair (Moderate) control, 13% had good control and 9% had normal values. Fair and poor control together comprised of 81.5% of the patients.

Timshina *et al.* found majority of the patients having good control of diabetes

Uncontrolled diabetes mellitus predisposes skin for various infections and also increases the risk of microangiopathy and related complications.

HbA1c levels done in 120 subjects revealed normal levels in 7.5% of the study group, 12.5% had good control, 41.7% had fair control and 38.3% had poor control. There is statistical significance (p value<0.001) between cutaneous infections and HbA1c levels; with all the patients (100%) showing fair to poor control of diabetes

In the present study, about 40.4% of patients with cutaneous infections, 35.7% of patients with lesions not specific to diabetes mellitus and 48.4% with strong to weak association of diabetes had diabetes since 5 – 10 years. All the patients with complications of diabetes mellitus for 5 – 10 years had DM since 5 – 10 years

Similar findings were also reported by Mahajan *et al* and Bhat *et al.* which are in concordance with the present study. Chronicity of diabetes plays a big role in the cutaneous manifestations. As the duration of DM increases, there is non-enzymatic glycosylation of dermal collagen and mucopolysaccharides, leading to various cutaneous manifestations and complications.

Conclusion

Poorly controlled sugar levels were the main cause for most of the cutaneous manifestations as evident in this study. A good glycemic control reduces the incidence and severity of the cutaneous disorders. However, several nonspecific cutaneous disorders that occur in diabetic patients can increase the likelihood of exposure to infectious organisms and contact allergens, resulting in chronic and recurrent infections and eczemas, respectively. Early detection of potentially grave or predisposing conditions and providing a comprehensive diabetic care to the patients is strongly advocated.

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