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Clinicopathological study of diabetic foot in Bundelkhand area with special reference to fungal infection in asymptomatic feet of diabetic patients

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ABSTRACT

Background: As with substantial increasing in incidence of diabetes mellitus in present century and with huge prevalence in population; the incidence of one of the dreadful complication of diabetes i.e. diabetic foot also increases, leading to increase morbidity and mortality. Fungal infection in foot is one of the underweighted cause of foot ulceration. These microulceration in conjunction with diabetes may leads to fulminant infection. The study comprised of 66 cases out of which 16 served as control. Aim and objectives of our study is to study the incidence of fungal infection in asymptomatic feet of diabetic patients, identification of the type of fungus, comparison with nondiabetics and clinicopathological study of the patients.

Methods: The present study was carried at Department of Surgery, MLB. Medical College, Jhansi, the study group was classified into two groups. Control group; this group comprised of non-diabetic patients with foot lesions. Disease group; diabetic patients with foot lesions. Webs scrapings were inoculated in Sabouraud's media slopes. Cultured media were examined after 3 days for the growth. Identification depends on colonial appearance and the morphology of the spores and by Gram, s and AFB Staining.

Results: By this study we conclude that fungal infection in asymptomatic foot of diabetes patient are significantly more than non-diabetic patients which is accentuated by duration, type, glycaemic control and practice of bare foot walking which makes diabetic patient more prone for diabetic foot. So, the foot care of patients of diabetes should include the prophylactic steps to prevent fungal growth.

Conclusions: By above study, we reasonably conclude that fungal infection in diabetic patients plays a pivotal role in formation of diabetic foot disease, so by eradication of fungal infection in asymptomatic foot of diabetic patient by general preventive methods and/or pharmacological methods may be beneficial in reducing morbidity and mortality in diabetic foot patients.

Keywords: Asymptomatic foot, Diabetic foot, Fungal infection

INTRODUCTION

The diabetes is on the rise in India and it is estimated that 62 million people have diabetes and every 4th diabetic is Indian. India is often referred as "Diabetic Capital" of the

world.^{1,2} As many as 25% of all diabetics are expected to develop severe problems during their life time. About 2-5% of diabetic develop foot ulcer annually. 40-60% of all non-traumatic lower extremity amputations are in diabetic.² Diabetic foot though still not fully understood

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but is Designated as "Syndrome" involving pain, deformation, inflammation, infection, ulceration, and tissue loss of foot either alone or in combination.³

The three pathologies affect the diabetic foot with interactions-Neuropathy Ischemia Infection And an occult pathology not very well realized but responsible in Immune dysfunction. Their combined impact is so great that it causes more amputations that any other lower limb disease. "Diabetic foot" though at presentation usually have combination of all the above-mentioned pathologies but are recognized and managed as per the dominant involvement, which could be either neuropathic, ischemic, septic, non-suppurative phlegmon deformities.⁴

Infection in diabetic foot are more severe and more difficult to treat as compared to non- diabetics because of prolonged hyperglycemia of the tissues, edema of tissue, microangiopathy and Immune dysfunction; neuropathy abolishes pain which is responsible for persistence, late recognition and spread of infection. Hence, "diabetic septic foot" is a serious medical problem requiring prompt attention appropriate diagnostic examination and proper therapeutic strategies. There can be three types of foot lesion in diabetics' septic lesions. Ulcer and ischemic lesion as stated by Theodore et al. Septic lesions comprised of any significant sepsis in the feet including cellulites, infected ulcers of planter abscesses. According to the study of Meade and Mucellar, there are three basic types of major foot infections in diabetes.

Abscess occurring in the deep spaces of foot, nonsupportive phlegmon of dorsum of foot, and infection of the mal-perforants neurotrophic ulcer of planter surface of the foot. Ischemic lesion includes gangrene, rest pain or threatened gangrene. Trauma i.e. mechanical, thermal or chemical is the most common etiological factor in development of gangrene. Other condition, influencing the development of the lesion is infection, arteriosclerosis and the diabetes itself.

The diabetic does not behave like the non-diabetic in relation to infection even when diabetes is well controlled. The diabetic is more susceptible to infection, localizes it with more difficulty and is prone to deep extension. It is therefore important to recognize the infection in the diabetic early and to treat it vigorously. This may be due malfunction of the leukocytes, which has been shown with decreased phagocytosis and decreased diapedesis (Howard et al). Hyperglycemia has been shown to interfere with leukocyte function and migration of leukocytes (Dreachaman et al. Ainsworth and Allison and Bagdade et al.). Various experimental and clinical data have been accumulated suggesting that it may be the blood glucose and not the presence or absence of diabetes mellitus per se that affects the host resistance.

Whereas the incidence of overall infection may not be increased in the diabetic, the response to specific infection is certainly increases by the complication of diabetes mellitus. Although the end of the infection process in the diabetic foot may be loss of limb or life or both. The initial event via break in the skin somewhere in the foot, followed by penetration of bacteria and local infection.7 It has been demonstrated that the moisture of the foot, especially in the toe web space increases the normal bacterial density of skin to over one million bacteria per square centimeter (Mailbach and Hildick-Smith). The presence of Corynebacterium minutissium, diphtheroid, Enterobacteriaceae, Pseudomonas candida in the toe webs contrast markedly with the coccal and lypophilic diphtheroid flora of lower calf. When peripheral vascular insufficiency and/or neurotrophic ulcers are present staphylococci and B-hemolytic Streptococci are most frequent invaders. (Normland; Forner, and Williams). Bybee and Rogers here found polymorph from acidotic diabetic patients' defective in capacity to phagocytize the bacteria. Dubas (has suggested that in acidosis, intra-cellular antibacterial substances may not be effective.^{8,9}

Although infections may alter diabetic control, the presence of diabetes itself does not change the response of local tissues to trauma and infection, except in the presence of neuropathy or vascular insufficiency (Bradely). Tissue anoxia resulting from poor blood supply probably contributes to the infection. Septicemia is more common when foot lesions are primarily due to deficient blood supply with superimposed infection than when the lesion is primarily due to infection in well vascularized foot (Mackittrick and Root). Involvement of the blood vessels is a significant factor and resultant ischemia is more frequently due to arteriosclerosis (Mckittrick and Root). 10 The vascular degenerative change occurs early in a diabetic as compared to nondiabetics. The disease is more wide-spread in the diabetic and more commonly involves the smaller distal vessels. In such a patient infection may result in serious gangrene (Pratt et al).¹¹

The chief distinguishing difference between the diabetic and non-diabetic foot is diabetic neuropathy (Ellenberg). There is increasing good evidence that this neuropathy develops early in patients with poorly controlled diabetes is due to segmental demyelination due to defect in the metabolism of the Schwann cells which is direct result of hyperglycemia. The presence of autonomic neuropathy may reduce the response to injury since the histamine induced triple response is reduced (Strokes et al. and Faris).¹² Microangiopathy in muscles and skin, manifested by thickened basement membranes and endothelial proliferation in the arterioles and capillaries are now considered as contributory factors for the foot lesion as studies by Goldberg et al., Moore et al. and Pederson.¹³ Siperstein et al. have suggested that may impede leucocyte migration from blood and impart adequate perfusion of nutrient and hormones at sites of bacterial invasion. Urbach, Proposed a condition of "Skin diabetes" responsible for increased susceptibility of diabetes for infections. 14,15

In addition to the bacteria, fungi are a problem in diabetic foot infections. The diabetics predisposes to two mucocutaneous mycotic infections, candidiasis and mucomycosis. Shedon and Bauer found a striking dissemination of subcutaneous mucor infections only during the period of acute diabetic acidosis and it was due to delay in leukocyte mobilization.

Scholar suggested that the diabetic patients may lack of protective protein, which is normally present in all individuals. These small proteins and being active against fungi other than candida albicans. Inter digital dermatophytosis predispose the infection because the resultant epidermal fissures and erosions create portals of entry for pyogenic cocci leading to cellulites and infractions gangrene of digits (Fitzpatrick et al.).

In greenwood and Rockwood's study of 100 generally well controlled diabetes, 70 were found to have dermatophytosis of the inter-digital areas of the feet because of the custom of wearing shoes, the local conditions on the surface of feet lead to retention of skin products especially water, the amount of fatty acids secreted by sebaceous glands is less and the lower fatty acids concentration may predispose to ringworm infection (Rothman et al).

Because the feet are cool, moist and usually less clean than the hand dermatophyte and atypical mycobacterial infections are common even in non-diabetics. In the diabetic patients, even minor trauma leads directly to stasis and ulceration, followed by penetration of pathogenic skin fungus and bacteria and ultimately by overt infection. ¹⁶

METHODS

The present study was carried out in the Department of Surgery, M.L.B. Medical College, Jhansi from February 2010 up to August 2011. The case materials for the present study was obtained from the out patients' clinics and indoor wards of the concerned department of M.L.B. Medical College, Jhansi. The study comprised of 66 cases out of which 16 served as control. The whole study group was classified into two broad groups.

Control group

This group comprised of non-diabetic patients with foot lesions.

Disease group

Patients with foot lesions suffering from diabetes were studied under this group. Clinical history for age, sex, religion, occupation, socio-economic status was taken. Detailed information about the type of foot wear used by the patient and duration of illness was collected. A detailed clinical history and examination of patient about the type and duration of disease (from the time of

detection) and treatment status was noted. Fasting and post prandial blood sugar was done.

Toe web scrapping and culture was done in every patient. In all cases specimen were collected from the toe webs. The toe webs cleansing with cotton wool and 70 percent alcohol. When dry, the skin scrapings were taken with a sterile scalpel and the materials was collected in sterile folded paper. Sabouraud's Dextrose Agar (SDA) media is use. The low pH and high sugar content of the media had made them particularly selective for fungi and inhibitory to bacteria.

The specimens were inoculated into sabouraud's dextrose agar (SDA) slopes. Cultured media were examined after 3 days for the growth. Identification depends partly on colonial appearance which change slowly with time but principally on the morphology of the spores which are most clearly seen soon after they first develop. Cultures were therefore examined every day for the first week and thereafter every 2-3 days. They were discarded as negative, if there not visible growth after 3 weeks.

Colonies were identified according to their size, shapes surface, texture growth, any cotton wool appearance and any pigment production. Smears were prepared and gram staining was 'done for identification. Positive slides were again stained by modified AFB. Three different types of pathological dermatophytes were identified Trichophyton rubrum, Trichophyton mentagrophytes and Epidermophyton floccosum.

RESULTS

By this study, we can safely and reasonably conclude that fungal infection in asymptomatic foot of diabetes patient are significantly more than non-diabetic patients which is accentuated by duration, type, glycemic control and practice of bare foot walking which increases risk of diabetic foot. So, the foot care of patients of diabetes should include the prophylactic steps to prevent fungal growth in foot by keeping the foot dry, avoiding moisture, prophylactic treatment with antifungal agent.

This is especially important in diabetes where the fungi are the initiating agents for the foot infections by causing microscopic breaches and creating a portal of entry for severe infections which its ultimate degree can result in loss of limb or foot. It is a well aware fact that once the septic infection is established, though many of such feet can be avoided but it requires prolonged treatment in hospital which includes multiple surgeries also. Naturally this can all be avoided just by adopting a prophylaxis against fungal foot infections.

DISCUSSION

The incidence of fungal infection in asymptomatic feet of Diabetics was studied in this series and was compared with control. 50 (75.26%) diabetic patients were included

in the study group and 16 (24.76%) controls were studied from February 2010 to August 2011 (Table 1).

Table 1: Distribution of patients.

Group	No. of cases	Percentage
Study group (diabetic):	50	75.76
Control group (non-diabetic)	16	24.24
Total	66	100

In age group of 0-25 years, there were 1 patients, which was male. In 25-50 years age group, number of patients were 19 among whom 18 (94.74%) were male. Similarly, in more than 50 years age group 22 (73.33%) were male out of 30. male/Female ratio is 4:1 (Table 2).

Cases with duration if illness (from the time of detection) more than 5 years were 36.00% and up to 5 years were 74.00% (Table 4). In present study there were 42 (84%) cases belonging to NIDDM and 8 (16%) from insulin dependent group. Male:female ratio in total cases was 4:1 (Table 4).

As shows in the table above, majority of patients 78.00% had polyurea, polydipsia, polyphagia as their major systemic general problems. Out of which Male were 29 (85.29%) and female were 5 (14.71%) (Table 5).

Table 2: Age/sex distribution.

	Total no. of cases	Male	%	Female	%
0-25 years	1	1	100.00	-	0.00
25-50 years	19	18	94.74	1	5.26
> 50 years	30	22	73.33	8	26.67
Total	50	41	82.00	9	18.00

Table 3: Duration of diabetes.

Group	No. of cases	Percentage
Upto 5 years	37	74.00%
More than 5 years	13	36.00%
Total	50	100%

Table 4: Types of diabetes.

Types of diabetes	Total no. of cases	Male	%	Female	%
NIDDM	42	34	80.95%	8	9.05%
IDDM	8	7	87.50%	1	12.50%
Total	50	41		9	

Table 5: Distribution of cases on the basis of systemic symptoms.

Age group	Total no. of cases	Male	%	Female	%
Polyurea					
Polyphagia	34 (78.00%)	29	85.29%	5	14.71%
Polydypsia					
Other					
Delayed wound healing	10 (20.00%)	7	70.00%	3	30.00%
Multiple boil/ulcers/itching	3 (6.00%)	2	66.66%	1	33.33%
Burning feet, pain in both lower limbs	3 (6.00%)	1	33.34%	2	66.66%
Total	50	39		11	

Table 6: Distribution of cases on the basis of specific systemic symptoms sign.

Specific systemic symptoms/sign	Total no. of cases	Male	%	Female	%
Peripheral neuropathy	17 (34.00%)	15	88.24%	2	11.76%
Hypertension	10 (20.00%)	8	80.00	2	20.00%
Nephropathy	9 (18.00%)	6	66.67%	3	33.33%
Retinopathy	2 (4.00%)	2	100.00%		
Total	50	31	62.00%	8	16.00%

Table 7: Status of treatment.

Total no.	Contro	lled	Uncont	Uncontrolled		
of cases	No.	%	No.	%		
50	38	76%	12	24%		

Peripheral neuropathy was major specific systemic symptoms with 15 males and 2 females (Table 6). In diabetics, incidence of fungi foot infection was 26.00% and in control group, it was 12.50% (Table 8).

Table 8: Incidence of fungi foot infection.

Group	Total no. of cases	No. of positive	Percentage
Study group (diabetic)	50	13	26.00%
Control (non-diabetic)	16	2	12.50%

From the above table it is clear that Trichophyton had the maximum incidence in both diabetics (76%) and control group (Table 9).

In 50 cases, 26 (52.00%) used open foot wear and 10 (20.00%) used closed foot wear and 14 (28.00%) was barefoot. It was observed in this study that barefoot walking had probably predisposed to higher incidence of fungal infection (44.85%) as compared: to use of closed and open foot wear (Table 10, 11).

Table 9: Distribution of cases on the basis of types of fungi.

Group	Total no. of cases	Trichophyton	Epidermophyton	Micro-sporum	candida
Study group (diabetics)	13	10	2	1	0
Control (non-diabetic)	2	2	0	0	0

Table 10: Use of foot wear.

Group	No. of cases	Percentage
Open (chappal)	26	52.00
Closed (shoes)	10	20.00
None (no foot wear)	14	28.00
Total	50	

The asymptomatic fungal foot infections in control group was found to-be 12.5% as compare to 26% in diabetic patients. In our series, types of superficial

dermatophytes present in the patients of study and control group were Trichophyton, Epidermophyton and Microsporum. Among which incidence of trichophyton was maximum. The number of patients in age group of more than 50 years was maximum in the study group (Table 12).

The percentage of male patients was more in comparison to female patients in the study as well in control groups. The asymptomatic fungal foot infection was more in those patients who has symptoms of illness for more than 5 years (46.15%) (Table 13).

Table 11: Correlation of fungal infection of foot with type of use/non-use of footwear.

Open foot wea	r (Chappals) Closed foot wear (Shoes)		No foot wear (none)					
No. of cases	Positive cases	%	No. of cases	Positive cases	%	No. of cases	Positive cases	%
27	5	18.52	9	2	22.20%	14	6	44.85%

Table 12: Age, sex, correlation with fungal infection of foot.

A go group Total no. of		0/	Male			Female		
Age group	+ve cases	70	No. of cases	Positive cases	%	No. of cases	Positive cases	%
0-25 yrs (2)	1	100.00	1	1	100.00%	0	0	0
25-50yrs (19)	4	21.05	18	3	16.66%	1	1	100.00
> 50yrs (30)	8	26.56	22	7	31.81%	8	1	12.50%
Total	13	100%	41	11	100%	9	2	100%

Table 13: Correlation of fungal infection of foot with duration of illness.

Duration of illness	No. of cases	Positive case	%
Up to 5 years	37	7	18.92
More than 5 years	13	6	46.15
Total	50	13	26.0

CONCLUSION

By above study, we reasonably conclude that fungal infection in diabetic patients plays a pivotal role in formation of diabetic foot disease, so by eradication of fungal infection in asymptomatic foot of diabetic patient by general preventive methods and/or pharmacological

methods may be beneficial in reducing morbidity and mortality in diabetic foot patients.

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