ORIGINAL RESEARCH

A study of fungal infections in diabetic patients in relation to glycemic status: A prospective study

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Abstract

Introduction: Diabetes mellitus is group of metabolic disorder by the high blood glucose level over a prolong period. Patients with diabetes are prone for fungal infection compared with general population.

Material and Method: This prospective observational study was done in department of medicine Gajraraja Medical College and JAH Hospital, Gwalior between January 2019 to June 2020. 200 cases of diabetes were included. All participants underwent clinical evaluation and baseline investigations followed by hba1c.

Result: Out of 200 cases 21% were 20-29 yrs age group, 17% belong to 40-49 yrs, 13.5% were 50-59 yrs and 20% were belong to 60-69 yrs age group. Male and Female percentage was 65% & 35%. Frequency of fungal infection was more in type II diabetes (62%). The mean age of fungal infection group (49.223) is significantly higher than non fungal infection disease group (42.541). In this study association between disease & sex of patients found to be statically significant & also the association between disease and DM type of patients found statically significant (P<0.05). Those patients who have high fasting and random blood sugar were more prone for fungal infection specially DM type 2 patients show high percentage of thin hyline septate (71.4%).

Conclusion: In our study observed majority of the diabetics had fungal infection which was seen more in elderly people. Fungal infection was more prevalent in DMII. Mean RBS, fasting blood glucose and post prandial blood glucose was higher significantly in patients with fungal infection.

Keywords:

Introduction

Diabetes Mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Diabetes Mellitus is caused by a complex interaction of genetic and environmental factors. Depending on the cause of DM, the factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilization and increased

glucose production. According to the International Diabetes Foundation, India had more diabetics than any other country in the world. Presently over 62 million Indians are diabetics and these number are on the rise[1].

Diabetes mellitus impairs functioning of neutrophil, macrophage, cellular immunity, humoral immunity and iron metabolism. In addition to them, diabetes-related a angiopathy is other factor that leads a patient to high-risk for several kinds of infectious diseases[2].In developing countries, infection is one of the three leading causes of deaths in patients with diabetes, and increases the excess risk to fourfold[3]. This study is therefore aimed to identified the common fungal infection in our patients and their correlation to glycemic index sothat we can prevent further complication.

Material method

This study was conducted in department of medicine for period of January 2019 to June 2020 after taking ethical clearence from ethical committee. Total 200 cases of diabetes mellitus were included after taking informed concent.

All participants underwent a detailed history, clinical examination and investigations which included 1-Cbc 2- RBS 3- Blood sugar fasting 4-Blood sugar post prandial 5-HbA1c 6-KOH mount 7-Urine R/M 8-LFT- Serum bilirubin (Total): (Direct): SGOT: SGPT: SAP: 9-RFT- [Blood urea ,Serum creatinine1] 10-Lipid Profile

Inclusion criteria

1. Cases are defined as diabetics with above 20 years or more with suspected fungal infection.

Exclusion criteria

1. All patients below 20 years. 2. Non Diabetic subjects. 3. Comorbid condition (Hypertension, Chronic Kidney Disease, Chronic Liver Disease, Sepsis). 4. All patients who did not give consent.

Diabetes Mellitus

Patient who was known diabetic or newly diagnosed diabetes mellitus (either by FBS, PPBS, RBS) were taken in the study. Fungal infection: Diabetics either with suspected fungal skin lesion or symptoms of UTI were subjected to KOH mount and urine R/M. KOH Mount: Skin scrapings from the site of lesion were collected. The specimen is placed in a few drops of 10% to 20% KOH and incubated for 5 to 10 minutes. Gentle heating clears samples more quickly. A coverslip is placed over the KOH-digested sample, and the slide is examined microscopically without staining.

Different fungal elements like hyphae, pseudohyphae, spores, yeast cells, spherules and sclerotic bodies can be seen clearly in a KOH wet mount.

Result
Table 1- Distribution based on age

Age group	Frequency	Percentage
20-29 Years	43	21.5
30-39 Years	30	15.0
40-49 Years	34	17.0
50-59 Year	27	13.5
60-69 Year	40	20.0
>=70 Years	26	13.0
Total	200	100.0

This study included 200 cases, table no 1 shows the distribution of patients based on their Age. The highest percentage of patients i.e. 21.5% belonged to 20-29 Years of Age Group followed by 20% who were of 60-69 Years of Age group, 17% belonged to 40-49 Years, 15% belonged to 30-39 Years, 13.5% were of 50-59 Years while, remaining 13% belonged to >=70 Years of Age group.

Table 2- Distribution based on sex

Sex	Frequency	Percentage
Female	70	35.0
Male	130	65.0
Total	200	100.0

Table no 2 shows the distribution of patients based on their Sex. The higher percentage of patients i.e. 65% were Male while, 35% were Female.

Table 3: Distribution Based on DM Type

DM type	Frequency	Percentage
Type I	76	38.0
Type II	124	62.0
Total	200	100.0

Table no 3 shows the distribution of patients based on their DM Type. The higher percentage of patients i.e. 62% had DM II while, 38% were having DM I.

Table 4: Distribution Based on Type of Disease

Disease	Frequency	Percent
Fungal infection	139	69.5
No fungal infection	61	30.5
Total	200	100.0

Table no 4 shows the distribution of patients based on Type of Disease they had. The higher percentage of patients i.e. 69.5% had Fungal Infection while, 30.5% were not having any Fungal Infection.

Table 5: Association between Disease and Age

Age Group		Disease		Total
		Fungal infection	No Fungal infection	
20-29	Count	22	21	43
Years	%	15.8%	34.4%	21.5%
30-39	Count	20	10	30
Years	%	14.4%	16.4%	15.0%
40-49	Count	26	8	34
Years	%	18.7%	13.1%	17.0%
50-59	Count	19	8	27
Years	%	13.7%	13.1%	13.5%
60-69	Count	35	5	40
Years	%	25.2%	8.2%	20.0%
>=70	Count	17	9	26
Years	%	12.2%	14.8%	13.0%
Total	Count	139	61	200
	%	100%	100%	100%
Pearson	Value	Df	P value	Result

ChiSquare	14.045	5	0.015	Significant

Table no 5 shows the association between Disease and Age of patients which found to be statistically significant (P<0.05). It implies that Disease of patients differs significantly with their Age.

Table 6: Comparison of Mean Age between Disease Groups

Variable	Disease	N	Mean	Std. Deviation	T test	P value	Result
Age	**Fungal infection**	139	49.223	17.557	2.385	0.018	Significant
	No Fungal infection	61	42.541	19.718			

Table no 6 shows difference between the mean Age scores of two groups was found to be statistically significant (P<0.05). The mean Age of Fungal Infection Disease group (49.223) is significantly higher than that of No Fungal Infection Disease group (42.541)

Table 7: Association between Disease and Sex

Sex		Disease		
		Fungal infection	**No Fungal infection**	**Total**
Female	Count	60	10	*70*
	%	43.2%	16.4%	35.0%
Male	Count	79	51	130
	%	56.8%	83.6%	65.0%
Total	Count	139	61	200
	%	100%	100%	100%
Pearson Chi-Square	Value	Df	P value	Result
	13.357	1	0.000	Significant

Table no 7 shows the association between Disease and Sex of patients which found to be statistically significant (P<0.05).Patients having Fungal Infection show higher percentage 56.8% for Male while, show 43.2% for Female.

Table 8: Association between Disease and DM Type

DM Type		Disease		
		Fungal infection	**No Fungal infection**	**Total**
DM Type I	Count	45	31	76
	%	32.4%	50.8%	38.0%
DM Type II	Count	94	30	124
	%	67.6%	49.2%	62.0%
Total patients	Count	139	61	200
	%	100%	100%	100%
Pearson Chi-Square	Value	Df	P valve	Result
	6.122	1	0.013	Significant

Table no 8 shows the association between Disease and DM Type of patients which found to be statistically significant (P<0.05). It implies that Disease of patients differs significantly with their DM Type. Patients having Fungal Infection show higher percentage 67.6% for DM II while, show 32.4% for DM I.

Table 9: Comparison of Mean Scores of different Variables between Two Groups

Variable	Disease	N	Mean	Std. Deviation	T Test	P Value	Result
RBS	Fungal infection	139	258.353	125.298	6.841	0.000	Significant
	No fungal infection	61	147.672	22.728			
Blood sugar fasting	Fungal infection	139	173.777	73.185	8.269	0.000	Significant
	No fungal infection	61	94.820	20.886			
Blood sugar PP	Fungal infection	139	257.072	91.086	8.179	0.000	Significant
	No fungal infection	61	160.262	22.793			

Table no 9 showing difference between the mean scores of different variables (RBS, Blood sugar fasting, Blood sugar PP) of two disease groups was found to be statistically significant (P<0.05).

It implies that mean scores of these variables vary with the Disease Group they belong to.

Table 10: Association between Test findings and DM Type

		Test findings			Total
		Thin hyaline Septate Hyphae	**Oval budding yeast with Pseudohyphae**	**Budding yeast cell, short Septate Hyphae**	
DM I	Count	12	25	8	45
	%	28.6	34.7%	32.0	32.4%
DM II	Count	30	47	17	94
	%	71.4%	65.3%	68.0%	67.6%
Total	Count	42	72	25	139
	%	100.0%	100.0%	100.0%	100.0%
Pearson Chi-Square	Value	Df		P Value	Result
	0.460	2		0.794	Non Sig

Table no 10 shows Patients having Thin hyaline Septate Hyphae show higher percentage 71.4% for DM II while, show 28.6% for DM I. Patients having Oval budding yeast with Pseudohyphae show higher percentage 65.3% for DM II while, show 34.7% for DM I.

Discussion

The present study was carried out in the Department of Medicine, G.R. Medical College, Gwalior (M.P.) during the period from January 2019 to June 2020. Total 200 Diabetic cases with suspected fungal infection were included in this study from IPD. Patients undergoing study were subjected to RBS, Blood sugar fasting, Blood sugar PP. 139 patients had fungal infection in the form of skin infection, urinary tract infection.

In our study 200 diabetics with suspected fungal infection were taken in study. 139(69.5%) had some form of microscoplically proven fungal infection while 69(30.5%) did not have fungal infection.

It was similar to the findings of study done by Saud B et al where the prevalence of fungal infection was higher in diabetic (34.0%) than nondiabetic individuals (4.7%)[4].

A study done by Thilak S et al among 400 diabetic individuals found that 52.5% of the subjects had some fungal infections [5].

Distribution of the fungal infection according to age group. In our study 43% belonged to age group 20-29 yrs, 30% to 30-39 yrs, 34 % to 40-49 yrs, 27% to 50-59 yrs, 40% to 60-69 yrs and 26 % to above 70 yrs of age.

Highest percentage of patient having fungal infection (35%) belonged to 60-69 Years of Age group while lowest percentage (12.2%) in >=70 Years of Age group

In a study done by Bouguerra R et al, one of the main risk factors for fungal infections was the age of patients. More number of older patient had fungal infection as compared to younger patients[6].

Study done by Wijesuriya TM et al also found the increase in the prevalence of fungal foot infections with advancing age[7].

Distribution of the fungal infection according to sex. In our study 35 % of the study population were females and 65% males. 43.2 % were females having fungal infection and 56.8% were males having fungal infection. 85.7% of female had fungal infection and 14.3% females did not have fungal infection .60.7% of males had fungal infection and 39.3% did not have fungal infection. Females had higher rateof fungal infection as compared to males.

It was similar to findings of Udeani TK et al where he did a study on systemic fungal infections in diabetic patients. Those with fungal growth were identified, Of 120 diabetic patients studied, 52.5% had fungal isolates. The females had higher isolates than the males[8].

Distribution of the fungal infection according to type of diabetes In our study 139 out of 200 diabetic patients had microscopically confirmed fungal infections. 32.4 % of total patient belong to DM I and 67.6% to DM II group. 59.2 % of DM I Patient had fungal infection and 40.8% did not have fungal infection. 75.8% of DM II had fungal infection and 24.2% did not have fungal infection. Fungal infection was higher in DM II as compared to DM I which was statistically significant in the study.

It was similar to the findings of Eckhard M et al where they found 82.1% patients had probable pedal fungal infections, of which 84..6% were mycologically confirmed by direct microscopy and ⁄ or culture. Fungal foot infections were confirmed for 35.5% (DM1), 53.1% (DM2)[9].

Distribution of the type of fungal infection among diabetics with controlled and uncontrolled blood sugar In our study mean RBS in diabetics with fungal infection was 258.3 and without fungal infection was 147.6. Mean Fasting blood glucose in diabetics with fungal infection was 173.7 and without fungal infection was 94.8 .Mean post prandial blood glucose was 257 in diabetics with fungal infection and 160.2 in patient without fungal infection   It was similar to the findings of study done by Wijesuriya TM et al where they found most patients with SFFI, had a raised fasting blood sugar (FBS) and high post prandial blood sugar (PPBS). Occurrence of SFFI was found to be statistically significant with less controlled FBS and PPBS[10]

Conclusion
- In this study it was observed that majority of the diabetics had fungal infection which was seen more in elderly people.
- Fungal infection was more prevalent in DMII.
- Mean RBS, fasting blood glucose and post prandial blood glucose was higher significantly in patients with fungal infection.

Thus we can conclude by saying that '**Glycemic status of diabetics has a significant direct relationship with the prevalence of fungal infection and well controlled blood sugar is beneficial for avoiding fungal infection in such patient'**

References
1. JL J. Harrison's endocrinology, 19E.
2. Okubo Y, Nakayama H, Hasegawa C, Mitsuda A, Hatori T, Tanikawa K, Shinozaki M, Shibuya K. Pathophysiology of invasive fungal infection in diabetic patients. Nihon rinsho. Japanese journal of clinical medicine. 2008 Dec;66(12):2327.
3. Ahmed AM. History of diabetes mellitus. Saudi medical journal. 2002 Apr 1;23(4):373-8.
4. 108. Saud B, Bajgain P, Paudel G, Shrestha V, Bajracharya D, Adhikari S, Dhungana G, Awasthi MS. Fungal Infection among Diabetic and Nondiabetic Individuals in Nepal. Interdisciplinary Perspectives on Infectious Diseases. 2020 Nov 18;2020
5. 99. Thilak S, Anbumalar M, Sneha PM. Cutaneous fungal infections in subjects with diabetes mellitus. Int J Res Dermatol. 2017 Jan;3:55- 8.
6. 106. Bouguerra R, Essaïs O, Sebaï N, Salem LB, Amari H, Kammoun MR, Chaker E, Zidi B, Slama CB. Prévalence et aspects cliniques des mycoses superficielles chez le diabétiquetunisienen milieu hospitalier. Médecine et maladies infectieuses. 2004 May 1;34(5):201-5.
7. 104. Wijesuriya TM, Weerasekera MM, Kottahachchi J, Ranasinghe KN, Dissanayake MS, Prathapan S, Gunasekara TD, Nagahawatte A, Guruge LD, Bulugahapitiya U, Fernando SS. Proportion of lower limb fungal foot infections in patients with type 2 diabetes at a tertiary care hospital in Sri Lanka. Indian journal of endocrinology and metabolism. 2014 Majority of the Jan;18(1):63.
8. 105. Udeani TK,Asogwa VN, Ezenwaka U. Assessment of Systemic Fungal Infections among Diabetic Patients in Enugu, Nigeria. Journal of Infectious Diseases and Epidemiology. 2018;4:051
9. 100. Eckhard M, Lengler A, Liersch J, Bretzel RG, Mayser P. Fungal foot infections in patients with diabetes mellitus–results of two independent investigations. Mycoses. 2007 Sep;50:14-9., Lengler A, Liersch J, Bretzel RG, Mayser P. Fungal foot infections in patients with diabetes mellitus–results of two independent investigations. Mycoses. 2007 Sep;50:14-9
10. 104. Wijesuriya TM, Weerasekera MM, Kottahachchi J, Ranasinghe KN, Dissanayake MS, Prathapan S, Gunasekara TD, Nagahawatte A, Guruge LD, Bulugahapitiya U, Fernando SS. Proportion of lower limb fungal foot infections in patients with type 2 diabetes at a tertiary care hospital in Sri Lanka. Indian journal of endocrinology and metabolism. 2014 Majority of the Jan;18(1):63.