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Profiling Infections in Diabetes Patients Admitted to IGMC Medicine Ward, Shimla

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ABSTRACT
Diabetes mellitus (DM) is a global health concern, with an increasing prevalence, particularly of Type 2 DM. This study conducted at Indira Gandhi Medical College, Shimla, investigates the intricate association between DM and infections, focusing on evolving infection patterns, especially during the COVID-19 pandemic. A one-year cross-sectional study was carried out in the Medicine wards of IGMC Shimla. The study included patients aged over 30 with confirmed diabetes and various clinical and biochemical parameters were assessed. Statistical analysis was conducted using SPSS software. The study revealed that COVID-19 has emerged as the most prevalent infection in patients with Type 2 DM, followed by urinary tract infections, diverging from pre-pandemic trends. Notably, males exhibited a slightly higher susceptibility to infections, except for urinary tract infections, which were more common in diabetic women. Mortality rates were significantly higher among COVID-19 patients, particularly those with poorly controlled diabetes (HbA1c $\geq$ 8%). The study also highlighted the gender-specific variations in infection profiles and the crucial role of glycemic control in determining clinical outcomes. This study underscores the evolving landscape of infections in diabetic patients, influenced by the COVID-19 pandemic and emerging pathogens. It emphasizes the importance of glycemic control in improving infection-related outcomes and the need for comprehensive strategies to manage infections in individuals with diabetes. Diabetes mellitus, infections, COVID-19, urinary tract infections, glycemic control, mortality, gender disparities.

INTRODUCTION

Diabetes mellitus (DM) is a prevalent metabolic disorder characterized by elevated blood glucose levels, affecting millions globally. It encompasses various types, with Type 2 DM rising at an alarming rate, attributed to factors like obesity, sedentary lifestyles and population aging. Notably, China, India, and the United States bear significant diabetes burdens[1].

Classification of glucose tolerance into normal, impaired and diabetic categories is pivotal for diagnosis and early intervention. Criteria like fasting plasma glucose (FPG) oral glucose challenge response and hemoglobin A1C (HbA1C) levels aid in defining these categories. Recognizing prediabetes is crucial as it often precedes clinical diabetes by up to a decade, offering a window for intervention and prevention[1]. Insulin resistance and impaired insulin secretion play central roles in Type 2 DM development, with genetics playing a significant role. Diabetes-related complications encompass vascular and nonvascular issues, including microvascular and macrovascular complications[2].

Furthermore, individuals with DM exhibit heightened susceptibility to infections due to inadequately understood abnormalities in cell mediated immunity, phagocyte function and compromised vascularization. Hyperglycemia fosters the colonization and growth of various microorganisms, making common infections more frequent and severe in diabetic populations. Pneumonia, urinary tract infections and skin and soft tissue infections become more common, involving gram-negative bacteria, Staphyylococcus aureus and Mycobacterium tuberculosis[3,4].

Vascular issues, neuropathy, skin colonization by pathogens and obesity further predispose diabetic individuals to infections, including nosocomial infections and surgical site infections. Vascular complications contribute to the risk of foot infections and ulcers, highlighting the multifaceted nature of diabetic complications[5,6].

The emergence of the novel coronavirus, SARS CoV-2, responsible for the COVID-19 pandemic, has drawn attention to the increased risk faced by individuals with diabetes. Notably, diabetes is associated with higher COVID-19 severity and mortality, partly due to elevated glucose levels, which may enhance viral replication. Additionally, diabetes is linked to immunological dysregulation, possibly contributing to poorer COVID-19 outcomes[7,8].

This study aims to provide insights into the profile of infections among patients with Type 2 DM in Himachal Pradesh an area lacking such research. Furthermore, it seeks to identify changes in infection patterns, potentially driven by increased diabetes awareness. It will also explore the impact of the global COVID-19 pandemic on infection patterns among individuals with diabetes, thereby contributing to our understanding of the intricate relationship between diabetes and infections.

Aims and objectives:

Aim: To study the profile of infections in patients with Diabetes mellitus admitted in Medicine ward in IGMC, Shimla.

Objectives:

- To study the association between diabetes mellitus and common community acquired infections
- To describe common clinical presentations of infections in diabetes mellitus
- To study diabetes as a risk factor contributing to severity and mortality in patients with covid 19
- Relation of glycemic control with outcome of infection
- Mortality and Morbidity associated with infections in Diabetes

MATERIALS AND METHODS

Study area: Department of General Medicine in collaboration with department of Microbiology, Biochemistry and Radiology, Indira Gandhi Medical College, Shimla (H.P.).

Study design: The present study, a hospital based, one-year cross-sectional study will be carried out in Medicine wards, IGMC Shimla (a tertiary care hospital). Study Year: One year(01-05-2020 and 30-04-2021).

Inclusion criteria:

- Patients of either gender
- Age $\geq$30 years
- Patients having Diabetes mellitus
- Symptoms of diabetes plus random blood glucose concentration $\geq$11.1 mmol L^{-1} (200 mg d L^{-1}) or
- Fastig plasma glucose $\geq$7.0 mmol L^{-1} (126 mg d L^{-1}) or
- Hba1c $\geq$6.5% or
- 2 hrs plasma glucose $\geq$11.1 mmol L^{-1} (200 mg dL^{-1}) during an oral glucose tolerance test
- Patients admitted in medicine ward IGMC, Shimla

Exclusion Criteria:

- Patients not willing to participate
- Age $\leq$30 years

Informed Consent: Written informed consent would be attained from all the eligible prospective patients before recording the data. An informed and written consent will be taken from all patients. A detailed history will be taken from each of these patients and

all of them will be subjected to a through clinical examination. These patients will undergo investigations like complete hemogram, peripheral smear, fasting and post prandial blood sugar, HbA1C, liver function test, renal function tests, blood culture and sensitivity, urine routine and microscopy, urine culture and sensitivity, pus culture and sensitivity (in case of diabetic foot or any abscess) qCRP, covid 19 testing, chest x-ray, ECG and any other relevant investigation.

Statistical analysis: Data collected was entered in excel sheet and accuracy of data entered was checked. Categorical variables were expressed as frequencies and percentages. It was done using statistical SPSS software 21.0. To find out the association between different variables appropriate parametric and non-parametric test of significance were applied depending upon type and normality of data. For association, p>0.05 was considered as statistically significant.

RESULTS AND OBSERVATIONS

The following observations were made in the study.The commonest age group was 51-60 years (32%) followed by 61-70 years (25%) 41-50 years (23%) though it was not statistically significant (p = 0.208). group 51-60 years (35%) followed by 41-50 years (30%) and Covid-19 was common among 51-60 years (31%) followed by 61-70 years (27%). Infections were more common in male diabetic patients (58%) than in female diabetic patients (42%) in the present study, which was statistically significant (p = <0.001).UTIs were more in females (65%) than in males shown in fig. 2(I).

Most of the patients stayed for 7-14 days (52.7%). 23.3 % stayed for less than 7 days, 21.3% for 15-21 days and 2.7% for more than ≥21 days. On an average the covid-19 patients with diabetes mellitus had hospital stay of 7-14 days. In the present study most of the diabetic patients with infections were discharged (80.7%). Death was observed among 16.7%, mostly seen in patients with COVID-19 followed by diabetic foot, with p>0.027, statistically significant. In the present study most of the patients were diagnosed with T2DM for around 5-10 years (38) of duration. The incidence of newly diagnosed diabetes was 12% (p = 0.34). HbA1Cwas measured in all 150 diabetic patients presenting with infection, the most commonly observed value was between 6.4-8.0 % in 51 patients (34%) followed by range of 8.1-10.0% in 49 patients (32.7%) it was statistically not significant (p = 0.277). The relationship between HbA_{1C} and mortality is statistically significant with p value of ≤0.001, out of 25 mortalities only 1 patient had HbA1C of ≤8.0% and the rest 24 patients had HbA1C of ≥8.1% Table 2-4.

The commonest symptom was fever/feverish feeling observed in 70 (46.7%) of patients followed by shortness of breath in 65 patients (43.3%). Other symptoms like cough (34%), burning micturition, nausea/vomiting (19.3%), altered sensorium (14.7%), pain abdomen (10.7) were also observed, with few patients presenting with loose stools (5.3%) and headache (2%). The most common sign observed in the present study was presence of crepts on chest

Table 1: Distribution of study participants according to age group

Age group	Overall infections (percentage)	UTI (percentage)	COVID-19 (percentage)
31-40	6 (4)	0 (0)	3 (4.4)
41-50	35 (23.3)	11 (29.7)	12 (17.6)
51-60	48 (32)	13 (35.1)	21 (30.8)
61-70	37 (24.6)	8 (21.6)	18 (26.4)
71-80	20 (13.3)	5 (13.5)	11 (16.9)
≥81	4 (2.6)	0 (0)	3 (4.6)
Total	150 (100)	37 (100)	68 (100)

Table 2: Distribution of study Participants according to Gender

Sex	Frequency	Percentage
Male	87	58
Female	63	42
Total	150	100

Table 3: Distribution of study Participants according to Hospital Stay (days), Outcome, Duration of disease (Years) and HbA_{1c} level

Hospital stay (days)	Overall (percentage)	Covid-19 (percentage)	UTI (percentage)	Diabetic foot (percentage)
≤7	35 (23.3)	16 (23.5)	5 (13.5)	3 (33.3)
7-14	79 (52.7)	39 (57.3)	24 (64.8)	3 (33.3)
15-21	32 (21.3)	11 (16.1)	8 (21.6)	2 (22.2)
≥21	4 (2.7)	2 (2.9)	0 (0)	1 (11.1)
Outcome				
Discharge	121 (80.7)	49 (40.4)	36 (29.7)	6 (4.9)
Death	25 (16.7)	17 (68)	1 (4)	3 (12)
Lama	4 (2.71)	2 (50)	0 (0)	0 (0)
Duration (years)				
Newly diagnosed	18 (12)	10 (14.7)	4 (10.8)	0 (0)
≤5	55 (36.7)	21 (30.8)	16 (43.2)	5 (55.5)
5-10	57 (38)	29 (42.6)	12 (32.4)	1 (11.1)
11-15	14 (9.3)	7 (10.3)	2 (5.4)	1 (11.1)
≥15	6 (4)	1 (1.4)	3 (8.1)	2 (22.2)
HbA_{1C}				
≤6.4	0 (0)	0 (0)	0 (0)	0 (0)
6.4-8.0	51 (34)	21 (30.8)	18 (48.6)	1 (11.1)
8.1-10.0	49 (32.7)	22 (32.3)	12 (32.4)	2 (22.2)
10.1-12.0	32 (21.3)	16 (23.5)	4 (10.8)	2 (22.2)
≥12.1	18 (12)	9 (13.2)	3 (8.1)	4 (44.4)
Total	150 (100)	68 (100)	37 (100)	9 (100)

Table 4: Distribution of study participants according to symptoms, signs and microbiological parameters (growth)

Symptoms	Frequency (percentage)	COVID-19	Non-Covid-19	p-value
Fever	70 (46.7)	29	41	1.000
Cough	51 (34)	44	7	<0.001
Shortness of breath	65 (43.3)	45	20	<0.001
Nausea/vomiting	29 (19.3)	1	28	<0.001
Pain abdomen	16 (10.7)	0	16	<0.001
Burning micturition	29 (19.3)	2	27	<0.001
Headache	3 (2)	0	3	0.264
Loose stools	8 (5.3)	7	1	0.010
Altered sensorium	22 (14.7)	10	12	0.816
Signs				
Pallor	59 (39.3)	15	44	0.001
Icterus	4 (2.7)	0	4	0.139
JVP	30 (20)	15	15	0.409
Pedal edema	54 (36)	16	38	0.025
Diabetic foot	9 (6)	0	9	0.021
Tachycardia	54 (36)	22	32	0.457
Crepts	72 (48)	51	21	<0.001
Microbiological parameters (growth)				
Blood C/S	11 (7.3)	0	11	0.003
Urine C/S	32 (21.3)	1	31	<0.001
Pus C/S	23 (15.3%)	0	23	<0.001

Table 5: Distribution of study Participants according to Biochemical parameters and Micro-organism in Urine C/S

Biochemical parameters	Frequency	Percentage
Anaemia	88 (58.6)	58.6
Leucocytosis	112 (74.6)	74.6
Thrombocytopenia	40 (26.6)	26.6
Raised ESR	140 (93.3)	93.3
Raised SGOT	57 (38)	38
Raised SGPT	45 (30)	30
Raised Creatinine	63 (42)	42
Raised qCRP	145 (96.6)	96.6
Raised FPG	119 (79.3)	79.3
WBCs in Urine	43 (28.6)	28.6
Micro-organism in urine C/S		
E. Coli	14	43.75
Pseudomonas aeruginosa	3	9.38
Klebsiella pneumonia	3	9.38
Enterococcus species	6	18.75
Citrobacter Kasori	3	9.38
Coagulase negative Staph	1	3.12
Candida Albicans	2	6.25
Enterobacter	0	0

Table 6: Distribution of study participants according to infection

Frequency of infections	Frequency	Percentage
Covid-19	68	45.33
UTI	37	24.66
Diabetic Foot	9	6.00
Deep tissue infection	9	6.00
Scrub typhus	7	4.67
Tuberculosis	6	4.00
Mucormycosis	6	4.00
CAP	5	3.33
VAP	5	3.33
Skin and subcutaneous infection	4	2.67
Sepsis	2	1.33

examination in 72 patients (72%) which was followed by presence of pallor in 59 patients (39.3%). Pedal edema was present in 54 of 150 patients (36%). On cardiovascular examination tachycardia was present in 54 patients (36%). Raised JVP was clinically observed in 20% of patients and diabetic foot was noticed in 8 patients (5.3%). In the present study urine culture and sensitivity growth of micro-organisms were found in 32 (21.3%) patients, growth in blood culture and sensitivity was found in 11 (7.3%) of patients and pus if available had growth in 23 (15.3%) patients. Investigations showed raised QCRP as the most common finding in the present study in 96.6% of the patients followed by raised ESR in 93.3% of the patients. Fasting plasma glucose was $\geq$126 mg dL^{-1} in 79.3%, which suggests poor glycemic control among the patients. Leucocytosis was found in 74.6% followed by anaemia in 58.6%. raised creatinine in 42%, raised SGOT in 38%, raised SGPT in 30%. WBCs/hpf were found in urine of 28.6% patients. In the present study the most common micro-organism found in diabetic patients with UTI was E. coli in 14 (43.75%) of patients followed by Enterococcus in 6 (18.75%) of patients and in 5 patients the urine c/s was sterile Table 6.

The most common infection which was encountered in patients with type 2 DM in this study was COVID-19 in 68 out of 150 patients (45.3%) which was followed by urinary tract infections in 37 patients

(24.66%). Diabetic foot and deeper tissue infections (like peritonitis, ischiorectal abscess, gluteal abscess, liver abscess etc.) were found in 9 patients (6%) each. Scrub typhus was presenting infection in 7 patients (4.67%) with T2DM, followed by Tuberculosis and mucormycosis in 6 patients. Other infections were community acquired pneumonia, VAP, skin infections and 2 patients presented in sepsis.

DISCUSSION

Diabetes mellitus (DM) presents a significant global health challenge, with an anticipated increase in cases from 425 million to 629 million adults between 2017 and 2045. This study, conducted at IGMC, Shimla, sheds light on the intricate relationship between diabetes and infections, offering important insights into disease patterns.

Historically, diabetic patients were recognized to be more susceptible to infections, with lower respiratory tract infections and urinary tract infections being the most common pre-COVID-19. However the emergence of the COVID-19 pandemic has brought about a shift in infection profiles. In our study, COVID-19 became the most prevalent infection among patients with Type 2 DM, followed by urinary tract infections and diabetic foot infections. Scrub typhus, linked to Orientia tsutsugamushi, was also identified in a subset of patients. These findings reflect the evolving landscape of infectious diseases among diabetic individuals[9].

Tuberculosis is another infection that demonstrates a strong association with diabetes, particularly in low and middle-income countries. In our study, we observed a significant prevalence of tuberculosis in individuals with diabetes, with a threefold higher risk compared to non-diabetic individuals. Furthermore, Mucormycosis a life threatening fungal infection, was detected among diabetic patients, particularly those who had contracted COVID-19 and received steroid treatment. This highlights the elevated risk for invasive mucormycosis in diabetic individuals with COVID-19, possibly due to the combined effects of endothelial dysfunction in diabetes and SARS-CoV-2 infection[10]. Rhino-orbital-cerebral mucormycosis was the most common form of mucormycosis observed, aligning with similar findings in other studies. Furthermore, community-acquired pneumonia, ventilator-associated pneumonia and skin infections were also identified in our study, underlining the diverse spectrum of infections diabetic patients can experience.

Gender disparities were noted in the infection profile, with males slightly more affected than females. Urinary tract infections were more prevalent in females, likely due to anatomical factors. This observation mirrored the global trend, where males exhibited a higher susceptibility to COVID-19. However, the impact of these gender differences on disease outcomes requires further investigation. The study also underscores the critical role of glycemic control in infection outcomes. Patients with poor glycemic control, as indicated by HbA1c levels exceeding 7.5%, had worse clinical outcomes. Mortality rates were notably higher among patients with COVID-19, emphasizing the gravity of the pandemic in diabetic populations.

Beyond immediate morbidity and mortality, the study revealed long-term complications in follow-up, such as domiciliary oxygen requirement, amputations due to diabetic foot and renal replacement therapy for acute kidney injury.

Urinary tract infections were prevalent in diabetic patients, with Escherichia coli as the most common pathogen. This aligns with broader findings of E. coli dominance in diabetic UTIs. Notably, the high prevalence of urinary tract infections underlines the need for vigilant monitoring and prevention strategies in diabetic populations[10].

Diabetic foot infections, on the other hand, revealed a mix of gram-positive and gram-negative pathogens, which may be attributed to prior antibiotic treatment before patients arrived at IGMC. This underscores the importance of prompt and effective antibiotic therapy in these cases[11].

Hence, this study highlights the evolving landscape of infections in diabetic patients, influenced by factors such as the COVID-19 pandemic and emerging pathogens. It underscores the significance of glycemic control and early intervention in improving outcomes for diabetic individuals facing infections. Further research is necessary to comprehensively address the complex relationship between diabetes and infections.

CONCLUSIONS

In conclusion, individuals with diabetes mellitus (DM) exhibit an increased susceptibility to infections, with a notable shift in the infection landscape, prominently influenced by the COVID-19 pandemic. This study reveals that COVID-19 pneumonia has become the most prevalent infection in patients with type 2 DM, followed by urinary tract infections, marking a departure from pre-pandemic infection profiles. Moreover, a gender-based susceptibility difference was observed, with men being more prone to infections, except in the case of urinary tract infections where diabetic women were more affected. Importantly, this research highlights the direct correlation between mortality and glycemic control, with higher mortality rates among patients with HbA1c levels exceeding 8%, particularly accentuated in those with COVID-19. The findings underscore the paramount importance of improving glycemic control in individuals with diabetes to mitigate the risk of infections, emphasizing the need for comprehensive measures to address this intricate relationship between diabetes and infectious diseases.

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