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Evaluation of bacteriological profile and risk factors for infections in diabetes mellitus in a tertiary care hospital

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Abstract

Prevalence of infection is generally higher in the patients with diabetes mellitus (DM) and the bacteriological profile varies in the myriad complications that are generally associated with it. Some infections are more common in diabetes probably due to dysregulation of immune function. As community-acquired and hospital-acquired infections galore in diabetes, strict glycemic control is indispensable in curbing the extremely high morbidity and mortality associated with the disease. Our study highlights the usual bacteriological profile in various diabetic infections in eastern India and reinforces upon strict glycemic control which profoundly affects the morbidity, hospital stay and mortality. Older age, longer duration of diabetes and poor glycemic control were associated with increased risk for infections in diabetic patients.

Keywords: *Diabetes Mellitus, E.coli, Glycaemic control, bacteriological profile, hospital stay.*

Introduction

It is often believed that the incidence of infection is higher in the persons with diabetes mellitus (DM) and that such infections result in complication & death more frequently than would be anticipated in otherwise healthy individual[1,2]. A number of variables including duration of illness, severity of non-infectious complications, concurrent illness, level of glucose control, and even degree of medical supervision, result in a very heterogeneous group of individuals at risk even within a more narrowly defined time frame[3]. Asymptomatic bacteriuria is actually more common over UTIs in diabetic women. In a recent study, asymptomatic bacteriuria defined by the occurrence of 100,000 or more colony forming

units per millilitre was characterized by microbial growth in 40% of samples from diabetic women and 6% of samples from controls[4]. Many specific infections and some exclusive ones are commonly seen in patients with diabetes. Some of the infections are associated with dangerous complications which need early recognition. Defective innate immunity contributes to increased susceptibility to infection, and mostly immune deficiencies are linked to glycaemic control. Blood glucose levels should be meticulously controlled in the presence of infection and appropriate antimicrobial therapy started early to reduce morbidity and mortality[5]. Data regarding such infections in DM in our region is meagre to absent. Taking these facts, we planned to study the bacterial profile in various infections in a diabetic individual in a tertiary care setup and to analyse the severity of infection with the duration of disease and glycaemic control (HbA1c).

Material and Methods

This was aobservational cohort study that was carried out at Institute of Medical Science (IMS) And SUM Hospital, a medical college in eastern Odisha from 2016-2018.

Inclusion criteria: The diabetic patients admitted to IPD or visited the OPD of our hospital with clinical evidence of infection such as fever, leukocytosis; pathological evidence such as pulmonary consolidation, significant pus cell in the urine, external wound or the patients admitted due to any infectious cause with a history of DM were included in our study.

Exclusion criteria: The patients who are already immunocompromised such as HIV, chronic kidney disease, old case of tuberculosis with DM as well as pregnant ladies were excluded from the study.

Study tools and technique: The study protocol was approved by ethical committee of the hospital before the beginning of the study. The informed consent was obtained from all the patients participated in the study. All the patients with DM or newly diagnosed with DM and having evidence of infection were registered in the study according to the inclusion and exclusion criteria. The demographic details of the patients were collected from the medical records of the patient using pre-defined case-record form. Each patient had undergone thorough physical examinations including complete blood count, fasting blood glucose, postprandial blood glucose, HbA1c, urine routine microscopy, and specific laboratory tests according to the site of infection.

Statistical analysis

Normally distributed continuous variables were expressed as mean, standard deviation (SD), correlations. Categorical variables were expressed in percentage. Data was analyzed using IBM SPSS statistics software (version 20.0, Chicago, IL, USA.)

Results

In our study, out of 200 cases, 141 were male (70.5%) and 59 were female (29.5%). The mean age of our patients was 56.2±10.3 years. The mean BMI was 24.2±2.08; which comes under overweight to pre obese as per WHO classification for Asians. The mean duration of diabetes was 7.5±5.03 years. (Table 1)

Table 1: Patients Statistics data

	Mean	Std. Deviation
Age	56.28	10.37
Height(m)	1.65	0.07
Weight(kg)	66.34	7.22
BMI	24.27	2.08
ABI	1.06	0.78
Duration(yrs)	7.55	5.03

The mean fasting, post prandial blood sugar of our patients were 209.9±49.6 mg/dL, 317.1±75.2 mg/dL respectively; whereas mean HbA1c was 9.4±1.8 %. That shows poor glycaemic control in our patients. The mean TLC obtained was 18.11±5.7 & the mean neutrophil percentage was 89.1±3.08. (Table 2). TLC & HbA1c were positively correlated. The correlation coefficient was 0.537, which is significant. It implies that higher HbA1c or poor glycemic control itself is a risk factor for infection.(Figure 1).

Table 2: Biochemical Profile

	Mean	Std. Deviation
FBS (mg/dL)	209.98	49.69
PPBS (mg/dL)	317.1	75.2
HbA1c (%)	9.4	1.83
TLC (x 10^3 cells/µl)	18.11	5.78
Neutrophil (%)	89.19	3.08
Creatinine (mg/dL)	1.23	0.32

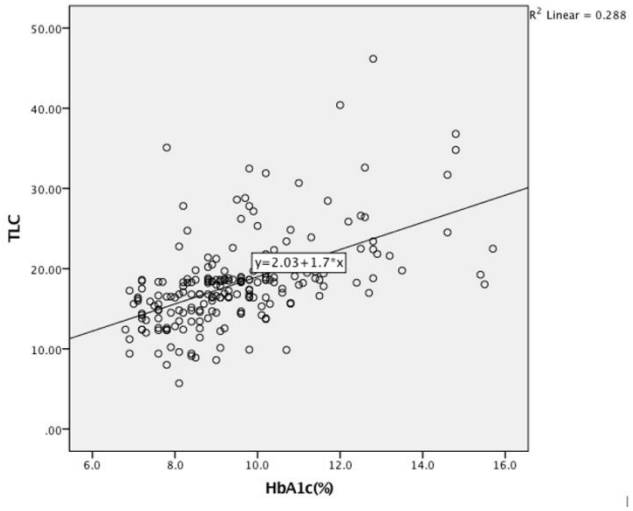

Figure 1 Correlation between Total leucocyte count and HbA1c

Out of 200 patients, 127(62.5%) were found to have Urinary tract infection (UTI). Among those cases, 21 had pyelonephritis and the most common organism isolated was *E.coli*. (table 3) Emphysematous pyelonephritis was found in 3 cases.

Table 3: Bacterial infection in Pyelonephritis

BACTERIA	FREQUENCY	PERCENT
E.COLI spp.	**16**	**76.19**
ATYPICAL E.COLI	**1**	**4.76**
PROTEUS MIRABILIS	**2**	**9.52**
ACINATOBACTER spp.	**2**	**9.52**

Out of 200 patients, 30 had respiratory tract infection, among them 19 had CXR abnormalities. Left lower and middle zoneopacity being the most common x-ray finding in our patients; and two of them had miliary shadows. 26 were culture positive for sputum, 2 of them were AFB positive & 4 of them had no growth. Out of those 26 patients 5 had similar organism positive in blood as well. (Table 4)

Table 4: Bacterial profile in pneumonia

BACTERIA	C/S Obtained from	Frequency	percent
KLEBSIELLA spp.	BLOOD +SPUTUM	1 + 10	33.33
ACINATOBACTER spp.	BLOOD + SPUTUM	0 +8	26.66
MSSA	BLOOD + SPUTUM	2+2	13.33
MRSA	BLOOD+SPUTUM	1+2	10
PSEUDOMONAS spp.	BLOOD+SPUTUM	1+1	6.66
ENTEROCOCCUS spp.	BLOOD+SPUTUM	0+1	3.33
AFB POSITIVE	SPUTUM	2	6.66
NO GROWTH		4	13.33

Out of 32 patients with Diabetic foot, most of them were culture positive for Gram negative organism. Nearly 20% cases were culture negative. (table 5)

Table 5: Bacterial variation in diabetic foot(wound swab/pus c/s)

BACTERIA	FREQUENCY	PERCENT
ACINATOBACTER spp.	8	25
KLEBSIELLA spp.	4	12.5
CITOBACTER spp.	4	12.5
E.COLI spp.	3	9.37
ENTEROBACTER spp.	2	6.25
MRSA	2	6.25
MSSA	1	3.12
PROTEUS spp.	1	3.12
NO GROWTH	7	21.87

Out of 10 cases of liver abscess, blood culture was positive in all cases; Klebsiella was found in 50% cases. But 50% were sterile as prior antibiotics were given to liquefy the abscess. In most of the cases abscess was solitary during presentation. Out of 10 cases, 5 had large abscess measuring more than 10sq.cm. In this study all were managed conservatively with antibiotics, none were required surgical drainage.

Nearly 17 types of antibiotics have been used in our study as per culture sensitivity report. Nitrofurantoin, Piperacillin with Tazobactam, Levofloxacin, Cefoperazone with Sulbactam, Imipenem with Cilastatin, Meropenem, Tigecycline were the common antibiotics used in different condition in various number of patients (Table-6).

Table-6 Antibiotics used in various infection

ANTIBIOTICS	FREQUENCY	PETCENT	INDICATION
NITROFURANTOIN	88	44	UTI
PIPERACILLIN+TAZOBACTAM	78	39	UTI,PYELONEPHRITIS, DIABETIC FOOT, PNEUMONIA
LEVOFLOXACIN	25	12.5	DIABETIC FOOT,LIVER ABSCESS
CEFTRIAXONE+SULBACTAM	20	10	UTI
TIGICYCLINE	18	9	PYLELONEPHRITIS,PNEUMONIA, DIABETIC FOOT,LIVER ABSCESS
MEROPENUM	18	9	PNEUMONIA,PYELONEPHRITIS, DIABETIC FOOT
IMIPENEM+CILASTATIN	18	9	LIVER ABSCESS, PNEUMONIA, PYLELONEPHRITIS
LINEZOLID	14	7	DIABETIC FOOT,PNEUMONIA
CLINDAMYCIN	11	5.5	DIABETIC FOOT
CEFIXIME	10	5	UTI
COLISTIN	5	2.5	PNEUMONIA
TEICOPLANIN	4	2	PNEUMONIA
CLARITHROMYCIN	4	2	PNEUMONIA
CEFEPIME+TAZO	3	1.5	UTI
CEFTRIAXONE	3	1.5	UTI
CEFUROXIME	2	1	UTI,DIABETIC FOOT
ANTI TUBERCULAR THERAPY (ATT)	2	1	TUBERCULOSIS

In infections like pyelonephritis, antibiotics were used for 21-28 days as per protocol. Similarlyin tuberculosis, ATT was given for 6 months. Among all other infections, liver abscess required prolonged treatment (21±4.66 days). (Table 7).

Table 7: Number of days antibiotics used in various infection

INFECTION	MEAN	STANDARD DEVIATION
UTI	10.71	5.76
LIVER ABSCESS	21	4.66
PNEUMONIA	11.52	3.42
DIABETIC FOOT	12.34	3.51
SEPTICEMIA	12.67	5.76

Discussion

This prospective cohort study was conducted in our hospital with 200 patients with diabetes with clinical and or biochemical evidence of infection. In our study, there was a significant correlation between TLC and HbA1c%. This shows that higher HbA1c% or poor glycemic control is itself is a risk factor for severity of infection which is in tune with the findings by Hussain et al[6]. The mean HbA1c level of our patients at the time of admission was 9.4 % ±1.8 7. Tseng CC et al[7] noted that a HbA1c > 8.1 % was associated with an increased risk of infections like UTI.

Urinary tract was the commonest site of infection in our study (62.5%). Several effects of DM on the genitourinary system predispose diabetics to urinary tract infections. In addition, complications of urinary tract infection (e.g., bacteremia, pyelonephritis and renal papillary necrosis) are generally more common in diabetic individuals[8]. E. coli was the most common microorganism obtained from culture in our study which was similar to the findings in the study by Lye et al. and it is significantly in higher numbers among diabetic patients as compared to non-diabetic controls[9]. In our study we found 21 cases of pyelonephritis, 3 of which had emphysematous pyelonephritis of either side. Again, the causative organism was found to be E. coli in80% cases, that affirmed the findings by Chandrasekhar et al[10].

In our study patients with longer duration of DM, had higher prevalence of bacteriuria. A statistically significant longer diabetes duration was found in diabetic patients with bacteriuria than without (9.9 years versus 5.4 years)[11]. Bacteriuria prevalence roughly becomes double with each 10-year increase in duration of DM[12]. There are no randomized control trials that answer

the question as to what is the optimal duration of treatment of various infections in diabetics. However, literature supports that treating uncomplicated UTI for 7-14 days is equally effective as compared to prolong treatment. In our study the average duration of treatment of UTI was 10.71±5.76 days which was in tune with previous studies[13].

It is not very clear if diabetes is a potential risk for respiratory tract infections. Respiratory infections were accounted in 30 patients in our study that included pneumonia and Tuberculosis. Infections due to certain specific microorganisms, including Staphylococcus, Gram negative bacteria, mycobacterium tuberculosis occur with increased frequency among diabetic subjects, while those due to streptococcus, legionella and influenza, though does not occur with increased frequency, are associated with increased morbidity and mortality in diabetics[14].

In our study 19 out of 30 patients had chest X-ray abnormalities, 2 had miliary shadows. 24 patients had a positive culture in sputum & 2 were for positive for AFB. Klebsiella was the commonest organism isolated in 33.33% of cases, followed by Acinetobacter in 26.66%. Blood culture was positive for similar organism as sputum in 5 cases. 4 of them (13.33%) were sterile. Studies by S.R. Masoodi et al. had comparable findings [15].Being a tertiary centre, majority of our patients had received antibiotics prior to their presentation; this explains the culture sensitivity pattern of our study. Contrary to previous studies where tuberculosis was the commonest respiratory infection[15], our study differed. This could be due to intense RNTCP programming tuberculosis cases are admitted very less into our department and patients are getting FDC as per RNTCP 2016 even in sub-centre and by health workers. Regarding respiratory tract infections, M Martins et al[16], showed that diabetic individual had 1.4 times increased duration of hospital stay for CAP than non-diabetics. Jackson et al.[17] reported that the adjusted Relative risk for hospitalizations for community acquired pneumonia was 1.52 among subjects with diabetes compared with subjects without diabetes. This implies longer duration of hospital stay as well as antibiotic treatment in diabetics than non-diabetics.

Diabetic foot infection accounted for nearly 20% of our diabetes related hospital admission which was similar to other studies[18]. Majority of patients were culture positive for Gram negative bacteria. Acinetobacter (25%) and Klebsiella (12.5%) were the two commonest bacteriacultured, where as 21.8% of culture revealed no growth. Our study showed mono-bacterial growth pattern contrary to the previous studies from India suggesting poly-microbial aetiology[19]. It is believed that poly-microbial infections in diabetic foot is mostly due to the chronicity of the wounds. Most of the diabetic foot in our study were of more than 1 months in duration; and were treated with antibiotics like quinolones, 3rd generation cephalosporins and linezolid, so organisms like E. coli, streptococcus, Methicillin sensitive staphylococcus aureus (MSSA) were killed leaving behind multi drug resistance organisms like Acinetobacter, Klebsiella and Citrobacter species. The dominance of gram-negative bacteria is supported by many studies[19,20]. Various studies show that diabetic foot infection had the longest hospital stay as compared to other complications of diabetes[21]. Most of our patients were hospitalized for about 2 weeks.

Diabetes is a strong, potentially modifiable risk factor for pyogenic liver abscess(PLA). PLA associated with DM has a poor prognosis than without diabetes[22]. In our study, 10 patients had PLA out of which 50% culture was positive for Klebsiella and the next common organism was E. coli which was in tune with observations made by Tian et.al.[23]. Majority of the organism grown were from blood culture as it was difficult to obtain pus at the time of presentation. Most of the PLAs require antibiotics for liquefaction. In our study blood culture was positive in all cases but pus culture was positive only in 4 patients; as prior antibiotic was given to manage septicemia.

Majority of the PLAs were in Right Lobe; that may be due to its anatomical position, large size and tendency to receive large amount of portal blood flow and lymphatic drainage. This isalso supported by the previous literature[23].In this study, USG was as sensitive as 98%, which was significantly higher than that of previously reported in the literature [24]. It may be due to the diagnostic skills of the radiologist.In our study, two methods were followed to treat PLA:(1) using antibiotics alone, (2)Antibiotics &USG guided drainage. In our hospital, empirical antibiotics were started as soon as a clinical diagnosis of PLA is made. The empirical antibiotic usually prescribed was piperacillin &tazobactam plus metronidazole. However, the antibiotic was changed once the blood or abscess fluid culture was obtained. In our study all cases were managed conservatively. The duration of the antibiotic therapy generally varied from 3 weeks to 6 weeks[25], which is similar in our study.The long-term hospitalisation in our case could be explained by the poor glycemic control of our patients.

Regarding the antibiotic use, all patients were managed as per possible culture sensitivity report. Our hospital has a strong antibiotic policy of using the antibiotic from the lower group or the cost effective one to be used as per the available culture. Nitrofurantoin had been used in most of the UTIs (44% cases) unless contraindicated. Piperacillin with tazobactam was used in various infection like UTI, Pyelonephritis, Diabetic foot & Pneumonia. It is the second most common antibiotic, used in 78 patients. Antibiotics like clindamycin were exclusively used in Diabetic foot for anaerobic coverage & clarithromycin was used for atypical coverage in pneumonia. Linezolid was used in soft tissue infection with purulent discharge. Higher class of antibiotics like carbapenem were used in patients with severe sepsis or septic shock as per culture sensitivity reports. Teicoplanin was used in patients with septic shock for gram positive coverage and was very much effective.

Conclusion

The long held controversial clinical prejudice that infections pretend to be more common and severe in diabetic subjects remains undetermined.While some studies have failed to establish a definite relationship between hyperglycemia and infections, the various immunological abnormalities seem to put the diabetics more labile for infections. Various immunological abnormalities are improved by strict glycemic control and that improves the prognosis in patients with diabetes. To conclude older age, longer duration of diabetes and poor glycemic control appear to increased risk for infections in diabetic subjects. The departures from the usual overall segment of various infections among diabetics in this study reflect, at least partly, admission bias.

Reference

1. Robbins SL, Tucker Jr AW. The cause of death in diabetes: a report of 307 autopsied cases. New England Journal of Medicine. 1944 Dec 28;231(26):865-8.
2. Phear AS. The causes of death in diabetes mellitus: a study of diabetic mortality in the Royal Adelaide Hospital from 1956 to 1960. Medical Journal of Australia. 1963 Jun;1(24):890-4.
3. Deborah E. Sentochnik and George M. Eliopoulos Infection and Diabetes.Joslin's Diabetes Mellitus. 2012:14; 60:1017-30
4. Paolo Pozzilli and R.D.G. Leslie. Infections, Immunity, and Diabetes. International Text Book of diabetes mellitus. 2009:3; 98:1729-37
5. BK Das, PK Das. Acute infections in diabetes mellitus.RSSDI Text Book of Diabetes Mellitus. 2012:2; 55:731-36
6. Hussain M, Babar MZ, Akhtar L, Hussain MS. Neutrophil lymphocyte ratio (NLR): A well assessment tool of glycemic control in type 2 diabetic patients. Pakistan journal of medical sciences. 2017 Nov;33(6):1366.
7. Tseng CC, Wu JJ, Liu HL, Sung JM, Huang JJ. Roles of host and bacterial

virulence factors in the development of upper urinary tract infection caused by Escherichia coli. American journal of kidney diseases. 2002 Apr 1;39(4):744-52.
8. Patterson JE, Andriole VT. Bacterial urinary tract infections in diabetes. Infectious Disease Clinics. 1997 Sep 1;11(3):735-50.
9. Lye WC, Chan RK, Lee EJC, Kumarasinghe G. Urinary tract infections in patients with diabetes mellitus. J Infect 1992;24:169-74.
10. Aswani SM, Chandrashekar UK, Shivashankara KN, Pruthvi BC. Clinical profile of urinary tract infections in diabetics and non-diabetics. The Austra-lasian medical journal. 2014;7(1):29.
11. Schmitt JK, Fawcett CJ, Gullickson G. Asymptomatic bacteriuria and hemoglobin A1. Diabetes care. 1986 Sep 1;9(5):518-20.
12. Keane EM, Boyk EG, Reller LB, Hamman RF. Prevalence of asymptomatic bacteriuria in subjects with NIDDM in San Luis valley of Colorado. Diab Care 1988;11:708-12.
13. Stamm WE, Hooton TM. Management of urinary tract infections in adults. New England journal of medicine. 1993 Oct 28;329(18):1328-34.
14. Koziel H, Koziel MJ. Pulmonary complications of diabetesmellitus: pneumonia. Infect Dis Clin North Am 1995;9:65-96.
15. Masoodi SR, Wani AI, Misgar RA, Gupta VK, Bashir MI, Zargar AH. Pattern of infections in patients with diabetes mellitus—data from a tertiary care medical centre in Indian sub-continent. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2007 Jun 1;1(2):91-5.
16. Martins M, Boavida JM, Raposo JF, Froes F, Nunes B, Ribeiro RT, Macedo MP, Penha-Gonçalves C. Diabetes hinders community-acquired pneumonia outcomes in hospitalized patients. BMJ Open Diabetes Research and Care. 2016 May 1;4(1):e000181.
17. Jackson ML, Neuzil KM, Thompson WW, Shay DK, Yu O, Hanson CA, Jackson LA. The burden of community-acquired pneumonia in seniors: results of a population-based study. Clinical Infectious Diseases. 2004 Dec 1;39(11):1642-50.
18. Armstrong DG, Liswood PJ, Todd WF. Prevalence of mixed infections in the diabetic pedal wound-a retrospective review of 112 infections. Journal of the American Podiatric Medical Association. 1995 Oct 1;85(10):533-7.
19. Gadepalli R, Dhawan B, Sreenivas V, Kapil A, Ammini AC, Chaudhry R. A clinico-microbiological study of diabetic foot ulcers in an Indian tertiary care hospital. Diabetes care. 2006 Aug 1;29(8):1727-32.
20. Parvez N, Dutta P, Ray P, Shah VN, Prakash M, Khandelwal N, Kaman L, Bhansali A. Microbial profile and utility of soft tissue, pus, and bone cultures in diagnosing diabetic foot infections. Diabetes technology & therapeutics. 2012 Aug 1;14(8):669-74.
21. Weiss A, Karpf A, Luger E, Schmilowitz H, Dekel S, Shapira I. Long-term antibiotic treatment in geriatric diabetic foot infection. Journal of medicine. 1998;29(5-6):365-73.
22. Thomsen RW, Jepsen P, Sørensen HT. Diabetes mellitus and pyogenic liver abscess: risk and prognosis. Clinical infectious diseases. 2007 May 1;44(9):1194-201.
23. Tian LT, Yao K, Zhang XY, Zhang ZD, Liang YJ, Yin DL, Lee L, Jiang HC, Liu LX. Liver abscesses in adult patients with and without diabetes mellitus: an analysis of the clinical characteristics, features of the causative pathogens, outcomes and predictors of fatality: a report based on a

large population, retrospective study in China. Clinical Microbiology and Infection. 2012 Sep 1;18(9):E314-30.

24. Hernandez JL, Ramos C. Pyogenic hepatic abscess: clues for diagnosis in the emergency room. Clinical microbiology and infection. 2001 Oct;7(10):567-70.
25. Bamberger DM. Outcome of medical treatment of bacterial abscesses without therapeutic drainage: review of cases reported in the literature. Clinical Infectious Diseases. 1996 Sep 1;23(3):592-603.