Section: Respiratory Medicine

Original Research Article

PREVALANCE AND ANTIBIOTIC SENSITIVITY PATTERN OF PATHOGENS IN DIABETICS AND NONDIABETICS IN EASTERN PART OF RAJASTHAN

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Abstract

Background: Diabetes mellitus (DM) is a multifactorial and multifaceted metabolic condition with a complex pathogenesis and various etiologies and presentations. There is a bidirectional relationship between diabetes and bacterial infections. While diabetes increases the susceptibility to bacterial infections and its complications, chronic infections such as periodontitis is associated with increased pro inflammatory cytokines which can exacerbate insulin resistance and worsen glycemic control. There is a recent growing evidence that abnormalities in the microbiota composition can have a major role in the development of diabetes, of which the Respiratory microbiota also comes important. **Materials and Methods:** This study was conducted in Department of Respiratory Medicine at Sh JP Medical college, Bharatpur, Rajasthan. This study was done over a period of one year. **Result:** This study analyzed 100 cases, with more male than female participants. Respiratory diseases observed in both diabetic and non-diabetic patients included COPD, asthma, pneumonia, ILD, bronchiectasis, and lung abscess. Bacterial growth was absent in 41% of cases, while the rest showed microbial presence. Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Staphylococcus aureus were the most common pathogens in both groups. **Conclusion:** Diabetic patients with respiratory infections face higher risks due to antibiotic resistance and increased ICU admissions, necessitating careful monitoring and targeted treatment. Strengthening antimicrobial stewardship and surveillance is crucial to managing these infections effectively.

INTRODUCTION

Diabetes mellitus (DM) is a multifaceted metabolic disorder characterized by a complex pathogenesis, diverse causes, and varying clinical presentations. Chronic hyperglycemia in individuals with DM triggers oxidative stress, inflammation, and immune dysfunction, all of which contribute to complications associated with poor glycemic control.[1] Research from both in vivo and in vitro studies has highlighted dysfunctions at multiple levels of the immune system in DM patients, ultimately increasing their vulnerability to infections and leading to worse health outcomes.[2,3] The prevalence of diabetes is rising globally, with an estimated 9.3% of the world's adult population affected in 2019, equating to 463 million individuals. Projections suggest this number could reach 700 million by 2045. Additionally, approximately 1.1 million children and adolescents under 20 years old are diagnosed with type 1 diabetes.[4] The well-documented clinical link between diabetes and bacterial infections further exacerbates the disease burden and its complications.[5] Diabetes and bacterial infections

share a bidirectional relationship. On one hand, diabetes heightens susceptibility to bacterial infections and their associated complications. On the other, chronic infections like periodontitis can elevate pro-inflammatory cytokines, aggravating insulin resistance, and worsening blood sugar regulation.[6] Emerging evidence also suggests that imbalances in gut microbiota may play a crucial role in the development of diabetes.[7] Understanding the intricate connection between diabetes and bacterial infections is essential for prevention and timely intervention. Certain bacterial infections, such as malignant otitis externa, emphysematous pyelonephritis, and emphysematous cholecystitis, are more prevalent in diabetic individuals, while others tend to present with increased severity in this population.[8] In some cases, infections may serve as an initial indicator of undiagnosed, long-standing diabetes.[9]

MATERIALS AND METHODS

Study Area: This study was conducted in Department of Respiratory Medicine at Sh JP Medical college, Bharatpur, Rajasthan.

Data collection: This study included two groups: one consisting of diabetic patients and the other comprising non-diabetic individuals, with both group containing 50 participants each so as to make an equal comparison, making a total of 100 cases. Participants included known cases of diabetes mellitus and non-diabetic individuals presenting with respiratory symptoms such as fever, cough with expectoration, breathlessness, chest pain. Adult Patients who agreed for written informed consent were included. Admitted patients in the hospital with clinical features suggestive of respiratory infections, including fever (temperature >100°F), cough lasting less than three weeks, sputum production, chest pain, and breathlessness were included. A confirmed respiratory infection (pneumonic patch) through chest X-ray or CT scan findings or raised TLC, CRP, ESR etc. with respiratory sign & symptoms was also a requirement for inclusion. The sputum sample were collected from both group and sent to Microbiology Department of Sh JP MC Bharatpur for Culture and susceptibility test.

Study duration: The duration of study was over a period of one year from 2023 to 2024.

Data analysis: Data were analyzed by using Microsoft Excel.

RESULTS

This study analyzed 100 cases, with a higher proportion of male participants than females. Among these cases, 42% were from urban areas, while 58% were from rural regions. The respiratory diseases identified in both diabetic and non-diabetic patients included Chronic Obstructive Pulmonary Disease (COPD), bronchial asthma, pneumonia, bronchiectasis, lung abscess, and interstitial lung disease (ILD). Specifically, COPD was observed in 9 diabetics and 11 non-diabetic cases, bronchial asthma in 9 diabetic and 12 non-diabetic cases, pneumonia in 13 diabetic and 11 non-diabetic cases, ILD in 5 diabetic and 3 non-diabetic cases, bronchiectasis in 7 diabetic and 9 non-diabetic cases, and lung abscess in 7 diabetic and 4 non-diabetic cases.

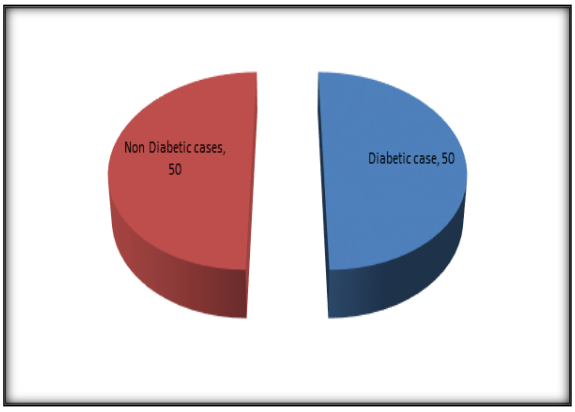

Figure 1: Diabetic and non-diabetic cases

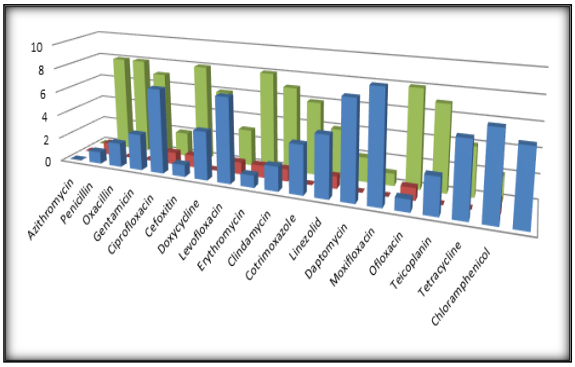

Figure 2: Antibiotic susceptibility pattern of Staphylococcus aureus

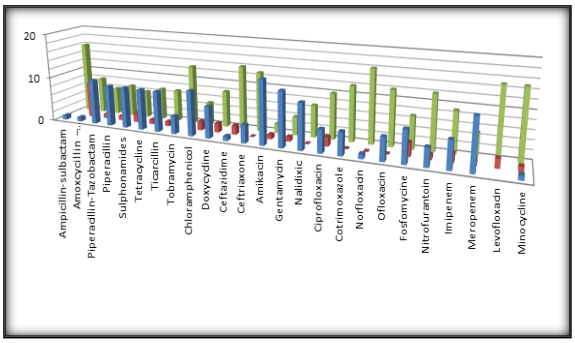

Figure 3: Antibiotic susceptibility pattern of Klebsiella pneumoniae

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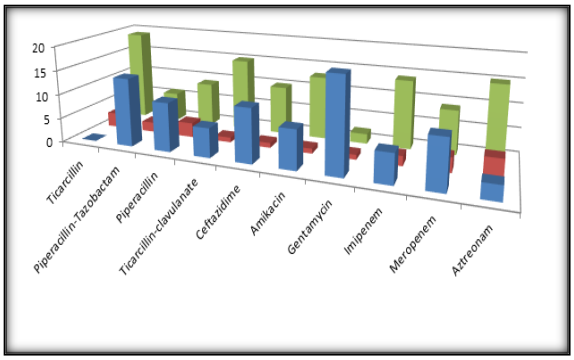

Figure 4: Antibiotic susceptibility pattern of Pseudomonas aeruginosa

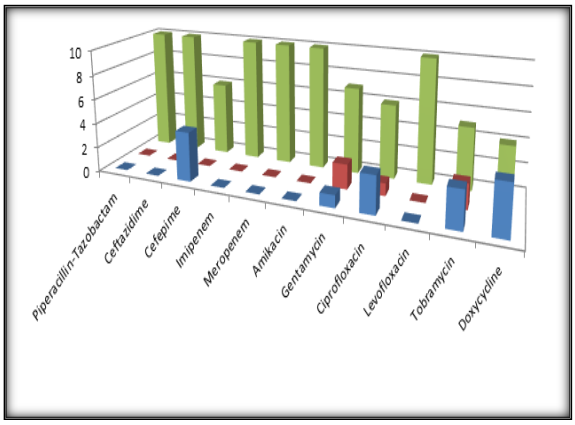

Figure 5: Antibiotic susceptibility pattern of Acinetobacter baumannii complex

Of the 100 cases, 41% showed no bacterial growth, while the remaining cases exhibited microbial presence. Among diabetic patients, 15 cases were identified with Klebsiella pneumoniae, 7 with Acinetobacter baumannii complex, 7 with Pseudomonas aeruginosa, and 4 with Staphylococcus aureus. In non-diabetic patients, 15 cases were found to have Pseudomonas aeruginosa, 6 had Staphylococcus aureus, 3 had Acinetobacter baumannii complex, and 2 had Klebsiella pneumoniae. Antibiotic susceptibility testing revealed that Staphylococcus aureus was most sensitive to daptomycin, followed by linezolid, tetracycline, and doxycycline, while it was resistant to azithromycin, penicillin, ciprofloxacin, levofloxacin, and other antibiotics. Klebsiella pneumoniae showed higher susceptibility to amikacin, followed by gentamicin and meropenem, while resistance was observed against ampicillin-sulbactam, ceftazidime, ceftriaxone, and others. Pseudomonas aeruginosa exhibited susceptibility to gentamicin, piperacillin-tazobactam, and ciprofloxacin, whereas resistance was noted against nalidixic acid, aztreonam, and ticarcillin-clavulanate. Lastly, Acinetobacter baumannii complex demonstrated susceptibility to doxycycline and cefepime, while resistance was observed against piperacillin-tazobactam, ceftazidime, imipenem, levofloxacin, and other antibiotics.

Table 1: Distribution of cases according to gender.

Gender	Number of cases	Percentage
Male	81	81%
Female	19	19%
Total	100	100%

Table 2: Distribution of cases according to demographic profile

Demographic profile	Number of cases	Percentage
Urban	42	42%
Rural	58	58%
Total	100	100%

Table 3: Distribution of diabetics & non diabetics cases according to disease

Sr. NO	COPD	Br. Asthma	ILD	Pneumonia	Bronchiectasis	Lung Abscess	Total
Diabetics	9	9	5	13	7	7	50
Non Diabetic	11	12	3	11	9	4	50
Total	20	21	8	24	16	11	100

Table 4: Organism isolated from Diabetic and non-diabetic cases

Organism isolated	Diabetic	Non- Diabetic	Total
No growth	17	24	41
Pseudomonas aeruginosa	7	15	22
Klebsiella pneumoniae	15	2	17
Staphylococcus aureus	4	6	10
Acinetobacter complex	7	3	10
Total	50	50	100

DISCUSSION

In the present study, 100 patients were selected from the Department of TB and Respiratory Medicine at Sh JP Medical College, Bharatpur, Rajasthan. Males were found to be predominant over females. A study conducted by Deshmukh et al,[10] conducted a study involving 138 TB-DM patients and found that 82.6% of the study population was above 45 years of age, with a higher incidence among males. This increased prevalence in men may be attributed to factors such as smoking, occupational and more environmental

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exposure, and alcohol consumption. Furthermore, males are more likely to seek medical treatment compared to females.

Most diabetic patients in our study presented with atypical pneumonia, with altered mental status and hypotension being the predominant clinical features in diabetic patients with community-acquired pneumonia (CAP). In contrast, non-diabetic patients exhibited more typical respiratory symptoms of pneumonia. The prevalence of lower respiratory tract infections among smokers in our study was found to be 36%. This is consistent with the findings of Vishwanathan R. (1964),[11] who reported an incidence of 28.5% higher in smokers compared to non-smokers (0.4–6%). Doll and Hill (1964),[12] also demonstrated in an epidemiological study that mortality due to chronic bronchitis was significantly higher in smokers than in non-smokers, with a direct correlation to the amount of tobacco smoked. In our study, bacterial organisms were isolated from 72% of sputum samples in diabetic patients and 67% in non-diabetic patients using sputum culture. A study conducted in Spain, which also utilized sputum culture as a diagnostic tool, detected a causative pathogen in 42% of CAP patients. Other studies have reported pathogen isolation in 46% of CAP cases, including both diabetic and non-diabetic individuals. Among the pathogens identified, Pseudomonas aeruginosa was the most frequently isolated organism in both diabetic and non-diabetic patients, followed by Klebsiella pneumoniae, Staphylococcus aureus, and the Acinetobacter baumannii complex. Specifically, in diabetic patients, the most common organisms were Klebsiella pneumoniae and Pseudomonas aeruginosa, whereas in non-diabetic patients, Pseudomonas aeruginosa and Staphylococcus aureus were predominant.

In our study, sputum culture yielded bacterial growth in 66% of diabetic patients and 52% of non-diabetic patients. This is comparable to findings from previous studies. For instance, Kulpathi et al. (1979),[13] reported bacterial growth in 51.4% of cases (18 out of 35). Similarly, Lee KH, Hui KP et al. (1996),[14] identified causative organisms in 68% of cases, with Klebsiella pneumoniae being the most common (15%). Overall, Gram-negative bacteria were responsible for 47% of cases. Bates JH et al. (1992) also reported that a specific etiological diagnosis was made in only about half of the patients. Ishida T, Hashimoto T et al. (1998),[15] found that causative organisms were identified in 61% of cases through sputum culture. Our findings align with these studies, further supporting the role of bacterial infections in respiratory illnesses among diabetic and non-diabetic individuals.

In our study, Antibiotic susceptibility testing revealed variations in resistance patterns among the identified bacterial isolates. Staphylococcus aureus showed the highest sensitivity to daptomycin and linezolid, making these effective treatment options. However, its resistance to azithromycin, penicillin, and fluoroquinolones raises concerns about the increasing prevalence of multidrug-resistant strains. Similarly, Klebsiella pneumoniae demonstrated susceptibility to amikacin, gentamicin, and meropenem, but resistance to ampicillin-sulbactam and third-generation cephalosporins was evident. This aligns with previous findings suggesting that Klebsiella pneumoniae exhibits resistance to beta-lactam antibiotics, particularly in diabetic patients.

The resistance pattern observed in Pseudomonas aeruginosa, with susceptibility to gentamicin and piperacillin-tazobactam but resistance to nalidixic acid and aztreonam, indicates the potential need for combination therapy in severe infections. Meanwhile, Acinetobacter baumannii complex showed susceptibility to doxycycline and cefepime, yet demonstrated high resistance to broad-spectrum antibiotics such as imipenem and ceftazidime. This highlights the challenge of treating infections caused by Acinetobacter baumannii, particularly in diabetic individuals who may have prolonged hospital stays or frequent antibiotic exposure.

A similar study, a systematic review and meta-analysis, examined the link between Type 2 diabetes mellitus (T2DM) and antibiotic-resistant infections. It revealed that individuals with T2DM had a higher likelihood of developing resistant infections compared to non-diabetic individuals, underscoring the increased risk of multidrug-resistant infections in diabetic patients. Another related study investigated the prevalence of carbapenem-resistant Acinetobacter baumannii (CRAB) infections among diabetic patients. The results showed a greater susceptibility to CRAB infections in individuals with diabetes, highlighting the importance of effective infection control strategies and targeted antibiotic treatments for this population.[16,17]

Overall, the findings emphasize the importance of targeted antibiotic therapy based on susceptibility testing, especially in diabetic patients who may have a higher risk of multidrug-resistant infections. The study also underscores the need for antibiotic stewardship programs to prevent the emergence of resistant strains and optimize treatment outcomes in both diabetic and non-diabetic patients. Further research with larger sample sizes and molecular studies can provide deeper insights into the mechanisms underlying bacterial resistance in diabetic individuals.

CONCLUSION

This study concludes that Klebsiella pneumoniae was the most common cause of chest infections in diabetic patients, while Pseudomonas aeruginosa was more frequent in non-diabetic patients. Diabetic patients with community-acquired pneumonia showed high resistance to standard antibiotics and had a greater risk of severe pulmonary complications, often requiring ICU admission. The study emphasizes significant antibiotic resistance variations, with Staphylococcus aureus, Klebsiella

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pneumoniae, and Pseudomonas aeruginosa requiring careful antibiotic selection. Acinetobacter baumanii's resistance to broad-spectrum antibiotics poses major treatment challenges in diabetic individuals. These findings highlight the need for antimicrobial stewardship, close monitoring, and tailored treatment strategies to manage infections effectively.

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