Original Article

Bacterial Etiology and Antibiotic Sensitivity Pattern of Community Acquired Pneumonia in Diabetic Patients: Experience in a Tertiary Care Hospital in Bangladesh

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Abstract

Background: *Diabetes mellitus (DM) is an immunosuppressive condition and uncontrolled diabetes is associated with increased susceptibility to various infections like pneumonia. Community acquired pneumonia (CAP) in diabetic patients is often caused by more virulent or atypical organisms and associated with increased resistance to conventional antibiotics. The aims of this study were to identify the bacterial etiology of CAP in patients with DM and to see their antibiotic sensitivity pattern.*

Methods: *This was a cross-sectional, observational study conducted in the Department of Internal Medicine & Pulmonology of BIRDEM General Hospital, Dhaka, Bangladesh, from January 2013 to December 2015. A total of 120 hospitalized diabetic patients diagnosed with CAP and with a positive sputum culture growth of any bacteria were included in the study.*

Results: *Majority (67%) of the patients were male. Mean age of the patients was - 55.69 ±10.5 years. Mean duration of diabetes was - 7.35 ±1.3 years. Mean HbA1c was - 8.6 ±1.89%. Sputum for culture showed that out of 120 (100%) patients, Klebsiella pneumoniae was detected in 53 (44.2%) patients, Staphylococcus aureus in 18 (15.0%), Pseudomonas species in 16 (13.3%) patients, Acinetobacter in 10 (8.3%), Escherichia coli in 9 (7.5%) patients and 14 (11.7%) patients had growth of other organisms. Sensitivity pattern of different bacterial growth in sputum to commonly used antibiotics like ceftriaxone, ciprofloxacin, amikacin and imipenem were as follows – Klebsiella (19%, 47%, 74%, 96% respectively), Staph aureus (11%, 33%, 78%, 67% respectively), Pseudomonas (19%, 75%, 81%, 88% respectively), Acinetobacter (0%, 0%, 20%, 50% respectively), E. coli (22%, 22%, 100%, 100% respectively). All (100%) of the Pseudomonas and Acinetobacter were sensitive to colistin. Most of the growth of all the bacteria (Klebsiella 94%, Staphylococcus 78%, Pseudomonas 81%, Acinetobacter 100%, E. coli 100%) occurred in patients with poor glycemic control (HbA1c ≥ 7.0%).*

Conclusion: *This study results suggest that CAP in diabetic patients are more frequently due to Klebsiella pneumoniae, Staphylococcus aureus and Pseudomonas species and mostly they are less sensitive to commonly used antibiotics like ceftriaxone and ciprofloxacin. So, whenever possible, treatment of CAP should be guided by sputum culture and sensitivity test and for empirical treatment of CAP in diabetic patients, alternative antibiotics like imipenem and amikacin should be considered.*

Key Words: *Antibiotic sensitivity pattern, community acquired pneumonia, diabetes mellitus*

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Introduction

Pneumonia is broadly defined as any infection of lung parenchyma.[1] Pneumonia is clinically divided into community acquired pneumonia (CAP) and nosocomial pneumonia. Infectious Diseases Society of America (IDSA) defines CAP as "an acute infection of the pulmonary parenchyma that is associated with at least some symptoms of acute infection, accompanied by the presence of an acute infiltrate on a chest radiograph or auscultatory findings consistent with pneumonia in a patient not hospitalized or residing in a long-term care facility for more than 14 days before onset of symptoms".[2]

Etiology of CAP is generally bacterial. The common etiological agents causing CAP include- *Streptococcus pneumoniae* (20-60%), *Hemophilus influenza* (3-10%), *Chlamydia pneumoniae* (4-6%), *Mycoplasma pneumoniae* (1-6%), *Legionella* (2-8%), *Staphylococcus aureus* (3-5%), Gram-negative bacilli (3-5%) and viruses (2-13%).[3] The bacteriological profile of CAP is different in different countries and changing with time within the same country, probably due to frequent use of antibiotics, changes in environmental pollution, increased awareness of the disease and changes in life expectancy. For instance *Streptococcus pneumoniae* remains the commonest organism leading to community acquired pneumonia in most parts of Europe, United States of America (USA) and India.[3-6]. *Klebsiella pneumoniae* is the most common pathogen leading to admission to a medical intensive care unit in Singapore.[7]

Pneumonia is increasingly common among older patients and those with co-morbidity like diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), renal failure, congestive heart failure, chronic liver disease (CLD) and other conditions.[8] DM is one of the most common chronic diseases worldwide and associated with numerous complications.[9] Respiratory infections are among the major infections associated with diabetes.[10] Multiple pulmonary vascular and functional abnormalities have been documented in diabetics known as pulmonary microangiopathy; that can contribute to delayed clearance of and spread of pulmonary infection in the host.[11] In relation to pulmonary infection, studies suggest that this alteration of immune system in diabetic patients is associated with increased susceptibility to uncommon microorganisms, particularly gram negative bacteria.[12,13]

This study was a sincere attempt to look into various causative agents of CAP and sensitivity pattern of organisms to plan therapy among patients with DM.

Methods

This cross-sectional observational study was carried out on 120 diabetic patients from January 2013 to December 2015 in the Department of Internal Medicine & Pulmonology of BIRDEM General Hospital, Dhaka, Bangladesh, a tertiary care hospital for diabetic as well as non-diabetic patients. Every consecutive patient who was admitted with fever, cough and sputum production were evaluated for the presence of CAP. Diagnosis of CAP was made on the basis of history, clinical examination, routine blood parameters (complete blood count including Erythrocyte Sedimentation Rate), chest radiograph and sputum examination. On admission, sputum samples were collected as per standard recommended protocols before the patients received first dose of antibiotics. In those patients who were unable to expectorate a satisfactory sputum specimen, sputum induction methods were followed. Sputum samples were sent for Gram staining and culture and sensitivity to antibiotics. In addition sputum was stained by Ziehl-Neelsen staining for presence of Acid Fast Bacilli (AFB). Patients in whom the sputum culture was positive for any bacterial growth were included in the study. Patients with CAP but without any bacterial growth in sputum, patients with growth of fungus or presence of AFB, patients who had already received antibiotics before sputum could be sent for culture sensitivity, aspiration pneumonia, nosocomial pneumonia and patients on immune-suppressive therapy were excluded from the study. The data was collected using a pre-tested semi-structured proforma. The collected data were analyzed using SPSS version 22.0.

Results

Out of 120 subjects, 80 (67%) were male, 40 (33%) were female. Mean age of the patients was - 55.69 ±10.5 years. Mean duration of diabetes was - 7.35 ±1.3 years. Mean HbA1c was - 8.6 ±1.89%. Sputum culture showed that majority (53%) of the patients had growth of

Klebsiella pneumoniae. Only 3 (2.5%) patients had growth of *Streptococcus pneumoniae* [Table I]. Bacterial antibiotic sensitivity pattern to ceftriaxone, ciprofloxacin, amikacin and imipenem were as follows – *Klebsiella pneumoniae* (19%, 47%, 74%, 96% respectively), *Staphylococcus aureus* (11%, 33%, 78%, 67% respectively), *Pseudomonas species* (19%, 75%, 81%, 88% respectively), *Acinetobacter* (0%, 0%, 20%, 50% respectively), *Escherichia coli* (22%, 22%, 100%, 100% respectively) [Table II]. All (100%) of the *Pseudomonas* and *Acinetobacter* were sensitive to colistin and all (100%) of the *Staphylococcus aureus* were sensitive to vancomycin. Most of the bacterial growth in sputum of all the bacteria was found in patients with HbA1c ≥7.0% [Table III].

Table I. Sputum culture findings of CAP in Diabetic Patients (n=120)

Bacterial growth in sputum culture	Frequency	Percentage
Klebsiella pneumoniae	53	44.2
Staphylococcus aureus	18	15.0
Pseudomonas species	16	13.3
Acinetobacter	10	8.3
Escherichia coli	9	7.5
Streptococcus pneumoniae	3	2.5
Other organisms	11	9.2

Table II. Sensitivity of common bacterial growth in sputum to different antibiotics *(n=120)*

Bacterial growth in sputum culture	Sensitivity of Antibiotic				
	Ceftriaxone	Ciprofloxacin	Amikacin	Imipenem	Colistin
Klebsiella pneumoniae(n=53)	10 (19%)	25 (47%)	39 (74%)	51 (96%)	-
Staphylococcus aureus(n=18)	2 (11%)	6 (33%)	14 (78%)	12 (67%)	-
Pseudomonas species(n=16)	3 (19%)	12 (75%)	13 (81%)	14 (88%)	16 (100%)
Acinetobacter(n=10)	0 (0%)	0 (0%)	2 (20%)	5 (50%)	10 (100%)
Escherichia coli(n=9)	2 (22)%	2 (22%)	9 (100%)	9 (100%)	-

[Not all antibiotics were tested for all bacteria]

Table III. Bacterial growth in sputum in relation to glycemic status of the diabetic patients (n=120)

Bacterial growth in sputum culture	HbA1c level	
	< 7.0 % Number (%)	≥ 7.0 % Number (%)
Klebsiella pneumoniae (n=53)	3 (6%)	50 (94%)
Staphylococcus aureus (n=18)	4 (22%)	14 (78%)
Pseudomonas species (n=16)	3 (19%)	13 (81%)
Acinetobacter (n=10)	0 (0%)	10 (100%)
Escherichia coli (n=9)	0 (0%)	9 (100%)

Discussion

In this study, the majority (67%) of the DM patients with CAP were male. This finding is similar to some other studies where 62% DM patients with CAP were male.[14] This may be due to the fact that male patients may have more incidence of CAP and also have more access to health facilities than female. Mean age of the patients in this study was around 55 years which was lower than other studies in western world where the mean age of the DM patients with CAP was around 72 years, may be due the difference of average life span in different countries.[14]

In this study the majority of the patients had growth of *Klebsiella pneumoniae* in sputum, followed by *Staphylococcus aureus* and then other gram negative bacteria like *Pseudomonas* and *E. coli*. This finding is similar to other studies conducted in Bangladesh,[15,16] but somehow different from another study in India where the majority of growth was *Pseudomonas* followed by *Staphylococcus aureus*.[17] It has been suggested that patients with DM have increased rate of colonization and adherence of gram negative bacteria to the upper respiratory epithelium. From there aspiration of these bacteria to the lung may be facilitated by the use of

anti-ulcerants and diabetic gastroparesis.[18,19] Diabetic patients are also at increased risk of staphylococcal pneumonia as because the rate of nasal carriage of *Staphylococcus* in diabetic patients is 30% compared to 11% in non-diabetic individuals.[20] It is worthy to note that growth of relatively rare organisms like *Acinetobacter* was quite high in diabetic patients. Moreover growth of *Streptococcus pneumoniae* is negligible compared to conventional finding in non-diabetic patients.[21]

Antibiotic sensitivity pattern showed that most of the bacteria including almost 80% of *Klebsiella* were resistant to ceftriaxone. This is similar to other studies in Bangladesh[15] and India[21] but different from another study finding where almost 90% of the *Klebsiella* was sensitive to ceftriaxone.[16] Ciprofloxacin sensitivity was low in almost all the bacteria except *Pseudomonas* in this study. Majority of the bacteria were sensitive to imipenem and amikacin which is similar to other studies.[22] No case of colistin resistance in *Acinetobacter* and vancomycin resistance in *Staphylococcus aureus* were observed in this study.

Regarding glycemic status, most of the bacterial growth was isolated in patients with uncontrolled DM as evidenced by HbA1c ≥7.0%. This is because uncontrolled DM causes immunosuppression leading to increased chance of any infection including pneumonia.

This was a single center study involving only diabetic patients. So no comparison with non-diabetic patients is possible through this study. Further larger multi-center study comparing both diabetic and non-diabetic patients is warranted.

Conclusion

This study results suggest that CAP in diabetic patients are more frequently due to gram negative bacilli like *Klebsiella pneumoniae*, *Pseudomonas* species and also *Staphylococcus aureus* and mostly they are resistant to commonly used antibiotics like ceftriaxone and ciprofloxacin. So, effective treatment of CAP in diabetic patients should be guided by sputum culture results and if empirical treatment has to be started then alternative antibiotics like imipenem and amikacin should be considered.

Conflict of interest: None

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