International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

Bacterial Pneumonia: Comparison between Diabetics and Non-Diabetics

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Abstract: ***To determine the causative organisms, anti microbial susceptibility, and outcome of community- and hospital acquired pneumonia in diabetics and to compare this with non-diabetics, sputum cultures done at Asram Medical College, Hospital, ELURU in the period between October 2016 and December 2018 were reviewed. A total of 354 cases were studied, of which 125 (35%) were diabetics. Diabetic patients were older with a male predominance compared to non-diabetics. H. influenza was the commonest pathogen in community-acquired pneumonia (CAP) in both diabetics and non-diabetics, but there was a predominance of Staphylococcusaureus in diabetics compared to non-diabetics. Gram-negative bacilli were the commonest pathogens in hospital-acquired pneumonia (HAP) in both diabetics and non-diabetics. Ampicillin, co-amoxyclav, flouroquinolones, second-generation cephalosporins and erythromycin were used empirically in CAP while aminoglycosides, fluoro- quinolones and imipenem were used in HAP in both diabetics and non-diabetics. No significant difference in mortality was found between diabetics and non-diabetics, for either CAP or HAP***

Keywords: Pneumonia, Diabetics, Microorganism, Mortality, Treatment

1. Introduction

Diabetes mellitus (DM) is often identified as an independent risk factor for developing respiratory tract infections. Diabetic patients are predisposed to colonization and pneu- monia because of disease-associated impairment in host defensive functions [1, 2]. Also, they are more liable to develop complications such as bacteremia, delayed resolution, and recurrent pneumonia[3]. Pneumonia is the leading cause of hospitalization and mortality [4]. Several studies have shown that the use of appropriate antimicrobial therapy can improve outcome with survival rate reaching 70%–80% [2]. The aim of this study was to determine the causative organisms, antimicrobial susceptibility of community- and hospital-acquired pneumonia in diabetics, and to report on any difference between them and nondiabetics.

2. Patients and Methods

For this study, we reviewed sputum cultures of patients above the age of 18 years, performed in the period between OCTOBER 2016 and December 2018. Sputum cultures positive for bacteria were analyzed, those positive for acid-fast bacilli were excluded.

Sputum samples were processed by gram stain and culture. Cultures were performed on 5% sheep blood agar (oxoid) and chocolate agar. Bacteria isolated from sputum culture were considered presumptive etiologic pathogens if they were compatible with the predominant organisms present on gram stain and if cultured in abundant growth or in pure growth.

Pneumonia was diagnosed according to the American Thoracic Society criteria [7]. Cases were classified into hospital-acquired pneumonia (HAP) if the sputum culture was first positive more than 72h after admission, excluding any infection that was incubating at the time of admission. Community-acquired pneumonia (CAP) was defined by a positive sputum culture with in 72 h after admission or by a positive culture performed as outpatient.

For each patient with pneumonia, we recorded age, gender, out- come, type of organisms isolated and their antimicrobial susceptibility, empiric use of antimicrobial agents, presence of DM ,treatment regimen for DM, and degree of control (good control was defined as a glycated hemoglobin (HbA1c) <7%).

The in vivo antibacterial susceptibility of the isolated bacteria was determined by the disk diffusion method. Patients were divided into two groups according to the pres- ence or absence of DM. Statistical analysis was done using Statistical Package for Social Sciences (SPSS) computer soft- ware and *p* values less than 0.05 were considered significant.

3. Results

From a total of 605 sputum cultures done during the study period, 354 cases with a positive culture were included in the study. Of these, 125 (35%) were diabetics, havingameanageof59.4±14.0yearsvs53.7±20.6years for the non-diabetics (p=0.006). Male predominance was noticed in the diabetic group: the male female ratio was 3:1 vs 1.2:1 for non-diabetics (p<0.001). Most of the diabetic patients were using oral hypoglycemia agents for blood glucose control (n=75, 60%); of the remainder, 38 (30%) were on insulin, 7 (6%) on diet, and 5 (4%) on combination therapy. There were 86 (69%) diabetics who were poorly controlled.

Table 1: Pathogens isolated 26 diabetics and 59 non-diabetics with community-acquired pneumonia

Pathogen	Diabetics	Non-diabetics	*p* value
	n (%)	n (%)	
Streptococcus pneumoniae	1 (4)	3 (5)	0.3
Staphylococcus aureus	**6 (23)**	**6 (10)**	**0.02**
Haemophilus influenzae	13 (50)	31 (53)	0.8
Moraxella catarrhalis	2 (8)	8 (14)	0.6
Pseudomonas spp.	3 (12)	5 (8)	0.7
Klebsiella spp.	1 (4)	3 (5)	0.6
Enterobacter spp.	–	1 (2)	0.5
Acinetobacter spp.	–	1 (2)	0.5
Streptococcus viridans	–	1 (2)	0.5

Table 2: Pathogens isolated from 99 diabetics and 170 non-diabetics with hospital-acquired pneumonia

Pathogen	Diabetics		Non-diabetics		*p* value
	n	(%)	n	(%)	
Streptococcus pneumoniae	3	(3)	1	(1)	0.1
Staphylococcus aureus	14	(14)	27	(16)	0.6
Haemophilus influenzae	13	(13)	26	(15)	0.9
Moraxella catarrhalis	6	(6)	9	(5)	0.4
Pseudomonas spp.	30	(30)	43	(25)	0.5
Klebsiella spp.	6	(6)	15	(9)	0.5
Enterobacter spp.	9	(9)	14	(8)	0.4
Proteus spp.	2	(2)	3	(2)	0.7
Escherichia coli	2	(2)	8	(5)	0.4
Enterococci	1	(1)		–	0.1
Citrobacter spp.	1	(1)	3	(2)	0.7
Acinetobacter spp.	6	(6)	7	(4)	0.2
Others[a]	6	(6)	14	(8)	0.3

[a]*Stentrophomonas maltophilia, Serratia* spp.

Table 3: Antibiotic sensitivity of some isolates in community and hospital acquired pneumonia

Antimicrobial agent	Pathogens, n(%)											
	Community acquired						Hospital acquired					
	S. pneumoniae		*H. influenzae*		*Moraxellacatarrhalis*		*S. aureus*		*Pseudomonas*spp.		*Enterobacter*spp.	
	D	ND	D	ND	D	ND	D	ND	D	ND	D	ND
	n=1	n=3	n=13	n=31	n=2	n=8	n=14	n=27	n=30	n=43	n=9	n=14
Penicillin	–	1 (33)	–	–	1 (50)	1 (13)	–	4(15)	–	–	6 (67)	2 (18)
Ampicillin	1(100)	3 (100)	9 (70)	23(74)	1 (50)	8 (100)	2(14)	-	2 (7)	–	–	1 (7)
Co-amoxyclav	1(100)	3 (100)	9 (70)	23(74)	2 (100)	8 (100)	2(14)	-	2 (7)	1 (2)	2 (22)	1 (7)
Ciprofloxacin	–	–	10 (77)	26(84)	1 (50)	8 (100)	2(14)	-	24 (79)	30 (70)	7 (78)	11 (79)
Cefuroxim	1(100)	3 (100)	12 (92)	30(97)	1 (50)	8 (100)	2(14)	-	1 (4)	–	2 (22)	2 (14)
Erythromycin	1(100)	3 (100)	6 (46)	19(60)	2 (100)	7 (86)	5(36)	18 (67)	–	1 (2)	4 (44)	3 (21)
Oxacillin	1(100)	3 (100)	–	–	–	–	9(64)	22 (81)	–	–	–	–
Vancomycin	–	3 (100)	–	1 (3)	–	–	12(86)	18 (67)	–	–	–	2 (14)
Azterionam	–	1 (33)	4 (31)	17(55)	–	–	–	-	20 (67)	25 (59)	2 (22)	7 (50)
Ceftazidim	–	–	1 (8)	–	–	–	–	-	21 (71)	29 (68)	2 (22)	2 (14)
Ceftriaxon	–	3 (100)	10 (77)	27(87)	–	1 (13)	–	-	8 (27)	9 (21)	2 (22)	7 (50)
Gentamycin	–	1 (33)	–	1 (3)	–	–	2(14)	8(30)	27 (79)	36 (84)	7 (78)	7 (50)
Amikacin	–	–	–	–	–	–	–	-	25 (82)	36 (85)	9 (100)	14 (100)
Imepenum	–	–	1 (8)	2 (6)	–	–	–	-	15 (50)	29 (68)	9 (100)	13 (93)
Pipracillin	–	–	–	–	–	–	–	-	22 (73)	30 (70)	2 (22)	7 (50)

D, Diabetics; *ND*, Non-diabetics; *co-amoxyclav*, a combination of amoxycillin and clavulanica acid

Of the 354 patients with a positive sputum culture, 85 (24%) were diagnosed as having CAP, while the remaining 269 patients (76%) had HAP. Among the patients diagnosed with CAP, 26 (31%) were diabetics while among those with HAP there were 99 diabetics (37%). Empiric antimicrobial treatment was in use at the time of specimen collection in 81 (95%) of patients with CAP vs. 231 (86%) of patients with HAP (p=0.2). Most of the patients were started on two empiric antimicrobial agents: 72 of 81 (85%) in CAP and 212 of 231 (92%) in HAP (p=0.09). *Haemophilus influenzae* was the commonest cause of CAP in both diabetics and non-diabetics (Table 1). There was a predominance of infections by *Staphylococcus aureus* among diabetics with CAP compared to non-diabetics. Gram-negative bacilli were the commonest cause of HAP in both diabetics and nondiabetics (Table 2). Ampicillin, co-amoxyclav (a combination of amoxycillin and clavulanica acid), flouroquinolone, second-generation cephalosporins and erythromicin were used empirically in CAP, while aminoglycosides, flouroquinolones and impenem were used in HAP in both diabetics and non-diabetics (Table3).

4. Discussion

Pneumonia is one of the most common infectious in India, It is clear from our study that almost one-third of the cases admitted with bacterial pneumonia were diabetics. Diabetics have alterations of pulmonary host defenses [11] which make them more susceptible to infection. Advanced age is also associated with immune changes that increase the risk of pneumonia [12]. In this study, diabetics were older than non-diabetics; therefore they were at increased risk for pneumonia also for their age.Several studies have shown that *S. pneumoniae* is the most common pathogen isolated in CAP [13–15]. Other organisms isolated in CAP include *H. influenzae*, atypical bacteria, *Moraxella catarrhalis*, *S. aureus*, and gram-negative bacilli [16–18]. Interestingly, this study showed that*H. influenzae* was the commonest pathogen isolated in CAP in both diabetics and non-diabetics, while *S. pneumoniae* was isolated in a smaller percentage. Some studies have found that sputum cultures were negative in about 50% of patients with pneumococcal bacteremia, and that the rate of isolation increases when more invasive methods are used for obtaining specimens, such as trans- tracheal aspiration

which eliminates contaminating oropharyngeal flora [16, 19]. Due to the retrospective design of this study, invasive methods for obtaining sputum specimens were not used for all the cases. Another possible reason for the low isolation rate of S. Pneumoniae is the use of antimicrobial agents at the time of specimen collection [20]. The majority of these patients were started on empiric antimicrobial agents. *S. aureus* is a major pathogen of CAP in diabetics compared to non-diabetics. This observation can be attributed to the high nasal carriage rate of *S. aureus* in diabetics where it reached 30% compared to 11% inhealthy individuals[21],The rate of nasal carriage of *S.aureus* is directly related to the glycosylated hemoglobin ($HbA1_C$)level[21].The ATS recommends to use empiric treatment for pneumonia as pathogen identification can be difficult [26]. We found that co-amoxyclav, ampicillin, flouroquinolones, second-generation cephalosporins, and erythromycin were used empirically to treat CAP in both diabetics and non- diabetics, while in severe cases of CAP (especially in poorly controlled diabetics Staphylococcus can be combatted with cloxacillin or vancomycin. In HAP, aminoglycosides, flouroquinolones, and imipenem were used in both diabetics and non-diabetics, which is in agreement with what has been recommended by others [10, 27–31].One of the limitations of microbiological diagnosis of pneumonia is the lower prevalence of positive sputum cultures due to either the use of empiric antimicrobial agents at the time of specimen collection or the failure to use of more invasive methods for obtaining sputum specimens. Due to the retrospective design of this study, these limitations could not be avoided.

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