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Bacteriology and Antibiotic Sensitivity Pattern of Sputum in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease

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Abstract

Introduction: *Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and mortality worldwide. Nowadays investigators need culture studies for proper selection of antibiotic, but it is a time consuming process. The choice of the antibiotic should be constituted on the bacterial sensitivity and resistance pattern.* ***Objective:*** *To identify the causative bacteriology and antibiotic sensitivity of sputum of chronic obstructive pulmonary disease patients with acute exacerbation.* ***Materials and Methods:*** *It was a prospective study in department of medicine Cumilla Medical College Hospital during the period of July 2019-2020. All the patients included in this study were above 37 years of age, diagnosed as acute exacerbation of COPD (AECOPD) were included in this study. Those patients were on antibiotic was advised to stop antibiotic for 48 hours and were included in this study. Fresh spot specimen as well as overnight collection of sputum samples were collected from each 257 patients of different age and sex groups in a sterile screw capped universal container. The specimen was labeled and transported to the microbiology laboratory for processing and cultured within half an hour of collection. Antibiotic susceptibility pattern was done following Kirby-Bauer disc diffusion method of clinical laboratory science (CLS) program.* ***Results:*** *Majority (45.5%) of the patients had growth of Klebsiella pneumoniae. All the isolated organisms except Acintobactor are mostly sensitive to Meropenum, Imipanum and Amikacin. In vitro sensitivity pattern against these antibiotics was more than 85%.* ***Conclusion:*** *Male is predominating and majority of them are older age group. Klebsiella pneumoniae, Pseudomonas and E. coli are common isolated organisms.*

Keywords: *COPD, AECOPD, Isolated organism, Antibiotics, Sensitivity pattern.*

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Introduction:

COPD is a major cause of morbidity and one of the predominant causes of the death across the world, characterized by a worsening in the patient's respiratory symptoms which is beyond normal day-to-day variations and eventually leads to a change in the medication[1]. Exacerbations of Chronic Obstructive Pulmonary Disease (AECOPD) are a common cause of hospitalization. It could have either an infective or non-infective etiology. Primary line of treatment is administration of empirical antibiotic therapy[2]. Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and mortality worldwide. Acute exacerbation is an acute and sustained worsening of a patient's condition from a stable state (beyond normal day-to-day variations) and it is caused in majority by infectious agents, particularly bacteria[3]. In AECOPD cases due to infection, three classes of pathogens have been found: respiratory viruses, aerobic gram-positive and gram-negative bacteria, and atypical bacteria[4]. Current data on bacteriology related to AECOPD are mainly obtained from the western countries[5]. The spectrum of organisms in India might be different from those of other countries or regions making it crucial to examine the bacteriology responsible for AECOPD, which is important for the choice of empirical antibiotic treatment[5]. It has been observed that the use of antibiotics used to treat AECOPD has an impact on the failure rate[6]. More than 90% of patients with AECOPD are treated with antibiotics, due to the emergence of resistant strains[7]. Nowadays investigators need culture studies for proper selection of antibiotic, but it is a time consuming process. The choice of the antibiotic should be constituted on the local bacterial resistance pattern. The aim of this study is to identify the causative bacteriology and antibiotic sensitivity of

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sputum of chronic obstructive pulmonary disease patients with acute exacerbation.

Materials and Methods:

It was a prospective study in department of medicine Cumilla medical college hospital during the period of July 2019-2020. All the patients included in this study were above 37 years of age, presented with AECOPD diagnosed either clinically or by investigations were included in this study. Those patients were on antibiotic advised to stop drug for 48 h and were included in this study. Fresh spot as well as overnight collection of sputum samples were collected from each 257 patients of different age and sex groups in a sterile screw capped universal container. The specimen was labeled and transported to the microbiology laboratory for processing and cultured within half an hour of collection. A modified semi-quantitative technique using a standard calibrated bacteriological loop was performed to transfer 0.001 ml of sample on blood agar and MacConkey agar media. After allowing the sample to be absorbed into the agar, the plates were then inverted and incubated aerobically at 37°C for 24 h. The plates were then examined macroscopically for bacterial growth. The colony count was done using semi quantitative method. Number of colonies obtained was multiplied by 1000 to obtain the colony forming units (CFU)/ml. A significant growth is considered if the number of colony is 105 CFU/ml. Colonial appearance and morphological characters of isolated bacteria was noted and gram staining was done for identification of the isolated organisms. The characteristic bacteria on the culture media were aseptically isolated. Antibiotic susceptibility pattern was done following Kirby-Bauer disc diffusion method of clinical laboratory science (CLS) program It was carried out by disc diffusion technique using Muller Hinton Agar. Interpretation of results was expressed in sensitive and resistant depending upon the size of the zone of inhibition. The antibiotics used for susceptibility testing in our study were amoxycillin, amoxyclav, cefotaxime, ceftriaxone, cephalexin, nalidexic acid, nitrofurantoin, mecillinum, amikacin, cefixime, ceftazidime cefuroxime, cephradine ciprofloxacin cotrimoxazole, gentamycin, tazobactum, meropenem, and imipenem.

Results:

Table I shows the baseline characteristics of included patients in the study with AECOPD. The study population of 257 consecutive patients with bacterial CAP comprised 166 men (64.6%) and 91 women (35.4%), ranging in age from 38 years to 80 years, mean 76 [standard deviation (SD) 20.37] years. Most frequent distribution of the isolates in the sputum was found in the age group 49 to 60 years. Out of total 257 isolates, 137 was belongs to this age group of which male and female were 88 and 49 respectively. Among the study population of 257 consecutive patients, Rural was 157 (61.09%) and Urban was 100 (38.91%). Out of total 475 subjects married 466 (98.10%) and unmarried 9 (1.90%), Illiterate 148 (31.16%), Primary 176 (37.05%), Secondary 98 (20.63%), Higher secondary 48 (10.11%) and Graduate 5 (1.05%). Occupation of the study population, Business 57 (12%), Farmer 24 (5.05%), House holder Workers 285 (60%), Service Holder 50 (10.53%) Laborer was 59 (12.42%). History of tobacco user 425 (89.47%) & Non-tobacco user was 50 (10.53%). History of hospitalized 215 (45.26%) & Not hospitalized 260 (54.74%).

Table I: Baseline Characteristics.

Age (years)	Male	Female
37-48	46	27
49-60	88	49
>60	32	15
Total	**166**	**91**

Marital Status	
Married - n (%)	466 (98.10)
Unmarried - n (%)	9 (1.90)
Residence, n (%)	
Rural	157 (61.09)
Urban	100 (38.91)
Qualification, n (%)	
Illiterate	148 (31.16)
Primary	176 (37.05)
Secondary	98 (20.63)
Higher Secondary	48 (10.11)
Graduate	5 (1.05)
Occupation, n (%)	
Business	57 (12)
Farmer	24 (5.05)
Housewife	285 (60)
Service Holder	50 (10.53)
Laborer	59 (12.42)
History of Tobacco use, n (%)	
Tobacco user	425 (89.47)
Non-tobacco user	50 (10.53)
History of Hospitalization (Past 1 year), n (%)	
Hospitalized	215 (45.26)
Not Hospitalized	260 (54.74)

Table II shows the growth status of the organisms in sputum culture of AECOPD patients. Out of total 475 subjects' female and male were 292 (61.5%) and 183 (38.5%) respectively. This table also displays out of 475 only 257(54.1%) samples yield bacterial isolates, on the other hand total 218(45.9%) samples fails to demonstrate growth of any bacteria.

Table II: Overall prevalence of growth of pathogen and their sex distribution.

Sex	Subjects (%)	Growth (%)	Not growth (%)
Male	292 (61.5)	166 (34.95)	126(26.53)
Female	183 (38.5)	91 (19.15)	92(19.37)
Total	**475 (100.0)**	**257 (54.1)**	**218(45.9)**

Table III shows that majority (45.5%) of the patients had growth of Klebsiella followed by Pseudomonas 76(29.6%), E. coli 32(12.5%), Staph**ylococcus aureus 16(6.2%), Acinetobacter 8(3.1%) and Streptococcus 8(3.1%).**

Table III: Frequency of isolation of organism and their overall percentage (n=257).

Bacterial growth in sputum culture	Frequency	Percentage
Klebsiella	117	45.5
Pseudomonas	76	29.6
E.coli	32	12.5
Stapylococcus aureus	16	6.2
Acinetobacter	8	3.1
Streptococcus	8	3.1
Total	**257**	**100.0**

Table IV shows the important statistics and objective of this research. All the isolated organisms are except Acintobactor are mostly sensitive to Meropenum, Imipanum and Amikacin. In vitro sensitivity pattern against these antibiotics was more than 85%. It can also be noted from this table that Klebsiella, Pseudomonas, E. coli and Acintobactor are less sensitive to Azythromycin, Amoxyclave, Ceftazime, Cefixime, Cefepinme and Ceftriaxone. In vitro sensitivity pattern against these antibiotics is less than 50%.

Table IV: Antibiotic sensitivity pattern of organisms isolated from sputum.

Organism isolated	Klebsiella		Pseudomonas		E. coli		Staphylococcus aureus		Acintobactor		Streptococcus	
Number of Isolate	117		76		32		16		8		8	
Sensitivity pattern (%)												
Meropenum	111	(95)	74	(94)	30	(94)	16	(100)	7	(87)	8	(100)
Imipenum	110	(94)	69	(91)	29	(91)	16	(100)	6	(75)	8	(100)
Netimycin	106	(90)	65	(85)	29	(91)	16	(100)	6	(75)	8	(100)
Amikacin	103	(88)	69	(91)	27	(84)	15	(94)	5	(62)	7	(87)
Teicoplanin	100	(85)	61	(80)	28	(87)	12	(75)	7	(87)	8	(100)
Gentamycin	98	(80)	57	(75)	26	(81)	15	(94)	6	(75)	8	(100)
Piperacilin / Tazobactum	94	(80)	61	(80)	28	(87)	16	(100)	6	(75)	7	(87)
Levofloxacin	88	(75)	68	(89)	24	(75)	5	(31)	5	(62)	3	(38)
Ciprofloxacin	86	(72)	67	(88)	26	(81)	14	(84)	5	(62)	7	(87)
Cefepinme	80	(68)	22	(45)	13	(41)	15	(94)	2	(25)	7	(87)
Cefuroxime	58	(50)	53	(70)	15	(47)	14	(87)	3	(37)	7	(87)
Cotrimoxazol	58	(50)	62	(81)	24	(75)	13	(81)	3	(37)	6	(75)
Ceftriaxone	55	(47)	49	(64)	16	(50)	14	(87)	3	(37)	8	(100)
Cefixime	54	(46)	34	(45)	20	(62)	15	(94)	3	(37)	7	(87)
Colistine	52	(44)	61	(80)	21	(66)	14	(87)	5	(62)	6	(75)
Tobramycin	50	(42)	61	(80)	26	(81)	12	(75)	5	(62)	5	(62)
Azythromycin	48	(41)	53	(70)	23	(72)	3	(19)	2	(25)	1	(12)
Amoxyclave	35	(30)	19	(25)	11	(34.4)	12	(75)	2	(25)	6	(75)
Ceftazime	32	(27)	54	(71)	16	(50)	5	(31)	3	(37)	2	(25)

Discussion:

Out of total 475 subjects' female and male were 292 (61.5%) and 183 (38.5%) respectively. This table also displays out of 475 only 257(54.1%) samples yield bacterial isolates, on the other hand total 218(45.9%) samples fails to demonstrate growth of any bacteria. Shashibhushan et al.[8] reported 122 (76.3%) males and 38 (23.7%) females with a male: female ratio of 61:19. Sputum culture positivity was observed in 78 cases (48.7%). Patel et al.[9] observed culture was positive was found in 41 (82%) patients. Abraham et al.[10] observed out of which 103 (42.9%) were positive for pathogenic bacteria and 137 (57.1%) were normal flora. Out of 240 patients with acute exacerbation of COPD, 184 (76.67%) were males and 56 (23.3%) were females. In this study observed that the study population of 257 consecutive patients with bacterial comprised 166 men (64.6%) and 91 women (35.4%), ranging in age from 37 years to 80 years, mean 76.0 [standard deviation (SD) 20.37] years. Most frequent distribution of the isolates in the sputum was found in the age group 49 to 60 years. Out of total 257 isolates, 137 was belongs to this age group of which male and female were 88 and 49 respectively. Shashibhushan et al.[8] reported the mean age of patients was 63.18 years (40-81) which comprises of 84% of males and 16 % of female patients. Maximum numbers of patients were in the age group of 61- 70 years. Sharma et al.[11] also reported maximum patients (32.05%) belonging to the age group of 51–60 years. Rashid and Ahmed[3] the age of the patients ranged from 46−88 years with most of the patients (56%) in the age group 55−65 years. Abraham et al.[10] reported maximum number (178) belonged to the age group of 60-79 years. Common organisms responsible for AECOPD, like S. pneumoniae, H.influenzae and M.catarrhalis, were sensitive to commonly used antibiotics, fluoroquinolones.cephalosporin, amino glycosides and piperacillin-tazobactam. Sharma et al.[11] In this study observed that the majority (45.5%) of the patients had growth of Klebsiella pneumoniae in followed by Pseudomonas 76(29.6%), E. coli 32(12.5%), Stapylococcus aureus 16(6.2%), Acinetobacter 8(3.1%) and Streptococcus 8(3.1%). Shashibhushan et al.[8] reported the commonest pathogenic bacteria isolated in sputum culture was Streptococcus pneumoniae 42 (42%), followed by Pseudomonas aeuroginosa 23 (23%), Klebsiella 15 (15%), E coli 12 (12%), gram-negative non fermenting bacteria (GNNF) 7 (7%) and Citrobacter 1 (1%). But other Indian study has reported different strain Pseudomonas aeruginosa[12]. Madhavi et al.[13] had found Klebsiella pneumonia was the most common organism. Rashid and Ahmed[3] reported Bacteriological profile: Klebsiella pneumoniae were the commonest (16 cases) bacteria isolated followed by Staphylococcus aureus (9 cases). Streptococcus pneumoniae was isolated in seven cases and Pseudomonas aeruginosa in three cases. Majumder et al.[14] observed among 198 culture positive samples, E. coli was ranked highest 171 (86%). Growth of Klebsiella pneumonia and Enterococcus was

found in 17 (9.6%) and 10 (5%) samples respectively. It was also observed from this table that the maximum numbers of isolates were distributed among the females 123 (62%). Patel et al.[9] reported streptococcus pneumoniae (32%) was the most common pathogen isolated followed by Streptococcus pyogens (16%) and Pseudomonas (12%). Abraham et al.[10] reported the most common pathogenic bacteria isolated in sputum culture was Klebsiella pneumoniae 31 (30.09%), followed by Pseudomonas aeruginosa 30 (29.1%), Acinetobacter 15 (14.56%). In this study showed all the isolated organisms except Acintobactor are mostly sensitive to Meropenum, Imipanum and Amikacin. In vitro sensitivity pattern against these antibiotics was more than 85%. It can also be noted from this table that Klebsiella, Pseudomonus, E. coli and Acintobactor are less sensitive to Azythromycin, Amoxyclave, Ceftazime, Cefixime, Cefepinme and Ceftriaxone. In vitro sensitivity pattern against these antibiotics is less than 50%. Shashibhushan et al.[8] reported streptococcus pneumoniae which was the commonest isolate in the culture was sensitive to ceftriaxone - a third generation cephalosporin, and only few strains of streptococcus pneumoniae were sensitive to piperacillin–tazobactum, cefotaxime and azithromycin. Pseudomonas aeuroginosa, prevalent gram-negative isolate was sensitive to piperacilin-tazobactum, amikacin and levofloxacin, while Klebsiella and E coli both were sensitive to ceftriaxone. Beside this gram-negative non-fermenting bacterium was sensitive to amikacin and another strain Citrobacter which was least isolated, sensitive to quinolone group ciprofloxacin. Patel et al.[9] which found that piperacillin-tazobactum was most effective against Streptococcus pneumonia. Sharma et al.[11] observed antibiogram of isolated organisms revealed that usual organisms considered responsible for AECOPD, like S. pneumoniae, H. Influenzae and M. catarrhalis, were sensitive to commonly used antibiotics fluoroquinolones, cephalosporin, amino glycoside and Piperacillin-tazobactam. However, GNB showed significant resistance ($p < 0.05$) to the above antibiotic groups. Among gram negative organisms, E. coli which was the most common isolate were mainly sensitive to carbapenems, colistin and Polymyxin-b followed by aminoglycosides and Piperacillin-tazobactam. E. coli were found to be significantly resistant to levofloxacin and third generation cephalosporin. Acinetobacter species were sensitive to mainly colistin and polymyxin-b with significant in vitro resistance to carbapenems, fluoroquinolones, cephalosporin and Piperacillin-tazobactam. Rashid and Ahmed[3] reported antibiotic sensitivity patterns of the isolates: Klebsiella pneumoniae, which was the most common isolate, was sensitive to gentamicin, meropenem, followed by ceftriaxone, moxifloxacin, levofloxacin, ciprofloxacin and azithromycin. Few authors[15-17] has found higher incidence of pseudomonas and enterobacteriacae in patients with more severely compromised lung functions. Groenewegan et al.[15,18,19] had also included more severe patients but found hemophilus influenza (45%) as most frequent organism[20] followed by streptococcus pneumonia (27%).

Conclusion

Male is predominating and majority of them are older age group. Klebsiella pneumonia, Pseudomonas and E. coli are common isolated organism. Most sensitive antibiotics were Meropenum, Imipanum and Amikacin and less sensitive to Azythromycin, Amoxyclave, Ceftazime, Cefixime, Cefepinme and Ceftriaxone.

Conflict of interest: None.

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