ORIGINAL ARTICLE

Relation of Patient Characteristics (BMI, FEV$_1$) with Bacterial Colonization Pattern of Sputum In Patients Suffering from Acute Exacerbation of Chronic Obstructive Pulmonary Diseases

Kamruzzaman Md. Zahir,[1] A.K.M. Mostafa Hussain,[2] Md. Sayedul Islam,[3] Md. Ali Hossain,[4] Md. Muhammed Arshad Ul Azim,[5] Tanwir Iqbal Ahmed,[6] S.M Lutfor Rahman[7]

Abstract

Background: *In patient with exacerbation of COPD positive sputum microbiology is associated with FEV$_1$, active tobacco smoking, prior exacerbations, presence of bronchiectasis, prior use of systemic corticosteroid, and/or antibiotics, sputum purulence.*

Methods: *It is a case control prospective study. This study was carried out in the indoor and outdoor of National Institute of diseases of the Chest and Hospital (NIDCH), Mohakhali, Dhaka during the period September 2010 to August 2011 on 65 patients having the diagnosis of acute exacerbation of COPD.*

Result: *It was observed according to BMI, the mean pseudomonous was found 21.50±1.76 kg/m², candida 23.57±1.51 kg/m², klebsiella 21.43±1.97 kg/m², E. Coli 22.13±1.65 kg/m², streptococcus 22.50±3.54 kg/m², S. aureus was 20.75±0.35 kg/m², no growth was 23.65±2.06kg/m².*

In this present series according to FEV$_1$ it was observed that the mean FEV$_1$ was 50.9±8.8 (%) in patients having pseudomonous, 48.4±7.8 (%) in klebsiella, 50.0±7.1 (%) in streptococcus, 42.0±5.7 (%) in H. Influenjae and 60.5±9.8 (%) in no growth. The positive sputum culture pseudomonous, klebsiella, streptococcus and H.influenjae are associated with low FEV$_1$.

Conclusions: *This study was undertaken to identify the patients of COPD who are more prone to have respiratory tract infection and thus acute exacerbation and also the ability to clinically identify patients likely or unlikely to yield bacterial sputum isolates. Pseudomonous, klebsiella, streptococcus and H.influenjae are associated with underweight and low FEV$_1$ patients. FEV$_1$ (<52%) and BMI (<20kg/m²) significantly influence to develop sputum culture positivity.*

Introduction:

COPD Is Highly Prevalent, underdiagnosed, undertreated and underperceived disease. It affects millions of individuals, limits the functional capacity of many, and has become an important cause of death worldwide.

1. Assistant Professor, Respiratory Medicine, Sher-E-Bangla Medical College, Barishal.
2. Professor cum Director NIDCH
3. Associate Professor, NIDCH
4. Professor of respiratory medicine, NIDCH
5. Assistant Professor, Department of nephrology, Shahid Sheikh Abu Naser Specialized hospital, Khulna
6. Registrar, NIDCH, 7. Associate Professor, NIDCH.

Correspondence to: Dr. Kamruzzaman Md. Zahir, Assistant Professor, Respiratory Medicine, Sher-E-Bangla Medical College, Barishal. Mobile: 01718-426134, E-mail: imam_md2004@yahoo.com

COPD diagnosis is strongly suspected in the presence of more than a 10 pack year smoking history in combination with a complaint of chronic cough with sputum production, shortness of breath, and infection which takes longer to resolve than usual. By 2020 it will represent the third most important cause of death world wide.[1] The anticipated rise in mortality and morbidity from COPD will be greatest in Asia and African countries as a result of their increasing tobacco consumption.

Exacerbations of COPD are important contributors to the severity of the patient's disease, by accelerating lung function decline, precipitating poor health status, increasing health care cost and negatively affecting survival.

In patient with exacerbation of COPD positive sputum microbiology is associated with FEV1, active tobacco smoking , prior exacerbations, presence of bronchiectasis, prior use of systemic corticosreroides, and/or antibiotics, sputum purulence. A prediction model based on the variables of purulent sputum, FEV1, and BMI predicted sputum culture result with about 90% accuracy.[2]

Rationale:
COPD burden is increasing in developing countries like Bangladesh. Acute exacerbation of COPD compels patient to admit into hospital. There are several factors causing acute exacerbation of COPD including respiratory tract infection. So if sputum bacterial colonization correlates patients characteristics like BMI FEV1, sputum purulence, age gender; it will help to institute antibiotic early without the delay of sputum microbiological report, thereby facilitating the orientation of antibiotic treatment and reducing the high number of failures recorded with empiric treatment as well as will reduce hospital admission.

Materials and Method:
It is a case control prospective study. This study was carried out in the indoor and outdoor of National Institute of diseases of the Chest and Hospital (NIDCH), Mohakhali, Dhaka during the period September 2010 to August 2011 on 65 patients having the diagnosis of acute exacerbation of COPD. Inclusion criteria was, age >40 years, diagnosed case of COPD, Worsening symptoms like breathlessness, increased

respiratory rate, fever, purulence of sputum. Exclusion criteria was, age <40 years COPD with allergic component, Bronchiectasis, antibiotic treatment within last month.

Observations and Results:
Table-I
Age distribution of the study patients (n=65)

Age (in year)	Number of patients	Percentage
40-50	20	30.8
51-60	17	26.2
61-70	18	27.7
71-80	7	10.8
>80	3	4.6
Mean ± SD	59.58	±12.31
Range (min-max)	(40	-85)

The above table shows the age distribution of the study patients. Most of the patients was found 20(30.8%) in age group of 40-50 years. The mean age was found 59.58±12.31 years with range from 40 to 85 years. Other results are depicted in the table.

Table-II
Sex distribution of the study patients (n=65)

Sex	Number of patients	Percentage
Male	55	84.6
Female	10	15.4

The above table shows the sex distribution of the study patients. Male was found 55(84.6%) and female was 10(15.4%). Male to female ratio was 5.5:1.

Table-III
Distribution of the study patients according sputum (n=65)

Sputum	Number of patients	Percentage
Yellow/purulent	36	55.4
Muco-purulent	12	18.5
Mucoid	17	26.2

The above table shows the sputum colour of the study patients. According to sputum, yellow/purulent was found 36(55.4%), Muco-purelent was 12(18.5%) and Mucoid was 17(26.2%).

Table-IV

Distribution of the study patients according to smoking (n=65)

Smoking	Number of patients	Percentage
Smoker	50	76.9%
Non smoker	10	15.4%
Ex smoker	5	7.7%

The above table shows the smoking pattern of the study patients. Maximum patients were smoker, which was 50(76.9%), 10(15.4%) non smoker and 5(7.7%) ex smoker.

Table-V

Distribution of the study patients according to use of antibiotics and steroid (n=65)

Use of antibiotics and steroid	Number of patients	Percentage
Occasional	23	35.4%
$1/_2$ per yrs	20	30.8%
$1/_3$ per yrs	4	6.2%
$2/_3$ per yrs	13	20.0%
$3/_4$ per yrs	5	7.7%

The above table shows the use of antibiotics and steroid of the study patients. More than one third (35.4%) of the patients received antibiotics and steroid occasionally and 20(30.8%) received 1/2 per year and other results are depicted in the table.

Table-VI

Distribution of the study patients according to BMI(n=65)

BMI (kg/m^2)	Number of patients	Percentage
Under weight	1	1.5%
Normal weight	55	84.6%
Over weight	9	13.8%
Obesity	0	0.0%
Mean±SD	22.29±2.03	
Range (min-max)	(18-26)	

Under weight:	$<18.5 \, kg/m^2$
Normal weight:	$18.5\text{-}24.9 \, kg/m^2$
Over weight:	$25\text{-}29.9 \, kg/m^2$
Obesity:	$\geq 30 \, kg/m^2$

The above table shows the distribution body mass index(BMI) of the study patient. Most 55(84.6%) of the patients had normal body weight (18.5-24.9 kg/

m^2) followed by 9(13.8%) over weight, 1(1.5%) under weight and obesity was not found. The mean BMI was 22.29±2.03 kg/m^2 with range from 18 to 26 kg/m^2.

Table-VII

Distribution of the study patients according to FEV_1 (%) (n=65)

FEV_1 (%) of predicted	Number of patients	Percentage
≤40	5	7.7
41-50	24	36.9
51-60	18	27.7
61-70	16	24.6
>70	2	3.1
Mean±SD	53.74	±10.84
Range (min-max)	(22	-74)

The above table shows the FEV_1 of the study patients. Maximum FEV_1 was found 24(36.9%) in 41-50 %. The mean FEV_1 was found 53.74±10.84 % with range from 22 to 74 %.

Table-VIII

Distribution of the study patients according to Sputum culture (n=65)

Sputum culture	Number of patients	Percentage
Pseudomonous	23	35.4
No growth	15	23.1
Candida	7	10.8
Klebsiella	7	10.8
E. Coli	4	6.2
Streptococcus	2	3.1
S.aureus	2	3.1
Acinetobactor/Psudomonous	1	1.5
Haemophilusinfluenjae	1	1.5
H.influenjae	1	1.5
Pseudomonous, Klebsiela	1	1.5
Streptococcus pneumoni	1	1.5

The above table shows the sputum culture of the study patients. Pseudomonous was found 23(35.4%) followed by no growth was 15(23.1%), candida was 7(10.8%), klebsiella was 7(10.8%), 4(6.2%) was E. coli, 2(3.1%) was streptococcus, 2(3.1%) was s. aureus and acinetobactor/psudomonous, haemophilus influenjae, H. influnjae, pseudomonous klebsiela & stereptococcus pneumoni was 1(1.5%).

Table-IX

Mean distribution of BMI according to sputum culture of the study patients (n=65).

Sputum culture	n	BMI (kg/m^2)			
		Mean	±SD	(Min	-max)
Pseudomonous	23	21.50	±1.76	(19	-26)
Candida	7	23.57	±1.51	(22	-26)
Klebsiella	7	21.43	±1.97	(18	-24)
E. Coli	4	22.13	±1.65	(20.5	-24)
Streptococcus	2	22.50	±3.54	(20	-25)
S.aureus	2	20.75	±0.35	(20.5	-21)
Acinetobactor/Psudomonous	1	24	.	(24	-24)
Haemophilusinfluenjae	1	19	.	(19	-19)
H.influenjae	1	22.3	.	(22.3	-22.3)
Pseudomonous,Klebsiela	1	21.5	.	(21.5	-21.5)
Streptococcus pneumoni	1	22.8	.	(22.8	-22.8)
No growth	15	23.65	±2.06	(18.5	-26)

The above table shows the mean distribution of BMI according to sputum culture of the study patients. According to BMI, the mean pseudomonous was found 21.50±1.76 kg/m^2, candida 23.57±1.51 kg/m^2, klebsiella 21.43±1.97 kg/m^2, E. Coli 22.13±1.65 kg/m^2, streptococcus 22.50±3.54 kg/m^2, S. aureus was 20.75±0.35 kg/m^2, no growth was 23.65±2.06kg/m^2.

Table-X

Mean distribution of FEV$_1$ (%) according to sputum culture of the study patients (n=65).

Sputum culture	n	FEV$_1$ (%)			
		Mean	±SD	(Min	-Max)
Pseudomonous	23	50.91	±8.75	(22	-70)
Candida	7	59.0	±15.95	(24	-70)
Klebsiella	7	48.43	±7.76	(40	-62)
E. Coli	4	52.25	±10.37	(45	-67)
Streptococcu	2	50.0	±7.07	(45	-55)
S.aureus	2	66.0	±11.31	(58	-74)
Acinetobactor/Psudomonous	1	45	.	(45	-45)
Haemophilusinfluenjae	1	38	.	(38	-38)
H.influenjae	1	46	.	(46	-46)
Pseudomonous,Klebsiela	1	45	.	(45	-45)
Streptococcus pneumoni	1	47	.	(47	-47)
No growth	15	60.53	±9.78	(40	-74)

The above table shows the mean distribution of FEV$_1$ according to sputum culture of the study patients. According to FEV$_1$, the mean pseudomonous was found 50.91±8.75 (%), candida 59.0±15.95 (%), klebsiella 48.43±7.76 (%), E. Coli 52.25±10.37 (%), streptococcus 50.0±7.07 (%), S. aureus was 66.0±11.31 (%), no growth was 60.53±9.78(%).

Discussion:

This cross sectional study was carried out with an aim to identify the patients of COPD who are more prone to have respiratory tract infection and thus acute exacerbation and also the ability to clinically identify patients likely or unlikely to yield bacterial sputum isolates. In addition to reduce unnecessary tests and to forecast the infective exacerbations in some patient of COPD. A total number of 65 consecutive patients having acute exacerbation of COPD who came in the national institute of diseases of the Chest and Hospital(NIDCH) Mohakhali, Dhaka, during the period of September 2010 to August 2011 were included in this study.The present study findings were discussed and compared with previously published relevant studies.

In this present study it was observed that more than one third (35.4%) of the patients was in 6th decade and the mean age was 59.58±12.31 years with range from 40 to 85 years. Almost similar age range observed by Tsimogianni et al. (2009) where they found age ranged between 44-91 years.[2] Similar almost consistent mean age observed by Patel et al. (2002) where they found age mean age 65.9±7.84 years.[3]

Regarding the sex incidence male was predominant, which was 84.6% and male to female ratio was 5.5:1, which indicates that male was predominant in this current study. Similarly, Tsimogianni et al. (2009) and Diamantea et al. (2007) showed male female ratio were 2.8:1 and 8:1 respectively, which is closely resembled with the current study.[2,4]

According to sputum, yellow/purulent was found in 55.4%, Muco-purelent in 18.5% and Mucoid in 26.2%. Maximum patients were smoker, which was more than three fourth 76.9%, had previous history of smoking 7.7% and rest 15.4% was never smoke, which is comparable with Tsimogianni et al. (2009),[2] where they found 55.3% were currently smoker, 44.7% had previous history of smoking and never smoker was not found.

Nearly a half (47.7%) of the patients were under weight (<18.5 kg/m^2), 38.5% were normal, 13.8% over weight and obesity was not found. The mean BMI was 20.8±3.43 kg/m^2 with range from 16.5 to 26 kg/m^2. (Tsimogianni et al. 2009) found mean BMI was 28±1 kg/m^2 with range from 17-54 kg/m^2, which is higher with the current study, this may be due to higher body surface area in their study patients.[2]

36.9% patients FEV$_1$ was found in 41-50%, more than one fourth(27.7%) patient belonged to 51- 60%, almost one fourth (24.6%) belonged to 61- 70%, 7.7% patients FEV1 was d"40% and 3.1% patient had more than 70%. The mean FEV$_1$ was found 53.74±10.84% with range from 22 to 74 %. Similarly, (Tsimogianni et al. 2009) have showed that mean FEV$_1$ (%) were 47±2% with Range from 15-87%, which support the current study.[2]

In this study sputum culture was observed and found that Pseudomonous was found 35.4%, candida in 10.8%, klebsiella in 10.8%, 6.2% was E. coli, 3.1% was streptococcus, 3.1% was s. aureus and acinetobactor/psudomonous, haemophilus influenjae, H. influnjae, pseudomonous klebsiela & sterepptococcus pneumoni was 1.5% and no growth in 23.1%. (Bari et al. 2010) observed 30 patients with stable COPD, out of which 3(20.0%) patients showed positive sputum culture for bacteria, Pseudomonas 3, Klebsiellia 1, Streptococcus pneumoniae 1,

Haemophilus influenza 1 and majority were Gram-negative organism.[5]

Clinical markers of COPD severity determined during an exacerbation of the disease can predict the isolation of bacteria from the sputum (Tsimogianni et al. 2009).[2] The authors showed that the presence of pus in the sputum, a post-bronchodilator FEV$_1$, lower than 35% predicted and a BMI lower than 22kg/m^2, were all associated with the isolation of bacteria in the sputum. The isolation of bacteria from the sputum of patients with an exacerbation of COPD can be predicted by the presence of pus in the sputum, low FEV$_1$ and BMI with an approximate accuracy of 90% found by (Tsimogianni et al. 2009).

According to BMI, the mean pseudomonous was found 21.50±1.76 kg/m^2, candida 23.57±1.51 kg/m^2, klebsiella 21.43±1.97 kg/m^2, E. Coli 22.13±1.65 kg/m^2, streptococcus 22.50±3.54 kg/m^2, S. aureus was 20.75±0.35 kg/m^2, no growth was 23.65±2.06kg/m^2.Tsimogianni et al. (2009) mentioned that patients with an exacerbation of COPD, pseudomonous, klebsiella, streptococcus and H.influenjae are associated with underweight patients.[2] Similar, findings also obtained by (Valk et al. 2004), (Rossi et al. 2007), (Lode et al. 2007) and (Niederman et al 2001), thus support the current study.[6,7,8]

Bacterial colonization in COPD is an important factor in disease progression mentioned by (Wilkinson et al. 2003).In this present series according to FEV$_1$ it was observed that the mean FEV$_1$ was 50.9±8.8 (%) in patients having pseudomonous, 48.4±7.8 (%) in klebsiella,50.0±7.1 (%) in streptococcus, 42.0±5.7 (%) in H. Influenjae and 60.5±9.8 (%) in no growth. The positive sputum culture pseudomonous, klebsiella, streptococcus and H.influenjae are associated with low FEV$_1$. In patients having an exacerbation of COPD (Tsimogianni et al. 2009) reported that positive suptum microbiology associated with FEV$_1$, active tobacco smoking, prior exacerbations, presence of bronchiectasis, prior use of systemic corticosteroids and/or antibiotics, sputum purulence. Patients with the greatest degree of functional impairment, as measured by their FEV$_1$, presented a higher probability of having an isolation of *P aeruginosa or H influenzae* in significant concentration in sputum during an exacerbation observed by Miravitlles et al. (2010). The diagnostic yield of sputum in patients with an FEV$_1$ >50% was low, with a predominance of non-PPMs. Low FEV$_1$ and active tobacco smoking are data that should be considered when establishing an empire antibiotic treatment for exacerbated COPD (Miravitlles et al. 2010).[9] In another study, (Eller et al. 1998) have shown there is a correlation

between deterioration of lung function and the bacteria isolated from patients with infective exacerbations of COPD.[10] In acute infective exacerbations, Enterobacteriaceae and Pseudomonas spp are the predominant bacteria in patients with an $FEV_1 <$ or $=35\%$ of the predicted value. Allegra et al. (2005) evaluated whether functional impairment (FEV_1) orientates as to the infectious etiology of exacerbations and found Gram negative and P. aeruginosa/Enterobacteriaceae were isolated more frequently in the sputum when FEV_1 was $<35\%$.[11] (Monso et al. 2003), (Patel et al. 2002) and (Zalacain et al. 1999) concluded in their respective studies that severe impairment of lung function, smoking and poor compliance with therapy are risk factors for bacterial infection in COPD, and p. aerugnosa should be suspected in patients who have been treated with antibiotics and in those not vaccinated against influenza. Thus the current study strongly consistent with the above mentioned studies.[12,3,13]

In this current study it was observed that sputum purulence, FEV_1 ($<52\%$) and BMI ($<20kg/m^2$) significantly influence to develop sputum culture positivity independently. Tsimogianni et al. (2009) showed a positive sputum culture was three-fold for BMI ≤ 22 kg/m (OR=12.1; 95% CI: 2.9-50.5; p=0.001), and one-fold for $FEV_1 <35\%$ (OR=3.9; 95% CI: 1.3-11.5; p=0.014) which is comparable with the current study.[2]

Conclusions:
This study was undertaken to clinically identify patients of COPD with exacerbation likely or unlikely to yield bacterial sputum isolates. Pseudomonous, klebsiella, streptococcus and H.influenjae are associated with underweight (low BMI) and low FEV_1 patients. FEV_1 ($<52\%$) and BMI ($<20kg/m^2$) significantly influence to develop sputum culture positivity.

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