

## Differential Patterns of Cough and Sputum in Patients with Asthma and COPD in Tertiary Care Hospital of Central India.

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### Abstract

**Introduction:** The evolution of knowledge concerning COPD and its components Emphysema, Chronic bronchitis, and Asthmatic bronchitis take us long back in to the history over 200 years. Since then there not a single terminology have been established to clearly demarcate difference between these components. Confusion still persists between chronic bronchitis and Emphysema. In this study, we aim to assess using the preexisting clinical, pathological, and radiological knowledge, whether these phenotypes can be distinguished or not.

**Material methods:** The present study is a prospective, observational, hospital based study conducted on 110 pre diagnosed patients on basis of complete clinical evaluation including a detailed preformatted directed history, detailed and thorough clinical examination were considered.

**Results:** 31 of asthma patients (100%) had episodic cough, while 29 (76.3%) of Emphysema patients and 18 (94.7%) of chronic bronchitis patients had constant cough. Our study showed that 30(96.8%) asthma had worsening at night time, while 13(34.1%) of Emphysema patients and 13(68.4%) of chronic bronchitis patients had worsening at both day and night. Cough was aggravated by dust, pollen and cold in 25(80.7%) of asthma patients. All chronic bronchitis patients 19 (100%) had sticky sputum, whereas non sticky sputum was present in majority of Emphysema 31 (93.9) and asthma 30(100%) patients. Sputum cytology in majority of asthma patients 26(83.9%) showed predominant eosinophils, whereas 18(94.8%) patients of chronic bronchitis and 18(50 %) patients of Emphysema had predominant neutrophils.

**Conclusion:** Thus a clear demarcating pictures of COPD and asthma can be found over coughing and sputum patterns of the patients.

**Keywords:** COPD, emphysema, asthma, chronic bronchitis.

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## Introduction

The evolution of knowledge concerning COPD and its components Emphysema, Chronic bronchitis, and Asthmatic bronchitis take us long back in to the history over 200 years. [1] Since then there not a single terminology have been established to clearly demarcate difference between these components. Different societies, doctors and countries have their own different descriptions. These diseases were divided into asthma and COPD and asthma has been clearly described as a different disease. Confusion still persists between chronic bronchitis and Emphysema. [2]

The term “chronic obstructive pulmonary disease” (COPD) was first used in 1964 by Mitchell and Filley, and has been in common use since the early 1980s. There is no universally accepted terminology or definition for the group of conditions characterized by airways obstruction that is incompletely reversible. [3]

There are several problems that have to be considered. The first results from the use of term chronic obstructive pulmonary disease, which is considered inaccurate since this is not truly a disease but a group of diseases. The second relates to the use of terms chronic bronchitis and Emphysema which although describing the two conditions with an apparently more precise clinical or pathological definition, lacks any reference to airways obstruction in their definition. The third problem, which is the most difficult to resolve, is the concern over differentiating this condition from asthma, which the terms chronic bronchitis and Emphysema seem to do whereas this is not the case for COPD. [4] In all the recent consensus statements from scientific societies COPD is the term used and is considered as a separate condition from asthma. This latter problem is compounded by the fact that the persistent airways obstruction in the older chronic asthmatics is often difficult or even

impossible to differentiate from that in COPD, although a history of cigarette smoking, evidence of Emphysema by imaging techniques and decreased diffusion capacity favours a diagnosis of COPD. [5]

There is increased prevalence of obstructive lung diseases owing to increase in smoking and pollution. Studies showed that during the 20th century the tobacco epidemic changed the disease pattern in respiratory epidemiology. The burden of COPD has been recognized worldwide. Global health statistics: a compendium of incidence, prevalence and mortality estimates for 200 countries. [6, 7, 8]

COPD became the most important respiratory disease among the middle-aged and elderly, and as a cause of mortality far more important than asthma. On the other hand, asthma and allergic conditions are the most prevalent chronic diseases among young adults and children. [9, 10]

In this study, we aim to assess using the pre existing clinical, pathological, and radiological knowledge, whether the phenotypes of COPD - Asthma , Chronic bronchitis and Emphysema, can be distinguished or not and to try and point out the differentiating features and similarities of these diseases, which the newly adapted GOLD guidelines fail to do. The main reason of differentiating these conditions is needed for identification of risk, early diagnosis, proper prognosis and specific treatment of the patients. Hence in the present study we are going to observe cough and sputum patterns of these diseases for similarities or differences. [11] These three conditions can also be present together. Recognizing and understanding the similarities and differentiating points between these entities may offer new insight into the mechanisms and treatment of chronic obstructive airway inflammatory diseases. [12]

## Material and Methods:

The present study is a prospective, observational, hospital based study conducted on 110 patients of obstructive lung disease presenting in Department of Pulmonary Medicine.

Informed and written consent in local language was taken from all the study subjects and no financial benefits were given to them. The patients were diagnosed on basis of complete clinical evaluation including a detailed preformatted directed history, detailed and thorough clinical examination with main emphasis on respiratory system, chest radiography and sputum analysis. All subjects underwent routine diagnostic tests as per the standard hospital practice.

### Inclusion criteria:

1. The patients who presented in pulmonary medicine wards with symptoms suggestive of airway obstruction for more than 2 years duration, and in whom clinical diagnosis of chronic obstructive pulmonary disease was made.
2. All patients with symptoms of obstructive lung diseases who were able to perform spirometry.
3. All patients having FEV<sub>1</sub>/FVC ratio of <0.7 on spirometry.

### Exclusion criteria

1. Acute pulmonary infection.
2. Pulmonary tuberculosis.
3. Acute myocardial infarction.
4. Unstable angina.
5. Congestive heart failure and cor pulmonale.
6. Unrelated life threatening major illness and other comorbid conditions.
7. Liver diseases, renal diseases.
8. Patients having HIV co infection.

9. Patients having other complicating lung diseases like bronchiectasis, fibrosis, pneumonia, old pulmonary tuberculosis etc.

### Initial evaluation

A total of 110 patients of airflow obstruction having following criteria were studied:

1. Presence of cough with expectoration/wheeze or dyspnoea for at least 3 months.
2. Patients having clinical picture of airflow obstruction.
3. Physical examination showing signs of airflow obstruction.

For each enrolled subject detailed history of symptoms including cough, expectoration, shortness of breath, wheeze, chronic productive cough, naso-bronchial allergy, and rhinitis were taken. Aggravating factors of all the main symptoms were studied.

Detailed history of smoking, personal history, family history, occupational history, seasonal variations, exposure to dust and biogas was taken. Smoking history was taken in pack years (one pack year was defined as smoking 20 cigarettes/bides in one day for one year)

For each enrolled subject detailed clinical examination was done including height, weight, Body Mass Index, nasopharyngeal examination, with detailed emphasis on respiratory system. *Diagnosis of Emphysema and chronic bronchitis* was based on history of cough with expectoration, dyspnoea, with history of exposure to risk factors (e.g. tobacco smoking) and Spirometry showing obstructive pattern - FEV<sub>1</sub>/FVC less than 70% and FEV<sub>1</sub> less than 80% predicted with poor bronchodilator reversibility.

*Diagnosis of Chronic bronchitis* was based on the history of constant chronic productive cough with large amount of sticky sputum, heavy smoking history,

above average BMI, presence of polycythaemia, normal chest examination except few crepitation's, Spirometry showing obstructive pattern, sputum cytology showing predominant neutrophils and X-ray chest suggestive of bronchitis .

*Diagnosis of Emphysema* was based on the of the history heavy smoking, chief complaint of progressive constant dyspnoea, with barrel shaped or Emphysematous chest (increased anteroposterior diameter, more horizontally set ribs, prominent sternal angle and wide sub costal angle). Chest percussion revealing findings of hyperinflation with obliteration of cardiac dullness and downward displaced upper border of liver dullness. Breath sounds

having a prolonged expiratory phase with a uniformly diminished intensity. Fine inspiratory crepitation's and rhonchi present. Use of accessory muscles of respiration and Spirometry showing features of obstruction.

Data of all the patients were collected and analysed using Microsoft excel 2013 and Graph pad 11, analysis of variance with Bonferroni's post hoc test was applied to see intergroup relationship amongst the numerical data.

### Results:

Total number of patients visited and enrolled for the study were 110 with comparable demographic data values as depicted in table 1:

**Table 1: Demographic values of the patients under consideration.**

	(Mean± SD)
Age (Years)	46.38 ± 6.46
Height (centimetre)	153.6 ± 6.65
Weight (kilogram)	54.48± 9.32

Considering the coughing patterns of the patients primarily two categories are made with patients having constant and episodic

coughing whose results are pointed out in table 2:

**Table 2: Type of cough in all patients**

Cough Type	Asthma	%	Emphysema	%	Chronic bronchitis	%	Mixed	%
Constant	0	0	29	76.3	18	94.7	15	68.2
Episodic	31	100	9	23.7	1	5.3	7	31.8
<b>Total</b>	<b>31</b>	<b>100</b>	<b>38</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>

31 of asthma patients (100%) had episodic cough, while 29 (76.3%) of Emphysema patients and 18 (94.7%) of chronic bronchitis patients had constant cough.

Considering the duration of coughing following observations were made as depicted in Table 3:

**Table 3: Duration of cough in all patients.**

Cough duration (years)	Asthma	%	Emphysema	%	Chronic bronchitis	%	Mixed	%
1-5	4	12.9	15	39.5	7	36.8	7	31.8
6-10	9	39.0	18	47.3	8	42.2	9	40.9
11-15	6	19.4	2	5.3	2	10.5	2	9.1
16-20	7	22.6	2	5.3	2	10.5	3	13.6

21-25	2	6.5	1	2.6	0	0	0	0
26-30	3	9.6	0	0	0	0	1	4.6
<b>Total</b>	<b>31</b>	<b>100</b>	<b>38</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>

Cough duration was longer in patients of asthma, 6-10 yrs - 9 (39%), 11-15 yrs - 6(19.4%), 16-20 yrs - 7(22.5%), while in maximum patients of Emphysema 15(39.4%), 18(47%) and chronic bronchitis 7(36.8), 8(42.2) cough duration

was 1-10 years showing long history and early onset of bronchial asthma.

Considering the diurnal variations of coughing following observations were made as depicted in Table 4:

**Table 4: Diurnal variation of cough in all patients**

Cough worsening	Asthma	%	Emphysema	%	Chronic bronchitis	%	Mixed	%
Day	0	0	0	0	0	0	0	0
Night	30	96.8	17	44.7	6	31.6	13	59.1
Day and night	1	3.2	13	34.2	13	68.4	7	31.8
No variation	0	0	8	21.1	0	0	2	9.1
<b>Total</b>	<b>31</b>	<b>100</b>	<b>38</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>

Our study showed that 30(96.8%) asthma patients had worsening of cough only at night time, while 13(34.1%) of Emphysema patients and 13(68.4%) of chronic bronchitis patients had worsening of cough at both day and night time. Majority of mixed patients 13(59.1%) had

worsening of cough at nighttime. 8(21.0%) patients of Emphysema had no variation of day night in worsening of cough.

When factors responsible for coughing were considered following observations were made as depicted in table5:

**Table 5: Aggravating factors of cough in all patients**

Cough Aggravated by	Asthma	%	Emphysema	%	Chronic bronchitis	%	Mixed	%
Dust	0	0	1	2.6	0	0	2	9.2
Pollen	0	0	0	0	0	0	0	0
Cold	1	3.1	22	57.9	11	57.9	9	40.9
Dust and pollen	0	0	0	0	0	0	0	0
Dust and cold	3	9.7	4	10.5	2	10.6	8	36.3
Pollen and cold	2	6.5	0	0	0	0	0	0
Dust pollen and cold	25	80.7	1	2.7	0	0	3	13.6
None	0	0	10	26.3	6	31.5	0	0
<b>Total</b>	<b>31</b>	<b>100</b>	<b>38</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>

Cough was aggravated by dust, pollen and cold in 25(80.7%) of asthma patients, whereas majority of Emphysema 22(57.9%) and chronic bronchitis 11 (57.9%) patients had aggravation of cough

by cold temperature alone. 10(26.3 %) Emphysema and 6(31.5 %) chronic bronchitis patients had no aggravating factor and cough was constant.

Depending upon productivity of cough following observations were made as illustrated in table 6:

**Table 6: Chronic Productive Cough in all patients**

Chronic productive cough	Asthma	%	Emphysema	%	Chronic bronchitis	%	Mixed	%
Present	3	9.7	6	15.9	18	94.7	12	54.5
Absent	28	90.3	32	84.1	1	5.3	10	45.5
<b>Total</b>	<b>31</b>	<b>100</b>	<b>38</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>

Chronic productive cough was absent in 28 of asthma patients (90.3%), and 32 of Emphysema patients(84.2), whereas 18 of chronic bronchitis patients(94.73%) had

chronic productive cough present.

Moving towards the presence of sputum following observations were made as portrayed in table7:

**Table 7: Presence of Sputum in all patients**

Sputum	Asthma	%	Emphysema	%	Chronic bronchitis	%	Mixed	%
Present	30	96.8	33	86.9	19	100	22	100
Absent	1	3.2	5	13.1	0	0	0	0
<b>Total</b>	<b>31</b>	<b>100</b>	<b>38</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>

Sputum was a constant feature and was present in 30 (96.8%) of asthma patients, 33(86.9%) of Emphysema patients and 19(100%) of chronic bronchitis patients. There was no sputum production in 5(13.1%) of Emphysema patients. On

comparison of only Emphysema and chronic bronchitis patients the Chi square test value was = 2.740, p=0.254 – not significant.

Considering character of sputum following observations were made:

**Table8: Character of sputum in all patients**

Sputum character	Asthma	%	Emphysema	%	Chronic bronchitis	%	Mixed	%
Sticky	0	0	2	6.1	19	100	13	59.1
Non sticky	31	100	31	93.9	0	0	9	40.9
<b>Total</b>	<b>31</b>	<b>100</b>	<b>33</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>

All chronic bronchitis patients19 (100%) had sticky sputum, whereas non sticky sputum was present in majority of Emphysema31 (93.9) and asthma30(100%) patients. On comparison of only Emphysema and chronic bronchitis

patients the Chi square test value was = 44.196, p= 0.001 – highly significant.

While considering quantity of sputum following observations were made as illustrated in table 9:

**Table9: Quantity of sputum in all patients**

Sputum quantity	Asthma	%	Emphysema	%	Chronic bronchitis	%	Mixed	%
Small	25	83.3	32	96.9	0	0	9	40.9
Large	6	16.7	1	3.1	19	100	13	59.1

<b>Total</b>	<b>31</b>	<b>100</b>	<b>33</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>
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Majority of asthma patients 25(83.3%) and Emphysema patients 32(96.9%) had small quantity of sputum, whereas there was large quantity of sputum present in all chronic bronchitis patients 19(100%). On comparison of only Emphysema and

chronic bronchitis patients the Chi square test value was = 47.903,  $p= 0.001$  – highly significant.

Considering the sputum cytology following results were made as depicted in table 10:

**Table10: Sputum Cytology in all patients**

<b>Sputum cytology</b>	<b>Asthma</b>	<b>%</b>	<b>Emphysema</b>	<b>%</b>	<b>Chronic bronchitis</b>	<b>%</b>	<b>Mixed</b>	<b>%</b>
Neutrophils	0	0	19	50	18	94.8	11	50
Eosinophils	26	83.9	1	2.6	0	0	3	13.6
Both	5	16.1	5	13.2	1	5.2	8	36.4
None	0	0	13	34.2	0	0	0	0
<b>Total</b>	<b>31</b>	<b>10</b>	<b>38</b>	<b>100</b>	<b>19</b>	<b>100</b>	<b>22</b>	<b>100</b>

Sputum cytology in majority of asthma patients 26(83.9%) showed predominant eosinophils, whereas 18(94.8%) patients of chronic bronchitis and 18(50 %) patients of Emphysema had predominant neutrophils. There were no significant cells present in 13(34.2%) Emphysema patients, showing eosinophils to be the predominant cells in asthma and neutrophils in chronic bronchitis. Emphysema patients had a mixed picture having neutrophils in majority followed by and no inflammatory cells in sputum.

### **Discussion:**

To determine whether patients with airflow obstruction have distinct clinical, pathological, and functional characteristics depending on history, clinical examination, sputum analysis, spirometry, chest radiography and blood investigations, we studied 110 patients presenting with features of airflow obstruction in our hospital.

Subjects with history and clinical features of Asthma (n=31), Emphysema (n=38), Chronic bronchitis (n=19) and mixed disorder (n=22) were studied and categorized into groups.

### **Type of Cough**

Our study showed that episodic type of cough was seen in asthma patients and constant cough was seen in Emphysema and chronic bronchitis patients. Similar results were seen by Fletcher CM et al [13] in their study of chronic bronchitis and Emphysema. Episodic nature of cough in asthma patients is described by Anthony Seaton et al in their literature. [14]

### **Chronic Productive Cough**

Majority of patients of chronic bronchitis had chronic productive cough as their main presenting complaint in our study which was similar to the results described by Fletcher CM et al [13] and J.B. Snoeck-Stroband et al. [15]

### **Character of Sputum**

Patients of chronic bronchitis were seen to have large quantity of sputum which was sticky in nature, in contrast to patients with Emphysema and asthma who had small quantity of non sticky sputum. Similar results were found in the study done by Burrows BE et al. [16]

### **Sputum Cytology**

Sputum cytology in majority of asthma patients (83.88%) showed predominant eosinophils, whereas (94.77%) patients of chronic bronchitis and (50 %) patients of Emphysema had predominant neutrophils

in their sputum. There were no significant cells present in (34.25%) Emphysema patients, showing eosinophils to be the predominant cells in airways of asthma patients and neutrophils in chronic bronchitis. Emphysema patients had a mixed picture, having neutrophils in majority followed by no inflammatory cells in the sputum.

AJ Wardlaw et al [17] Leonardo M. Fabbri et al [18], Pin I et al [19], Frigas E et al [20] and Hassall TT et al [21]. Also showed increased number of eosinophils in sputum of asthma patients as compared to patients of Emphysema and chronic bronchitis.

P. Boschetto et al [22], Lacoste JY et al [23], Linden M et al [24], Maestrelli P et al [25] and Keatings VM et al [26] showed increased neutrophils in sputum of chronic bronchitis patients which supports our findings and makes presence of neutrophils in sputum an important investigation for the diagnosis of chronic bronchitis. [27] Predominant emphysema phenotype in chronic obstructive pulmonary disease patients.

**Conclusion:** Thus to conclude a clear demarcating pictures of COPD and asthma can be found over coughing and sputum patterns of the patients. The findings of the present study could be a stepping stone towards further studies in Indian continent with more wide population under consideration.

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