

**ISSN: 0975-833X****RESEARCH ARTICLE****CLINICAL PROFILE IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS AND THEIR EVALUATION WITH SPIROMETRY AND 2D ECHO*****¹Dr. Vithal narayan dhadke, ¹Dr. Mrs. Shubhangi Vithal dhadke and ²Dr. Nikhil Raut**¹Dr. Vaishampayan Memorial Government Medical College, Solapur, Maharashtra, India²Department of Cardiology, Bombay Hospital, Mumbai, India**ARTICLE INFO****Article History:**Received 16th December, 2014

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Spirometry.

ABSTRACT

Introduction: Chronic obstructive pulmonary disease (COPD) is defined as a disease state characterized by airflow limitation that is not fully reversible. The Global Burden of Disease Study has projected that COPD, which ranked sixth as the cause of death in 1990, will become the third leading cause of death worldwide by 2020. The pooled global prevalence of COPD in adults 40 years or older is approximately 9 to 10% and is higher in smokers than non smokers, and is higher in men than in women. COPD includes emphysema, chronic bronchitis and small airway disease.

Aims and Objectives: To study the clinical profile of Chronic Obstructive Pulmonary disease patients. Evaluation of COPD patients with spirometry and 2D Echocardiography. To correlate between spirometry and 2D Echocardiography findings. Evaluation of left ventricular function in COPD patients by 2D Echocardiography.

Material s and Methods: The proposed study is comprised of 100 patients of COPD admitted in Dr. V. M. Govt. Medical College, Solapur. (Maharashtra) (India) They were studied clinically and with routine laboratory investigations, ECG, chest x ray, pulmonary function tests on spirometry and 2D and Doppler Echocardiography during their hospital stay.

Inclusion criteria: Patients who present with symptoms suggestive of COPD like dyspnea, chronic cough with or without sputum production. Spirometry showing ratio of forced expiratory volume in one second (FEV₁) to forced vital capacity (FVC) expressed in percentage less than 70%.

Exclusion criteria: Pulmonary tuberculosis, Pneumonia, Bronchiectasis. Pneumoconiosis. Primary cardiovascular or renal disease particularly if these result in pulmonary edema. Patients with rheumatic valvular heart disease, Ischemic heart disease and hypertension. Patients with Bronchial Asthma.

Results: All patients in our study were more than 40 years of age indicating a rising trend of COPD in patients above the age of 40 years. The mean age was 62 ± 9 years. In our study COPD was predominantly found in males, comprising 80% of the total patients and Male: Female= 4:1. 75% of the patients in our study were smokers indicating higher incidence of COPD in smokers than non smokers. The common symptoms were dyspnea and cough with expectoration. Most common sign was wheeze present in 70% of COPD patients in our study.

Conclusions: 1) 25% of the patients had normal chest x-ray. Changes observed in chest x-ray were prominent bronchovascular markings, changes of emphysema, prominent central pulmonary artery and cardiomegaly. 2) 50% of the patients had normal ECG. Most common ECG finding in our study was P pulmonale present in 40% of the patients. 3) Spirometry is an essential tool to establish the diagnosis and grading of severity of COPD by calculating FEV₁ % predicted and FEV₁/ FVC.

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is defined as a disease state characterized by airflow limitation that is not fully reversible. The Global Burden of Disease Study has projected that COPD, which ranked sixth as the cause of death in 1990, will become the third leading cause of death worldwide by 2020². The pooled global prevalence of COPD in adults 40 years or older is approximately 9 to 10% and is higher in smokers than non smokers, and is higher in men than in women. COPD includes emphysema, chronic bronchitis and small airway disease. According to Global Initiative for Chronic Obstructive Lung Disease (GOLD), COPD is defined

as a disease state characterized by airflow limitation that is not fully reversible ([John et al., 2011](#)).

GOLD criteria for COPD severity ([John et al., 2011](#))

Staging	Severity	Spirometry
I	Mild	FEV ₁ /FVC <0.7 and FEV ₁ ≥ 80% predicted
II	Moderate	FEV ₁ /FVC <0.7 and 50% ≤ FEV ₁ < 80% predicted
III	Severe	FEV ₁ /FVC < 0.7 and 30% ≤ FEV ₁ < 50% predicted
IV	Very severe	FEV ₁ /FVC < 0.7 and FEV ₁ < 30% predicted Or FEV ₁ < 50% predicted with respiratory failure or signs of right heart failure.

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A clinical diagnosis of COPD should be considered in any patient who has dyspnea, chronic cough or sputum production and/or a history of exposure to risk factors for the disease. The diagnosis should be confirmed by spirometry. For the diagnosis and assessment of COPD, spirometry is the gold standard because it is the most reproducible, standardized and objective way of measuring airflow limitation. A post bronchodilator FEV₁/FVC <0.70 confirms the presence of airflow limitation that is not fully reversible Cor Pulmonale, often referred to as pulmonary heart disease, is defined as dilatation and hypertrophy of the right ventricle in response to diseases of the pulmonary vasculature and/or lung parenchyma (**Alfred P. Fishman, 2005**). COPD is the most common cause of cor pulmonale in United States. In Delhi (India), the incidence of cor pulmonale has been estimated to be about 16 percent (**Rubens Michael and Padley Simon, 2009**). Several factors contribute to the development of pulmonary arterial hypertension in patients with COPD. The most important of these factors is alveolar hypoxemia (**Alfred P. Fishman, 2005; Wagner, 2011**). The common pathophysiologic mechanism in the development of cor pulmonale is pulmonary hypertension that is sufficient to lead to RV dilatation (**Alfred P. Fishman, 2005**). COPD affects pulmonary blood vessels, right ventricle, as well as left ventricle leading to development of pulmonary hypertension, cor pulmonale, right ventricular dysfunction, and left ventricular dysfunction too. Echocardiography provides a rapid, non-invasive, portable and accurate

Aims and objectives

- 1) To study the clinical profile of Chronic Obstructive Pulmonary disease patients.
- 2) Evaluation of COPD patients with spirometry and 2D Echocardiography.
- 3) To correlate between spirometry and 2D Echocardiography findings.
- 4) Evaluation of left ventricular function in COPD patients by 2D Echocardiography.

RESULTS

Table 1. Age wise distribution in patients of COPD

Age(years)	No. of patients	Percentage
41-50	12	12
51-60	35	35
61-70	38	38
71-80	15	15
Total	100	100

Table 1 shows, age distribution of 100 patients of COPD. Age ranged from 41 to 80 years. Maximum numbers of patients were in the age group 61-70 years i.e. 38 patients (38%). Minimum numbers of patients were in the age group 41-50 years i.e. 12 patients (12%).

Table 2. Sex wise distribution in patients of COPD

Gender	No. of patients	Percentage
Male	80	80
Female	20	20
Total	100	100

Out of 100 patients, 80 patients (80%) were male and 20 patients (20%) were female. Male: Female = 4: 1.

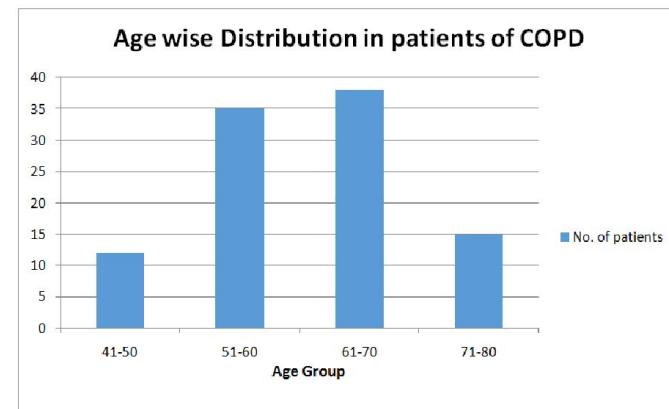


Chart 1.

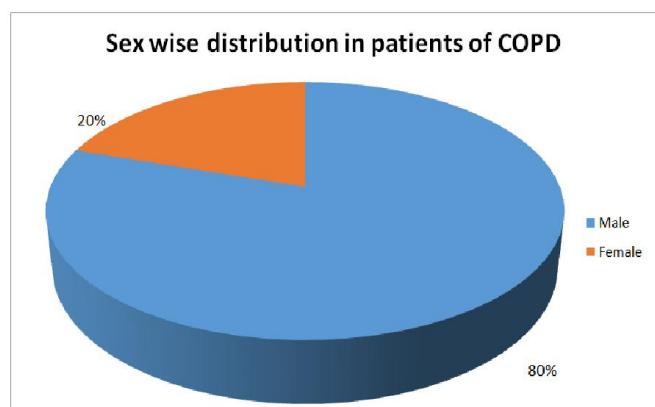


Chart 2.

Table 3. Smoking in patients of COPD

Smoking	No. of patients	Percentage
Smoker	75	75
Non smoker	25	25
Total	100	100

Out of 100 patients, 75 patients (75%) were smokers and 25 patients (25%) were non smokers.

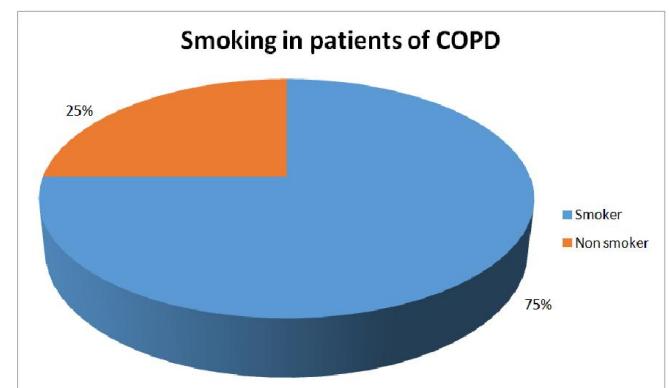
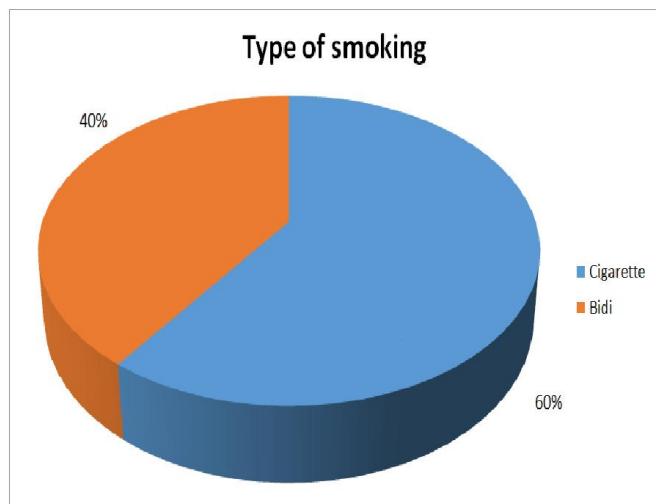


Chart 3.

Table 4. Type of Smoking in patients of COPD

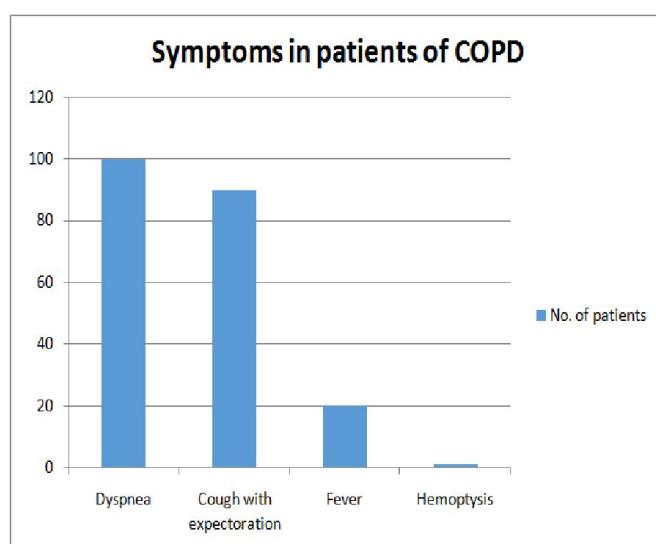
Smoker	No. of patients (Smokers)	Percentage
Cigarette	45	60
Bidi	30	40
Total	75	100

Out of 75 patients who were smokers, 45 patients (60%) were cigarette smokers and 30 patients (40%) were bide smokers.

**Chart 4.****Table 5. Symptoms in patients of COPD**

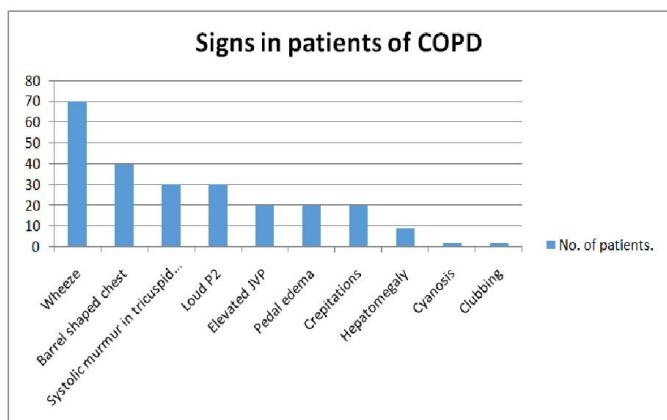
S. No.	Symptoms	No. of patients	Percentage
1	Dyspnea	100	100
2	Cough with expectoration	90	90
3	Fever	20	20
4	Hemoptysis	1	1

Dyspnea was the commonest symptom found in all 100 patients (100%) while hemoptysis was the least common symptom found in 1 patient (1%).

**Chart 5.****Table 6. Signs in patients of COPD**

S. No.	Signs	No. of patients	Percentage
1	Wheeze	70	70
2	Barrel shaped chest	40	40
3	Systolic Murmur in tricuspid area	30	30
4	Loud P2	30	30
5	Elevated jugular venous pressure	20	20
6	Pedal edema	20	20
7	Crepitations	20	20
8	Hepatomegaly	9	9
9	Cyanosis	2	2
10	Clubbing	2	2

The most common sign was wheeze present in 70 patients (70%), while less common signs were cyanosis and clubbing present in 2 patients (2%).

**Chart 6.****Table 7. X-Ray chest findings in patients of COPD**

S.No.	X-Ray chest findings	No. of patients	Percentage
1	Normal	25	25
2	Increased bronchovascular markings	39	39
3	Changes of emphysema	36	36
4	Prominent central pulmonary artery	30	30
5	Cardiomegaly	30	30

Out of 100 patients, 25 patients (25%) had normal chest x-ray. Increased bronchovascular markings were present in 39 patients (39%), changes of emphysema in 36 patients (36%), prominent central pulmonary artery and cardiomegaly was present in 30 patients (30%).

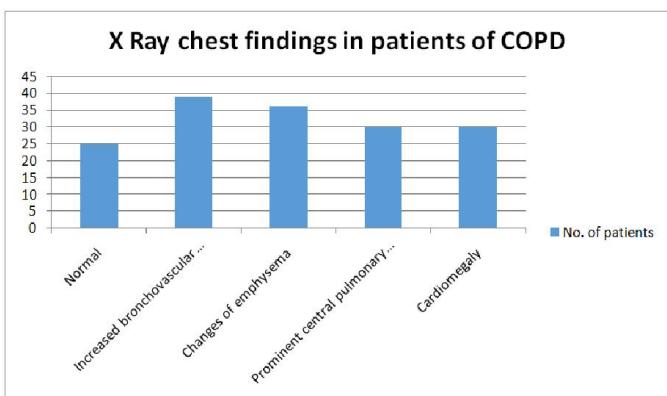
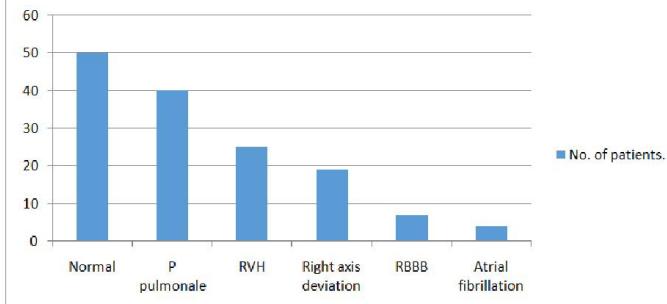
**Chart 7.**

Table 8. Electrocardiographic (ECG) findings in patients of COPD

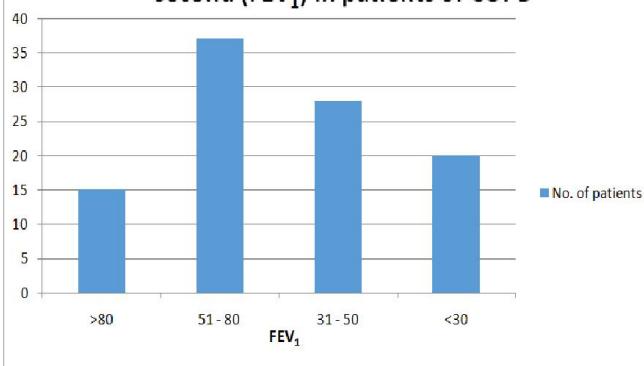
S.No.	ECG findings	No. of patients	Percentage
1	Normal	50	50
2	P pulmonale	40	40
3	Right ventricular hypertrophy (RVH)	25	25
4	Right axis deviation	19	19
5	Right bundle branch block (RBBB)	7	7
6	Atrial fibrillation	4	4

Out of 100 patients, 50 patients (50%) had normal ECG. Most common ECG finding was P pulmonale present in 40 patients (40%) while the least common finding was atrial fibrillation present in 4 patients (4%).

Electrocardiographic (ECG) findings in patients of COPD**Chart 8.****Table 9. Forced Expiratory Volume (% predicted) in 1 second (FEV₁) in patients of COPD**

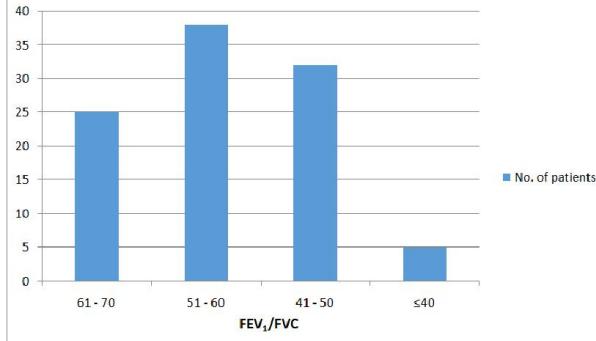
FEV ₁ (% predicted)	No. of patients	Percentage
≥80	15	15
50-79	37	37
30-49	28	28
<30	20	20
Total	100	100

Out of 100 patients, 37 patients (37%) had FEV₁ between 50-79 % predicted, 28 patients (28%) had FEV₁ between 30-49 % predicted, 20 patients had FEV₁<30 % predicted, 15 patients had FEV₁≥80 % predicted.

Forced Expiratory Volume (%predicted) in 1 second (FEV₁) in patients of COPD**Chart 9.****Table 10. FEV₁/FVC ratio in patients of COPD**

FEV ₁ /FVC x 100 (%)	No. of patients	Percentage
61 - 69	25	25
51 - 60	38	38
41- 50	32	32
≤40	5	5
Total	100	100

All patients had FEV₁/FVC < 70%. Out of 100 patients, 38 patients (38%) had FEV₁/FVC between 51-60%, 32 patients (32%) had FEV₁/FVC between 41-50%, 25 patients (25%) had FEV₁/FVC between 61-69% and 5 patients (5%) had FEV₁/FVC <40%.

FEV₁/FVC ratio in patients of COPD**Chart 10.****Table 11. Grading of severity of COPD patients**

Grading of severity of COPD	No. of patients	Percentage
Mild	15	15
Moderate	37	37
Severe	28	28
Very severe	20	20
Total	100	100

Out of 100 patients, 15 patients (15%) had mild COPD, 37 patients (37%) had moderate COPD, 28 patients (28%) had severe COPD and, 20 patients (20%) had very severe COPD as per GOLD guidelines.

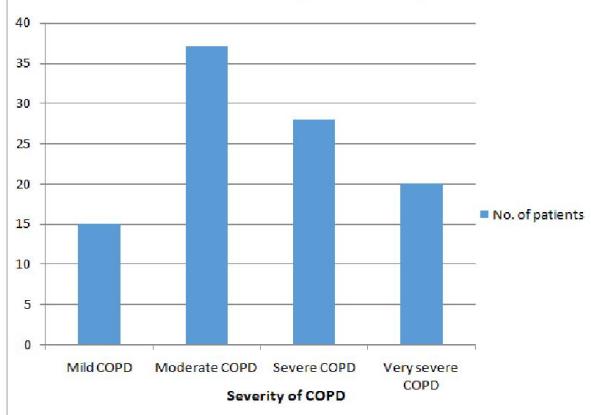
Grading of severity of COPD patients**Chart 11.**

Table 12. Pulmonary Hypertension and functional tricuspid regurgitation on 2D and Doppler Echocardiography in patients of COPD

Grading of severity of COPD	Pulmonary hypertension and functional tricuspid regurgitation		Total
	Present	Absent	
Mild	0	15	15
Moderate	2	35	37
Severe	18	10	28
Very severe	20	0	20
Total	40	60	100

Out of 100 patients, 40 patients (40%) had pulmonary hypertension and functional tricuspid regurgitation on 2D and Doppler Echocardiography.

Chi-square = 65.33

Degree of freedom = 3

P<0.0001

Highly significant correlation between severity of COPD and presence of PH and functional TR on 2D Echo

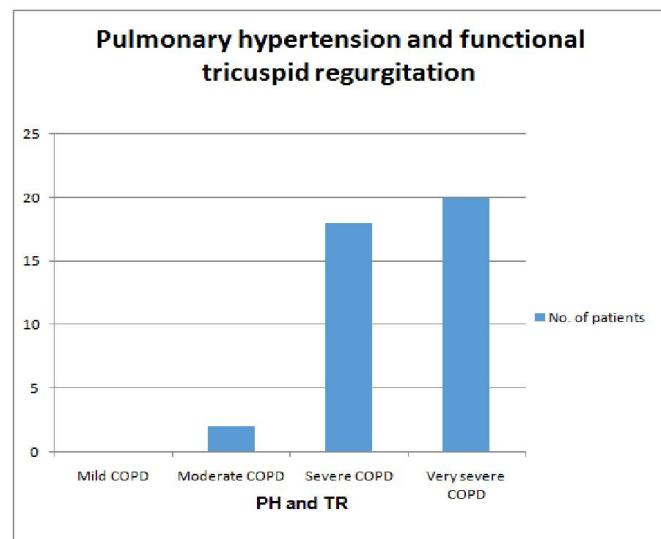


Chart 12.

Table 13. Right ventricular dilatation on 2D Echocardiography in patients of COPD

Grading of severity of COPD	Right ventricular dilatation on 2D Echocardiography		Total
	Present	Absent	
Mild	0	15	15
Moderate	2	35	37
Severe	18	10	28
Very severe	20	0	20
Total	40	60	100

Out of 100 patients, 40 patients (40%) had Right ventricular dilatation on 2D and Doppler Echocardiography.

Chi-square = 65.33

Degree of freedom = 3

P<0.0001

Highly significant correlation between severity of COPD and presence of RV dilatation on 2D Echo.

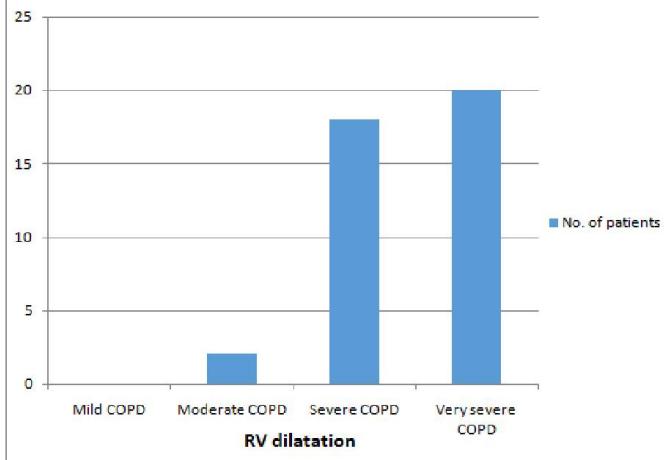
Right ventricular dilatation on 2D Echocardiography

Chart 13.

Table 14. Left ventricular systolic dysfunction on 2D Echo in patients of COPD

Grading of severity of COPD	Left ventricular systolic dysfunction on 2D Echocardiography		Total
	Present	Absent	
Mild	0	15	15
Moderate	0	37	37
Severe	2	26	28
Very severe	3	17	20
Total	5	95	100

Out of 100 patients, 5 patients (5%) had Left ventricular systolic dysfunction on 2D and Doppler Echocardiography.

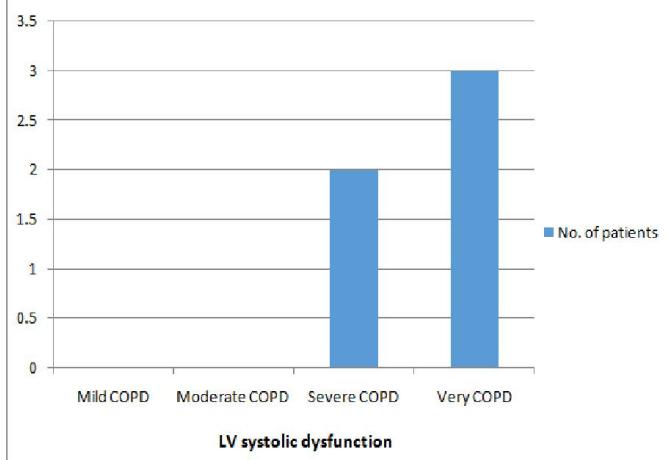
Left ventricular systolic dysfunction on 2D Echocardiography

Chart 14.

Table 15. Left ventricular diastolic dysfunction on 2D Echocardiography in patients of COPD

Grading of severity of COPD	Left ventricular diastolic dysfunction on 2D Echocardiography		Total
	Present	Absent	
Mild	0	15	15
Moderate	4	33	37
Severe	16	12	28
Very severe	17	3	20
Total	37	63	100

Out of 100 patients, 37 patients (37%) had Left ventricular diastolic dysfunction on 2D and Doppler Echocardiography.

Chi-square = 44.34

Degree of freedom = 3

P<0.0001

Highly significant correlation between severity of COPD and presence of left ventricular diastolic dysfunction on 2D Echo.

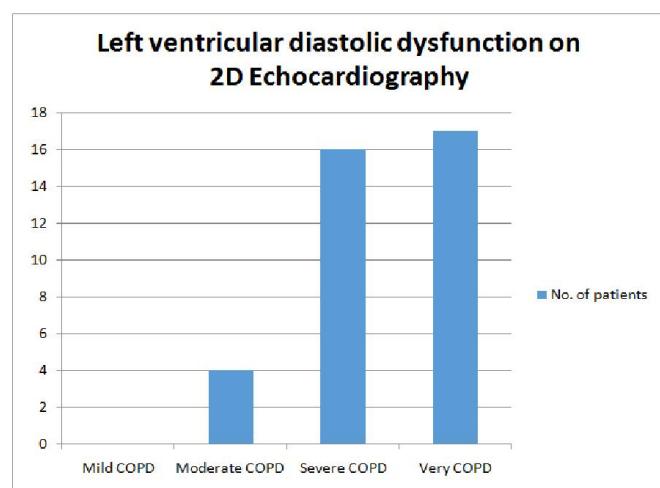


Chart 15.

Table 16. 2D Echocardiographic findings according to severity of COPD

2D Echo findings	Mild COPD (15)	Moderate COPD (37)	Severe COPD (28)	Very severe COPD (20)
PH	0	2	18	20
Functional TR	0	2	18	20
RV dilatation	0	2	18	20
LV systolic dysfunction	0	0	2	3
LV diastolic dysfunction	0	4	16	17

2D Echo was normal in all mild COPD patients. In moderate COPD group, 2 patients (5.4%) had PH, functional TR, and RV dilatation. None had LV systolic dysfunction. 4 patients (10.81%) had LV diastolic dysfunction. In severe COPD group, 18 patients (64.28%) had PH, functional TR, and RV dilatation. 2 patients (7.14%) had LV systolic dysfunction and 16 patients (57.14%) had LV diastolic dysfunction. In very severe COPD group, 20 patients (100%) had PH, functional TR, and RV dilatation. 3 patients (15%) had LV systolic dysfunction and 17 patients (85%) had LV diastolic dysfunction. As the severity of COPD increases, the prevalence of cardiac dysfunction on 2D Echo also increases.

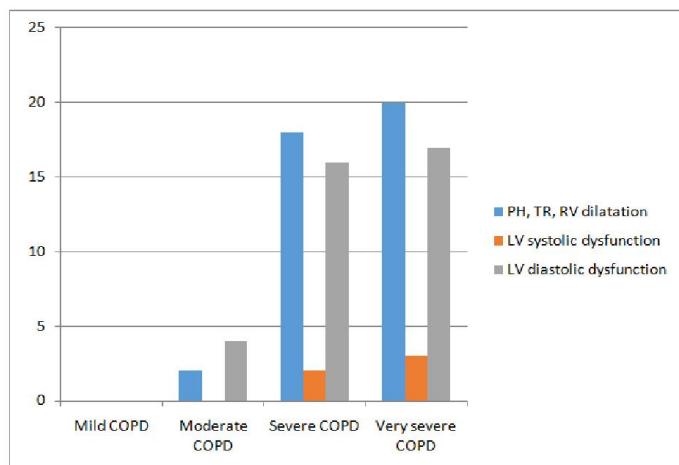


Chart 16. Echocardiographic findings according to severity of COPD

DISCUSSION

COPD is a disease of increasing public health importance around the world. Estimates suggest that COPD will rise from sixth to third most common cause of death worldwide by 2020. Right ventricular hypertrophy and pulmonary hypertension are commonly found in patients of COPD who have chronic hypoxemia. Right ventricular enlargement affects left ventricular filling by interventricular dependence causing left ventricular diastolic dysfunction. Severe enlargement of the right heart can displace the interventricular septum and impede the left ventricular performance. Further both ventricles are bound by common pericardial sac. As intrapericardial pressure increases with progressive enlargement of the right heart, further right ventricular dilatation becomes limited along with left ventricular distensibility⁴. 100 patients of COPD admitted to a tertiary centre were studied during their hospital stay.

1) Age distribution in patients of COPD.

- All patients in present study were more than 40 years of age. The mean age was 62 ± 9 years.
- Suchon et al. (2007)** found mean age of 62.1 ± 7.7 years in patients of COPD in their study.
- Nayak et al. (2008)** found mean age of 67.4 years in their study.
- Gothi et al. (2007)** found highest incidence of COPD in age group of above 40 years and the mean age was 54 years in their study.
- Klaus et al. (2007)**, observed a rising trend of COPD in patients above the age of 40 years.
- Thus present study correlates with the above studies.

2) Sex distribution in patients of COPD

- In our study, out of 100 patients, 80 patients (80%) were male and 20 patients (20%) were female and the male: female ratio = 4:1.
- According to **Gothi (2007)**, there is male predominance in COPD.
- Viji et al. (2008)** found that 84% of COPD patients were male.

- **Suchon et al. (2007)** found that 71% of the COPD patients were male and 29% were female.
- **Nayak et al. (2008)** found male: female ratio of 9:1 among COPD patients.
- Thus present study correlates with above studies.

3) Smoking in patients of COPD

- In present study, out of 100 patients, 75 patients (75%) were smokers. Out of 75 smokers, 40 (60%) were cigarette smokers and 30 (40%) were bidi smokers.
- **Viji et al. (2008)** documented that 80% of the patients were smokers in their study.
- **Klaus et al. (2007)** found higher incidence of COPD in smokers than non-smokers.
- According to **John et al. (2011)** cigarette smoking is a major risk factor for mortality from chronic bronchitis and emphysema.
- **William Macnee (2009)**: Cigarette smoking is clearly the single most important etiological factor in COPD.
- Thus present study correlates with above mentioned studies

4) Symptoms in patients of COPD

- In present study, the common symptoms were dyspnea and cough with expectoration. Dyspnea was present in all 100 (100%) patients and cough with expectoration was present in 90 (90%) patients. Fever was present in 20 (20%) patients while hemoptysis was present in 1 (1%) patient.
- **Roche et al. (2008)** found dyspnea in 99.2% patients of COPD and cough was present in 78.1% of the patients.
- In a study by **Kessler et al. (2011)** dyspnea was the most common symptom present in 72.5% of COPD patients.
- According to **John et al. (2011)** the three most common symptoms in COPD are cough, sputum production, and exceptional dyspnea. Fever may be present in exacerbations of COPD.
- Thus present study correlates with **Roche et al. (2008)**

5) Signs in patients with COPD

- In present study, out of 100 patients 70 patients (70%) had wheeze, 40 patients (40%) had barrel shaped chest, 30 patients (30%) had loud P2 and systolic murmur in tricuspid area, elevated jugular venous pressure, pedal edema and reputations were present in 20 patients (20%), 9 patients (9%) had hepatomegaly and 2 patients (2%) had cyanosis and clubbing.
- **Roche et al. (2008)** found wheeze in 69.3% and reputations in 28.9%.
- According to John et al. (2011) the signs found in patients of COPD are wheeze, barrel shaped chest, cyanosis.
- **William Macnee (2009)**: signs found in patients of COPD are wheeze, barrel shaped chest, cyanosis, reputations According to Fishman's Pulmonary Diseases and Disorders (**Rubens Michael and Padley Simon, 2009**), loud P2 indicates development of pulmonary hypertension. Presence of systolic murmur in tricuspid area, pedal edema, hepatomegaly, elevated jugular venous pressure indicate right heart failure i.e Cor Pulmonale.
- Thus present study correlates with **Roche et al. (2008)**

6) X-Ray chest findings in patients of COPD

- In present study, X-Ray chest findings in patients of COPD were prominent bronchovascular markings, changes of emphysema, prominent central pulmonary artery and cardiomegaly. Out of 100 patients, 25 (25%) patients had normal chest X-Ray.
- According to Textbook of Radiology and Imaging by David Sutton (**Alfred P. Fishman, 2005**), in patients of chronic bronchitis there is generalized accentuation of bronchovascular markings (dirty chest), however, approximately 50% of patients with chronic bronchitis have normal chest x-ray. Radiological appearance of emphysema includes decreased pulmonary vascularity in the periphery, hyperinflation of lungs, heart is long and narrow, flattening of diaphragm. Enlargement of central pulmonary arteries usually signifies pulmonary arterial hypertension. Presence of cardiomegaly indicates development of Cor Pulmonale (**Rubens Michael and Padley Simon, 2009**).
- According to **William Macnee (2009)** following radiographic signs may be seen on chest x-ray: decreased pulmonary vascularity in the periphery, hyperinflation of lungs, area of transradiancy, bullae and increase in lung markings.
- In present study findings are similar to William Macnee (**Darren B. Taichman, Alfred P. Fishman, 2008**) and Textbook of Radiology and Imaging by David Sutton (**Alfred P. Fishman, 2008**).

7) ECG changes in patients with COPD

- In present study, ECG changes were present in 50% of the COPD patients. Out of 100 patients, P pulmonale was present in 40 (40%) patients, right ventricular hypertrophy was present in 25 (25%) patients, right axis deviation was present in 19 (19%) patients, right bundle branch block was present in 7 (7%) patients and atria fibrillation was present in 4 (4%) patients.
- In a study done by **Agarwal et al. (2008)** ECG changes were present in 35.7% and P pulmonale was present in 35.7% patients of COPD.
- In a study by **Chappell (1966)**, P pulmonale was found in 10% of COPD patients and right ventricular hypertrophy in 10%.
- **Ursa Bones et al. (2011)** found right ventricular hypertrophy in 17% patients, right axis deviation in 11%, right bundle branch block in 8% patients and atrial fibrillation in 13% patients.
- According to Marriots Practical Electrocardiography (Wagner, 2011, The electrocardiographic changes in Cor Pulmonale and emphysema are: tall peaked 'P' waves in II, III and avf leads, right ward shift of axis of QRS complex, decreased progression of R waves in primordial leads, low voltage of the QRS complexes in left primordial lead, right ventricular hypertrophy i.e. R wave in lead I + S wave in lead V5 or V6 \geq 1.1mV and (RBBB).
- According to Leo Schamroth⁷ tall peaked 'P' waves in II, III and aft leads is termed as P pulmonale (P wave amplitude > 2.5mm) (**Schamroth Colin, 2010**; http://whqlibdoc.who.int/trs/WHO_TRS_213.pdf).

- Thus, In present study findings correlate with **Agarwal et al. (2008)** and **Ursa Bones et al. (2011)**.

8) Pulmonary function test (PFT) results with spirometry

- In present study, all patients had $FEV_1/FVC < 70\%$. Out of 100 patients, 37 patients (37%) had FEV_1 between 50-79 % predicted, 28 patients (28%) had FEV_1 between 30-49 % predicted, 20 patients had $FEV_1 < 30\%$ predicted, 15 patients had $FEV_1 \geq 80\%$ predicted.
- Grading of severity of COPD was done according to GOLD criteria for COPD⁵. 15 patients (15%) had mild COPD, 37 patients (37%) had moderate COPD. 28 patients (28%) had severe COPD, and 20 patients (20%) had very severe COPD
- In a study by **Gupta et al. (2011)** the numbers of patients with mild, moderate, severe, and very severe COPD were 45%, 27.5%, 12.5%, 15%, respectively.
- Thus, In present study findings are similar to **Gupta et al. (2011)** who also used GOLD criteria for staging of severity of COPD.

9) 2D Echocardiography and color Doppler study in patients of COPD

a) Pulmonary hypertension, functional tricuspid regurgitation and right ventricular dilatation in patients of COPD

- In present study, out of 100 patients of COPD, 40 patients (40%) had pulmonary hypertension, functional tricuspid regurgitation and right ventricular dilatation i.e Cor Pulmonale (**Alfred P. Fishman, 2005; Rubens Michael and Padley Simon 2009**).
- The presence of pulmonary hypertension, functional tricuspid regurgitation and right ventricular dilatation in mild, moderate, severe, and very severe COPD was 0%, 5.4%, 64.28%, 100% respectively.
- Chi-square test was applied and the p value was < 0.0001 indicating statistically significant correlation between severity of COPD (which is based on spirometry evaluation of FEV_1 and FVC based on GOLD criteria for COPD severity) and presence of pulmonary hypertension and right ventricular enlargement on 2D Echocardiography and color Doppler study.
- According to **Gupta et al. (2011)** pulmonary hypertension was observed in 42.5% of COPD patients in their study. PH in mild, moderate, severe, and very severe COPD was present in 16.67%, 54.55%, 60%, 83.33%, respectively thus indicating good correlation between the frequency of PH and severity of COPD.
- In a study by **Thabut et al. (2005)** pulmonary hypertension was present in 50.2% of COPD patients.
- In a study by **Higham et al. (2001)** pulmonary hypertension was present in 55% of COPD patients and pulmonary hypertension correlated with FEV_1 .
- According to **Adil Shujaat et al. (2007)** the reported prevalence of pulmonary hypertension and cor pulmonale varies considerably from 20%-91%.
- In a study by **Nayak et al. (2008)** RV dilatation was present in 60% of the patients

- In a study by **Shrestha et al. (2009)** Cor pulmonale was present in 56.3% of COPD patients.
- **Viji et al. (2008)** found that the incidence of pulmonary hypertension, tricuspid regurgitation and RV enlargement increases with the duration and severity of the disease with COPD patients.
- Thus, present study correlates with above mentioned studies.

b) Left ventricular systolic dysfunction in patients of COPD

- In present study, out of 100 patients LV systolic dysfunction was present in 5 patients (5%)
- In a study by **Gupta et al. (2011)** LV systolic dysfunction was present in 7.5% of COPD patients
- Jorgenson **Houltz et al. (2007)** found that LV systolic function is not significantly impaired in patients of COPD.
- Thus, our study correlates with **Gupta et al. (2011)**.

c) Left ventricular diastolic dysfunction in patients of COPD.

- In our study, LV diastolic dysfunction was present in 37 patients (37%). Left ventricular diastolic dysfunction in mild, moderate, severe, and very severe COPD group was present in 0%, 10.81%, 57.14% and 85% respectively. Chi-square test was applied and the p value was <0.0001 indicating statistically significant correlation between severity of COPD and LV diastolic dysfunction.
- In a study by **Shrestha et al. (2009)**, LV diastolic dysfunction was present in 38.7 % of COPD patients.
- In a study by Gupta et al. (2011), LV diastolic dysfunction was present in 47.5% of COPD patients. LV diastolic dysfunction in mild, moderate, severe, and very severe COPD was present in 33.33%, 36.36%, 60%, 100% respectively.
- **Suchon et al. (2007)** found that LV diastolic function in patients with advanced COPD was impaired in their study.
- In a study by **Georg-Christian Funk et al. (2008)**, Left ventricular diastolic dysfunction was present in COPD patients.
- Thus in our study the LV diastolic dysfunction was more common in severe COPD and very severe COPD group patients which is similar to above mentioned studies.

Summary and Conclusion

- 1) All patients in our study were more than 40 years of age indicating a rising trend of COPD in patients above the age of 40 years. The mean age was 62 ± 9 years.
- 2) In our study COPD was predominantly found in males, comprising 80% of the total patients and Male: Female= 4:1.
- 3) 75% of the patients in our study were smokers indicating higher incidence of COPD in smokers than non smokers.
- 4) The common symptoms were dyspnea and cough with expectoration.
- 5) Most common sign was wheeze present in 70% of COPD patients in our study.
- 6) 25% of the patients had normal chest x-ray. Changes observed in chest x-ray were prominent bronchovascular

- markings, changes of emphysema, prominent central pulmonary artery and cardiomegaly.
- 7) 50% of the patients had normal ECG. Most common ECG finding in our study was P pulmonale present in 40% of the patients.
 - 8) Spirometry is an essential tool to establish the diagnosis and grading of severity of COPD by calculating FEV1 % predicted and FEV1/ FVC.
 - 9) As the severity of COPD increases, incidence of pulmonary hypertension and RV dilatation on 2 D and Doppler Echocardiography i.e. Cor Pulmonale goes on increasing.
 - 10) LV systolic dysfunction was present in 5% of the COPD patients in our study.
 - 11) LV diastolic dysfunction was present in 37% of the patients. As the severity of COPD increases, incidence of LV diastolic dysfunction on 2 D and Doppler Echocardiography goes on increasing

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