INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A PROSPECTIVE, NON-RANDOMISED, SINGLE CENTER, OBSERVATIONAL STUDY OF MONITORING CARDIAC COMPLICATION WITH ECHOCARDIOGRAPHIC (ECG) AND ELECTROCARDIOGRAPHIC (2D-ECHO) FINDINGS IN PATIENTS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

Medicine

Tejas Amin	Senior Resident, Department of Medicine, GMERS Gandhinagar, Gujarat, India.
Dhaneshwar Tripathi*	Assistant Professor, Department of Medicine, American International Institute of Medical Sciences, Udaipur, Rajasthan, India. *Corresponding Author
Atul Rajpara	Assistant Professor, Department of Pharmacology, American International Institute of Medical Sciences, Udaipur, Rajasthan, India.

ABSTRACT

INTRODUCTION: Cardiac complications in COPD has often been postulated to be secondary to increased intrathoracic pressure-induced impaired low-pressure ventricular filling, as is expected with hyperinflated lungs in this population. Patients with COPD also have increased risk for cardiac arrhythmias. Coronary artery disease is also common and is undertreated in patients with COPD independent of cigarette smoking.
AIM: This study was aimed to study the ECG and 2D-Echo changes in COPD patients with different grades of severity of the disease as assessed clinically and through pulmonary function testing.
MATERIAL AND METHODS: In this study, 84 patients who were diagnosed as having COPD as per GOLD guidelines with FEV1/ FVC <70% were enrolled. A Detailed History, Clinical Examination, Signs of right heart failure like raised JVP, congestive hepatomegaly and pedal edema, ECG changes of COPD and Right Heart failure, Chest X-ray, 2D Echo and Spirometry was performed. By using spirometry results, severity of clinical symptoms and history of smoking, patients were classified based on GOLD staging of COPD. Patients who showed clinical sign of right heart failure where subjected to 2D-Echo for confirmation and mean-maximum TR velocity was recorded in mt/sec and inserted into the modified Bernoulli's equation (4v2), thus calculating the trans-tricuspid pressure gradient (TTPG) and the pulmonary artery pressure. All p-values were calculated using one-way ANOVA test while p-values for 2D ECHO were calculated using Fissure t-test.
RESULTS: The findings of pulmonary arterial hypertension, right ventricular dilatation, right atrial dilatation, right ventricular hypertrophy is found to have increased incidence with duration and severity of illness and found mostly in severe (stage-3 GOLD) and very severe (stage-4 GOLD) classes of COPD. All the findings had highly significant correlation with the severity of the disease, the incidence being high in very severe disease.
CONCLUSION: A linear relationship is seen between ECG changes and 2DEcho findings with COPD GOLD stages. From the results of our study, we recommend that ECG and 2D-Echo can be used as markers of severity of COPD.

KEYWORDS

COPD, GOLD, ECG, 2D-Echo, Cardiac Complications.

INTRODUCTION:

Heart failure (HF) is common in COPD patients, and COPD is common in HF patients. COPD is indeed a predictor of mortality in HF. Studies have shown 5-year survival in HF patient with COPD to be as low as 31%, compared with 71% in its absence. HF in COPD patients has often been postulated to be secondary to increased intrathoracic pressure-induced impaired low-pressure ventricular filling, as is expected with hyperinflated lungs in this population. Patients with COPD also have increased risk for cardiac arrhythmias. Coronary artery disease is also common and is undertreated in patients with COPD independent of cigarette smoking[1-3].

The presence of COPD in patients with myocardial infarction (MI) is also associated with a poorer prognosis. Hospital re-admissions from recurrent MI (10% vs 6.9%, P<01) and HF (10% vs 6.9%, P<.01) were significantly more frequent in patients with COPD when compared with those without. Also, hospital readmission for COPD was found to be a strong independent risk factor for recurrence of MI (HR 2.1, 95% CI 1.4–3.3) and HF (HR5.8,95% CI4.6-75).[4-5]

In the Lung Health Study, for every 10% decrease in FEV1, cardiovascular mortality increased by approximately 28% and nonfatal coronary events increased by approximately 20% in mild to moderate COPD. Even a moderate reduction of expiratory flow volumes multiplies the risk of cardiovascular morbidity and sudden cardiac deaths by 2 to 3 times, independent of other risk factors. [6,7]

COPD patients also have shown evidence of atherosclerotic plaque burden as assessed by increased carotid intimal medial thickening (CIMT are associated with increased cardiovascular and all-cause mortality.)

Present study was undertaken to study the electrocardiographic and echocardiographic changes in COPD patients with different grades of severity of the disease as assessed clinically and through pulmonary function testing. Further, an attempt has been made to compare the electrocardiographic and the echocardiographic changes with respect to duration and severity of the disease so that the patients can be

identified at an early stage of the disease, as early recognition and treatment of right ventricular dysfunction in COPD, leads to increased survival and improved quality of life.

MATERIAL AND METHODS:

This Cross-sectional study was carried out on adult patients admitted in a tertiary Care Teaching Hospital of Western India under department of Internal Medicine and fulfilling curtained predefined inclusion and exclusion criteria. It was decided to include the patients with age >40 years admitted with symptoms suggestive of airway obstruction of more than 2 years duration and in whom clinical diagnosis of COPD is made. Also, the criteria of FEV1/ FVC ≤ 0.7 and FEV1< 80% of the predicted, which does not change significantly(<200ml) after bronchodilator therapy with 0.3 mg of salbutamol nebulisation were taken into consideration. The patients with Bronchial asthma (isolated), Tuberculosis, clinically symptomatic patients of Ischemic Heart Disease, Rheumatic Heart Disease and Clinically symptomatic patients of Thyrotoxicosis were excluded from the study.

A total of 84 patients who were diagnosed as having chronic obstructive pulmonary disease as per GOLD guidelines with FEV1/ FVC <70% were further divided into 3 groups. In Group I, Patients who fulfil the inclusion criteria and belong to moderate COPD (GOLD stage- 2 based on predicted FEV1 50-80%), in Group II, Patients who fulfil the inclusion criteria and belong to severe COPD (GOLD Stage 3 based on predicted FEV1 30-50%) and in Group III, patients who fulfil the above criteria and belong to very severe COPD (GOLD stage 4 based on predicted FEV1 <30%) were selected.

We prepared a detailed proforma to collect all the relevant information to meet the objectives of the study. All the patients were subjected as for 1) Detailed History, 2) General examination and examination of Respiratory system and other systems, 3) Examination specifically for signs of right heart failure like raised JVP, congestive hepatomegaly and pedal edema, 4) Conventional 12 lead Electro cardiography was taken for ECG changes of COPD and Right Heart failure, 5) X-ray chest PA view and left lateral view, 6) 2D Echocardiography, 7) Spirometry.

Spirometry was performed when the patient was clinically stable. Tests were performed with the patient comfortably seated, with clothes loosened. The patients were instructed to take a deep inspiration then close the lips around the mouth piece and blow out as hard and fast as possible, following deep inspiration. Volume was obtained on the vertical axis of recording paper and time on the horizontal axis. The curve which was obtained is referred to as forced vital capacity curve.

By using spirometry results patients were classified based on GOLD staging of COPD. Severity of clinical symptoms were correlated with GOLD staging of COPD. Pack Years of smoking was compared with severity of COPD. Patients who showed clinical sign of right heart failure where subjected to Echo cardiography for confirmation.

In echocardiography Mean maximum TR velocity was recorded in mt/sec and inserted into the modified Bernoulli's equation (4v2), thus calculating the trans-tricuspid pressure gradient (TTPG) and the pulmonary artery pressure. All the P values were calculated using one-way ANOVA test. The p values for 2D ECHO were calculated using Fissure t-test.

RESULTS:
Out of the 84 COPD patients studied, 59 (70.23%) had electrocardiographic changes and 25 (29.76%) had normal ECG study. Of the 25 patients with normal ECG, 5 had significant 2D ECHO findings. The most common electrocardiographic finding is p Pulmonale (33.33%) seen in most of the very severe group of COPD. The next common finding is R/S in V1>1 found in 21.42% and R/S in V6>1in 19.04 %. Right axis deviation alone is found in 13.09%. 8.33 % had RBBB, a finding found in severe and very severe groups of COPD in the present study.

Table-I: Electrocardiographic Findings

|	Moderate (stage2) (n=21)	Severe (stage 3) (n=39)	Very severe (stage 4) (n=24)	Total	Percentage	P value
P pulmonale	5	9	14	28	33.33%	0.00081
R/S in V1>1	2	5	11	18	21.42%	0.0049
R/s in V6<1	1	5	10	16	19.04%	0.0023
RAD	4	3	4	11	13.09%	0.7
RBBB	1	2	5	7	8.33%	0.0935

Figure: II ECG showing RBBB

In the present study group of 84 COPD patients, 62 (73.80%) had 2D ECHO findings and 22 (26.19%) had normal study. Of these 22 subjects, with normal ECHO, 5 had electrocardiographic changes. 5 patients in the total study had absolutely normal ECG but had significant echocardiographic changes.

The most common echocardiographic finding in the study was pulmonary artery hypertension observed in 55.95% followed by right atrial dilatation and right ventricular dilatation seen in 48.80% & 47.77% respectively. Right ventricular hypertrophy was found in 35.71%. 45.23% of the cases had tricuspid regurgitation.

Table-II: Echocardiographic Findings

Echocardiographic Findings	Moderate (stage2) (n=21)	Severe (stage 3) (n=39)	Very severe (stage 4) (n=24)	Total	Percentage	P value
PAH	4	20	23	47	55.95%	<0.00004
RA Dilatation	3	18	20	41	48.8%	<0.000005
RV Dilatation	3	17	20	40	47.61%	<0.000006
TR	3	15	20	38	45.23%	<0.0003
RVH	3	10	17	30	35.75%	<0.003

Figure: III 2DEcho showing dilated right atrium and ventricle
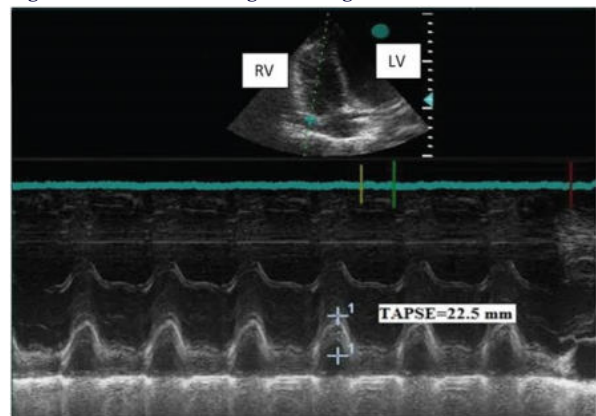
The findings of pulmonary arterial hypertension, right ventricular dilatation, right atrial dilatation, right ventricular hypertrophy is found to have increased incidence with duration and severity of illness and found mostly in severe (stage-3 GOLD) and very severe (stage-4 GOLD) classes of COPD. All the findings had highly significant correlation with the severity of the disease, the incidence being high in very severe disease.

DISCUSSION:
By electrocardiography poor progression of 'R' Wave was the most frequent abnormality detected in this present study constituted 40.46%. The 33.33% of cases showed 'P' pulmonale and QRS axis > + 900 R/S in V1>1was found in 21.42% and R/S in V6>1in 19.04 %. Boushy SF et al., 1971, in his study observed that 'P' pulmonale and QRS axis > + 900 were the major ECG changes present in 12.5% of the patients.[8] It was observed from this study a greater number of cases with ECG changes were seen in Stage IV COPD. Which denoted that as the severity of COPD increases, ECG changes also increase.

By echocardiography pulmonary arterial hypertension was the most frequent abnormality detected in this present study constituted 55.95%. Around 48.8% of cases showed right atrial dilation, right ventricular dilatation was found in 47.61%. Tricuspid regurgitation and right ventricular hypertrophy were found in 45.23% and 35.71% respectively. 'It was observed from this study a greater number of cases with 2DEcho changes were seen in Stage IV COPD. Which denoted that as the severity of COPD increases, 2DEcho changes also increase. In the study the greatest number of patients were in GOLD Stage III COPD which constituted 46.29% of cases. The study by Higham et al [9] showed that majority of patients were in Stage III (BTS Scheme for COPD) constituted 57 – 58% of cases. Renzeti AD et al, 1966 observed 76% of his cases belong to moderate to severe stages of COPD. [10]

In this study it is observed that 42.8% of cases showed clinical evidence of right heart failure. All the patients who showed the clinical evidence of right heart failure were subjected to echocardiography and confirmed the presence of right heart failure. Mattay R et al, 1981, observed that 12.5% of his cases were showed evidence of cor pulmonale. [11]

CONCLUSION:
Severity of Chronic Obstructive Pulmonary Diseases has direct

relation with incidence of ECG changes in Chronic Obstructive Pulmonary Diseases. Severity of Chronic Obstructive Pulmonary Diseases has direct relation with incidence of 2DEcho changes in Chronic Obstructive From this study, it is evident that ECG and 2D-Echo can be used as markers of severity of COPD. A linear relationship is seen between ECG changes and 2DEcho findings with COPD GOLD stages.

Limitations Of the Study:

The sample size of the study was 50 patients. Study would have been more representative if a larger group was studied. Most of the references which are available are from the studies carried out in western world. So, the results of those studies though are consistent with our present study due to a small sample size, may not be comparable when are extrapolated to a large group of patients as there are many differences including climate, diet, available medical facilities etc., in western countries and our country.

ACKNOWLEDGEMENT:

REFERENCES:
1. Global initiative for chronic obstructive pulmonary disease, 2003. *Global obstructive lung disease. NHLBI / WHO report. NIH* Publication, No. 2701.
2. John J. Reilly Jr. Edwin K. Silver man, Steven D Shapiro, Chronic obstructive pulmonary disease" Chapter 242, Pg 1547 – *57, in Harrison's Principles of Internal Medicine Volume II by* Eugene Brauwald, Anthony S Fauci, Dennis L Kasper.
3. William MacNee "Chronic Bronchitis and emphysema". Crofton *and Douglass Respiratory Diseases Chapter 616, edited by* Anthony Seaton, Douglas Seaton, fifth edition, Blackwell Sciences, Volume – 1, 650.
4. Suzanne Hurd, Ph.D. 2000. "The impact of COPD on lung health worldwide, epidemiology and incidence:, Chest, Vol. 117 : 1S – 4S.
5. Scott W, and Gravin. 1941. American Heart Journal, 22:50.
6. I.T.T. Higgins. 1959. "Tobacco smoking, respiratory symptoms and ventilatory capacity", British Medical Journal, 325 – 29.
7. Benjamin Burrows, Richard H. Earle. 1669. "Course and prognosis of chronic obstructive lung disease", The New England Journal of Medicine, Vol. 280 – 8, Pg. 297 – 404.
8. Boushy SF et al., 1971. "Electrocardiogram in chronic obstructive pulmonary disease". Amer Rev Resp Disease, 104 : 1067 – 70.
9. Higham M.A. Dawson D. et al., 2001. "Utility of Echocardiography in Assessment of Pulmonary hypertension secondary to COPD", European Respiratory Journal. Vol. 17 (3), 350 – 355.
10. Renzeti AD. et al., 1966. "The Veterans Administration Cooperative Study of Pulmonary Function, 111, Mortality in relation to respiratory function in COPD", AM J Med, 41 : 115 – 9.
11. Mattay R. et al., 1981. "Cardiovascular performance in chronic obstructive pulmonary disease – Symposium on obstructive lung disease", Medical Clinics of North America, 65(3) : 489.