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ELECTROCARDIOGRAPHIC AND ECHOCARDIOGRAPHIC CHANGES IN PATIENTS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Medicine

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ABSTRACT

Introduction- Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease. Cardiovascular disease accounts for approximately 50% of all hospitalization and nearly one third of all deaths, if forced expiratory volume in one second (FEVI) > 50% of predicted.3 In this study we made an attempt to see the importance of ECG and echocardiography in the evaluation of COPD patients and early recognition of complications.

Materials and Methods- 100 Patients were included in the study. Patients were subjected to Spirometry and diagnosis of COPD was confirmed. Electrocardiography and Echocardigraphy was done. ECG was evaluated for Rate, Axis deviation, 'P' pulmonale, Evidence for RVH, Low voltage complexes and RBBB. Color Doppler Echocardiography was doneto evaluate Tricuspid regurgitation, Pulmonary artery hyp ertension and Regional Wall Motion Abnormality.

Results- It has been observed in our study the commonest electrocardiographic finding was P pulmonale followed by right axis deviation.These electrocardiographic changes correlate with the severity of COPD as per GOLD guidelines. The commonest echocardiographic finding was Pulmonary Hypertension followed by Right Ventricular Hypertrophy. The patients of severe and very severe group had presence of right ventricular failure. In few patients of asymptomatic COPD ischemic changes were observed in ECG.

Conclusion- The Commonest ECG finding in our study was found to be P pulmonale followed by right axis deviation. The early assessment of ischemic heart disease in patients of COPD may prevent fatal complications by providing appropriate treatment. The commonest echocardiographic finding was Pulmonary Hypertension followed by Right Ventricular Hypertrophy

KEYWORDS

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.[1]

COPD is a leading cause of death and disability worldwide. COPD is currently the fourth leading cause of death in the world but is projected to be the 3rd leading cause of death by 2020.[2]

COPD includes emphysema, an anatomically defined condition, characterized by destruction and enlargement of lung alveoli; chronic bronchitis, a small airways disease in which small bronchioles are narrowed.

COPD is characterized by chronic inflammation throughout the airways, parenchyma, pulmonary vasculature, Macrophages, T-lymphocytes and neutrophils are increased in various parts of the lungs.

It is necessary to diagnose the disease early and identify patients who are likely to develop complications of pulmonary hypertension, right ventricular hypertrophy and corpulmonale to prevent long term complications, promote longevity and improve quality of life.
Cardiovascular disease accounts for approximately 50% of all hospitalization and nearly one third of all deaths, if forced expiratory volume in one second (FEVI) > 50% of predicted.[3]

In more advanced disease, cardiovascular disease account for 20% - 25% of all deaths in COPD.[4]

In this study we made an attempt to see the importance of ECG and echocardiography in the evaluation of COPD patients and early recognition of complications.

ECG changes in COPD patients focus on ECG abnormalities related to pulmonary hypertension and corpulmonale i.e. right atrial enlargement, right ventricular hypertrophy, P-pulmonale, right axis deviation and right bundle branch block.

Echocardiography provides a rapid, noninvasive portable and accurate method to evaluate the right ventricle function, right ventricular filling pressure, tricuspid regurgitation, left ventricular function and valvular function.[5]

Many studies have confirmed that echocardiographically derived estimates of pulmonary arterial pressure co-relate closely with pressure measured by right heart catheter.[6,7]

This study is being undertaken to study the electrocardiographic and echocardiographic changes in COPD patients with different grades of severity of the disease, as assessed through pulmonary function testing.

OBJECTIVES

1. To evaluate Electrocardiography and echocardiography findings in patients of COPD and assessment of their relation to severity of COPD.
2. To study the presence of already co-existing asymptomatic ischemic heart disease in patients of COPD.

MATERIAL & METHODS

Study Design: A Cross-Sectional Observational Study
100 cases of COPD were included in the study.
Duration: January 2016 to June 2017

Place of study: Patients admitted in wards of General Medicine and Pulmonary Medicine, SRMS IMS, Bareilly, through OPD and Emergency, were taken for the study considering the inclusion and exclusion criteria.

Methods of Collection of Data- In all the 100 patients a detailed clinical history and clinical examination was done and recorded in a prescribed proforma prepared for the purpose after taking a written informed consent.

All patients were subjected to:
1. Spirometry
2. 12-lead ECG
3. 2D-Echocardiography

INCLUSION CRITERIA :
All patients of COPD, of both genders, and of more than 40 years of age, were taken in the study as cases. The diagnosis of COPD was established by clinical history, general and physical examination, radiological examination, electrocardiography and echocardiography.

The patients were subjected to Pulmonary Function Test (PFT) with flow sensing PFT machine and assessed for severity and stage of COPD according to GOLD guidelines as per follows.

Based on Post Bronchodilator Forced Expiratory Volume in first second (FEV1) .In patients with FEV1/FVC <0.70 [1]:

GOLD 1: Mild 80% ≤ FEV1 predicted
GOLD 2: Moderate 50% ≤ FEV1 < 80% predicted
GOLD 3: Severe 30% ≤ FEV1 < 50 % predicted
GOLD 4: Very severeFEV1 < 30% predicted

All the patients were subjected to 12 lead Electrocardiography and a detailed evaluation was done including:

1. Rate
2. Axis deviation
3. 'P' pulmonale
4. Evidence for RVH
5. Low voltage complexes
6. RBBB

All patients were subjected to transthoracic Doppler echocardiography using SEIMENS echocardiography machine with a 4 MHz transducer to assess the pericardium, valvular anatomy and function, left and right side chamber size and cardiac function.

Tricuspid regurgitant flow was identified by color flow Doppler technique and the maximum jet velocity was measured by continuous wave Doppler without the use of intravenous contrast.in the absence of right ventricular outflow obstruction the pulmonary artery systolic pressure equals the right ventricular systolic pressure (RVSP) in echocardiography. The Modified Bernoulli equation (DP (mm Hg) = 4 x V2) was used, where DP is the pressure gradient between the right ventricle and right atrium and v is the velocity of tricuspid regurgitant jet. Right ventricular systolic pressure was calculated as: right ventricular systolic pressure = 4TRV2 + RAP where v is the velocity of tricuspid regurgitant jet and RAP the right atrial pressure. Right atrial pressure was estimated from the inferior vena cava imaged with two-dimensional echocardiography. RAP was estimated to be 5, 10, 15 mm HG based on variation in the size of inferior vena cava with inspiration as follows: complete collapse, RAP=5 mm HG; partial collapse RAP= 10 mm HG; and no collapse, RAP= 15 mm HG.[8]

Pulmonary hypertension (PH) was defined in this study as pulmonary artery systolic pressure (PASP)≥ 30 mm HG. This value was chosen according to the definition of pulmonary hypertension. Pulmonary hypertension was classified into mild, moderate and severe category as PASP 30-50, 50-70, >70 mm HG, respectively.

Right ventricle dimension was measured and right ventricle dilatation or corpulmonale was said to be present when it exceeded > 23mm.[9] Right ventricle contractility was also noted and right ventricle systolic dysfunction was said to be present when it was hypokinetic.

Inter ventricular septum thickness was also noted and said to be increased if > 5 mm.[9]

Regional wall motion abnormality was also seen.

Left ventricular function was also assessed by using following parameters: EF (ejection fraction) = measure of how much end diastolic value is ejected from LV with each contraction.

EXCLUSION CRITERIA
1. Presence of restrictive respiratory diseases.
2. Presence of malignancy or any serious comorbidities that would prevent the study completion.
3. Patients with active pulmonary tuberculosis will be excluded.
4. Patients with dilated cardiomyopathy, acute coronary artery disease,LV dysfunction.
5. Patients less than 40 years of age.
6. Patients with poor echogenic window.
7. Patients with any chest wall deformity.
8. Patients with congenital heart disease

OBSERVATIONS
In our study it was observed that most of the study subjects were above 60 years of age (65%) followed by those in the age group 41-60years (33%). Similar trend was observed in male (69.3% and 29.3% respectively) and female (52% and 44% respectively) subjects. The mean age of the study population was 62.46±10.57 years. The mean age of the female subjects was 58.44±14.94 years while that of male subjects was 63.8±8.35 years.

Table 1: Distribution of the study patients according to COPD

COPD Grade	N	%
MILD OBSTRUCTION	5	5.0
MODERATE OBSTRUCTION	47	47.0
SEVERE OBSTRUCTION	28	28.0
VERY SEVERE OBSTRUCTION	20	20.0
Total	100	100.0

It was seen in the present study that most of the COPD patients under study had moderate obstruction (47%) followed by severe obstruction (28%), very severe obstruction (20%) and least having mild obstruction (5%).

Table 2: Distribution of the COPD patients according to ECG findings

ECG findings*	COPD Grade								Total		p- value
	MILD		MODERATE		SEVERE		VERY SEVERE				
	N	%	N	%	N	%	N	%	N	%	
P Pulmonale	0	0.0	33	70.2	21	75.0	15	75.0	69	69.0	0.0109
RAD	1	20.0	29	61.7	21	75.0	15	75.0	66	66.0	0.0836
RVH	0	20.0	21	44.7	20	71.4	16	80.0	57	57.0	0.0007
RBBB	0	0.0	29	61.7	19	67.9	6	30.0	54	54.0	0.0025
Low voltage QRS	0	0.0	13	27.7	7	25.0	3	15.0	23	23.0	0.5098
ST-T changes	1	20.0	4	8.5	2	7.1	5	25.0	12	12.0	0.1975
Q waves	0	0.0	0	0.0	2	7.1	2	10.0	4	4.0	0.1084
Ventricular Ectopics	0	0.0	0	0.0	1	3.6	1	5.0	2	2.0	0.3259
AF	0	0.0	0	0.0	2	7.1	1	5.0	3	3.0	0.2509
Total	5	100.0	47	100.0	28	100.0	20	100.0	100	100.0	-

In our study it was observed that most of the study subjects had positive findings on ECG.

P-pulmonale was seen in total of 69 (69.0%) COPD patients. On aggrouping the COPD patients according to severity, it was seen that p-pulmonale was present in no case of mild obstruction, in 33 (70.2%) cases of moderate obstruction, in 21 (75.0%) cases of severe obstruction and in 15 (75.0%) cases of very severe obstruction. On statistical analysis it was seen that the difference in proportions was statistically significant (p-value 0.0109).

Right axis deviation (RAD) was seen in total of 66 (66.0%) COPD patients. On aggrouping the COPD patients according to severity, it was seen that RAD was present in 1 (20.0%) case of mild obstruction, in 29 (61.7%) cases of moderate obstruction, in 21 (75.0%) cases of severe obstruction and in 15 (75.0%) cases of very severe obstruction. On statistical analysis it was seen that the difference in proportions was statistically insignificant (p-value 0.0836).

Right ventricular hypertrophy (RVH) was seen in total of 53 (53.0%) COPD patients. On aggrouping the COPD patients according to severity, it was seen that RVH was present in no case of mild obstruction, in 21 (44.7%) cases of moderate obstruction, in 20 (71.4%) cases of severe obstruction and in 16 (80.0%) cases of very severe obstruction. On statistical analysis it was seen that the difference in proportions was statistically significant (p-value 0.0007).

Right bundle branch block (RBBB) was seen in total of 54 (54.0%) COPD patients. On aggrouping the COPD patients according to severity, it was seen that RBBB was present in no case of mild obstruction, in 29 (61.7%) cases of moderate obstruction, in 19 (67.9%) cases of severe obstruction and in 6 (30.0%) cases of very severe obstruction. On statistical analysis it was seen that the difference in proportions was statistically significant (p-value 0.0025).

Low voltage QRS was seen in total of 23 (23.0%) COPD patients. On aggrouping the COPD patients according to severity, it was seen that Low voltage QRS was present in no case of mild obstruction, in 13 (27.7%) cases of moderate obstruction, in 7 (25.0%) cases of severe obstruction and in 3 (15.0%) cases of very severe obstruction. On statistical analysis it was seen that the difference in proportions was statistically insignificant (p-value 0.5098).

ST-T changes were present in total of 12 (12.0%) COPD patients. On aggrouping the COPD patients according to severity, it was seen that ST-T changes were present in 1 (20.0%) cases of mild obstruction, in 4 (8.5%) cases of moderate obstruction, in 2 (7.1%) cases of severe obstruction and in 5 (25.0%) cases of very severe obstruction. On statistical analysis it was seen that the difference in proportions was statistically insignificant (p-value 0.1975).

Distribution of the COPD patients according to presence of Tricuspid regurgitation

P-value 0.0001.df= 6. Patients of mild and moderate COPD were merged for applying statistical test

It was observed in our study that majority of the COPD patients on Echocardiography had severe Tricuspid regurgitation (TR) (27.0%) followed by moderate TR (22.0%), followed by mild TR (15.0%) and least having no TR (36.0%). No TR was seen in patients of mild COPD. Similar trend of TR (mild, severe, moderate and absent) in ascending order was seen in patients of moderate (10.6%, 14.9%, 17% and 57.4% respectively), and different trend of TR (absent, mild, moderate and severe) in ascending order was seen in severe (7.1%, 25.0%, 32.1% and 35.7% respectively) and very severe (10.0%, 15.0%, 25.0% and 50.0% respectively) COPD.

On statistical analysis, it was seen that the difference in proportions was statistically significant (p-value 0.0001).

Table 3: Distribution of the COPD patients according to presence of Pulmonary artery hypertension

PAH	COPD Grade								Total	
	MILD		MODERATE		SEVERE		VERY SEVERE			
	N	%	N	%	N	%	N	%	N	%
NO	5	100.0	27	57.4	2	7.1	2	10.0	36	36.0
MILD	0	0.0	5	10.6	7	25.0	3	15.0	15	15.0
MOD	0	0.0	8	17.0	9	32.1	5	25.0	22	22.0
SEVERE	0	0.0	7	14.9	10	35.7	10	50.0	27	27.0
Total	5	100.0	47	100.0	28	100.0	20	100.0	100	100.0

P-value 0.0001.df= 6. Patients of mild and moderate COPD were merged for applying statistical test

It was observed in our study that majority of the COPD patients on Echocardiography had severe Pulmonary hypertension (PH) (27.0%) followed by moderate PH (22.0%), followed by mild PH (15.0%) and least having no PH (36.0%). No PH was seen in patients of mild COPD. Similar trend of PH (mild, severe, moderate and absent) in ascending order was seen in patients of moderate (10.6%, 14.9%, 17% and 57.4% respectively), and different trend of PH (absent, mild, moderate and severe) in ascending order was seen in severe (7.1%, 25.0%, 32.1% and 35.7% respectively) and very severe (10.0%, 15.0%, 25.0% and 50.0% respectively) COPD.

On statistical analysis, it was seen that the difference in proportions was statistically significant (p-value 0.0001).

Table 4: Distribution of the COPD patients according to presence of Regional wall motion abnormality

RWMA	COPD Grade								Total	
	MILD		MODERATE		SEVERE		VERY SEVERE			
	N	%	N	%	N	%	N	%	N	%
Present	1	20.0	1	4.3	1	3.6	4	20.0	7	7.0
Absent	4	80.0	46	95.7	27	96.4	16	80.0	93	93.0
Total	5	100.0	47	100.0	28	100.0	20	100.0	100	100.0

p-value 0.0276

Presence of already co-existing asymptomatic ischemic heart disease in patients of COPD was ascertained by looking for presence of any Regional Wall Motion Abnormality (RWMA). RWMA was present in 16 (16.0%) cases of COPD. Similarly, only a small proportion of the study subjects had RWMA among patients of mild 0 (0.0%), moderate 7 (14.9%), severe 2 (7.1%) and very severe 7 (35.0%) COPD while majority had no RWMA (100.0%, 85.1%, 92.9% and 65.0% respectively).

On statistical analysis, for which cases of mild obstruction were merged with cases of moderate obstruction, it was seen that the difference in proportions was statistically significant (p-value 0.0459).

CONCLUSION

It is concluded from our study that spirometry is an essential tool to establish the diagnosis and grading of severity of COPD by calculating FEV1% predicted and FEV1/FVC.

It has been observed in our study the commonest electrocardiographic finding was P pulmonale followed by right axis deviation.

These electrocardiographic changes correlate with the severity of COPD as per GOLD guidelines.

The commonest echocardiographic finding was Pulmonary Hypertension followed by Right Ventricular Hypertrophy. The patients of severe and very severe group had presence of right ventricular failure.

The early assessment of ischemic heart disease in patients of COPD may prevent fatal complications by providing appropriate treatment.

SUMMARY

In Electrocardiographic majority of the subjects had P pulmonale (69%) followed by right axis deviation (66%) on electrocardiography majority of which was found in patients belonging to severe and very severe group. 12% of the patients had ST-T changes and 2% of patients had ventricular ectopics and atrial fibrillation.

In echocardiography majority of the patients had right ventricular hypertrophy (67%) maximum in patients with very severe obstruction. Tricuspid regurgitation (64%) and pulmonary hypertension (64%) was maximum seen in patients belonging to group of severe obstruction.

Right ventricular dilatation was observed in 30% of patients maximum observed in patients with very severe obstruction.

28% patients had increased inter ventricular septal thickness belonging to very severe group and only 2% patients had left ventricular systolic dysfunction on echocardiography.

Regional wall motion abnormality was seen in 7 % of study subjects on echocardiography.

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