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Original Research Article

"CORRELATION OF ECG & ECHOCARDIOGRAPHY PARAMETER WITH SEVERITY OF DISEASE BY USING BODE INDEX IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)''

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ABSTRACT

Background: Chronic obstructive pulmonary disease is a common health problem seen world-wide. It carries significant morbidity and mortality. COPD has considerable effects on cardiac functions. Electrocardiography (ECG) and echocardiography can provide valuable information about cardiac disease and prognosis.

Aim and Objectives:

- Evaluation of ECG and Echocardiographic parameters in Chronic Obstructive Pulmonary Disease (COPD) patients.
- To determine whether higher BODE index is associated with more severe cardiac involvement.
- To determine the correlation between severity of disease & BODE index in Chronic Obstructive Pulmonary Disease (COPD) patients.

Material and Methods: This is an cross-sectional study was done from September 2022 to August 2023 in Shyam Shah Medical College and Sanjay Gandhi hospital Rewa M.P. All patients with the diagnosis of chronic obstructive pulmonary disease (copd) were evaluated for the patient with FEV1/FVC < 70 % . In addition, all the patients underwent routine blood tests, pulse oximetry, chest X-rays, pulmonary function test, Electrocardiography and 2D Echocardiography, BODE Index and MMRC Scale.

Results: Out of 200 patients in our study, COPD was identified in 63.5% are male while 36.5. % are female patients . In our study 55.5% are under severe category while 44% are fall under moderate category and 0.5% fall under mild category according to BODE INDEX. In our study 46% are fall under RVH and Right Axis Deviation and also 46% fall under clockwise rotation. In our study Tricuspid Regurgitation (TR) is present in 82 % (35% mild , 42.5% moderate and 9% are severe) . In this study PAH found in 74% (25.5 % are mild, 61% moderate and 36% are severe).

Conclusion: Study concluded that COPD is more common in males and in the 5th and 6th decade of life. Most of the patients have mild to moderate disease at presentation. ECG abnormalities, were common in cases of COPD, affecting seven out of ten cases and have a significant association with COPD and symptoms severity.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

Keywords: Chronic Obstructive Pulmonary Disease (COPD), PFT, Electrocardiography, Echocardiography

Study Resign: Observational study

1. Introduction

Chronic obstructive pulmonary disease is a common health problem seen world-wide. It carries significant morbidity and mortality. COPD has considerable effects on cardiac functions. Electrocardiography (ECG) and echocardiography can provide valuable information about cardiac disease and prognosis.1 COPD is characterized by chronic airflow limitation and a range of pathological changes in the lungs. In addition COPD presents significant extrapulmonary effects and is associated with important comorbidities that may contribute to the disease severity.2 COPD is associated with significant extra pulmonary (systemic) effects among which cardiac manifestations are most common. Cardiovascular disease accounts for approximately 50 % of all hospitalization and nearly one third of all deaths, if FEV1> 50 % of predicted. In more advanced disease cardiovascular disease account for 20 %- 25 % of all deaths in COPD.3 COPD affects pulmonary blood vessels, right ventricle as well as left ventricle leading to the development of pulmonary hypertension (PH), Cor-pulmonale (COR-P), right ventricular dysfunction and left ventricular dysfunction.2 Different explanations have been suggested including systemic inflammation, vascular dysfunction and lung hyperinflation. The level of Pulmonary Hypertension has a prognostic value in COPD patients demonstrated by several studies and a high degree of PH bears a poor prognosis and this has been observed in COPD patients receiving long-term oxygen therapy. Hypoxia is one of the major factor in bringing about ECG changes in COPD. Furthermore, pulmonary hypertension (PH) which is a frequent complication of COPD and the resulting right ventricular dysfunction are both predictive ofsurvival in COPD. Given the prognostic implications of cardiovascular disease in COPD its detection could serve as a guide to appropriate treatment and eventually improve survival. The ECG abnormalities are usually less pronounced in COPD than other forms of pulmonary hypertension because of the relatively modest degree of pulmonary hypertension and effects of hyperinflation.4 2D echocardiography can be used to assess right ventricular dimensions and wall thickening and right ventricular volume overload in patients with COPD and also the presence of pulmonary artery hypertension. Many studies hypothesised that a high proportion of COPD patients might present clinically silent echocardiographic abnormalities and that these cardiac alterations could constitute a clinically relevant trait in COPD. The severity of COPD is usually assessed on the basis of a single parameter – forced expiratory volume in one second (FEV1). However the patients with COPD have systemic manifestations that are not reflected by the FEV1. Hence a multidimensional grading system that assessed the respiratory and systemic expressions of COPD will be designed to predict outcome in these patients5 . The four factors that predicted the severity most will be the body-mass index (B), the degree of airflow obstruction (O) and dyspnea (D), and exercise capacity (E), measured by the six-minute–walk test. These variables will be used to construct the BODE index, a multidimensional 10-point scale in which higher scores indicate a higher risk of death. The process of allocating scarce medical resources to the most needed patients can be extremely difficult in diseases which affect a large number of patients. Decision makers need a rational and consistent scoring system that is designed to identify those who are maximally in need of a diagnostic or a therapeutic intervention under a health-care budget constraint. BODE index

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

has been proposed to serve this purpose in patients with chronic obstructive pulmonary disease (COPD)6 .

Aim and Objectives

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2. Material and Methods:

This is an cross-sectional study was done from September 2022 to August 2023 in Shyam Shah Medical College and Sanjay Gandhi hospital Rewa M.P. All patients with the diagnosis of chronic obstructive pulmonary disease (copd) were evaluated for the patient with FEV1/FVC < 70 % . In addition, all the patients underwent routine blood tests, pulse oximetry, chest X-rays, pulmonary function test, Electrocardiography and 2D Echocardiography, BODE Index and MMRC Scale.

Sample size: 200 cases (satisfying inclusion and exclusion criteria during the study period)

Inclusion Criteria:

- All the patients with post FEV1/FVC ≤ 70%.

Exclusion criteria: The patients with history of cardiac diseases like ischemic heart disease, rheumatic heart disease, valvular heart diseases, congenital heart disease, kidney disease, liver disease and others. Patients who will be immune compromised.

- Very poor echogenic subjects in whom meaningful echocardiographic examination could not be performed will be also excluded.
- Recent myocardial infarction < 4months unstable angina
- Congestive heart failure (NYHA class III or IV)
- Inability to perform spirometry or 6 minute walk test
- Unrelated life threatening major illness
- Liver disease
- patients with acute exacerbation

PROCEDURE PLAN:

Spirometry showing post bronchodilator FEV1/FVC ratio < 0.70 considered as COPD

(ii) PFT parameter:

- Percentage predicted
- FEV1
- FVC
- FEV1 / FVC %
- PEFR

(iii) BODE index

(iv) ECG Parameter: P wave amplitude QRS Axis RV Hypertrophy Rotation of heart: clockwise rotation -present or absent

(v) ECHO parameter: LVEF RV Parameter - TAPSE TR PAH RV Functional Assessment.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

Criteria for the diagnosis of COPD

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.
The most common respiratory symptoms include dyspnea, cough and/or sputum production. These symptoms may be under-reported by patients.
The main risk factor for COPD is tobacco smoking but other environmental exposures such as biomass fuel exposure and air pollution may contribute. Besides exposures, host factors predispose individuals to develop COPD. These include genetic abnormalities, abnormal lung development and accelerated aging.
COPD may be punctuated by periods of acute worsening of respiratory symptoms, called exacerbations.
In most patients, COPD is associated with significant concomitant chronic diseases, which increase its morbidity and mortality.

Data Collection And Methods:

A detailed history of the dyspnea experienced by the patient will be taken. MMRC dyspnea scale will be used to score the patients dyspnea. Six minute walk test will be performed twice with a gap of 30 minutes rest in between and the average will be taken. Patients will be asked to walk on a level ground for maximum possible distance within a duration of 6 minutes. Periods of rest taken, will be also included in the 6 minutes test period. The BODE index will be calculated for each patient using the body mass index, the threshold value of FEV1, the distance walked in 6 min, and the score on the modified Medical Research Council (MMRC) dyspnea scale. The patients received points ranging from 0 (lowest value) to 3 (maximal value). For body mass index the values will be 0 (>21) or 1 (350 ms), 1 (250 – 350 ms), 2 (150 – 249ms) and 3 (< 150 ms). The MMRC dyspnea class 0 and I will be given 0 points, class II – 1 point, class III – 2 points and class IV – 3 points. The points for each variable will be added, so that the BODE index ranged from 0 to 10 points in each patient. The BODE score of 0 – 2 will be taken as mild COPD. Scores between 3 – 5 will be considered as moderate disease and those more than or equal to 6 will be considered as severe COPD. Conventional Echocardiography The echocardiographic studies including 2D, M-mode, pulsedwave Doppler and pulsed tissue Doppler imaging (TDI) examinations will be performed from all standard echocardiographic windows using a commercially available echocardiography machine (GE Vivid S5, Vingmed Ultrasound A.S., Horten, Norway) equipped with a 3.6-MHz transducer. LV and RV measurements will be performed according to the American Society of Echocardiography guidelines [7-8]. During the echocardiographic examination, a 1-lead electrocardiogram will be recorded continuously. LV dimensions (end-diastolic and end-systolic) and wall thickness (septum and posterior wall) will be obtained from the parasternal long axis with an M-mode cursor positioned just beyond the mitral leaflet tips, perpendicular to the long axis of the LV. LV volume and ejection fraction will be measured using the modified Simpson method from the apical 4-chamber and 2-chamber views. Mitral inflow velocities will be evaluated by pulsedwave Doppler with the sample volume placed at the tip of the mitral leaflets from the apical 4-chamber view[9-12]. Using the average of three beats, we measured the diastolic early- and latepeak, i.e. the Doppler E

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

wave (E) and Doppler A wave (A) transmitral flow velocity and the E/A ratio. Mitral annulus velocity will be measured at the lateral corner of the annulus by TDI using the pulsed-wave Doppler mode. The lateral mitral annular tissue Doppler S wave and E wave (Em) will be measured from the apical 4-chamber view with a 2- to 5-mm sample volume. Measurements will be recorded with simultaneous electrocardiography at a sweep of 50– mm/s. To evaluate LV filling pressures, E/Em ratio will be calculated. For RV parameters, TDI recordings will be obtained from apical 4-chamber-view-focused RV with the pulsed-wave Doppler sample volume placed on the tricuspid lateral annulus. Peak systolic myocardial velocity (Sm RV) will be measured[13]. The sum of RV isovolumic contraction and relaxation time will be obtained by subtracting RV ejection time from the interval between the cessation and onset of the tricuspid inflow velocities using pulsed-wave Doppler. The RV myocardial performance index (MPI) will be obtained by dividing the sum of both isovolumic intervals by the ejection time. From the modified apical 4-chamber view including the RV apex, the RV end-diastolic and end-systolic areas will be calculated. RV fractional area change (FAC) will be calculated as the percentage value of difference between RV end-diastolic and end-systolic areas divided by the RV end-diastolic area[14-16].

STATISTICAL ANALYSIS: Data was collected and managed on an excel work sheet. All values are expressed as mean. Data were calculated by appropriate statistical test.

3. Results:

Out of 200 patients in our study, COPD was identified in 63.5% are male while 36.5. % are female patients . In our study 55.5% are under severe category while 44% are fall under moderate category and 0.5% fall under mild category according to BODE INDEX. In our study 46% are fall under RVH and Right Axis Deviation and also 46% fall under clockwise rotation. In our study Tricuspid Regurgitation (TR) is present in 82 % (35% mild , 42.5% moderate and 9% are severe) . In this study PAH found in 74% (25.5 % are mild, 61% moderate and 36% are severe).

Table 1- Gender Distribution

S.No.	Gender	N	%
1	Male	127	63.5%
2	Female	73	36.5%
TOTAL		200	100%

In the study, majority of male patients (63.5 %) were smokers. All females (36.5 %) were exposed to biomass fuel.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

Table 2 - PFT Interpretation among COPD patient

S.No.	PFT Interpretation	Mean	P-Value
1	FEV1 (L)	0.4242±0.035	<0.0001
2	FVC (L)	0.70±0.009	
3	FEV1/FVC	0.60±0.468	
4	PEFR (L)	1.15±0.024	

All the patients were investigated by spirometry and diagnosed and classified according to GOLD guidelines (postbronchodilator FEV 1 /forced vital capacity (FVC) ratio < 70% predicted), mild (FEV 1 ≥ 80% of predicted), moderate (50% ≤ FEV 1 < 80% predicted), severe (30% ≤ FEV 1 < 50% predicted), and very severe (FEV 1 < 30% predicted), respectively. According to the GOLD guidelines our majority of patients were fall under GOLD 3 (Severe) with mean value of FEV1 - 0.4242±0.035.

Table 3- Distribution of COPD patients according to QRS Axis:-

S.No.	QRS Axis	N	%
1	RAD	92	46%
2	LAD	06	3%
3	NAD	102	51%
TOTAL		200	100%

In this study the correlation of ECG findings with severity of the disease showed that the findings of ‘p’ pulmonale, RAD (right axis deviation), poor r-wave progression, incomplete RBBB and RVH correlate significantly with severity of the disease. ($p < 0.05$). 46% patient were fall under right axis deviation.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

Table 4 - Distribution of COPD patients according to RV Hypertrophy.

S.No.	RV Hypertrophy	N	%
1	YES	92	46%
2	NO	108	54%
TOTAL		200	100%

Right ventricular dysfunction arises in chronic lung disease when chronic hypoxemia and disruption of pulmonary vascular beds contribute to increase ventricular afterload, and is generally defined by hypertrophy with preserved myocardial contractility and cardiac output. In our study RV hypertrophy found in 46% (92 patients) respectively.

Table 5- Distribution of TR among COPD Patients

S.No.	TR	N	%
1	Mild	70	35%
2	Moderate	85	42.5%
3	Severe	09	4.5%
4	TR Absent	36	18%
TOTAL		200	100%

TR is known to be associated with lower survival irrespective of left ventricular ejection fraction (LVEF) or pulmonary hypertension (PH). Patients with chronic obstructive pulmonary disease (COPD) often have PH and pre-existent TR with higher morbidity and mortality from worsening TR. In above table 42.5% patients had moderate TR.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

Table 6- Distribution of PAH among COPD Patients

S.No.	PAH	N	%
1	Mild	51	25.5%
2	Moderate	61	30.5%
3	Severe	36	15%
4	PAH Absent	52	26%
TOTAL		200	100%

Pulmonary hypertension usually worsens during exercise, sleep and exacerbation. Pulmonary vascular remodelling in COPD is the main cause of increase in pulmonary artery pressure and is thought to result from the combined effects of hypoxia, inflammation and loss of capillaries in severe emphysema. In our study majority of patients 30.5% had fall under the criteria of moderate PAH.

4. Discussion

COPD is a male dominant disease, the high prevalence in males is due to higher prevalence of smoking in this gender and also males are more susceptible to smoking than females. In present study 63.5 % of the population were males, 36.5% were females. Male to female ratio is 3:2. Use of biomass and coal as their main source of energy for cooking, heating and other household needs of possibly a strong risk factor for development of COPD among female patient[17-19]. This study is similar to other studies done by Manasa Reddy Musku et al, Suma et al, Swathi talari et al, dhadke et al, Jatav VS et al. COPD is a disease of late adulthood. As the age advances the lung function (FEV1) declines and other risk factors add to the disease process. Patients between 50 - 60 years and above 60 years form the maximum number of patients admitted mainly because of the longer duration of tobacco exposure and repeated respiratory tract infections, which would have compromised their quality of life. This study age distribution is similar to studies conducted by Dhadke et al (38 %), Jatav VS et al (70 %), Dave L et al, Lokesh et al (40 %), Rajan Chaudhari et al (70 %), where maximum number of patients were present in the 6th and 7th decade. In our study, patients with an mMRC dyspnea score of 3 and score of 4 had a lower RVFW-S value than those with a score of 0-2[20]. The mMRC dyspnea scale reflects the perception by patients of symptoms related to skeletal muscle atrophy and loss of muscle mass as a consequence of the systemic manifestation of COPD. A higher mMRC dyspnea score and a lower RVFW-S may contribute to common presentations that reflect increased systemic inflammation. In a study done by Tayyar Gökdeniz et al, we found same results. Celli et al. introduced a new multidimensional grading system, the BODE index, incorporating the systemic (i.e. BMI and exercise capacity) and functional (airflow obstruction and dyspnea) components of COPD.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

The BODE index was found to bea better predictor of death from any cause and from respiratory causes than the FEV1 value. The BODE (Body mass index, airflow Obstruction, Dyspnea, and Exercise capacity) index is a predictor of the number and severity of acute exacerbations of COPD. This study focused on the correlation between the BODE index, comorbidity, and healthcare resource utilization in COPD. In present study according to BODE index 55.5% patients found under severe BODE index criteria and 44% patients had fallen under the category of 3-5 BODE index criteria[21]. In Tayyar Gökdeniz et al study, increased BODE index scores were associated with decreased RVFW-S, which could not be detected by conventional parameters that evaluate RV functions. In a similar manner, Giusca et al. stated that RV functions could be better described with deformation imaging rather than conventional parameters, due to changes in apical transverse motion when RV dysfunction occurs. In the remaining male patients (7 %) who did not smoke, no definite cause can be established hence passive smoking and environmental factors like outdoor pollution was considered to be the possible aetiology for COPD in them. In the studies by Suma et al and Jatav VS et al mean duration of smoking was 23.2 years and 25.06 pack years respectively which is similar to the present study. Cough with expectoration, Dyspnea, Wheeze control and Breathlessness is the symptom that commonly causes the patient to seek medical attention and is usually the most disabling of these symptoms. Close questioning usually reveals the presence of a "smokers cough" with scanty mucoid sputum, mainly in the morning for many years. This study correlates with Suma et al, Jatav et al, Lokesh et al studies. Physical signs and chest xray features of this study correlates with Suma et al, Dhadke et al, Jatav et al studies. According to the GOLD guidelines our majority of patients were fall under GOLD 3 (Severe) with mean value of FEV1 - 0.4242±0.035. The mean FEV1 was 0.4242±0.035% of predicted range. In this study most of the population were moderate (44%) and severe COPD (55.5 %) this study findings correlates with Suma et al, Jatav et al studies who also used GOLD guidelines for staging of severity of COPD. ECG changes observed in this study correlates with Suma et al, dhadke et al, Lokesh S et al. Ghosh et al, V.V. Rao et al, Rachaiah et al studies. ECG changes are mainly due to change in haemodynamics of pulmonary vasculature secondary to hypoxia. The presence of increased air (hyperinflation of lungs) between the heart and recording electrodes has a dampening effect, leading to reduced amplitude of the QRS complexes. Thus we can say that development of ECG findings demonstrate that the COPD is progressive and is of higher grade. In this study the correlation of ECG findings with severity of the disease was studied as the hypoxia in COPD is directly proportional to severity of airway obstruction. This study correlates with Suma et al, Jatav VS et al, Dave L et al, Lokesh S et al, Ghosh et al Rachakonda et al, Janak chokshi et al studies. In this study, P-pulmonale, incomplete RBBB, RVH, RAD had significant correlation with duration of symptoms ($p< 0.05$). The other findings low voltage complexes and poor progression of r wave did not show any correlation with the duration of symptoms[22]. This study correlates with Suma et al, Lokesh et al, Rajan Chaudhari et al, Sachadeva et al studies. Most common echocardiographic finding was pulmonary hypertension. Pulmonary arterial hypertension (PAH) which is defined as pulmonary arterial systolic pressure (PASP) > 30 mmHg was observed in 50 % cases. In the pulmonary circulation in patients with COPD significant structural changes occur. Hypoxemia and chronic ventilator insufficiency is associated with early evidence of medial hypertrophy and intimal thickening in the smaller branches of the pulmonary arteries. Along with these pathological changes, pulmonary vasoconstriction arising from the presence of alveolar hypoxemia, pulmonary vascular bed destruction, changes in intrinsic pulmonary vasodilator substances (decrease in prostacyclin synthase), decrease in eNOS (endothelial nitric oxide synthase) and increase in ET1 (endothelin 1) lead to remodeling, increase in

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blood viscosity and alteration in respiratory mechanics. All the above-mentioned changes lead to a significant increase in pulmonary vascular resistance because of which PH arises. Other echocardiographic findings noted in our study were cor pulmonale in 44 % cases, RV hypertrophthy in 46 %, RA dilatation in 32 %, RVH in 24 %, LVDD in 16 %, Interventricular septal motion abnormality in 14 %, RVSD in 4 % and LVSD in 4 % of cases. This study correlates with Suma et al, Dhadke et al, Dave L et al, V.V. Rao et al, Rachakonda et al, Jatav VS et al studies. In patients with COPD hypoxic vasoconstriction leads to right ventricular hypertrophy and dilation which leads to development of right heart failure with systemic congestion and inability to adapt to the peripheral demand on exercise19. Numerous studies have examined the correlation between right ventricular systolic pressure (RVSP) as estimated by Doppler echocardiography and RVSP as directly measured during right heart catheterization and most of the studies reported a relatively tight correlation (the r value ranged from 0.57 – 0.95). In the present study, the incidence of all the ECHO findings increased as the severity of the disease increased. Other studies (Suma et al, Jatav et al) correlating the ECHO findings with severity of the disease have also made similar observations and also have given different explanations for their observation. Some studies indicate that LV function remains normal in persons with COPD where as others suggest that LV dysfunction may be present. Abnormal LV function in patients with COPD may be due to factors such as hypoxemia and acidosis, coronary artery disease, ventricular interdependence RV and LV share a common septum, hence RV dilatation may lead to bulging of the septum into the LV which would in turn increase LV end-diastolic pressure, decrease venous return, and diminish LV stroke volume and cardiac output and large swings in intrathoracic pressure (negative pleural pressure) would increase Ppa and diminish LV stroke volume due to ventricular interdependence, negative pleural pressures may also increase LV after load. LVDD was seen in COPD patients with normal pulmonary arterial pressure and its incidence increased with increase in right ventricular after load. Left diastolic dysfunction in COPD patients may be due to chronic hypoxemia leading to myocardial relaxation abnormalities, lung hyperinflation and distension thereby leading to increased stiffness of the parietal pleura and hence the wall of cardiac fossa leading to an extra load on the ventricle and also due to ventricular interdependence. The echocardiographic findings of PH, RA dilatation, RV dilatation, LVDD, LVSD, RVSD, Interventricular septal motion abnormality, RVH and cor pulmonale correlated significantly with the duration of disease ($p< 0.05$). This can be explained by the fact that longer the duration of the disease higher is the chances that the patient has developed pulmonary hypertension and cor pulmonale. This study correlates with the study conducted by Suma et al. In this study, a diagnosis of cor pulmonale could be made in 24 % of patients by clinical, 34 % by electrocardiographic and 44 % by echocardiographic methods. This shows that echocardiography can detect more number of patients with cor - pulmonale in COPD and is similar to previous studies[23]. This is because clinical signs of RV dysfunction are difficult to detect in COPD due to lung hyperinflation and posterior rotation of heart. ECG criteria for detecting RVH have a reasonably high specificity but relatively low sensitivity. Most studies report that adequate examination can be obtained in more than 70 % of the patients. Many studies (Suma et al, Rachakonda et al, Gupta NK et al, Satish Kinagi et al, Vikram B Vikhe et al) have proved that echocardiography is more sensitive than electrocardiography in detecting RV dysfunction in COPD. The BODE index is an easily calculated multidimensional grading system for evaluating COPD patients in pulmonary clinics[24]. It not only provides information about the pulmonary aspects of the disease such as airflow limitation, it also evaluates the systemic clinical manifestations. Our study revealed that assessment of the BODE index provides information about RV functions and that as the BODE index parameters increase, there is a decrement in RVFW-S as a sign

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of RV dysfunction. The present study shows high prevalence of cor pulmonale, left ventricular dysfunction complicating COPD, more so with more severe COPD.

5. Conclusion

Study concluded that COPD is more common in males and in the 5th and 6th decade of life. Most of the patients have mild to moderate disease at presentation. ECG abnormalities, were common in cases of COPD, affecting seven out of ten cases and have a significant association with COPD and symptoms severity. The most common electrocardiographic abnormality seen was arrhythmias. As cardiovascular events especially arrhythmias are a leading cause of COPD related mortality, every patient of COPD, should undergo ECG monitoring for early diagnosis of rhythm disturbances, thereby ensuring prompt treatment and better prognosis. In our study 55.5% are under severe category while 44% are fall under moderate category and 0.5% fall under mild category according to BODE INDEX. In our study 46% are fall under RVH and Right Axis Deviation and also 46% fall under clockwise rotation. In our study Tricuspid Regurgitation (TR) is present in 82 % (35% mild, 42.5% moderate and 9% are severe). In this study PAH found in 74% (25.5 % are mild, 30.5% moderate and 15% are severe).

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