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Research Article

A clinical study of cardiac rhythm disturbance in patients with chronic obstructive pulmonary disease using 24 hour Holter monitoring

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) has been defined by GOLD (guidelines for obstructive lung disease) as a disease state characterised by airflow limitation that is not fully reversible, with FEV_1/FVC <70%. COPD increases the risk of cardiac arrhythmias. In acute exacerbation and also in stable COPD, it has been found that arrhythmias are associated with more mortality. Holter monitoring enhances the possibility of observing cardiac rhythm during symptoms and can detect arrhythmias in asymptomatic patients. The aim of this study was to estimate the prevalence and types of arrhythmias in COPD patients and to correlate them with severity.
Methods: This was a cross-sectional prevalence, analytical study conducted for a period of two years. Fifty cases with sign and symptoms of COPD diagnosed on pulmonary function tests (PFT) as per GOLD's criteria were included. Diagnosis of arrhythmia in COPD was on the basis of Holter monitoring. 24 hour Holter monitoring was done with Release 2.9 Digitrak XT Philips. The data was analysed using chi square test.
Results: The most common arrhythmias on Holter monitoring were atrial pair and atrial premature beats which were present in 29 (58%) and 25 (50%) patients respectively, atrial run (32%), ventricular premature beats (32%), ventricular couplets (30%), ventricular triplets (24%), ventricular trigeminy (24%) and ventricular run (22%). Atrial fibrillation was noted in 7 patients (14%).
Conclusions: The significant presence of supraventricular and ventricular arrhythmias in patients with COPD were detected on Holter monitoring.

Keywords: COPD, Arrhythmias, Holter monitoring

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) has been defined by GOLD (guidelines for obstructive lung disease) as a disease state characterised by airflow limitation that is not fully reversible, with FEV_1/FVC <70%.[1] COPD includes chronic bronchitis and emphysema. It is the fourth leading cause of the death worldwide exceeded only by myocardial infarction, malignancy and stroke.[2] According to several studies, a substantial proportion of deaths in patients with mild COPD was the result of cardiovascular complications, including arrhythmias, especially in younger patients.[3]

COPD increases the risk of cardiac arrhythmias. Although the risk is elevated during an acute exacerbation, a high rate of rhythm disturbances exists in stable patients as well.[4,5]

Few studies have shown more prevalence of supra-ventricular tachycardia in patients of COPD.[6]

In another study with ambulatory ECG monitoring, ventricular premature beats occurred in 83 percent, ventricular bigeminy in 68 percent, paired ventricular premature beats in 61 percent, and nonsustained ventricular tachycardia in 22 percent of the patients.

Supraventricular tachycardia occurred in 69 percent. Repetitive ventricular arrhythmia occurred in 64 percent of the patients, and was significantly more frequent in men and in patients with edema or elevated PCO_2. Ventricular premature beats greater or equal to 25 per hour occurred in 35 percent of the patients.[5] The pathogenesis of arrhythmias in COPD is likely multifactorial and includes number of risk factors such as hypoxemia, acidosis, and reduced FEV_1. Reduced FEV_1 is independent predictor of new onset atrial fibrillation in stable COPD patients.[7]

In acute exacerbation, and also in stable COPD, it has been found that arrhythmias are associated with more mortality.[4,8] Hence the detection and analysis of arrhythmias in COPD is important. Holter monitoring continuously records heart rhythms during ambulation. Therefore, it enhances the possibility of observing cardiac rhythm during symptoms and can detect arrhythmias in asymptomatic patients.[6]

The aim of this study was to estimate the prevalence and types of arrhythmias in COPD patients and to correlate them with severity and presence of right heart failure and acute exacerbations. This would impact management of COPD patients.

METHODS

This was a cross-sectional prevalence, analytical study conducted for a period of two years in a tertiary care teaching hospital in Western India. Institutional ethics committee approval was obtained before the start of study. Informed consent was taken from each patient. Fifty cases admitted in medicine and chest wards and intensive care units with sign and symptoms of COPD diagnosed on chest X ray and Pulmonary function tests (PFT) as per GOLD's criteria were included in the study. Diagnosis of arrhythmia in COPD was on the basis of ECG and Holter monitoring. Gold stages were defined according to the current guidelines: Stage 1 (mild): FEV_1 >80% of predicted; Stage II (moderate): FEV_1 ≤80% of predicted value; Stage III (severe): FEV_1 >50% of predicted value; Stage IV (very severe) FEV_1 <50% of predicted value. The exclusion criteria were: All the patients of ischemic heart disease, structural heart disease and heart failure diagnosed on ECG and 2D ECHO study, patients with other lung diseases like interstitial lung disease, pneumonia and active TB diagnosed on chest X ray, sputum microscopy and PFT, patients on medications other than those prescribed for COPD which have a tendency to cause arrhythmias, patients with endocrine and metabolic disturbances which are known to cause arrhythmias.

Patients were asked the history of breathlessness, cough, expectoration, chest pain and palpitations, swelling over feet, syncope. A thorough physical examination was conducted and vital signs, pallor, edema, icterus, cyanosis and lymphadenopathy were recorded. Overt arrhythmia was looked for and accessory muscles of respiration were noted. Respiratory and cardiovascular systems were examined in detail. Signs of respiratory failure were looked for. All patients were subjected to a PFT, on which the COPD was diagnosed and its severity graded. All patients included in the study then underwent routine blood investigations such as hemogram, erythrocyte sedimentation rate, blood sugars, renal function tests, liver function tests, electrocardiogram and 2D echocardiography. Then 24 hour Holter monitoring was started with the machine Release 2.9 Digitrak XT Philips. Type of arrhythmia was noted. Results were compiled and the data was analysed using chi square test.

RESULTS

Out of 50 patients, 33 (66%) were males and 17 (34%) were females. All the patients were above 50 years of age. Out of them, 18 (36%) were between ages of 50 to 60 years, 24 (48%) between 61 to 70 years age and 8 above 70 years of age. 35 (70%) were suffering from chronic obstructive pulmonary disease (COPD) for more than 10 years and 15 (30%) were having COPD for less than 10 years (Table 1). 45 (90%) were having one or another type of smoking addiction. All the 50 (100%) patients had symptoms of cough and dyspnoea. Out of all, 17 (34%) patients had edema, 21 (42%) had palpitation, 11 (22%) had cyanosis. No patient had chest pain. According to pulse rate examination, 21 (42%) patients had tachycardia. All the patients had rhonchi on auscultation.

Table 1: Distribution of study subjects according to duration of COPD.

Duration of disease	Frequency	Percentage
Less than 10 years	15	30
More than 10 years	35	70
Total	50	100

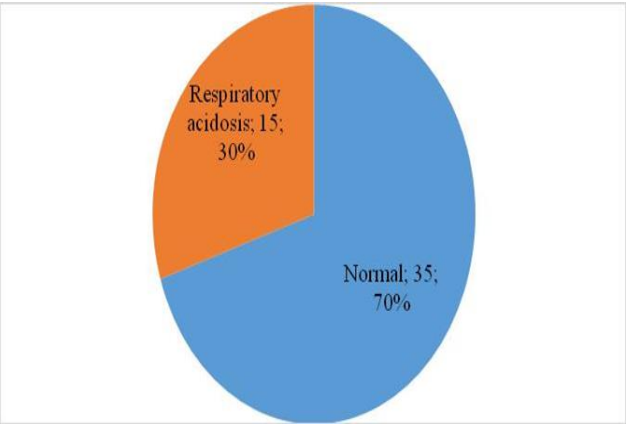

Figure 1: Distribution of study subjects according to arterial blood gas analysis.

On blood investigations, renal function (RFT) and liver function (LFT) were normal in all the 50 patients. On arterial blood gas analysis (ABGA), 15 (30%) patients had respiratory acidosis (Figure 1). Most patients, i.e. 30 (60%), had moderate obstruction with poor reversibility on PFT (Table 2). The most common electrocardiographic (ECG) abnormalities were low voltage and P pulmonale which were present in 26 (52%) and 19 (38%) patients respectively. Other abnormalities like ventricular premature complexes (VPC), RAD (right axis deviation) and RBBB (right bundle branch block) were present in 1 patient each (Figure 2).

Table 2: Distribution of study subjects according to pulmonary function test (PFT).

Pulmonary function test (PFT)	Frequency	Percentage
Mild obstruction with poor reversibility	8	16%
Moderate obstruction with poor reversibility	30	60%
Severe obstruction with poor reversibility	11	22%
Very severe obstruction with poor reversibility	1	2%
Total	50	100%

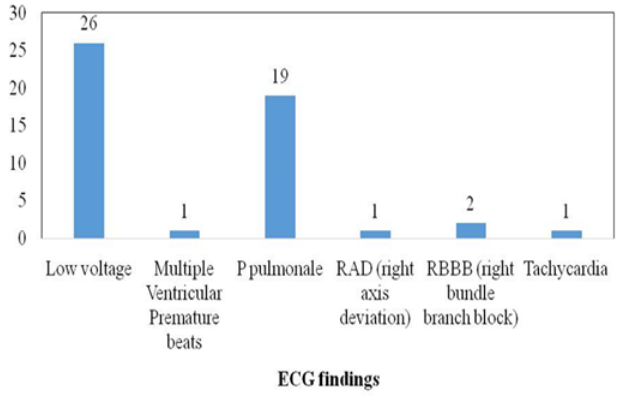

Figure 2: ECG findings.

On 2D Echo, 20 (40%) patients had mild PAH (pulmonary arterial hypertension), 9 (18%) participants had moderate PAH and 21 (42%) had normal pulmonary pressure (Figure 3).

The most common arrhythmias on Holter monitoring were atrial pair and atrial premature beats which were present in 29 (58%) and 25 (50%) patients respectively. Other arrhythmias on Holter were atrial run (32%), ventricular premature beats (32%), ventricular couplets (30%), ventricular triplets (24%), ventricular trigeminy (24%) and ventricular run (22%). Atrial fibrillation was noted in 7 patients (14%) and ventricular bigeminy in 9 (18%) (Table 3).

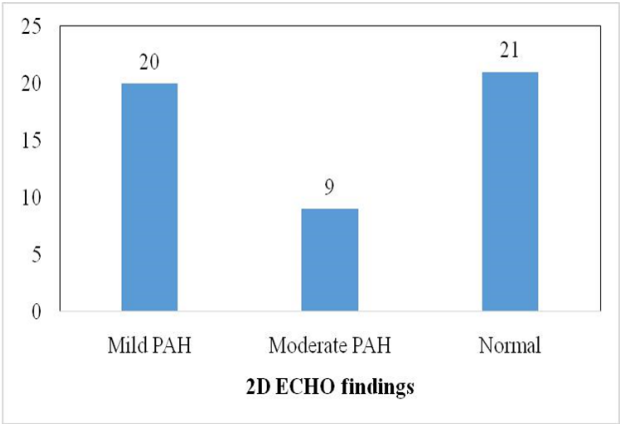

Figure 3: Distribution of study subjects according to 2D-Echo findings.

Table 3: Distribution of study subjects according to Holter monitoring findings

Holter monitoring findings	Frequency	Percentage
Atrial pair	29	58%
Atrial run	16	32%
Atrial fibrillation	7	14%
Atrial premature beats	25	50%
Ventricular couplets	15	30%
Ventricular triplet	12	24%
Ventricular bigeminy	9	18%
Ventricular trigeminy	12	24%
Ventricular run	11	22%
Ventricular premature beats	16	32%
Ventricular tachycardia	0	0

Out of 29 patients with atrial pair, 16 (55.1%) were suffering from moderate obstruction and 8 (27.8%) had severe obstruction. On applying chi square test, p value obtained was 0.701 which means that association between atrial pair and severity of COPD was not statistically significant (Figure 4).

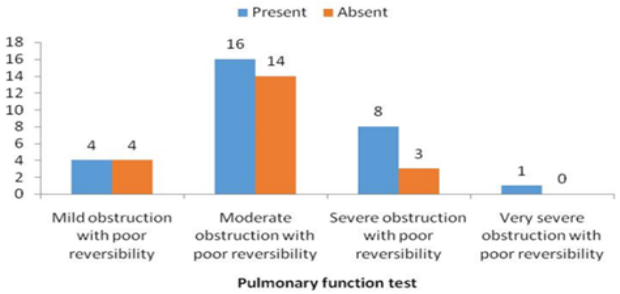

Figure 4: Association between atrial pair and severity of COPD.

Out of 7 patients with atrial fibrillation, 5 (71.4%) were suffering from moderate obstruction and 2 (28.6%) had severe obstruction. On applying chi square test, p value obtained was 0.437 which means that association

between atrial fibrillation and severity of COPD was not statistically significant. Out of 25 patients with atrial premature beats, 14 (56%) were suffering from moderate obstruction and 7 (28%) were suffering from severe obstruction. Out of 15 patients who had ventricular couplets, 10 (66.7%) had moderate obstruction and 4 (26.7%) had severe obstruction. Out of 12 patients of ventricular triplets, 9 (75%) were suffering from moderate obstruction and 3 (25%) had severe obstruction (Figure 5). Out of 9 patients who had ventricular bigeminy, 6 (66.7%) had moderate obstruction and 2 (22.2%) had severe obstruction. Out of 11 patients with ventricular run, 8 (72.7%) were suffering from moderate obstruction, 2 (18.2%) had mild obstruction and 1 (16.7%) had severe obstruction (Table 4). Out of 16 patients with ventricular premature beats, 7 (43.8%) were suffering from moderate obstruction, and 5 (31.3%) were suffering from severe obstruction (Table 5). But none of these arrhythmias had statistically significant association with the severity of COPD.

In this study 16 patients (32%) had respiratory acidosis of which 62.5% showed ventricular arrhythmias and 50% showed supraventricular arrhythmias and 12.5% showed atrial fibrillation.

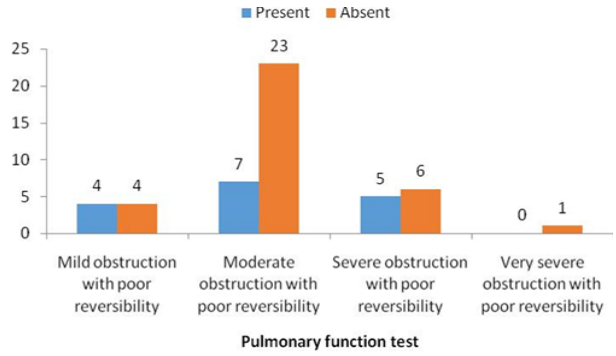

Figure 5: Association between ventricular triplets and severity of COPD.

Table 4: Association between ventricular run and severity of COPD.

Ventricular run						
Pulmonary function test (PFT) Findings	**Present**	**Percentage**	**Absent**	**Percentage**	**Total**	**P value**
Mild obstruction with poor reversibility	2	18.2%	6	15.4%	8	0.653
Moderate obstruction with poor reversibility	8	72.7%	22	56.4%	30	
Severe obstruction with poor reversibility	1	9.1%	10	25.6%	11	
Very severe obstruction with poor reversibility	0	0.0%	1	2.6%	1	

Table 5: Association between ventricular premature beats and severity of COPD.

Ventricular premature beats						
Pulmonary Function Test (PFT) findings	**Present**	**Percentage**	**Absent**	**Percentage**	**Total**	**P value**
Mild obstruction with poor reversibility	4	25%	4	11.8%	8	0.386
Moderate obstruction with poor reversibility	7	43.8%	23	67.7%	30	
Severe obstruction with poor reversibility	5	31.3%	6	17.6%	11	
Very severe obstruction with poor reversibility	0	0	1	2.9%	1	

DISCUSSION

COPD is a major cause of morbidity and mortality in the world today. This study estimated the prevalence of cardiac arrhythmias in COPD patients with 24 Holter monitoring. In this study, 66% were males and 34% females and most were above 50 years of age. A study by Miravitlles M et al demonstrated a similar age and sex preponderance.[9]

In present study, 70% were suffering from COPD for more than 10 years and 30% had it for less than 10 years. In a study conducted by Zaghla H et al, mean disease duration was 5.4±3 years (ranging from 1 to 12 years).[10] Most common electrocardiography (ECG) abnormalities were low voltage and P pulmonale which were present in 52% and 38% patients respectively. Other abnormalities like multiple ventricular premature beats, RAD (right axis deviation), RBBB (right bundle branch block) and sinus tachycardia were present in 1 patient each. In a study conducted by Warnier MJ et al on ECG characteristics in patients with COPD, ventricular premature complexes were seen in 11%, premature atrial complexes in 4%, atrial fibrillation was noted in 7% and sinus tachycardia in 2%.[11] On 2D Echo, in present study, 40% patients had mild pulmonary hypertension (PH) and 18% had moderate PH. In a study conducted by Cuttica M et al, the prevalence of PH was 30.4% in all, with severe PH in 4%.[12]

Holter monitoring is undoubtedly more sensitive than ECG in detecting cardiac arrhythmias and resting ECG

may not demonstrate the arrhythmias. In present study, most common arrhythmia on Holter monitoring was atrial pair and atrial premature beats which were present in 58% and 50% participants respectively. Other arrhythmias were atrial run (32%), ventricular premature beats (32%), ventricular couplets (30%), ventricular triplets (24%), ventricular trigeminy (24%) and ventricular run (22%).

In a study by Shih et al, ventricular premature beats occurred in 83 percent, ventricular bigeminy in 68 percent, paired ventricular premature beats in 61 percent, and non-sustained ventricular tachycardia in 22 percent of the patients. Supraventricular tachycardia occurred in 69 percent.[5]

In a study by Konecny et al, which compared prevalence of arrhythmia in COPD patients with a control group, atrial fibrillation/atrial flutter occurred in 23.3%, non-sustained ventricular tachycardia in 13.0% and sustained ventricular tachycardia (0.9%).[13]

In this study, the association of arrhythmias with severity of COPD was not found to be statistically significant. It could be because of limited sample size. Maximum patients with all varieties of arrhythmias had moderate grade of COPD. In this study 16 patients (32%) had respiratory acidosis of which 62.5% showed ventricular arrhythmias, 50% showed supraventricular arrhythmias and 12.5% showed atrial fibrillation. In a study conducted by Terzano C et al, risk of new AF was higher in those subjects with lower FEV_1 and higher $PaCO_2$ values.[14]

CONCLUSION

Hence this study demonstrated a significant presence of supraventricular and ventricular arrhythmias in patients with COPD which were detected on Holter monitoring. These rhythm disturbances were mostly asymptomatic and were not found on routine ECG. As studies have related these with mortality, clinicians need to keep a look out for these arrhythmias in COPD patients, which will impact their outcomes and treatments.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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