Original Research Article

COPD with Atrial Fibrillation

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Abstract

Background: COPD is one of the leading cause of morbidity and mortality and is associated with variety of cardiovascular disease especially Arrhythmia which is directly associated with severity of COPD so there was a need to identify the incidence of Atrial Fibrillation (AF) in COPD patients and its effect on mortality and morbidity of patients admitted in hospital for COPD. **Material and Methods:** A retrospective study was conducted and data analysis was done, of all patients with established COPD diagnosis. The number of patients were divided into two groups: (1) Patients with diagnosed COPD in ordinance with GOLD guidelines (2) Patients with COPD diagnosed with AF, new onset and old. Post admission patients were divided on the basis of age, sex, H/o, CAD and H/o smoking. **Results:** Out of 200 study patients, 30% had AF (old and new). 34% had new onset AF and 66% were known cases of AF. Out of patients with AF 18% were less than 50 years of age, 60% between 50-70 years, 22% more than 70 years, 80% were smoker, 20% non-smokers, 80% had CAD; 75% were male and 25% female. **Conclusion:** COPD patients are at higher risk of developing AF. COPD with AF patients have longer Hospital stay and increased mortality.

Keywords: COPD, Atrial fibrillation, cardiovascular disease, arrhythmia, mortality and morbidity.

Introduction

Chronic obstructive pulmonary disease (COPD) is a type of obstructive lung disease characterized by long-term breathing problems and poor airflow. The main symptoms include shortness of breath and cough with sputum production. It is a progressive disease, meaning it typically worsens over time. Eventually everyday activities, such as walking or getting dressed, become difficult. Chronic bronchitis and emphysema are older terms used for different types of COPD. The term "chronic bronchitis" is still used to define a productive cough that is present for at least three months each year for two years.

Emphysema is defined pathologically as an abnormal, permanent enlargement of the air spaces distal to the terminal bronchioles, accompanied by destruction of their walls and without obvious fibrosis.Patients typically present with a combination of signs and symptoms of chronic bronchitis, emphysema, and reactive airway disease.

The formal diagnosis of COPD is made with spirometry; when the ratio of forced expiratory volume in 1 second over forced vital capacity (FEV_I/FVC) is less than 70% of that predicted for a matched control, it is diagnostic for a significant obstructive defect. Criteria for assessing the severity of airflow obstruction (based on the percent predicted postbronchodilatorFEVi) are as follows[1]:

- Stage I (mild): FEVi 80% or greater of predicted
- Stage II (moderate): FEVi 50-79% of predicted
- Stage III (severe): FEVi 30-49% of predicted
- Stage IV (very severe): FEV_i less than 30% of predicted or FEV_1 less than 50% and chronic respiratory failure.

Pathologic changes in COPD occur in the large (central) airways, the small (peripheral) bronchioles, and the lung parenchyma. Most cases of COPD are the result of exposure to noxious stimuli, most often cigarette smoke.

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Chronic bronchitis Pathology

Mucous gland hyperplasia is the histologic hallmark of chronic bronchitis. Airway structural changes include atrophy, focal squamous metaplasia, ciliary abnormalities, variable amounts of airway smooth muscle hyperplasia, inflammation, and bronchial wall thickening.

Emphysema Pathology

Emphysema is a pathologic diagnosis defined by permanent enlargement of airspaces distal to the terminal bronchioles. This leads to a dramatic decline in the alveolar surface area available for gas exchange. Furthermore, loss of alveoli leads to airflow limitation by two mechanisms. First, loss of the alveolar walls results in a decrease in elastic recoil, which leads to airflow limitation. Second, loss of the alveolar supporting structure leads to airway narrowing, which further limits airflow.

Emphysema has three morphologic patterns

- Centriacinar
- Panacinar
- Distal acinar, or paraseptal

Atrial fibrillation

Atrial fibrillation (AF) is an irregular, rapid heart rate that may cause symptoms like heart palpitations, fatigue, and shortness of breath. AF has strong associations with other cardiovascular diseases, including COPD and it is characterized by an irregular and often rapid heartbeat[2,3,4,5]. Catecholamine excess, hemodynamic stress, atrial ischemia, atrial inflammation, metabolic stress, and neurohumoral cascade activation are all purported to promote AF.The clinical presentation of AF spans the entire spectrum from asymptomatic AF with rapid ventricular response to cardiogenic shock or devastating cerebrovascular accident (CVA).

Unstable patients requiring immediate direct current (DC) cardioversion include the following

- Patients with decompensated congestive heart failure (CHF)
- Patients with hypotension
- Patients with uncontrolled angina/ischemia

Initial history and physical examination include the following

- Documentation of clinical type of AF (paroxysmal, persistent, long-standing persistent or permanent)
- Assessment of type, duration, and frequency of symptoms
- Assessment of precipitating factors *(e.g.,* exertion, sleep, caffeine, alcohol use)
- Assessment of modes of termination *(e.g.,* vagal maneuvers)
- Documentation of prior use of antiarrhythmics and rate-controlling agents
- Assessment of presence of underlying heart disease
- Documentation of any previous surgical or percutaneous AF ablation procedures
- Airway, breathing, and circulation (ABCs)
- Vital signs (particularly heart rate, blood pressure, respiratory rate, and oxygen saturation)
- Evaluation of head and neck, lungs, heart, abdomen, lower extremities, and nervous system.

Findings from 12-lead electrocardiography (ECG) usually confirm the diagnosis of AF and include the following

- Typically irregular ventricular rate (QRS complexes)
- Absence of discrete P waves, replaced by irregular, chaotic F waves
- Aberrantly conducted beats after long-short R-R cycles *(i.e.,* Ashman phenomenon)
- Heart rate (typically 110-140 beats/min, rarely >160-170 beats/min)
- Preexcitation
- Left ventricular hypertrophy
- Bundle-branch block or intraventricular conduction delay
- Acute or prior myocardial infarction (MI).

Atrial fibrillation is strongly associated with the following risk factors[6,7]

- Hemodynamic stress
- Atrial ischemia
- Inflammation
- Noncardiovascular respiratory causes
- Alcohol and drug use
- Endocrine disorders
- Neurologic disorders
- Genetic factors
- Advancing age.

Chronic obstructive pulmonary disease and atrial fibrillation

COPD is independently associated with AF. Decreased oxygenation, hypercapnia, pulmonary hypertension, diastolic dysfunction, oxidative stress, inflammation, changes in atrial size by altered respiratory physiology, increased arrhythmogenicity from nonpulmonary vein foci commonly located in the right atrium, and respiratory drugs have been implicated in the pathogenesis of AF in COPD[3,8,9,10]. The understanding of the relationship between COPD and AF is of particular importance, as the presence of the arrhythmia has significant impact on mortality, especially in COPD exacerbations[4,11,12,13].

On the other hand, COPD in AF is associated with AF progression, success of cardioversion, recurrence of AF after catheter ablation, and increased cardiovascular and all-cause mortality.There seem to be a wide variety of reasons for arrhythmias to occur in COPD beginning from risk factors, its effect in altering cardiopulmonary physiology to the treatment of COPD.Smoking, airway inflammation, hypoxia, hypercapnia, pulmonary hypertension, §-adrenergic agonist and steroids all contribute to ultimately causing or worsening AF[4,8,9,7]. Smoking was found to be an independent risk factor in the recurrence of AF/AFL after cardioversion in women while an increased risk of mortality and not arrhythmia was found in men.

It has been shown consistently that there exists an inverse relationship between FEV i, FVC with AF. The Copenhagen City Heart Study demonstrated that the risk of new AF at reexamination was 1.8-times higher for FEVi between 60-80% of predicted compared with a FEVi of >80% after adjustment for sex, age, smoking, blood pressure, diabetes and body mass index. They also showed that the risk of AF hospitalization was 1.3 times more with a FEVi between 60-80% of predicted and 1.8 times with a FEV1Of ñ60% compared with a FEV1of80%, proving that reduced lung function as an independent predictor of AF.

Patients with COPD are prone to have acute exacerbations of the disease and common causes for this are usually viral infections of the upper respiratory tract and infections of the tracheobronchial tree.

Terzano et al. showed that suboptimal pulmonary function, hypercapnia and high values of pulmonary artery systolic pressure are independent predictors of incident AF[14]. P-pulmonale (P wave >0.25 mV in the inferior leads) is usually omnipresent on EKG's of patients with chronic lung diseases. Hayashi et a1, in a digital analysis of EKG's in a 25 year period showed P-wave duration and PQ interval were significantly longer in the AF group than in the non-AF group (115.4 $\pm$ 17.2 ms vs. 107.0 $\pm$ 17.2 ms and 166.3 $\pm$ 23.9 ms vs. 153.2 $\pm$25.4 ms, respectively)[19]. They concluded that the PQ interval is the strongest stratifier for AF development in patients with P pulmonale. The P wave dispersion (PwD), which is the difference in the maximum and minimum duration of the P wave, was also found to be an independent risk factor associated in the development of AF and the PwD was found to be increased more in the acute phase than in stable phase and is greater in patients with more frequent exacerbations suggesting that the PwD could be a target for prediction, prevention and therapy of acute exacerbation of COPD.

The BODE index is a multidimensional 10-point scale which integrates body mass index, degree of airflow obstruction and dyspnea and exercise capacity measured in 6-min walk test and the score is directly proportional with mortality. It was shown that patient's with higher BODE index scores had a significantly greater prevalence of arrythmias including AF/AFL and SVT[20]. The Dyspnea, Eosinopenia, Consolidation, Acidemia and atrial Fibrillation (DECAF) score was introduced by Steer et al, as a predictor of mortality in hospitalized patients with COPD exacerbations. The DECAF score includes the 5 strongest predictors of mortality[10] i.e. MRC Dyspnea Score, eosinopenia, consolidation, acidemia, and atrial fibrillation and was found to be a stronger than the other predictors like the CURB-65.

Aim of the study

As chronic obstructive pulmonary disease (COPD) is one of the leading cause of mortality and morbidity and is associated with wide variety of cardiovascular disease especially arrhythmias, which is directly associated with the severity of COPD described in gold initiative and COPD is also an independent risk factor of Atrial Fibrillation[2,10,18]. So there was a need to identify the incidence of atrial fibrillation in COPD patients and its effect on mortality and morbidity of patients admitted in hospital for COPD.

Objectives

The primary objective of our study is to quantify the magnitude of association between COPD and Atrial Fibrillation

- To know the prevalence of Atrial Fibrillation in COPD patients.
- To know the incidence (new onset) of Atrial Fibrillation inCOPD patients.
- To know the nature of relationship between COPD and Atrial Fibrillation and does this relationship varies with
- Age,

- sex,
- smoking history,
- type of Atrial Fibrillation ,
- requirement of admissions in (icu),
- length of stay in hospital
- effect on morbidity and mortality of the patients.

Material and methods

Study Design and Duration

Retrospective type of study conducted for one year. (January 1st, 2020 to December 31st2020) was conducted in the Emergency Division of Department of Medicine, Govt. Medical College Baramulla after obtaining clearance from the Institute Ethical Committee.

The number of patients were grossly divided into two groups

1. Patients with diagnosed COPD in accordance with GOLD Guidelines.
2. Patients with COPD diagnosed with Atrial Fibrillation(known case) in this group we also included those COPD's who had new onset of Atrial Fibrillation at the time of admission or during hospitalization, post admission the number of patients were further divided on the basis of Age, sex, history of CAD, History of smoking.

Exclusion Criteria

In this study we excluded all patients of age less than 18 years, patients who were previously not diagnosed as COPD and patients who were currently passive smokers were not included in history of smoking.

Inclusion Criteria

Included criteria is further sub divided as

1. Age: Age <50 years, Age 50 to 70 years, age > 70 years
2. Sex: Male/ Female
3. Comorbidities: Coronay artery disease,
4. Smoking history:

Mortality COPD, COPD with AF(diagnosed or new incidence)

Results

A total of 200 patients were studied including 140 (70%) with COPD alone and 60 (30%) with COPD with AF. Of these 60 patients of COPD with AF, 40 (66.66%) were known cases of atrial fibrillation (old AF) while 20 (33.33%) patients with new onset AF.

Table 1. Basic characteristics of study patients (n=200)

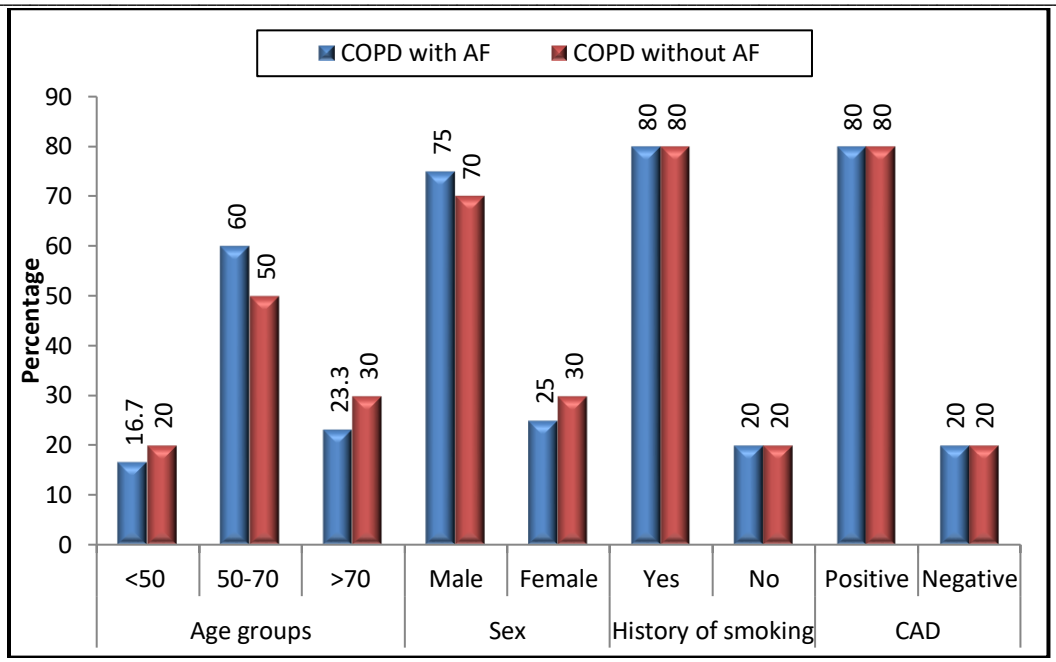
		No. of Patients	Percentage
Age groups	<50 years	38	19.0
	50-70 years	106	53.0
	>70 years	56	28.0
Sex	Male	143	71.5
	Female	57	28.5
History of smoking	Yes	160	80.0
	No	40	20.0
CAD	Positive	160	80.0
	Negative	40	20.0

Table 2: Various parameters in patients COPD with AF

		Percentage	No.of patients
Age in Years	<50	11	18%
	50-70	36	60%
	>70	13	22%
Gender	Male	45	75%
	Female	15	25%
Smoking	Smoker	48	80%
	Non-smoker	12	20%
CAD	Known CAD	48	80%
	Non CAD	12	20%
X-ray	Positive finding	10	17%
	Negative finding	50	83%

Table 3. Distribution of patients by COPD with and without Atrial Fibrillation (AF)

		COPD with AF (n=60)	COPD without AF (n=140)	p- value
Age groups	<50 years	16.7	20.0	<0.05
	50-70 years	60.0	50.0	
	>70 years	23.3	30.0	
Sex	Male	75.0	70.0	0.001
	Female	25.0	30.0	
History of smoking	Yes	80.0	80.0	0.001
	No	20.0	20.0	
CAD	Positive	80.0	80.0	0.001
	Negative	20.0	20.0	



Graphical representation of COPD with and without Atrial Fibrillation (AF)

Table 4: COPD with AF by onset and type		
		Percentage
Timing of onset	New onset of AF	34.0
	Old history of AF	66.0
Type of AF	FUR	91.7
	Controlled rate	8.3

Table 5: Mean duration of hospitalization for patients	
Mean duration of hospitalization for patients	Mean (in days)
COPD with AF	10
COPD without AF	5

Table 6: Electrolyte imbalance among COPD patients with AF	
Electrolyte imbalance among COPD patients with AF	Percentage of patients
Positive	30
Negative	70

Table 7: TLC, CHF, PCO2 level among COPD with and without AF				
		COPD with AF	COPD without AF	p value
TLC	Positive	60.0	30.0	<0.0001
	Negative	40.0	70.0	
CHF	Positive	60.0	30.0	<0.0001
	Negative	40.0	70.0	
PCO2	High	90.0	85.0	<0.0001
	Normal	10.0	15.0	

Table 8: Mortality observed in COPD patients		
	Patients died among COPD with AF	Patients died among COPD without AF
Number ofPatients	7	7
% of patients	11.7	5.0
p value	<0.0001	

Discussion

In a period of one year, we did a random study on 200 patients of diagnosis Chronic Obstructive Pulmonary Disease (COPD) in ordnance with gold guidelines. We found that out of 200 patients, it was found that 30% had Atrial Fibrillation (AF) including old as well as new onset of Atrial Fibrillation. We further subdivided Chronic Obstructive Pulmonary Disease (COPD) patients with Atrial Fibrillation (AF) in two groups.One group was taken who had new onset of Atrial Fibrillation (AF) at the time of admission or during the course of treatment. Another group were those who were known case of Atrial Fibrillation (AF). Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) where further subdivided into

two groups. It was found that 34% of the patients develop new onset of Atrial Fibrillation and 66% of the patients were known case of Atrial Fibrillation, in which 91% of the patients had Atrial Fibrillation (AF) with FVR (Fast Ventricular Rate) and 8.33% of the patients had Atrial Fibrillation with controlled rate. Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) and Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF) were further subdivided as per Age, Sex, History of Smoking and Coronary Artery Disease (CAD). In Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) 18% of the patients were of Age less than 50 years, 60% of the patients were 50 to 70 years and 22% of the patients were greater than 70 years. In this category 75% of the patients were Male and 25% were Female.

It was found that 80% of the patients gave history of Smoking and 20% of the patients were Non-smoker[17]. In this group 80% were found to have Coronary Artery Disease (CAD).In another group Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation, 20% of the patients were of Age less than 50 years, 50% of the patients were 50 to 70 years and 30% of the patients were greater than 70 years. In this category 70% of the patients were Male and 30% were Female. It was found that 80% of the patients gave history of Smoking and 20% of the patients were Non-smoker. In this group 80% were found to have Coronary Artery Disease (CAD)[10]. In Chest X-Ray findings were also subdivided into two groups. Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) and Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF). In patients of Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF), 18% of the patients had positive findings in Chest X-Ray and 82% of the patients did not show any findings in Chest X-Ray.In patients of Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF), 40% of the patients did show a positive findings in Chest X-Ray, were 60% of the patients did not show any positive findings in Chest X-Ray. 2D Echo finding were also subdivided into two groups, Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) and Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF). In patients, Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) 83% of the patients showed a positive finding in 2D ECHO that is IPAP pressures and Dilated RAR, while as 17% of the patients 2D ECHO was grossly normal[8]. In patients of Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF) only 40% of the patients showed positive findings in 2D Echo. (IPAP, dilated RAR), and 60% of the patients had normal 2D ECHO[10]. It was found that 60% of COPD patients with Atrial Fibrillation had sign of Congestive Heart Failure, Fluid Overload whereas only 20%of the patients of COPD without Atrial Fibrillation showed findings of Congestive Heart Failure/Fluid Overload[10]. PC02 level were also compared between the two groups. It was found that 90% of the patients of Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) had high PCo2, whereas in patients of Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF) 85% of the patients had high PCo2[13]. Electrolyte Imbalances were found in 30% of the patients of Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF). In patients of Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) 60% of the patients had high Total Leukocyte Count (TLC), whereas only 30% of the patients of Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF) had high Total Leukocyte Counts (TLC)[6]. The duration of Hospitalization of Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) was approximately two times greater than compared to patients admitted with Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF)[18]. In Chronic Obstructive Pulmonary Disease patients (COPD) without Atrial Fibrillation (AF) 5% of the patients expired, but the death toll was approximately 2.5 times greater than in patients of Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF).

Conclusion

The result of our study suggests that Chronic Obstructive Pulmonary Disease (COPD) patients are at higher risk of developing Atrial Fibrillation (AF). The majority of which is due to inspiratory Positive Airway Pressure (IPAP) and strain on RA,RV which was confirmed by our 2D ECHO Data.

In our study we saw that patients who are known case of Atrial Fibrillation (AF) or developed Atrial Fibrillation during the course of treatment, there length of hospitalization and mortality was high as compared to Chronic Obstructive Pulmonary Disease (COPD) without Atrial Fibrillation (AF) patients. We also found that Chronic Obstructive Pulmonary Disease (COPD) with Atrial Fibrillation (AF) have high chances of going into Heart Failure which can further complicate the course of disease.

Thus we concluded that when a Chronic Obstructive Pulmonary Disease (COPD) patients come into Emergency Department apart from measures to settle down his exacerbation, adequate measures should be taken to prevent/manage arrhythmias (AF).

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