Original Research Article

Echocardiographic findings in patients with chronic obstructive pulmonary disease

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a common respiratory condition involving the airways and characterized by airflow limitation. Pulmonary hypertension (PH) is a well-known predictor of increased morbidity and mortality in COPD. The present study was done to assess the cardiac changes in patients diagnosed with COPD in this department using two-dimensional echocardiography.
Methods: This observational study was conducted on fifty patients admitted with signs and symptoms suggestive of COPD in the Department of Pulmonary Medicine, Dr. DY Patil Medical College, Navi Mumbai from January 2018 to December 2018. Pulmonary function tests (PFT) were done in all and patients were graded according to the severity of COPD with guidelines given by Global initiative for Obstructive Lung Disease (GOLD). Comprehensive two-dimensional echocardiography was performed.
Results: The most common age group was 60 to 69 years. There were 68% males and 32% females. Mean body mass index of the patients included in the study was 27.8 ± 8.13 kg/m^2. COPD according to the GOLD classification was mild, moderate, severe and very severe in 12%, 36%, 30% and 22% of the patients. PH was diagnosed in 56% of the patients, Cor pulmonale in 54%, right ventricular dilatation in 48%, right atrial dilatation in 38%, inter-ventricular septal wall motion abnormality in 18% and right ventricular failure in 14% of the patients.
Conclusions: Echocardiography examination is a reliable method in COPD patient to assess PH and helps in early detection of cardiac complications in COPD cases giving time for early interventions.

Keywords: Cardiovascular diseases, COPD, Cor pulmonale, Echocardiography, Pulmonary hypertension, Right ventricular failure

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common respiratory condition involving the airways and characterized by airflow limitation.[1] It affects more than 5% of the population and is associated with high morbidity and mortality.[2] In an individual, the pattern of pathologic changes depends on the underlying disease (e.g., chronic bronchitis, emphysema, alpha-1 antitrypsin deficiency), possibly individual susceptibility, and disease severity.[3] Airways abnormalities in COPD include chronic inflammation, increased numbers of goblet cells, mucus gland hyperplasia, fibrosis, narrowing and reduction in the number of small airways, and airway collapse due to the loss of tethering caused by alveolar wall destruction in emphysema.[4] Chronic inflammation in chronic bronchitis and emphysema is characterized by the presence of CD8+ T-lymphocytes, neutrophils, and CD68+ monocytes/macrophages in the airways.[5] Changes in the pulmonary vasculature include intimal hyperplasia and smooth muscle hypertrophy/ hyperplasia thought to be due to chronic hypoxic vasoconstriction of the small

pulmonary arteries. Destruction of alveoli due to emphysema can lead to loss of the associated areas of the pulmonary capillary bed. Pulmonary hypertension (PH) is a well-known predictor of increased morbidity and mortality in COPD.

As early as 1975, Ourednik et al, found that 5-year survival was 50% in patients whose mPAP was 20-30 mmHg, 30% for those with mPAP of 30-50 mmHg, and 0% for those with mPAP greater than 50 mmHg.[6] More recent studies have confirmed that PH associated with COPD carries an increased risk of death compared to COPD patients with normal PAPs. Transthoracic echocardiography with Doppler ultrasound assessment of right ventricular pressure is a non-invasive technique that is readily available at most hospitals, making this a feasible tool to detect the presence of PH in this patient population.[7] The present study was done to assess the cardiac changes secondary in patients diagnosed with COPD in this department using two-dimensional echocardiography.

METHODS

This observational study was conducted on fifty patients admitted with signs and symptoms suggestive of COPD in the Department of Pulmonary Medicine, Dr. DY Patil Medical College, Navi Mumbai from January 2018 to December 2018. Patients were diagnosed clinically as having COPD with following confirmation by spirometry.

Sample population

Author included patients who were diagnosed clinically with COPD during the study period. Patients with bronchial asthma, bronchiectasis, tuberculosis, and pneumoconiosis, restrictive lung disease like kyphoscoliosis, congenital and those with ischemic heart disease were excluded from the study. All enrolled patients were explained the purpose of the study and their rights to refuse. The informed written consent was taken from patients before including in the study.

Data collection and data analysis

Patients were enquired about their demographic information like age and gender. Anthropometric measurements like weight and height were noted to measure body mass index. History was obtained about the duration of smoking. Pulmonary function tests (PFT) were done in all and patients were graded according to the severity of COPD with guidelines given by Global initiative for Obstructive Lung Disease (GOLD). PFTs were completed by American Thoracic Society standards.[8] Chest X-ray, twelve lead electrocardiogram, and 2-D Echo were done to evaluate cardiac function. Comprehensive two-dimensional echocardiography was performed using a machine equipped with a transducer 3 V2c operating at 2-4 MHz. Multiple views were recorded

to identify optimal view (s) for analysis. The right atrial pressure was estimated by evaluating the inferior vena cava diameter and its change with respiration. Continuous wave Doppler was used to determine the peak velocity of the tricuspid regurgitant jet at end-expiration. The systolic pulmonary artery pressure was calculated using the highest right ventricular-right atrial gradient plus estimated pressure. Right ventricular systolic pressure (RVSP) was measured using the modified Bernoulli equation: RVSP = 4 (Tricuspid regurgitant velocity)^2 + Right atrial pressure. Right atrial pressure was estimated by degree of inferior vena cava collapse on inspiration (RAP = 5 mmHg if complete, 10mmHg if partial, and 15mmHg if there was no collapse on inspiration) as previously described.[9] RVSP was assumed to be equal to systolic PAP (sPAP). The presence of pulmonary hypertension was defined as sPAP ≥45 mmHg, using the WHO criteria of 40mmHg as the upper limit of normal for RVSP measured by 2D echocardiography. The cardiologist who read the echocardiograms was blinded to all patient characteristics. The data collected were analysed by SPSS version 16. Quantitative data were expressed as mean and standard deviation, while qualitative data were expressed as number and percentage.

RESULTS

During the study period a total of 50 patients were included in the study. The most common age group was 60 to 69 years. There were 68% males and 32% females. Mean body mass index of the patients included in the study was 27.8±8.13 kg/m^2 (Table 1).

Table 1: Baseline characteristics of the patients included in the study (n=50).

Variables	N (%)
Age distribution (in years)	
40 to 49	8 (16%)
50 to 59	14 (28%)
60 to 69	16 (32%)
70 to 79	10 (20%)
More than 80	02 (04%)
Gender distribution	
Females	16 (32%)
Males	34 (68%)
Body mass index (kg/m²)	27.8 ± 8.13
Duration of smoking (in pack years)	
Less than 10	04 (08%)
10 to 19	19 (38%)
20 to 29	13 (26%)
30 to 39	08 (16%)
More than 40	06 (12%)
Severity according to GOLD classification	
Mild	06 (12%)
Moderate	18 (36%)
Severe	15 (30%)
Very severe	11 (22%)

Duration of smoking was noted for all patients and it was found that 38% of the patients smoked for 10 to 19 pack years, 26% smoked for 20 to 29 pack years and 12% smoked more than 40 pack years. The severity of COPD was assessed as per the GOLD classification. It was mild, moderate, severe and very severe in 12%, 36%, 30% and 22% of the patients. All patients underwent echocardiographic examination. Pulmonary hypertension was diagnosed in 56% of the patients (Table 2), Cor pulmonale in 54%, right ventricular dilatation in 48%, right atrial dilatation in 38%, inter-ventricular septal wall motion abnormality in 18% and right ventricular failure in 14% of the patients.

Table 2: Distribution of patients according to their echocardiographic findings.

Two-dimensional echocardiography findings	N (%)
Pulmonary hypertension	28 (56%)
Cor pulmonale	27 (54%)
Right ventricular dilatation	24 (48%)
Right atrial dilatation	19 (38%)
Interventricular septal wall motion abnormality	09 (18%)
Right ventricular failure	07 (14%)

DISCUSSION

In the present study, more than half of all patients had pulmonary hypertension and cor pulmonale. Furthermore, echocardiography revealed right ventricular dilatation, right atrial dilatation and right ventricular failure in 48%, 38% and 14% of the patients. Pulmonary function tests have been used to determine the disease progression in COPD patients, however their ability to predict survival one year after hospitalization for acute exacerbation of disease is poor.[10] In addition, changes in arterial blood gases have not been useful in assessing the progression of disease and predict the clinical outcome.[10] Previous studies that have examined the impact of PH on outcome in COPD patients used pulmonary artery catheterization to assess pulmonary artery pressure (PAP).[11] However, this invasive technique is not only expensive, but carries a significant risk of infection, bleeding, and pneumothorax, especially in patients with hyper-inflated lungs. Previous authors found ultrasonic imaging of the right heart to be difficult during COPD exacerbation, but recent technical advancements in echocardiography have led to increased success in assessing PAP in COPD patient's population.[12] Recently developed therapies for pulmonary arterial hypertension (PAH) have been shown to be effective at lowering PAP and increasing life expectancy in idiopathic PAH and in PAH associated with connective tissue disease. The efficacy of these medications in treating PH associated with chronic lung disease has only recently been studied, but their availability offers a new opportunity to determine if PAP can be lowered in COPD patients with PH and if lowering PAP improves the clinical outcome in these patients.[13]

In present study population, 56% had pulmonary hypertension. One possible reason for this high prevalence of pulmonary hypertension could be selection bias that favored ordering echocardiogram in patients with clinical features of pulmonary hypertension or cor pulmonale. However, in the general practice and after reviewing the medical records, author found that the most common reason for ordering an echocardiogram was to exclude the presence of congestive heart failure rather than to diagnose pulmonary hypertension or right heart failure. Another reason for the high prevalence of pulmonary hypertension could have been another selection bias, as possibly the COPD patients included in the study had such an advanced disease that it required hospitalization. Recent studies have found that the presence of pulmonary hypertension in mild COPD has an especially poor prognosis and may identify a subset of COPD patients with a different pathophysiologic basis characterized by greater inflammation than those with normal pulmonary artery pressures.[14]

There are a few limitations of this study. Firstly, author did not assess the clinical outcome of the patients and correlate it with their echocardiographic findings.

Thus, prospective studies are needed to determine the ability of echocardiogram to predict outcome in stable COPD patients and to determine if it is cost-effective to include echocardiograms in the routine evaluation of COPD exacerbation. Secondly, future studies are needed to ascertain whether pulmonary hypertension increases mortality in COPD patients and the clinical utility of treating pulmonary hypertension in COPD patients also needs to be studied in large scale randomized trials.

CONCLUSION

Results showed high prevalence of cardiac co-morbidities in COPD patients. Echocardiography examination is a reliable method in COPD patient to assess pulmonary arterial hypertension and helps in early detection of

cardiac complications in COPD cases giving time for early interventions.

REFERENCES

1. Gershon AS, Warner L, Cascagnette P, Victor JC, To T. Lifetime risk of developing chronic obstructive pulmonary disease: a longitudinal population study. Lancet. 2011;378(9795):991-6.
2. Centers for Disease Control and Prevention (CDC). Chronic obstructive pulmonary disease among adults-United States, 2011. MMWR Morb Mortal Wkly Rep. 2012;61:938.
3. Global Initiative for Chronic Obstructive Lung Disease (GOLD). GOLD 2017 Global Strategy for the Diagnosis, Management and Prevention of COPD, 2017. Available at: https://goldcopd.org/gold-2017-global-strategy-diagnosis-management-prevention-copd/. Accessed December 2, 2018.
4. McDonough JE, Yuan R, Suzuki M, Seyednejad N, Elliott WM, Sanchez PG, et al. Small-airway obstruction and emphysema in chronic obstructive pulmonary disease. New Eng J Med. 2011 Oct 27;365(17):1567-75.
5. Cosio MG, Saetta M, Agusti A. Immunologic aspects of chronic obstructive pulmonary disease. N Eng J Med. 2009;360:2445.
6. Ourředník A, Susa Z. How long does the pulmonary hypertension last in chronic obstructive bronchopulmonary disease? Pulmonary Hypertension. 1975;9:24-8.
7. Bredikis AJ, Liebson PR. The echocardiogram in COPD: estimating right heart pressures. J Resp Dis. 1998;19:191-8.
8. Miller MR, Crapo R, Hankinson J, Brusasco V, Burgos F, Casaburi R, et al. General considerations for lung function testing. Euro Res J. 2005;26(1):153-61.
9. Arcasoy SM, Christie JD, Ferrari VA, Sutton MS, Zisman DA, Blumenthal NP, et al. Echocardiographic assessment of pulmonary hypertension in patients with advanced lung disease. Am J Respir Crit Care Med. 2003;167:735-40.
10. Groenewegen KH, Schols AM, Wouters EF. Mortality and mortality-related factors after hospitalization for acute exacerbation of COPD. Chest. 2003;124(2):459-67.
11. Oswald-Mammosser M, Weitzenblum E, Quoix E, Moser G, Chaouat A, Charpentier C, et al. Prognostic factors in COPD patients receiving long-term oxygen therapy: importance of pulmonary artery pressure. Chest. 1995;107(5):1193-8.
12. Higham MA, Dawson D, Joshi J, Nihoyannopoulos P, Morrell NW. Utility of echocardiography in assessment of pulmonary hypertension secondary to COPD. Eur Res J. 2001;17(3):350-5.
13. Blanco I, Gimeno E, Munoz PA, Pizarro S, Gistau C, Rodriguez-Roisin R, et al. Hemodynamic and gas exchange effects of sildenafil in patients with chronic obstructive pulmonary disease and pulmonary hypertension. Am J Res Crit Care Med. 2010;181:270-8.
14. Joppa P, Petrasova D, Stancak B, Tkacova R. Systemic inflammation in patients with COPD and pulmonary hypertension. Chest. 2006;130(2):326-33.