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RIGHT VENTRICULAR AND PULMONARY HYPERTENSION IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE AND RESTRICTIVE LUNG DISEASE

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ABSTRAK

Background: Chronic lung disease is frequently associated with lung vascular lesion. We evaluated the structural-functional related changes of right ventricle under CLD with or without PH at RSUP dr. Kariadi, Semarang. **Methods:** We studied patients at RSUP dr. Kariadi who underwent routine evaluation that included resting spirometry and echocardiography. Patients with either COPD or RLD were studied, exclusion were made for patients with valvular heart disease and congestive heart disease. This study was performed during May through June of 2019 (n = 20). PASP, RVD, RVWT, TAPSE and spirometry values were analyzed for the association between PASP and RVD, RVWT, TAPSE, TAPSE/PASP ratio and FVC, FEV1, FEV1/FVC. **Results:** Thirteen (65%) of 20 patients who underwent echocardiography and spirometry evaluation were male and their average age were 55 years old. Mean PASP was 49.30 mmHg (range 2–111 mmHg). Ninety five percents patients had restrictive spirometry and 5% patients had moderate-severe mixed spirometry. The majority of the population of the study sample is dominated by a very severe degree of restriction spirometry. Out of the 20 subjects, 15 subjects (75%) had a diagnosis of COPD and 10 subjects (50%) had a history of pulmonary TB. In this study, 75% subjects had right ventricular dilatation, 85% subjects had right ventricular hypertrophy, and 15% subjects had decreased right ventricular systolic function (low TAPSE). The majority of structural and functional abnormalities of the right heart are found on patients with very severe degree of restriction spirometry. There were 13 subjects (65%) pulmonary hypertension, with the most findings being severe pulmonary hypertension as many as 8 subjects (40%). As many as 14 subjects (70%) had high TAPSE / PASP ratio. **Conclusions:** PH prevalence in patients with CLD is significantly associated with spirometry values. PH severity degree in patients with CLD is not significantly associated with spirometry values.

Key words: spirometry; pulmonary hypertension; right heart echocardiography.

INTRODUCTION

Pulmonary hypertension (PH) is a hemodynamic abnormality of cardio-pulmonary units, marked by the increase of mean pulmonary artery pressure (mPAP) \geq 25 mmHg at rest that is measured by right heart catheterization as gold standard^(1,2). Group 3 PH is common among advance Chronic Lung Diseases (CLD) such as Chronic Obstructive Pulmonary Disease (COPD) and Restrictive Lung Disease (RLD).⁽³⁾ Multiple pathophysiological changes on right heart structure and function are imposed by PH. The aim of this study is to describe PH and changes on right

heart ventricle in CLD patients and to study about the association between spirometry values and echocardiographic parameters.

METHODS

This study was approved by the ethics committee of RSUP dr. Kariadi, Semarang.

Study Population

All inpatients at RSUP dr. Kariadi those were admitted with COPD or RLD with clinical symptoms such as tachypnea, chest tightness, cough, and chest pain were referred for further evaluation. This



evaluation includes thorough echocardiography and resting spirometry. We included patients evaluated at RSUP dr. Kariadi during May through June of 2019, who were diagnosed with COPD or RLD based on basic spirometry were included. Patients were excluded from the study if they had congenital heart disease, heart failure, severe myocardial infarction, pulmonary embolism, bronchial asthma, or cancer.

Spirometry

Gold standard modality to diagnose COPD or RLD is spirometry, as defined by American Thoracic Society (ATS).^(4,5) We collected the following spirometry data: forced volume vital capacity (FVC), forced expiratory volume in one second (FEV₁), and FEV₁/FVC at rest. Spirometry values then were classified into obstructive or restrictive spirometry and its severity degree as defined by the American Thoracic Society.⁽⁵⁾

Echocardiography

Echocardiography is to assess structural-functional of right heart ventricle, as an alternative and non-invasive modality.⁽⁶⁾ All the echocardiograms were obtained with three device, Philips EPIQ 7, Philips EPIQ 7C, and Philips CX50. Echocardiography studies were performed and interpreted by two cardiovascular consultant, internist specialized in echocardiography. We collected echocardiography data such as systolic pulmonary artery pressure (PASP), right ventricle diameter (RVD), right ventricular wall thickness (RVWT) and tricuspid annular plane systolic excursion (TAPSE). This study used M-mode to assess TAPSE values and 2 windows: parasternal long axis/subcostal view to assess RVWT and apical 4-chamber view to assess RVD. PASP >35 mmHg indicates PH, basal right ventricle diameter (RVD1) >42 mm and/ mid right ventricle diameter

(RVD2) >35 mm indicates right ventricle dilation, RVWT >5mm indicates right ventricle hypertrophy, and TAPSE ≤17 mmHg indicates decreasing of right ventricle function.⁽⁷⁾ We also excluded any patients with low ejection fraction (EF <50%).

Statistical Analysis

The data were arranged in tabulated form, were given coded and did the process. We processed the data using descriptive statistical methods and presented them through distribution tables and bar or pie chart. The associations between echocardiography and spirometry findings was assessed with Spearman correlation.

RESULT

A total of 20 patients underwent resting spirometry that was interpreted as restrictive spirometry (95%) and mixed spirometry (5%) during May through June of 2019. 15 patients (75%) had been diagnosed with COPD and 10 patients (50%) with history of TB infection. Severe PH was found in most patients (40%). 14 patients (70%) had heart dilation, 16 patients (80%) had heart hypertrophy, and 3 patients (15%) with decrease systolic function. Severity degree of spirometry significantly correlated with PH (P = 0.028). No correlation was found between RVWT (p=0.522), RVD (p=0.765), and TAPSE values (p=0.086) with CLD prevalence. Right heart dysfunctional score (p = 0.006), RVWT (p = 0.005), TAPSE values (p = 0.040) were significantly correlated with severity degree of PH, yet TAPSE/PASP ratio (p=0.000) had negative correlation with severity degree of PH.

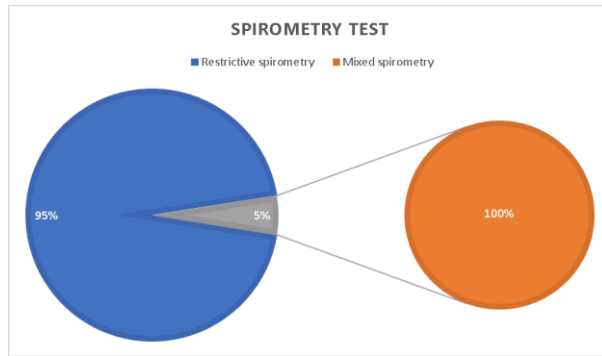


Figure 1

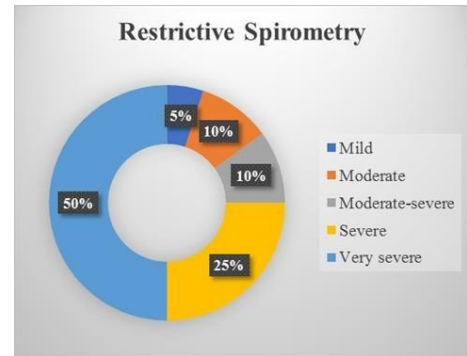


Figure 2

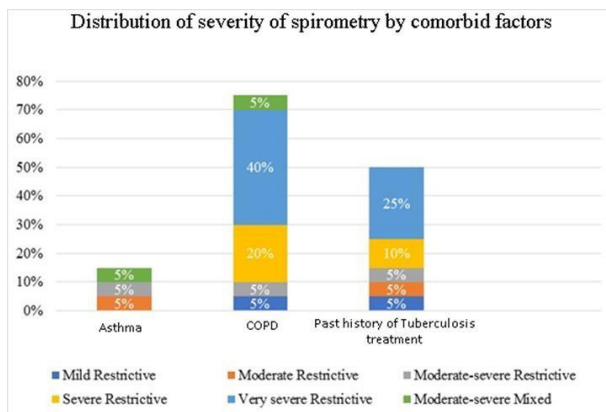


Figure 3

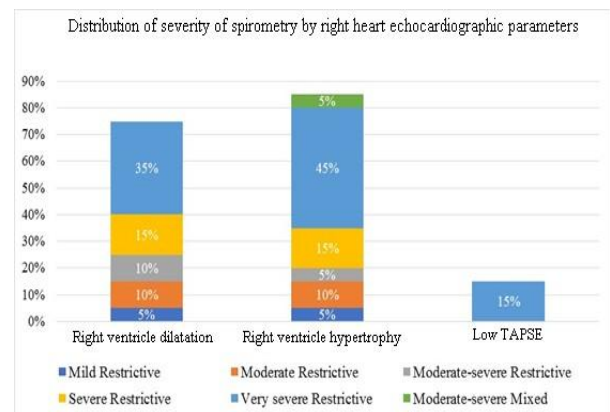


Figure 4

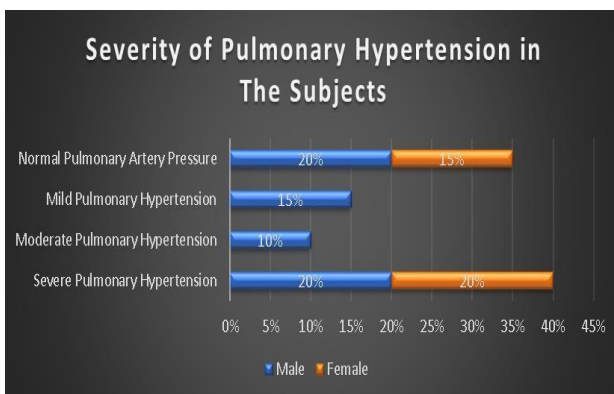


Figure 5

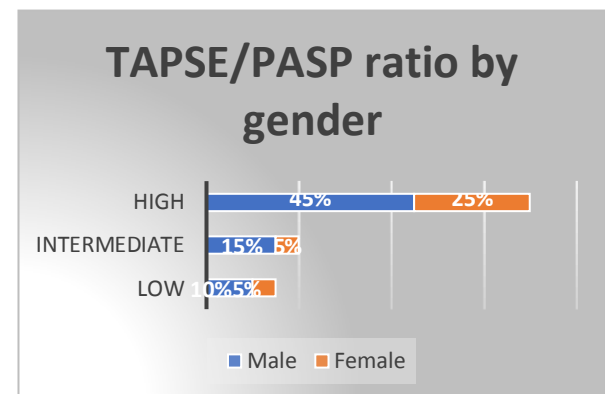


Figure 6

Figure 1. Distribution of Mixed Spirometry by severity grades Figure 2. Distribution of Restrictive Spirometry by severity grades Figure 3. Distribution of severity of spirometry by comorbid factors Figure 4. Distribution of severity of spirometry by right heart echocardiographic parameters Figure 5. Severity of Pulmonary Hypertension by gender Figure 6. TAPSE/PASP ratio by gender



DISCUSSION

The majority of subjects with chronic obstructive pulmonary disease are male, with 13 subjects (65%). Carey et al. explained that the prevalence of chronic obstructive pulmonary disease in men is due to higher smoking habits.⁽⁸⁾ The average age of the population of the study subjects was 55 years, this is per with the review of Robert et al. that at the age above 50 years the prevalence of pulmonary fibrosis is higher than the age of 20-40 years.⁽⁹⁾

Majority of subjects with the diagnosis of COPD (75%) having restrictive pattern spirometry are explained in the study of Keddissi et al. that reversible restrictive pattern spirometry is a variant of chronic obstructive pulmonary disease characterized by the presence of air trapping and low forced vital capacity (FVC) values (<80%). This is consistent with the finding of low FVC values in 19 subjects (mean FVC 44%) out of a total of 20 subjects in this study.⁽¹⁰⁾

Subjects with a history of TB infection have a restrictive spirometry pattern. Amaral et al. mentioned that adults aged 40 years and over with a history of TB infection have a higher risk of airway obstruction and have a restrictive spirometry pattern, this is explained by the mechanism of bronchiectasis and bronchial stenosis which triggers obstruction and formation of scar tissue in the parenchyma causing a restrictive spirometry pattern.⁽¹¹⁾

Right heart dysfunction, which consists of right heart structural abnormalities that is dilatation and right ventricular hypertrophy and abnormal heart function that is marked by low TAPSE values, these majority findings are found in subjects with a very severe degree of restrictive spirometry. This is consistent with the findings in a study conducted by

Sieenthal et al. where morphological changes due to pulmonary hypertension encountered in the heart consist of hypertrophy, dilatation and progressive right ventricular systolic dysfunction.⁽¹²⁾

Right ventricular dilatation is not always accompanied by right ventricular hypertrophy or pulmonary hypertension. Of the 20 study subjects, there were 5 subjects (25%) did not have right ventricular dilatation but had pulmonary hypertension. Right ventricular dilatation can only occur in conditions of chronic pulmonary hypertension accompanied by left ventricular systolic dysfunction and left ventricular diastolic dysfunction as described in the Vonk et al.⁽¹³⁾

Patients with a history of COPD and TB infection tend to experience pulmonary hypertension. Mild to moderate pulmonary hypertension is a frequent complication of chronic lung disease. In the study of Brewis et al., Chronic obstructive pulmonary disease (COPD) it was reported that the prevalence of complications of pulmonary hypertension was 30-70%.⁽¹⁴⁾ Another pulmonary hypertension study published by Jo et al. state that pulmonary hypertension inpatients with tuberculosis is determined by the degree of pulmonary parenchymal damage. Lower vital capacity was found on patients with tuberculosis compared to patients with COPD.⁽¹⁵⁾

Measurement of right heart function was assessed using the TAPSE parameter. In this study, there was a tendency that low TAPSE values were always accompanied by dilatation abnormalities and right ventricular hypertrophy. Vonk et al. state that the right ventricular systolic function as assessed by the tricuspid annular plane systolic excursion (TAPSE) parameters, right ventricular space dimensions, right atrial volume, and right ventricular



cardiomyocyte thickness index are interrelated with right cardiac echocardiographic parameters in both diagnostic and prognostic aspects of pulmonary arterial hypertension.⁽¹³⁾

Subjects with a low TAPSE / PASP ratio was found with both right atrial dilatation and right ventricular thickening. Tello et al. state that these findings led to the severity of heart failure based on WHO functional class in patients with pulmonary arterial hypertension.⁽¹⁶⁾

CONCLUSION

Right ventricle structural and functional changes were observed in patient with CLD, however lung function test should be supported with echocardiographic modality and patients clinical state in determining the severity of CLD due to several limitations of echocardiographic measurements in estimating pulmonary arterial hypertension. Echocardiographic parameters measurement values were obtained with clinical information of the patient are being taken into account to minimize the probability of overestimation or underestimation. However due to several limitations of echocardiographic measurements in estimating pulmonary arterial hypertension, echocardiographic parameters measurement values were obtained with clinical information of the patient are being taken into account to minimize the probability of overestimation or underestimation.

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