Conference Paper

The Correlation of Hyperinflation Chest Radiographic Image with Spirometry in Chronic Obstructive Pulmonary Disease Patients

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Abstract

Chronic Obstructive Pulmonary Disease (COPD) is defined by irreversible airflow obstruction due to chronic inflammation airway, destruction of the lung parenchyma and narrowing of the small airways. In this way, a predominant feature of destructive parenchymal changes is referred to hyperinflation. The diagnosis of COPD is based on clinical and radiological findings, as well as functional respiratory and pathological anatomical changes. To show the correlation between hyperinflation chest radiography image and the severity of airflow obstruction, spirometry test was performed in COPD patients. This retrospective cross-sectional study was conducted in 40 patients in BBKPM, Surakarta between April and October 2016 who met our inclusion criteria. The study variables were spirometry results and hyperinflation chest radiographic image. There were 36 males, and four females with age ranged from 19 to 60 years old. There was a significant correlation between hyperinflation chest radiographic image (DMHT/diaphragm height) and the severity of airway obstruction measured with spirometry. However, hyperinflation on chest radiography (LL/lung length) did not correlate with airway obstruction severity. DMHT/diaphragm height image was significantly correlated with the severity of airway obstruction in COPD patients. Thus, this image can be used as a predictor for the severity of obstruction.

Keywords: COPD, chest radiographic image, hyperinflation

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1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is defined as irreversible airway obstruction characterized by inflammation of the airways involving chronic inflammation, pulmonary parenchymal destruction, and bronchiole narrowing. The dominance of parenchymal damage changes is termed as emphysema and a change in bronchus is called chronic bronchitis. The diagnosis of COPD is based on clinical and radiological

data, anatomical, functional and pathologic changes [1, 2]. Based on current statistical and epidemiological data, COPD is the fourth cause of death. In Indonesia, there is no accurate data about the incidence of COPD. The main cause of COPD, which is smoking habit, is still high in men over the age of 15 years; i.e., about 60-70% in prevalence [3].

Airway obstruction causes hyperinflation of the lungs. Airway obstruction in COPD is best measured by using conventional chest radiographic spirometry. Chest radiography is one of the most frequently requested tests to evaluate patients with complaints and history associated with COPD but in the early stages, there is a little change in chest radiography whereas in advanced stage conventional radiographs can be used to detect some changes with good sensitivity and low specificity. One of the signs found in the pulmonary radiographic image is hyperinflation. An increase in anteroposterior diameter and retrosternal space is another manifestation associated with increased lung volume [2]. In this study, we examined the correlation of hyperinflation chest radiographic image with spirometry results in COPD patients.

2. Method

A retrospective cross-sectional study was performed in the *Balai Besar Kesehatan Paru Masyarakat* (BBKPM) Surakarta between April and October 2016. The study subjects were 40 COPD patients examined by spirometry (≤ 6 months) and chest radiography of Posteroanterior - Lateral position. The study subjects should meet our inclusion and exclusion criteria. The inclusion criteria included chronic bronchitis and emphysema. Patients with pneumonia, pulmonary tuberculosis, and lung tumors, were excluded from this study.

Chest radiography showed signs of hyperinflation (low-horizontal diaphragm and lung hyperinflation) and anterior-posterior diameter – retrosternal space. The measurement of emphysema on chest radiography showed Lung Length (LL) ≥29.9 cm and right horizontal diaphragm in the posterior-anterior position, and horizontal diaphragm height (DHMT) <2.7 cm from the anterior-posterior costophrenic angle, retrosternal space widening > 4.4 as well as sternum diaphragm ≥90% in the lateral position.

The severity of airflow obstruction was measured with spirometry based on Global initiative for chronic Obstructive Lung Disease (GOLD) guideline which is: stage 0: have risk factors and chronic sign but normal spirometry, stage 1: mild; FEV1/Forced Vital Capacity (FVC) < 70%, FEV1>80%, stage 2: moderate; FEV1/FVC < 70%, 50% ≤ FEV1 < 80%, stage 3: severe; FEV1/FVC < 70%, 30% ≤ FEV1 < 50% and stage 4: very severe; FEV1/FVC < 70%, FEV1< 30% [4–7].

3. Result

In this study, there were 36 males and four females: two patients aged < 40 years old, three patients aged 41-50 years old, 17 patients aged 52-60 years old and 18 patients aged > 60 years old.

Table 1: Severity of airway obstruction (n=40).

Severity of obstruction	Frequency (number)	Percentage (%)
Mild obstruction	2	5.0
Moderate obstruction	11	27.5
Severe obstruction	18	45.0
Very severe obstruction	9	22.5
Total	40	100.0

Based on airway obstruction severity, there were 4 categories: mild, moderate, severe and very severe airway obstruction in 2 (5%), 11 (27.5%), 18 (45%) and (22.5%) patients (Table 1).

Table 2: Association of lung length, right diaphragm height, retrosternal space, weight, height, age, and sex with obstruction severity in COPD patients*.

	R	*p* value
Lung length	.079	0.628
Right diaphragm height	-.570	0.000
Retrosternal space	-.117	0.470
Weight	-.223	0.167
Height	.086	0.597
Age	-.118	0.469
Sex		0.864
*Statistical test using Spearman Rank		

Non-parametric correlation data analysis by using *Spearman Rank* statistical test found a significant correlation between chest radiography (right diaphragm height (DHMT) with the severity of airway (p= 0.000) and no significant correlation between chest radiography (Lung Length and Lateral/space retrosternal) with the severity of airway obstruction measure with spirometry in COPD patients (p= 0.628). The coefficient correlation of chest radiography for lung length revealed a positive result while the right diaphragm height (DHMT) and Lateral – retrosternal space was negative. Our study also showed no significant correlation between height, weight, age, and sex and chest radiography as well as with the obstruction severity in COPD patients (Table 2).

4. Discussion

Chronic obstructive pulmonary disease is defined as irreversible airway obstruction associated with emphysematous, pulmonary parenchymal damage and airway constriction [2]. Emphysema is defined pathologically as abnormal dilatation of the distal airway until the terminal bronchiole which is caused by destruction in the alveoli and without fibrosis. Conventional chest radiography is considered to have only a small diagnostic role [5].

Our study involved male patients with the history of previous smoking and all of those patients had a clinical symptom of a previous cough. These findings are similar to those of in study by Capone D, Capone R, Rolim A [2]. Chest radiography is included in the criteria to examine COPD which shows the image of bronchitis and emphysema. Chest radiography is done with posteroanterior and lateral position. Chest radiography images in our study also revealed bronchitis and emphysema. These meet the criteria of COPD. Spirometry results in our study showed that most of our patients with COPD had a severe obstruction (n= 18;45%).

Our study analysis found a significant correlation between DHMT chest radiography and severe airway obstruction (p= 0.000) and no significant correlation (p= 0.628) between Lung Length - Lateral/retrosternal space chest radiography and the severity of airway obstruction measured with spirometry in COPD patients with airway obstruction. However; descriptively, our data show a tendency on the chest radiography of the lung length showing a positive result which means the more prolonged the lung length, the more severe the degree of obstruction. This study is following several previous studies [6, 8, 9].

Komatsu S study [8] reported that chest radiography is not an accurate diagnostic method in evaluating early-stage COPD, but chest radiography shows an increased retrosternal lucency and high diaphragm in advanced-stage COPD. Ghobadi H et al. study [6] showed that several cases of pulmonary hyperinflation in chest radiography were significantly related to spirometry parameters and also indicated the association of right diaphragm height (DHMT) in COPD patients with severe airway obstruction and a weak association between FEV1/FVC and lucency of retrosternal space. Ghobadi H et al. stated that in COPD patients some chest radiography parameters could be used to predict the severity of the obstruction. In most studies, researchers have shown that in advanced-stage COPD, chest radiography is useful for evaluating hyperinflation by assessing pulmonary hyperinflation. Faumani et al. [9] also showed that the height of

the diaphragm correlates with spirometry index but not the lung length. In their study, Faumani et al. used a large diaphragm for analyzing airway obstruction.

Our study have several limitations including small sample size, short study time, and variations in posture or body shape, chest width, chest radiograph inspiration force, and strength during spirometry examination. Height, weight, age, and sex were not proven to affect the correlation of chest radiograph with severe airway obstruction in COPD patients so that these variables were not considered as confounding variables. Chest radiograph has a limited value in evaluating the COPD patients. However, this examination can be used as a screening modality to evaluate emphysema with signs of hyperinflation such as a horizontal diaphragm, increased lung volume and increased retrosternal space.

5. Conclusion

There were significant correlations between hyperinflation on chest radiography (right diaphragm height [DHMT] /diaphragm height) and the severity of airflow obstruction measured with spirometry in COPD patients. The length of the right diaphragm height (DHMT) / diaphragm height is related to the severity of obstruction, however further studies with larger sample sizes are warranted.

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