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Relationship between thoracic CT scan imaging with clinical degree of acute exacerbation chronic obstructive pulmonary disease

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Abstract. This study aims to analyze the relationship between Thoracic CT scan imaging and the degree of clinical acute exacerbations. Method of this study is a cross-sectional analytic study. Sample that used in this study are 71 adult Chronic Obstructive Pulmonary Disease (COPD) patients who seek treatment at Pulmonary Hospital Dr. Ario Wirawan Salatiga in January-July, 2016. Data acute exacerbations of COPD clinical degrees with imaging Thoracic CT Scan taken from secondary data, medical records. Univariate analysis use descriptive statistics, while bivariate analysis to examine the relationship between the degree of acute exacerbations of COPD with clinical imaging Thoracic CT Scan, use bivariate Spearman Rank. The result of this study show that COPD patients are more male than female, and the average age of 65,15 years. CT Scan imaging results are known COPD is a spectrum with a variety of phenotypes are manifold includes pneumonia, bronkiektasis, bronkiolektasis, corpulmonale, hypertensipulmonal, lung tumors, lung bullae, lung emboli, tuberculosis, pneumothorax and calcified Aortae. Other result also shows there is a correlation between CT-Scan Imaging Thoracic and the degree of Acute Exacerbations of COPD clinic.

1. Introduction

In Computed Tomography (CT) is a diagnostic imaging test used to create detailed images of internal organs, bones, soft tissue and blood vessels [1], as the beam passes through the patient, it is attenuated according to Lambert-Beer's Law, expressed as [2]:

$$I = I_o \exp(-\mu \Delta x) \qquad (1)$$

where I = transmitted beam intensity, I_o = original beam intensity, e = Euler's constant, μ = linear attenuation coefficient and Δx = finite thickness of the section. Graphically, this can be shown as:

As the beam passes through stack of voxels (volume elements) that is part of the slice, an attenuation measurement called a ray sum is obtained. A ray sum is the sum of all ms along the path of a single ray through the patient as shown:
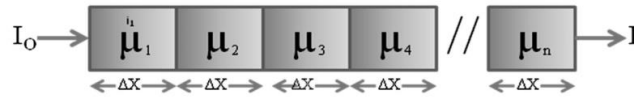
In this situation, the transmitted intensity I, is represented as [2]:

$$I = I_o \exp(-\sum_{i=1}^{n} \mu_i \, \Delta x) \tag{2}$$

or

$$-\sum_{i=1}^{n} \mu_i \, \Delta x - \left(\mu_1 + \mu_2 + \mu_3 + ... + \mu_n\right)\Delta x \tag{3}$$

By taking the natural logarithm (ln), this equation becomes:

$$\ln(I_o \, / \, I) = \sum_{i=1}^{n} \mu_i \, \Delta x \tag{4}$$

Meanwhile, Chronic Obstructive Pulmonary Disease (COPD)　is a chronic respiratory illness that becomes a public health problem in the world. Mortality and disability rates Chronic Obstructive Pulmonary disease increases with increasing number of smokers, and indoor and outdoor air pollution [3]. Symptoms of Lung Disease Chronic obstruction of acute exacerbations is: increased spasms, increased sputum production and sputum discoloration. Acute exacerbations will be divided into three: (1) Type I (severe exacerbations), has 3 symptoms above, (2) Type II (moderate exacerbations), has 2 symptoms above, and (3) Type III (mild exacerbations) 1 above symptoms plus upper respiratory tract infection for more than 5 days, fever without any other reason, cough increase, increased wheeze or increased breathing frequency> 20% baseline, or pulse rate> 20% baseline [4].

Mortality rate of patients with COPD reach 4%, mortality rate reaches 6% and female morbidity 2% mortality 4%, age above 45 years. In 1999, 9518 Canadians died from COPD – 5544 men and 3974 women. COPD accounted for 4.9% of deaths among men and 3.8% of deaths among women in Canada in 1999, making it the fourth leading cause of death for men and the fifth for women. Overall mortality rates for COPD from 1988 to 1999 have increased; the rate for women has increased by 53% and is still increasing. The rate among men has decreased by 7% and continues to fall. Mortality rates increase rapidly over the age of 75 years [5].

According to the National Health Interview Survey, 2.5 million people with emphysema, 1986 in the United States, found 13.4 million people, and 30% more needed hospitalization. The Tecumseh Community Health Study found 66,100 deaths due to COPD, representing 3% of all deaths, as well as the fifth order of death in America. Other researchers say, COPD is the fifth cause of death in the United States with a mortality rate of 3.6%, 90% occurs at age above 55 years (Redline S, 1991 quoted from Amin 1966). In 1992 the Thoracic Society of the Republic of China found 16% of people with Chronic Obstruction of Chronic Lung disease aged over 40 years, in 1994 found cases of death 16.6% per 100,000 population and ranked 6th in Taiwan [6].

In Indonesia there is no accurate data about the frequency of COPD. The Household Health Survey of the Ministry of Health, Republic of Indonesia 1992, found mortality rates of emphysema, chronic bronchitis and asthma ranked 6th out of 10 of the most common causes of death in Indonesia. Survey patients with COPD in 17 Community Health Center (*Puskesmas*) in East Java found the morbidity rate 13.5%, pulmonary emphysema 13.1%, chronic bronchitis 7.7%. In 1997 patients with COPD in Persahabatan Hospital as much as 124 (39.7%), while outpatient as much as 1837 or 18.95%. In dr. Moewardi Hospital Surakarta, in 2003 was found in chronic obstructive lung disease as many as 444 (15%), and outpatient 2368 (14%). The World Health Organization (WHO) says, the mortality rate of

COPD in 2010 is estimated to be ranked 4th even the next decade to rank 3rd. The condition is unnoticed by the community mortality caused by COPD continues to increase [6].

COPD patients in Pulmonary Hospital dr Ario Wirawan Salatiga occupied the first rank of existing disease pattern. Based on hospital data, in 2013 there are patient history of hospitalization with COPD diagnosis. COPD patients are predominantly 75% male, and are in the age range of 44 years and over. After treatment is known 89% declared cured and only 4% who died. Similarly for COPD patients in 2014, 89% were also declared cured and only 6% died.

The data indicate an anomaly of the success of Pulmonary Hospital dr. Ario Wirawan Salatiga in dealing with COPD sufferers, one of which is supported by the use of CT Scan Thorax which is the standard of modalities to make the diagnosis of COPD. CT Scan Thorax is a modality that has sensitivity and specificity and thist is superior to conventional Radiography. The CT Scan Thorax COPD is a wide range of pathologies including hyperinflation, aortic knop away, pendulum heart, flattening & straightening diaphragm, pneumonia, hypertension pulmonary, pulmonary embolism, pneumothorax, corpulmonale, bronchiectasis, bronchiolectasis, lung tumor, bullae, atherosclerosis, and osteoporosis. CT Scan Thorax is able to determine four types of emphysema, namely panacinar, centrolobular, paraseptal, and scar [7].

Research result explains the chest radiograph has meaning or value to diagnose emphysema or bronchial wall thickening in chronic bronchitis [8]. Emphysema patients show impaired lung function and shortness of breath. The more frequent comorbidities in chronic bronchitis require certain treatment strategies. The other study showed more male patients than women. Clinically, two major forms of COPD are chronic bronchitis and pulmonary emphysema, but in reality both forms are often coincided so that they are called bronchitis - emphysema[6]. The other study also showed a correlation between the degree of smoking and the prevalence of COPD and chronic bronchitis [9].

This study aimed to analyze the relationship between thoracic CT imaging with clinical degrees of Chronic Obstructive Pulmonary Disease (COPD) acute exacerbation at Pulmonary Hospital dr. ArioWirawan Salatiga.

2. Materials and Methods

The research design that used in this study include the design of cross sectional analytic study method. The sample in this study was the patients who came to Pulmonary Hospital dr. Ario Wirawan Salatiga for a CT scan on the thorax. All subsequent subjects were examined using Multi Slice Computed Tomography / CT Scan in the thoracic cavity. Sample criteria were taken from sample subjects with data to Pulmonary Hospital dr. Ario Wirawan Salatiga for Multi Slice Computed Tomography / CT Scan examination on piston cavity. The study of sample criteria are as follows: adult patients (Age > 18 years), patients get CT Scan Thorax examination, and willing to be joined in the study.

This research is used purposive sampling technique. Univariate descriptive analysis of categorical and numerical is used to describe the data in this study. Spearman correlation bivariate analysis is used in this study as a statistical test tool in testing the associative hypothesis of two variables, because the data used ordinal scale (rank).

3. Results and Discussion

Univariate analysis based on CT-Scan Thorax imaging results, it can be seen that COPD is a spectrum with a variety of phenotype variation, namely Pneumonia, Bronchiectasis, Bronchiolectasis, Corpulmonale, Pulmonary Hypertension, Lung Tumor, Bullae Lung, TB, Pneumonic Thorax, Emboli Lung, Pendulum Heart Form, Aortic Knop Remote, and Calcified Aortae.

The results of CT scan with contrast imaging showed in Figure 1(a), in male patients aged 54 years with a history of acute exacerbations of mild COPD, found Coronary Artery Atherosclerosis. The contrasting CT Scan imaging results in patients with acute moderate acute exacerbation COPD showed in Figure 1(b), found Pulmonary Embolism. Results of chest X-ray of moderate-degree COPD patients with shortness of breath showed in Figure 1(c), found hyper-age area, and aortic knop away.

The results of CT scan with contrast imaging in COPD patients with acute exacerbation of moderate Figure 1(d), was found Aortic Atheros Sclerosis.

(a)

(b)

(c)

(d)
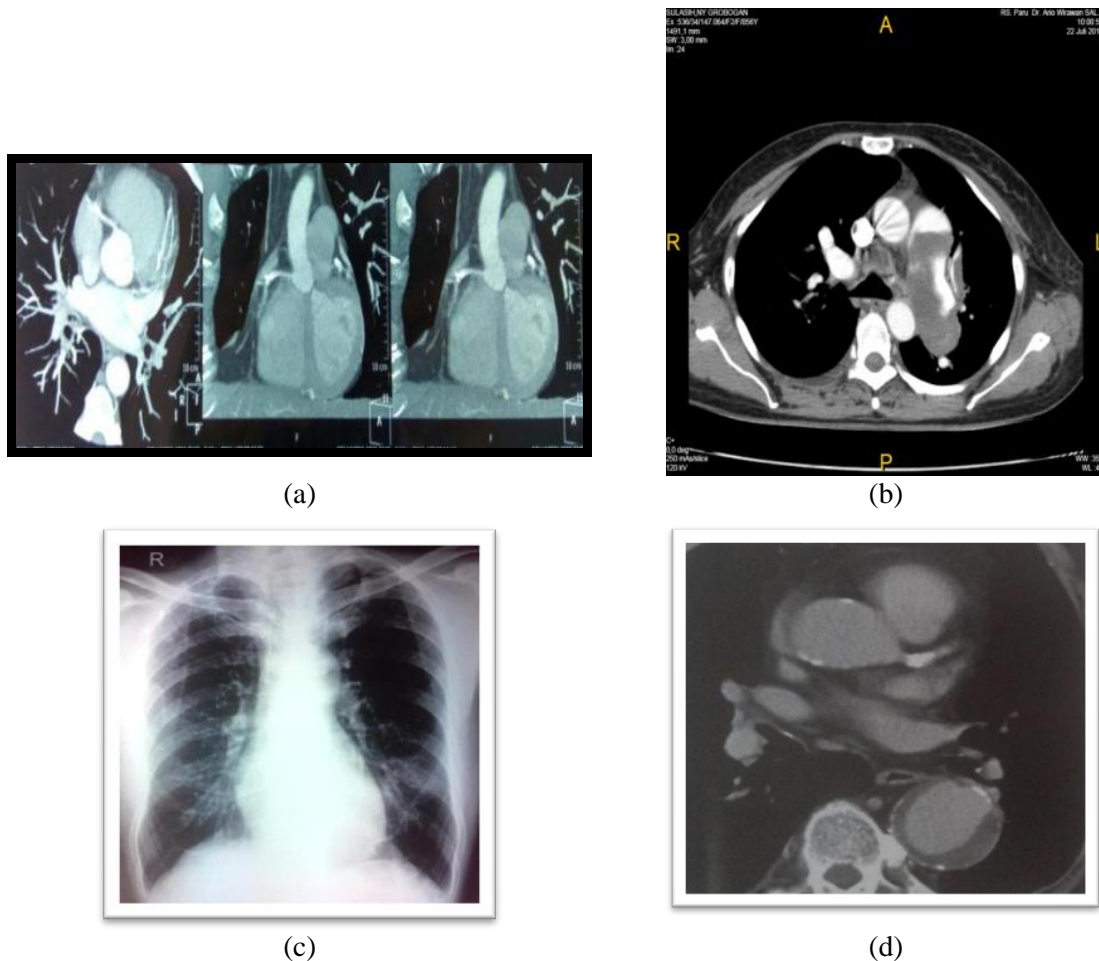
Figure 1. (a) Coronary Artery Atherosclerosis (b) Pulmonary Embolism (c) Chronic Obstructive Pulmonary Disease (COPD) (d) Aortic Atherosclerosis

Meanwhile, bivariate test of Rank Spearman statistic is used to find out the correlation between CT-Scan imaging with clinical degree of Acute Exacerbation COPD. The result can be explained in Table 1. Based on the table, the result of correlation coefficient of Rank Spearman value is 0,409 in medium criterion, and obtained by p-value of 0.000 smaller than alpha (0.05). These results indicate that there is a correlation between CT-Scan Thorax Imaging with Clinical Degradation of Acute Exacerbation COPD at Pulmonary Hospital dr. Ario Wirawan Salatiga.

Table 1. Correlation between CT-Scan Imaging with Clinical Degree of Acute Exacerbation COPD

			Clinical Degree	CT Scan
Spearman's rho	Clinical Degree	Correlation Coefficient	1.000	.409[**]
		Sig. (2-tailed)	.	.000
		N	71	71
	CT Scan	Correlation Coefficient	.409[**]	1.000
		Sig. (2-tailed)	.000	.
		N	71	71

**Correlation is significant at the 0.01 level (2-tailed).

The survey results revealed that patients with COPD Pulmonary Hospital dr. Ario Wirawan, Salatiga mostly male sex than women, average age of 65 years. This finding is consistent with the results of the study Hassan and Abo-Elhamd (8) that the age of COPD patients is 62 years. Research result Suradi (6) also mentioned that the morbidity rate of people with COPD is mostly male, with age above 45 years. Similarly, the results of research Windrasmara (9) describes the distribution of COPD patients by sex of most men, and aged 65 and older. The same is also mentioned in the research results Sidabutar, Rasmaliah (10) that COPD patients are more male than female, with age more than 60 years.

The results describe COPD as a spectrum with a wide variety of phenotypes, according to a theory that mentions many COPD patients with Pneumonia, Bronchiectasis, Bronchiolectasis, Corpulmonale, Pulmonary Hypertension, Pulmonary tumors, Tuberculosis, Bullae, and Pneumothorax [7]. These results are also consistent that thoracic CT scan is superior to conventional radiography with a sensitivity of 87% and a specification of 83%. [8].

The results of the study can be explained that the clinical degree of Acute Exacerbations COPD is in the medium category, with two indicators found among the three, namely increased tightness, an increase in the number of sputum, and the sputum color change. This result is not consistent with the study which states the proportion of COPD sufferers based on severity is mostly in the mild category, followed by moderate, severe last [10].

The results showed that treatment outcomes revealed that all patients recovered from Chronic Obstructive Pulmonary Disease, and none of the patients died. This is different research results Suradi (6) which says deaths in male COPD reach 6% and women 4%. The results of this study are also not in line with the study Oemiati (11) that COPD was ranked fifth out of 10 major causes of death. These results do not fit the WHO report that lung disease accounts for 17.4 percent of all deaths in the world. This shows the success of Pulmonary Hospital dr. Ario Wirawan Salatiga as a Class A hospital with superior service of asthma and COPD.

4. Conclusion

Based on thoracic CT scan results, the diseases that accompany Chronic Obstructive Pulmonary Disease (COPD) are: Pneumonia, Bronchiectasis, Bronchiolectasis, Corpulmonal, Pulmonary Hypertension, Lung Tumor, Bullae, TB, Pneumothorax, Pulmonary Emboli, Pendulum Heart Form and Aortic Knop. Characteristics of clinical degrees of acute exacerbation COPD were moderate at 94.4 percent, 71 patients with 100% recovery rate and no death. Based on bivariate analysis it can be concluded that there is a correlation between CT Scan Thorax imaging with clinical degree of acute exacerbation COPD.

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