ORIGINAL ARTICLE

CORRELATION BETWEEN CARDIOMEGALY AND PULMONAL DYSFUNCTION IN CHRONIC HEART FAILURE

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ABSTRACT

***Background**: Cardiac enlargement or cardiomegaly has always been found in chronic heart failure (CHF). Progressivity of cardiac enlargement relates with pulmonal function changes in CHF. This study examined the influence of increased cardiac enlargement on pulmonal function.*

***Methods**: This was a cross sectional study on 63 CHF patient of New York heart Association (NYHA) class I and II that fulfilled inclusion criteria. Definition of CHF was based on Framingham criteria. Cardiac enlargement measured by Danzer's methods through postero anterior chest radiography. Spirometry was used to evaluate FVC and FEV1.*

***Results**: Male subjects had an equal proportion (49.21%) with female subjects (50.79%) with mean of CTR 59.47 ± 5.57%. Spirometry test showed mean predicted FVC (%) 61.83 ± 9.62, predicted FEV1 (%) 75.27 ± 12.55, and FEV1/FVC mean ratio 95.53 ± 2.19%. Coefficient correlations between cardiomegaly and FVC (%) and FEV1 (%) predicted were -0.537 ($p<0.001$) and -0.460 ($p<0.001$). Duration of disease had a negative correlation with FVC (%) and FEV1 (%) predicted (-0.329; p= 0.008 and -0.341; p=0.006).*

***Conclusions:** Cardiomegaly on CHF showed a restriction type and had a negative correlation with pulmonal function.*

***Keywords:** cardiomegaly, pulmonal dysfunction, chronic heart failure*

INTRODUCTION

Background

Chronic heart failure (CHF) is a clinical syndrome caused by structural and functional cardiac abnormalities[1]. Chronic heart failure is often associated with impaired lung function[2]. Abnormalities of lung restriction from mild to moderate levels are more common in CHF than lung obstruction[3]. Lung restriction may affect exercise capacity which indicates the degree of severity of heart failure[4].

Epidemiological studies showed a relationship between lung function and mortality, particularly in relation with the incident of cardiovascular mortality[5]. The relationship between lung function and mortality remains unclear, but allegedly associated with progressive changes in hearty size. Heart enlargement or cardiomegaly can lead to abnormalities of lung restriction resulting in the reduction of total lung volume and vital capacity[6,7].

The aim of this study was to determine the correlation between cardiomegaly that was measured by cardiothoracic ratio (CTR) with impaired lung function in patients with CHF.

Materials and Methods

The study was cross-sectionally designed. The study was conducted at the Dr. Sardjito Hospital from June 2011 to August 2011. Participants were patients with CHF who visited the heart clinic. Inclusion criteria included CHF patients with NYHA functional class I-II, aged 18-65 years, BMI <30 kg/m^2, CTR ≥ 50%, and approved informed consent. The exclusion criteria included the presence comorbid of lung diseases, scoliosis, myasthenia gravis, Guillain-Barre syndrome, and spinal cord trauma, as well as extra-pulmonary disorders such as hepatospenomegaly, abdominal tumors, grade 3-4 ascites, active smokers or smoking history > 20 packs for years, based on the Brinkman index, and the reversibility test results an improvement of FEV1 predicted <12%.

Cardiomegaly is the enlargement of the heart volume as presented on PA chest radiological examination with CTR > 50% [1]. Cardiothoracic ratio was measured by Danzer's method[8].

The entire participants underwent pulmonary function test using VMI ventilometer Clement Clarke made in UK. Predicted value of FVC (%) and FEV1 (%) were calculated based on normal Physiology of the lung for Indonesian accordance to the American Thoracic Society (ATS) standard by Indonesia Pneumobile Project team[9]. Restriction lung function can be obtained if the predictive value of FVC < 80% with anormal FEV1/FVC ration (>70%)[10].

Statistical analysis used the correlation test. Linear relationship between a cardiomegaly and pulmonary restriction can be seen from the scatter plot. The final result was expressed in correlation coefficient (r). Limit of significance was $p<0.05$.

Result and Discussion

Based on the basic characteristic of the study, the proportion of male subjects were 30(49.21%) as well as the women (50.79%) with a mean age of 50.27 ± 12.79 years. The mean duration of the heart failure was 3 years (0.25 to 30) with a mean index of CTR was 59.46 ± 5.57. Spirometry test showed the average FVC (%) and FEV1 (%) predicted respectively were 61.83 ± 9.62% and 75.27 ± 12.55% with a mean FEV1/FVC ratio was 95.53 ± 2.19%. Pearson correlation analysis found a negative correlation between cardiomegaly with FVC (%) and FEV1 (%) predicted, with (r) respectively were -0.537 and -0.498 (table 1). This study also showed a pattern of lung restriction in patients with CHF with a mean of FEV1/FVC ratio was 95.53 ± 2.19 % and the mean of FVC (%) predicted was 61.83 ± 9.62% with (r) of -0.537.

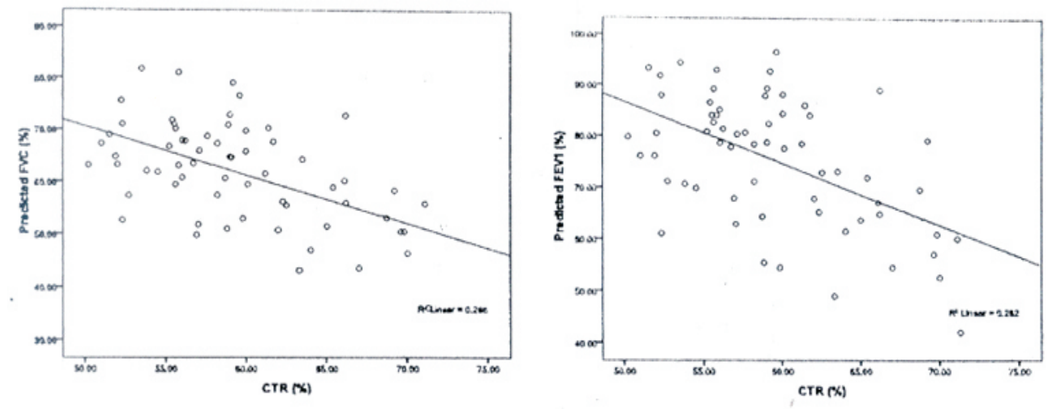

Figure 1. Scatter plot of CTR with pulmonary function
Description: ** significant at $p<0.001$

Correlation analysis was also performed with other variables that may influence the decrease in FVC (%) and FEV1 (%) predicted. The results of this study indicate that the duration of illness has a poor negative correlation with predicted value of FVC (%) and FEV1 (%) with (r) respectively were -0.329 (p=0.008) and -0.341 (p=0.006), can be seen in table 1.

Table 1. Correlation analysis of variables that affect FVC and FEV1 predicted

Variable	FVC (%) predicted		FEV1 (%) predicted	
	r	*P*	r	*p*
CTR	-0.537	<0.001**	-0.531	<0.001**
Duration of disease	-0.329	0.008*	-0.341	0.006*
TDS	0.129	0.312	0.269	0.083
TDD	-0.019	0.884	0.129	0.334

Description: ** significant at p<0.001; * significant at p<0.01

The results were consistent with previous study[7] that heart enlargement is associated with the decrease of FVC and FEV. Heart enlargement, commonly seen in HF, leads to reductions in intra thoracic space and limits the ability of the lungs to fill adequately. This could potentially reduce the effectiveness of the elastic recoil component of exhalation due to insufficient stretch of the lungs and result in reduced maximal expiratory flows. The inability of the lungs to fill would be represented by restrictive lung function[6,7].

This study also showed a linear regression analysis from variables that can influence the decrease of FVC (%) FEV1 (%) is predicted. The results in this study indicated that the correlation between cardiomegaly with the decreased of FVC (%) and FEV1 (%) predicted were more meaningful than the duration of disease with R^2= 0.288 (β = -0.471, p<0.001) and R^2 = 0.282 (β = -0.469; p<0.001). This result may imply that cardiomegaly account 28.8% for decline from FVC (%) predicted and amounted to 28.2% for decreased of FEV1 (%) predicted. The remainder may be explained by other variables not examined (Table2).

Table2. Regression analysis of variables that affect the decrease in lung function

Variable	R^2	S.E	βeta	t	*p*
FVC (%) predicted					
CTR	0.288	0.189	-0.471	-4.296	<0.001*
Duration		0.214	-0.231	-2.110	0.039
FEV1 (%) predicted					
CTR	0.282	0.249	-0.469	-4.240	<0.001
Duration		0.282	-0.220	-1.988	0.051

Description: *significant at p<0.01, SE: Standard Error

Nevertheless, this study has a possible limitation. The cross-sectional study design made it difficult to make a clear statement about the temporal sequence and causality between cardiomegaly and lung function.

Conclusion

There was a negative correlation between cardiomegaly with pulmonary function patients with CHF. Cardiomegaly also contributes to restriction of lung disorders in patients with CHF.

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