

Right ventricular ejection fraction in patients with chronic obstructive pulmonary disease

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Citation

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Abstract

Background: Prevalence of right ventricular dysfunction in patients with chronic obstructive lung disease (COPD) is controversial. The goal of this study was to evaluate the prevalence of decreased right ventricular ejection fraction RVEF in patients with the diagnosis of COPD in comparison to a control group.

Methods: A series of 157 patients, who underwent LVEF assessment using blood pooled scintigraphy for clinical indications, underwent simultaneous measurement of RVEF. Patients with a history of COPD were compared to a control group.

Results: LVEF was measured in 155 and RVEF was measured in 152 patients. Mean LVEF in patient with COPD (13 patients) was 46.5 ± 16.8 SD vs. 53.2 ± 16.4 SD in the control group (142 patient) $p=0.16$. Mean RVEF in patient with COPD (12 patients) was 46.8 ± 13.9 SD vs. 50.8 ± 12.7 SD in the control group (140 patients), $p=0.29$. Subgroups analysis of mild, moderate or severely decreased LVEF and RVEF revealed no statistical differences between the patients with or without the diagnosis of COPD.

Conclusion: RVEF appears to be similar in patients with or without COPD.

BACKGROUND

Background: Increased prevalence of right and left ventricular dysfunction in patients with chronic obstructive lung disease (COPD) has been controversial and understudied. The study by Vizza et al¹ showed decreased RVEF but not LVEF in patients with severe pulmonary disease. Their study lacked a control group and most of their patients had severe lung disease. In contrary, LVEF was found to be decreased in an experimental animal study in dogs with COPD² and in a small study of patients with COPD.³ Furthermore, RVEF was found to be normal in patients with COPD at rest by other investigators.^{4,5} The goal of this study was to evaluate any association between COPD and on right ventricular cardiac function. We used RVEF as a measure of right ventricular function in patients with the diagnosis of COPD and a control group with diagnosis other than COPD.

METHODS

This study is a cross-sectional study of a series of 157 patients, who underwent LVEF assessment using blood

pooled scintigraphy (MUGA) for clinical indications by their physicians. These patients underwent simultaneous measurement of RVEF for this study. Patients with a history of smoking or COPD were compared to a control group using Chi square and Fisher Exact Test. The diagnosis of COPD was extracted from the patient's past medical history. The severity of COPD was not recorded in this study.

LVEF and RVEF were categorized as normal ($EF > 50\%$) or decreased (mild: $EF < 50\%$, moderate: $EF < 40\%$ and severe: $EF < 30\%$). Using univariate analysis, we compared mean LVEF and RVEF in patients with or without a history of COPD.

MUGA TECHNIQUE

The patients were required to fast for 4 hours prior to the study, and refrained from caffeine for 24 hours. They were injected with 40 mg of stannous pyrophosphate in 1.5 ml saline. Ten minutes later, the patients were positioned on the bed of the camera with the detector in the right anterior oblique (RAO) position. A rapid bolus of 20 mCi technetium-99m pertechnetate was given intravenously,

together with the start of a list mode acquisition. The study was performed as 1000 frames at 0.04 seconds per frame, in a 64x64 matrix. Following the first pass study and after time for equilibration in the blood volume, a standard gated cardiac blood pool study was acquired in the anterior, left anterior oblique (LAO) and left lateral projections. The R to R interval was divided into 16 frames, not greater than 0.04 seconds in length. Acquisition was recorded for 900 seconds in a 64x64 matrix. Quantization was performed on the LAO view.

PROCESSING

RVEF measurements: Frames showing maximum right ventricle activity were selected and summed into a single frame. This was used to draw a region of interest around the right ventricle. This ROI was applied to the first pass study and a time activity curve was generated for the right ventricle. Three or four cardiac cycles with good contractility were selected and the end-diastolic and end-systolic points identified for each. A computer generated ejection fraction was calculated for each cycle and an average ejection fraction was obtained.

LVEF measurements: Using automated software (Cedars) the left ventricle in the LAO image was identified and a variable region of interest fitted to the margin of the ventricle in each frame. A composite left ventricle volume curve was obtained and the LVEF was calculated from this curve. Wall motion was evaluated for both right and left ventricle from the gated equilibrium study by two independent observers.

Results: Male gender was predominant gender in this study from a veteran administration hospital (91%). There was no differences in regards to gender, history of coronary artery disease, valvular abnormalities, diabetes or hypertension between the patients with or without COPD. LVEF was measured in 155 and RVEF was measured in 152 patients. Mean LVEF in patient with COPD (13 patients) was 46.5 ± 16.8 SD vs. 53.2 ± 16.4 SD in the control group (142 patient) $p=0.16$. Mean RVEF in patients with COPD (12 patients) was 46.8 ± 13.9 SD vs. 50.8 ± 12.7 SD in the control group (140 patients). $p=0.29$. Subgroups analysis comparing mild, moderate and severe left ventricular systolic dysfunction in patients with or without COPD revealed no significant differences between the groups (table 1).

DISCUSSION

Our study evaluated the occurrence of low LVEF and RVEF in patients with COPD. We found no differences in the prevalence of low RVEF in patients with or without COPD. Our study is consistent with smaller trials showing normal resting RVEF when considering all comers.^{4,5,6} Most of the studies with documented depressed RVEF have been found in patients with severe pulmonary hypertension^{1,3,5,7}, severe resting COPD,^{3,8} right heart failure or after exercise.⁶ Burghuber et al. found that the assessment of RVEF is a poor indicator of overall right ventricular function in patients with COPD.⁹ The finding of normal LVEF in COPD patients in our study is consistent with most trial that COPD does not directly effect LVEF unless pulmonary hypertension or coronary artery disease is present.^{3,8, 10} The lack of negative effect of COPD in our study as an independent factor on EF needs to be confirmed in a larger population.

CONCLUSION

We found that patients with a history of COPD do not have lower RVEF in comparison to other patients. This suggests that COPD patients without evidence of right heart failure or pulmonary hypertension might not be at risk for low right ventricular EF. However, due to small size, our study needs to be confirmed in a larger population.

LIMITATION

Men were the predominant gender in our study limiting our results to men. This study was a cross-sectional study and the number of patients with COPD was small limiting our results. Furthermore, we did not have any data about the severity of COPD.

Figure 1

Table 1: LVEF and RVEF prevalence in patients with and without COPD (chronic obstructive pulmonary disease)

	COPD	No COPD	P
LVEF > 50%	8 (61.5%)	97 (68.3%)	0.71
LVEF < 50%	5 (38.5%)	45 (31.7%)	0.71
LVEF < 40%	5 (38.5%)	26 (18.3%)	0.14
LVEF < 30%	4 (30.8%)	16 (11.3%)	0.07
RVEF > 50%	5 (41.7%)	73 (52.1%)	0.55
RVEF < 50%	7 (58.32%)	67 (47.9%)	0.55
RVEF < 40%	5 (41.7%)	28 (20%)	0.13
RVEF < 30%	1 (8.3%)	7 (5.0%)	0.49

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