Right Atrial Volume Index in Patients with Chronic Obstructive Pulmonary Disease

S. M. Shankar Rajan¹, M. Chokkalingam², G. Ashok³, Durga Devi⁴

Department of Cardiology, Chettinad Hospital and Research Institute, Chennai, India

¹DM Postgraduate Student, Department of Cardiology, Chettinad Hospital and Research Institute, Chennai, India
²Professor and Head of the Department, Department of Cardiology, Chettinad Hospital and Research Institute, Chennai, India
³Associate Professor, Department of Cardiology, Chettinad Hospital and Research Institute, Chennai, India
⁴Assistant Professor, Department of Cardiology, Chettinad Hospital and Research Institute, Chennai, India

Abstract: "Right Atrial Volume Index in patients of Chronic Obstructive Pulmonary Disease-(COPD) "


Keywords: Right Atrial, Volume Index, Chronic Obstructive Pulmonary Disease, Right Ventricular Systolic, Diastolic Function, Pulmonary Hypertension

1. Introduction

Remodeling in the pulmonary vascular bed leads to pulmonary arterial hypertension and RV dysfunction in COPD. RA provides RV filling with its reservoir, conduit and booster pump functions. In chronic RV pressure overload as in COPD with PHT, initially the RV diastolic function is impaired with preserved systolic function. This is due to compensatory increase in RA contractility and expandability. Later, RA enlargement and hypertrophy with reduced contractility occur. Thus Right atrium is of clinical importance in COPD. Echocardiography is the relevant noninvasive technique for screening, diagnosis, and follow-up assessments in COPD. RA can be visualized by 2D Echocardiography for a quantitative assessment of the RA volume. RA volume correlates with RV dysfunctional severity.

Aim
We aimed at correlation between right atrial volume index (RAVI) and severity of COPD, PHT and RV dysfunction in patients with COPD.

2. Materials & Methods

This is a prospective study from April 2019 to January 2021. 100 cases of proven COPD were studied.

Inclusion Criteria
Proven case of COPD as per GOLD criteria

Exclusion Criteria
Very severe COPD-GOLD 4,
Acute exacerbation of COPD

Arrhythmias
Other causes of PHT
Patients not willing for the present study
Patient’s consent was obtained
Gold criteria were applied to label the severity of COPD.

Detailed history & clinical examination was done. Relevant blood tests, X ray chest, 12-lead ECG & ECHO were done.

Standard transthoracic echocardiographic studies were performed.

Apical 4-chamber view and 2 chamber view were used. All data were stored and analysed.

Apical 4-chamber view was used for RA measurements. Planimetry was used to calculate RA area. Simpson’s modified rule was applied. RA volume index was deducted by the echo machine according to height and weight of the person thereby the body surface area.3 consecutive cardiac cycles were studied for averaging all measures.

More than 36 mm was considered as RA dilatation. Normal cut off value for RAVI was taken as 28mL/m², in comparison with 10 normal individuals. More than 6 mm thickness of anterior wall of RV in end-diastole was considered as RVH. Tricuspid regurgitation, dilatation of inferior vena cava and hepatic veins were studied to diagnose RV failure. Tricuspid regurgitation velocity plus estimated RA pressure was used to calculate

Pulmonary artery systolic pressure. More than 25 mm of Hg was considered as pulmonary arterial hypertension (PHT). PHT were divided into two groups with 35 mm of Hg as mid value.
Apical four chamber view was used to measure TAPSE and RV EF.

RV systolic dysfunction was diagnosed if TAPSE < 16 mm and RV EF < 50%. Apical 4-chamber view was used for tricuspid diastolic flow measurement. E/A ratio was used to assess RV diastolic function.

Only 40 patients were co-operative for 6 Minute Walk Test (MWT).

Their walking distance was compared for the RAVI. Normal cut off value of 500MTS was arrived through 10 healthy volunteers.

Mean value± standard deviation (SD) was derived.

The correlation between RAVI and the severity of RV systolic and diastolic dysfunctions were analysed using the ANOVA TEST. Relationships between other echocardiographic variables and RAVI were evaluated.

**Statistical Methods:**
1) Descriptive statistics
2) Univariate & Multivariate analysis

Software used-IBM SPSS version-21

### 3. Observations & Analysis

Among 100 cases studied, 90 were males and 10 were females.

Age group ranged from 40 yrs to 82 yrs.

Majority belonged to the age group of 51-60yrs.

Among males, 54 pts were smokers and none females were smokers.

COPD Severity Gold (Criteria)
MILD – 38 cases
MODERATE – 47 cases.
SEVERE -15 cases.

RA Measurements: cm/m2

RA AREA index cm/m2: Ranging from 8.5+-2.4 cm/m2 for mild cases, 10.7+-1.5 cm/m2 for moderate COPD and 12.0+-2.1 cm/m2 for severe COPD CASES. (P VALUE <0.01)

LONG AXIS index cm/m2: Ranging from 3.0 to 4.3 cm/m2 (3.2+-0.2 cm/m2 for mild COPD, 3.4+/-.05 cm/m2 FOR MODERATE COPD and 3.7+/-.06 cm/m2 for severe COPD.) (P VALUE 0.23)

SHORT AXIS index cm/m2: Ranging from 1.5 to 2.9 cm/m2 according to COPD SEVERITY. (P VALUE 0.14)

RVH mm: 5.1 to 9.2 mm (6.5+/-.14 mm for mild, 7.0+/-.12 mm for moderate and 7.8+/-.14mm for severe COPD.

RV Dilatation mm: 25.2 mm to 33 mm (26.4+/-.1.2 mm for mild, 29.5+/-.1.5 mm for moderate and 31.5+/-.1.5mm for severe COPD RV EF %: 28 to 36 % (34+/-.2.0 % for mild, 31.5+/-.1.5 % for moderate and 29.5+/-.1.5 % for severe COPD.

RAVI of 25.2+/-.2.2 ML/ M² FOR MILD COPD. 28 +/-1.5 ML/M² FOR MODERATE COPD AND 33.4+/-.1.2 ML/M² FOR SEVERE COPD (P VALUE <0.001).

RAVI of 26.5+/-.1.4 ML/M² FOR MILD PHT AND 30+/-.1.2 ML/M² FOR SEVERE PHT (P VALUE<0.001). 

RAVI of 30.5+/-.4.1 ML/M² FOR RV DIASTOLIC DYSFUNCTION VS 24.2+/-3.2 ML/M² FOR NORMAL RV DIASTOLIC FUNCTION. (P VALUE <0.001)

RAVI VS RV DILATATION: 30.0+/-.1.4 ml for dilated RV vs 24.2+/-2.2 ml for normal RV. (P VALUE<0.001)

RAVI OF 30+/-.1.5 ML/M² FOR DECREASED TAPSE VS 25.2+/-.2.2 ML/M² FOR NORMAL TAPSE (P Value <0.001).

RAVI OF 31.7+/-.MML/M² FOR 6MWT OF 251 MTS VS 25.2+/-.2.2 ML/M² FOR 478MTS. (P Value <0.001)

RAVI was increased in 68% of cases.
4. Discussion

Echocardiographic study for RA size in COPD was done by many authors (1-9). In this study, RA area indices, long axis and short axis indices were directly proportional to the severity of COPD. However, only RA area index increment in relation to severity of COPD is statistically significant. (p value <0.001).

In the present study, RAVI increment in relation to severity of COPD is also statistically significant (p value <0.001).

Linear measurements were studied by Oben Baysan and others (10, 3, 4, 11-21) and compared with volumetric quantification of right atrium in COPD. Volumetric quantification of the right atrium is very useful than linear measurements (10, 3, 4, 11-21).

In our study, right atrial area and volume reflect the RV function and is correlated with pulmonary hypertension due to COPD. Similar observations were noted by others also. (22-26).

In our study RAVI is not significantly affected by gender.

Lang RM et al (19) observed that RA volumes are affected by gender but RA volume index is more or less same for both genders.

RA size correlates with RV diastolic and systolic dysfunctions (27-30). In our study, Right Atrial Volume Index is associated with Right Ventricular dysfunction. (p value <0.001)

In our study, RAVI increases significantly with severity of PHT. (P value <0.001) Giovanni Cioffi et al (31) found that increased RA size is an early sign and has negative impact in PH.

Similar findings were observed by Agoston Coldea, et al (7).

In the present study, RAVI increases in relation to RVDD, as observed by Nagueh SF (29).

In the present study, RAVI increases with increase of RV wall thickness (RVH).
RAVI is correlated to indices of RV systolic dysfunction (RV dilatation TAPSE and RVEF).

Sallach et al concluded that RAVI reflects RV dysfunction severity (9).

In our study, RV systolic dysfunction and elevated pulmonary systolic pressure are independently related to RAVI. Agoston-Coldea et al (7) concluded that in COPD, RAVI correlates with PHT and RV Systolic dysfunction.

We observed the inverse correlation between RAVI and six minute walk distance.

Zh. Cherneva et al (32) noted that higher RAVI is directly proportional to increased pulmonary artery pressure and increased E/e ratio and decreased six minute walking distance.

Cuttica MJ et al observed the relation between right heart changes and exercise capacity in COPD (24). Increased RAVI is related to low functional capacity and higher mortality (33).

Vikram B Vikhe et al studied the 2D echocardiographic findings as cardiovascular complications in COPD. (34). They noticed increased RAVI in 34% of COPD. They compared their echo findings with Himelman’s observations. (35). They observed elevated RAVI in 89% of COPD.

We noticed that increased RAVI in 68% of COPD according to severity of COPD.

5. Conclusion

Our study reveals that increased RAVI is correlatve with severity of COPD, severity of pulmonary arterial hypertension, RV diastolic dysfunction and RV systolic dysfunction. Increased RAVI in COPD is associated with decreased work capacity.

References:


[34] Vikram B Vik et al. 2D echocardiographic findings as cardiovascular complications in COPD. NATIONAL JOURNAL OF MEDICAL RESEARCH: Volume 3 | Issue 4 | Oct – Dec 2013 Page 385