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Dr. Prasad Sudhir
Associate Professor, Department of Respiratory Medicine, Prathima Institute of Medical Sciences, Karimnagar, Telangana, India

Dr. Madire Ramulu
Assistant Professor, Department of Respiratory Medicine, Prathima Institute of Medical Sciences, Karimnagar, Telangana, India

Dr. Chenimilla Nagender Prasad
Professor, Department of Respiratory Medicine, Prathama Institute of Medical Sciences, Karimnagar, Telangana, India

Corresponding Author:
Dr. Madire Ramulu
Assistant Professor, Department of Respiratory Medicine, Prathima Institute of Medical Sciences, Karimnagar, Telangana, India

An observational study of the association between the type and extent of bronchiectasis with the findings of spirometry, ABG and 2D Echo

Dr. Prasad Sudhir, Dr. Madire Ramulu and Dr. Chenimilla Nagender Prasad

Abstract
Background: Bronchiectasis is an airway disease characterized by abnormal and permanent dilatation of the bronchi, affecting the proximal and medium-sized ones (>2mm in diameter). It is an uncommon disease, most often secondary to an infectious process, that results in the abnormal and permanent distortion of one or more of the conducting bronchi or airways.
Objective: To assess whether the type and the extent of bronchiectasis have any correlation with pulmonary arterial hypertension and right heart dysfunction and in turn to correlate these findings with the impairment of lung function and pulmonary gas exchange.
Material & Methods
Study Design: Prospective cross-sectional study.
Study area: Dept. of. Respiratory Medicine, Prathima Institute of Medical Sciences, Karimnagar, Telangana.
Study Period: Feb. 2016 - July. 2016.
Population: Patients with clinical features and CXR findings consistent with Bronchiectasis are subjected to HRCT Thorax, for confirmation of disease and to assess extent of involvement.
Sample size: study consisted a total of 30 patients.
Sampling method: Simple Random sampling method.
Ethical consideration: Institutional Ethical committee permission was taken prior to the commencement of the study.
Study tools and Data collection procedure: Written informed consent has been obtained from all the patients before enrolment in the study. Patients with clinical features and CXR findings consistent with Bronchiectasis are subjected to HRCT Thorax, for confirmation of disease and to assess extent of involvement, along with all routine analysis (Hb%, TC, DC, ESR, RBS, Serum creatinine, blood urea). Arterial blood gas analysis is done at room air and the patients are subjected to Spirometry and 2D Echocardiography. Patients are screened for sputum AFB, gram staining and culture sensitivity.
Results: The age range of the study population is 14 to 75 years. Mean age is 41.5 years (SD is +/- 15.25 yrs). 20 out of 30 (66.6%) patients have presented in the most economically productive age group (21-50 years). More number of cases are noted in the age group 31-40 (9/30 patients i.e., 30%).
Conclusion: It is concluded that ventilatory defects, abnormal gas exchanges, development of Pulmonary Hypertension and right ventricular dysfunction are more common in cystic than in cylindrical type of bronchiectasis.

Keywords: Bronchiectasis, right heart dysfunction, pulmonary arterial hypertension

Introduction
Bronchiectasis is an airway disease characterized by abnormal and permanent dilatation of the bronchi, affecting the proximal and medium-sized ones (>2mm in diameter). It is an uncommon disease, most often secondary to an infectious process, that results in the abnormal and permanent distortion of one or more of the conducting bronchi or airways.
Bronchiectasis was a common disabling and fatal condition in the pre-antibiotic era, but after the advent of antibiotics, introduction of childhood immunization against measles and pertussis, the advent of improved social and living conditions, improved sanitation and nutrition, the incidence has decreased in developed countries. However in developing countries, the incidence has not decreased much. Currently no systematic data are available on the incidence or prevalence of bronchiectasis.

The differences in prevalence between age groups are a direct reflection of the differences in prevalence of the underlying causes of bronchiectasis, lung disease, and/or chronic infections [1]. No racial predilection exists other than those that may be associated with socioeconomic status. Evidence suggests that non- Cystic fibrosis-related bronchiectasis is more common and more virulent in women, particularly slender white women older than 60 years. In these patients, bronchiectasis is often caused by primary *Mycobacterium avium* complex (MAC) infection and has been called the Lady Windermere syndrome, named after a character in a novel by Oscar Wilde [2, 3, 4].

The diagnosis of bronchiectasis is based on history, clinical features, and radiologic demonstration of bronchiectasis airways. The classic clinical manifestations of bronchiectasis are daily cough and mucopurulent sputum production. Cough is invariably present and often may be the only symptom for years. Purulent, tenacious sputum production, frequently worse in the morning (having accumulated during recumbency in sleep) is present in most patients. "Dry bronchiectasis" presenting as cough, minimal sputum expectoration, and/or hemoptysis is occasionally described. Hemoptysis occurs in 56-92% of patients with bronchiectasis. Hemoptysis is more commonly observed in dry bronchiectasis. Massive hemoptysis may occur but is rarely a cause of death [5, 6, 7].

Since bronchiectasis continues to be a common disease in our country with significant sequelae, this study was undertaken to correlate pulmonary hypertension with impairment of lung function and pulmonary gas exchange in patients with Bronchiectasis.

Objective: To assess whether the type and the extent of bronchiectasis have any correlation with pulmonary arterial hypertension and right heart dysfunction and in turn to correlate these findings with the impairment of lung function and pulmonary gas exchange.

Material & Methods

Study Design: Prospective cross-sectional study.

Study area: Dept. of. Respiratory Medicine, Prathima Institute of Medical Sciences, Karimnagar, Telangana.

Study Period: Feb. 2016 - July. 2016.

Study population: Patients with clinical features and CXR findings consistent with Bronchiectasis are subjected to HRCT Thorax, for confirmation of disease and to assess extent of involvement.

Sample size: study consisted a total of 30 patients.

Sampling method: Simple Random sampling method.

Inclusion Criteria: Patients who presented with clinical features and CXR findings consistent with Bronchiectasis at Prathima Institute of Medical Sciences, were subjected to HRCT Thorax, for confirmation of disease and to assess extent of involvement.

Exclusion criteria

1. Patients who are smokers / ex-smokers.
2. Patients with hypertensive heart diseases
3. Patients with H/O valvular heart diseases / rheumatic heart diseases and congenital heart diseases, Ischemic heart diseases, Cardiomyopathies.
4. Patients with other concomitant lung diseases like Asthma,
5. Patients with active tuberculosis or its sequelae are excluded from the study.

Ethical consideration: Institutional Ethical committee permission was taken prior to the commencement of the study.

Study tools and Data collection procedure

Written informed consent has been obtained from all the patients before enrolment in the study. Patients with clinical features and CXR findings consistent with Bronchiectasis are subjected to HRCT Thorax, for confirmation of disease and to assess extent of involvement, along with all routine analysis (Hb%, TC, DC, ESR, RBS, Serum creatinine, blood urea). Arterial blood gas analysis is done at room air and the patients are subjected to Spirometry and 2D Echocardiography. Patients are screened for sputum AFB, gram staining and culture sensitivity.

The HRCT scan findings suggestive of bronchiectasis are the following (according to Naidich-criteria) [8]:

The internal bronchial diameter greater than that of the adjacent artery. Lack of bronchial tapering (the same diameter as the parent bronchus for > 2cms). The bronchi may be within 1cm of costal pleura or abutting the mediastinal pleura. Bronchial wall thickening may be seen. A cystic cluster of thin walled cystic spaces may be present, often with air fluid levels. Other findings may be associated with bronchiectasis: Areas of increased and decreased perfusion and attenuation. Tracheo-bronchomegaly. Enlarged mediastinal nodes.

ABG: Arterial blood gases are measured while patients were breathing room air. Blood sample is collected from the radial artery according to the guide lines and is subjected for analysis without any delay. PH, PaO2, $PaCO_2$ are recorded. The normal PH being 7.35-7.45, PaO280-100 mmHg and $PaCO_2$ 35-45 mmHg. Findings outside the range are considered as abnormal. Hypoxemia is defined as a PaO2 of < 60 mmHg and hypercapnia is defined as $PaCO_2$ of >45 mmHg.

Spirometry: Pulmonary function assessment has been measured as FEVI, FVC and percentages of predicted values using the standard protocol from American Thoracic Society [9]. Patients are divided into three groups on the basis of spirometry data.

1. **Obstructive disease:** Defined as FEV1/FVC ratio of less than 70% predicted. FEV1 of less than 80% predicted (FEV1 observed / FEV1 predicted), FVC of greater than 80% predicted.
2. **Restrictive disease:** Defined as preserved FEV1 / FVC ratio > 70%, FEV1 and FVC < 80% of the predicted.
3. **Mixed disease:** FEV1 & FVC < 80% of the predicted and FEV1 / FVC ratio < 70%.

2D Echo and Doppler: The Echocardiographic examination is done by a cardiologist who did not know the aim of the study. Standard measurements are taken with M-mode and Doppler study. The following parameters are

measured. RV function is measured qualitatively. RVSP (right ventricular systolic pressure). Left ventricular ejection fraction (LVEF).

Right Ventricular Systolic Pressure: Tricuspid jet velocity interrogated and RVSP is calculated according to modified Bernouli equation. Right atrial pressure is added based on inferior vena cava collapsibility [10]. Patients considered having pulmonary hypertension when RVSP is more than 30mmHg.

Left Ventricular Ejection Fraction: Left ventricular dimensions are taken and ejection fraction is calculated using Teicholz formula. Normal LVEF is taken between 55-70%.

Statistical Analysis

The data was collected, compiled and compared statistically by frequency distribution and percentage proportion. Quantitative data variables were expressed by using Descriptive statistics (Mean ± SD). Qualitative data variables were expressed by using frequency and Percentage (%). P values of <0.05 were considered statistically significant. Data analysis was performed by using SPSS Version 20.

Observations & Results

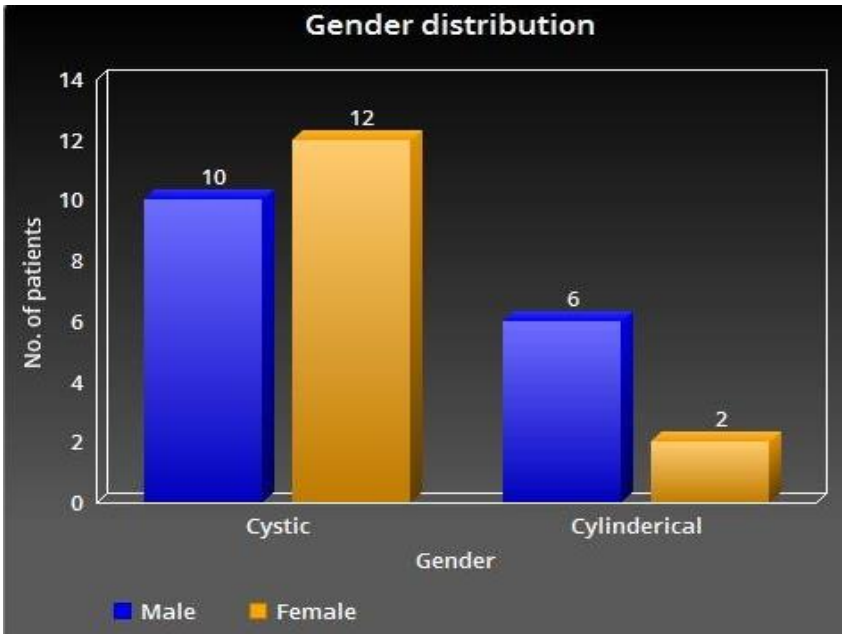

Fig 1: Gender distribution

Of the 30 patients included in the study, 16 patients (53.3%) are men and 14 patients (46.6%) are women.

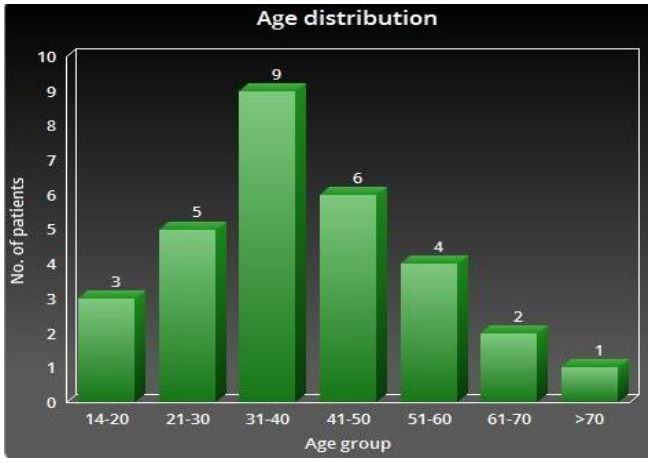

Fig 2: Age distribution

The age range of the study population is 14 to 75 years. Mean age is 41.5 years (SD is +/- 15.25 yrs). 20 out of 30 (66.6%) patients have presented in the most economically productive age group (21-50 years). More number of cases are noted in the age group 31-40 (9/30 patients i.e., 30%).

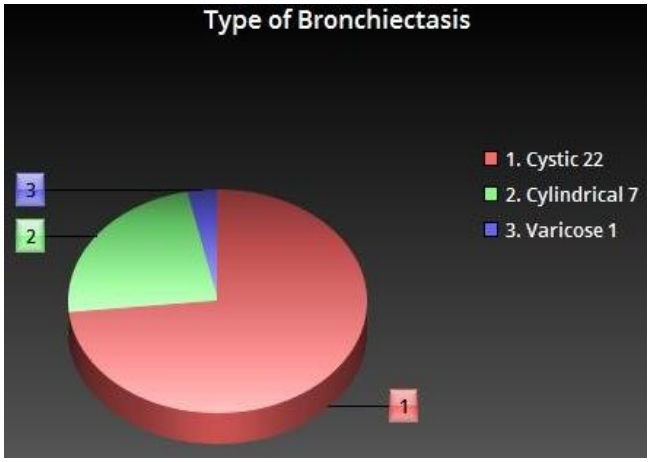

Fig 3: Showing the distribution of different types of Bronchiectasis

Majority of the study group, 73.3% of the patients (22/30) had cystic bronchiectasis and 23.3% of cases (7/30) had cylindrical bronchiectasis, whereas varicose type of bronchiectasis was present in only 1 patient. However varicose variety also had cylindrical type bronchiectasis changes. Therefore for analysis varicose type is included in the cylindrical type of bronchiectasis.

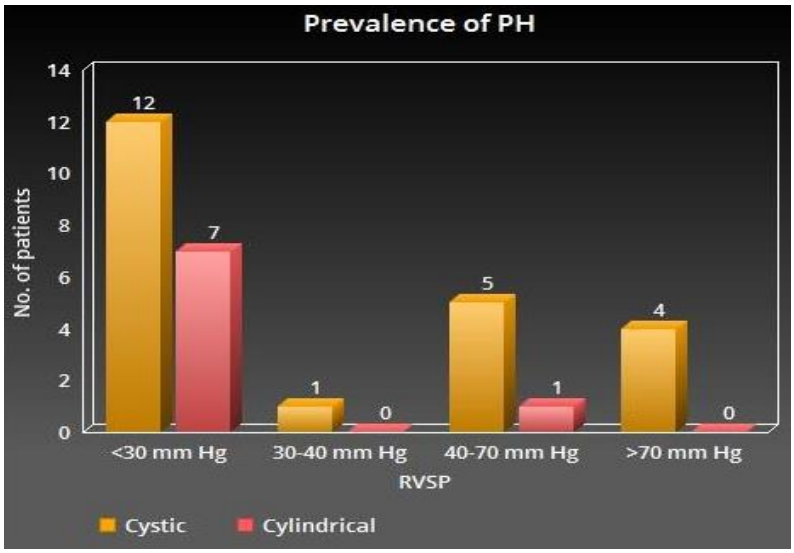

Fig 4: Showing Prevalence of PH in bronchiectasis patients.

Pulmonary hypertension (> 30mm Hg) was found in 11/30 of patients (36.66%), affecting 10/22 of cystic bronchiectasis patients (45.45%) and 1/8 of cylindrical bronchiectasis patients (12.5%). (X^2 = 3.131; Df=3 p value= 0.372) which is not statistically significant. The four patients who had severe PH (RVSP >70mmHg) belonged to cystic bronchiectasis with extensive disease.

Table 1: Table showing extent of involvement with Pulmonary Hypertension in relation to type of Bronchiectasis

Extent of involvement	Cystic		Cylindrical	
	No PH	PH	No PH	PH
Limited	10	8	5	1
Extensive	1	3	2	0
Total	11	11	7	1

When the extent of involvement of bronchiectasis is compared with the development of pulmonary hypertension, no statistical significance is found (p value =0.6985).

Table 2: Table showing Spirometric Analysis

	All cases (n=30) Mean +/- SD	Cystic (n=22) Mean +/- SD	Cylindrical (n=8) Mean +/- SD	Cystic vs Cylindrical (p value)
FEV1/FVC	77.53+/-	75.18+/-	83.13+/-	0.1794
	14.10	14.94	10.53	
FEV1	65.43+/-	62.82+/-	72.63+/-	0.2711
%pred	21.25	21.54	19.96	
FVC %	83.86+/-	84.45+/-	86.38+/-	0.8313
pred	22.37	22.36	19.32	

The lowest observed value of FEVI/FVC in this study was 46, FEVI was 34% of the predicted and FVC was 33% of the predicted which indicates the severe obstruction and restriction.

The mean values FEVI/FVC, FEVI and FVC were lower in patients with cystic bronchiectasis than the mean values in patients with cylindrical bronchiectasis though they are not statistically significant.

Table 3: Table showing ABG analysis

	All cases (n=30) Mean+ /-SD	Cystic (n=22) Mean+ /-SD	Cylindric al (n=8) Mean+/- SD	Cystic vs Cylindric al (p value)
pH	7.380+	7.375+	7.395+/-	0.502
	/-0.068	/-0.075	0.046	
PaO_2	74.57+	72.22+	81.00+/-	0.155
	/-14.80	/-15.42	11.40	
$PaCO_2$	42.20+	42.50+	41.25+/-	0.736
	/-9.06	/-10.53	2.43	

The mean PaO_2 values of the cystic bronchiectasis group are lower and $PaCO_2$ are higher than in cylindrical type. But there is no statistically significant difference in the mean values of PH, PaO_2 and $PaCO_2$ between the two groups.

Table 4: The mean and p- value of Right Ventricular Systolic Pressure

	All cases (n=30) Mean+/- SD	Cystic (n=22) Mean+/-SD	Cylindrical (n=8) Mean+/- SD	Cystic vs Cylindrical (p value)
RVSP	41.80+/- 30.17	47.36+/ -33.37	26.50+/- 8.053	0.0943

Though the mean RVSP is higher in cystic type than cylindrical, it is not found statistically significant (p=0.0943).

Table 5: The mean and p- value of Left Ventricular Ejection Fraction

	All cases (n=30) Mean+/- SD	Cystic (n=22) Mean+/- SD	Cylindrical (n=8) Mean+/- SD	Cystic vs Cylindrical (p value)
LVEF	64.26+/- 4.59	64.22+/- 5.033	64.37+/- 3.335	0.9394

The mean LVEF is slightly lower in cystic group compared to cylindrical type though is not statistically significant.

Table 6: Correlation coefficients for patients with Cystic bronchiectasis

Dependent variable	Independent variables	Correlation coefficient		2-tailed p value
RVSP	FEV1	-	0.235	0.293
	PaO2	-	0.486	0.022*
	PaCO2	+	0.555	0.007**

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

In cystic bronchiectasis patients there is a significant negative correlation between RVSP and PaO_2 (p valve 0.022) and a highly significant positive correlation between RVSP and $PaCO_2$ (p value 0.007) and no significant correlation with FEV_1 (p value 0.293) noted.

Table 7: Correlation coefficients for patients with cylindrical bronchiectasis

Dependent variable	Independent variables	Correlation coefficient		2-tailed p value
RVSP	FEV1	-	0.215	0.608
	PaO2	-	0.734	0.038*
	$PaCO_2$	+	0.459	0.253

*Correlation is significant at the 0.05 level (2-tailed).

In patients with cylindrical type there is a significant negative correlation between RVSP and PaO_2 (p valve 0.038) and no correlation between RVSP and FEV_1 or $PaCO_2$ is found.

Discussion

Bronchiectasis continues to be a clinically significant disease in the developing countries in spite of the advent of antibiotic therapy. Advances in radiologic imaging with HRCT, improved the recognition of early disease and can be useful in evaluating the type, the extent and the distribution of bronchiectasis. Cylindrical bronchiectasis is the mild form of the disease, varicose bronchiectasis being more severe type and cystic form is the most severe type. The vicious cycle of chronic infection and damage to the airways leads to increasingly severe symptoms, physiological impairment manifesting as ventilatory defects, abnormalities in gas exchange and hemodynamic consequences of development of pulmonary hypertension, RV dysfunction and cor pulmonale.

This study is conducted with the aim of understanding the prevalence of pulmonary hypertension in patients with bronchiectasis, and the possible relationship between the type of bronchiectasis and spirometry abnormalities, 2D Echo parameters and ABG abnormalities, so that this knowledge aids in identifying the patients who are at a risk for developing complications like respiratory failure, cor pulmonale and for preventing further deterioration by early detection.

This study comprised of 30 consecutive patients with radiologically proven bronchiectasis (X-Ray Chest, HRCT Thorax) after carefully applying exclusion criteria, of which 14 are females and 16 are males. The youngest of affected is 14 years and oldest patient is 75 years. Mean age is 41.5 years (SD is +/- 15.25 years). 20 out of 30 (66.6%) patients have presented in the most economically productive age group (21-50 years). More number of cases are noted in the age group 31-40 (9/30 patients i.e., 30%).

In the total 30 cases the HRCT findings showed that 73.3% of the patients (22/30) had cystic bronchiectasis and 23.3% of cases (7/30) had cylindrical bronchiectasis predominantly, whereas varicose type of bronchiectasis was present in only 1 patient. However varicose variety also had cylindrical type bronchiectasis changes. Therefore for analysis varicose type is included in the cylindrical type of bronchiectasis. In the study by Gayatri Devi *et al.* [11], they observed 48 cases as cystic, 10 cases as cylindrical and 2 cases as varicose bronchiectasis. In a large study of 261 patients with bronchiectasis by David A. Lynch *et al.* [12], the most common type was cystic bronchiectasis (163/261) followed by varicose type. In another study by Abdulazi Z.H. Alzeer *et al.* [13], about 2/3 of the study group (62/94) had cystic bronchiectasis and the remainder being cylindrical type.

When the duration of symptoms as said by patients is compared with the prevalence of Pulmonary Hypertension, the 7 patients with <1 year of symptomatology are noted to have no PH, whereas 8/16 (50%) with symptoms persisting from 1-5 years had PH and 4/7 (57%) with symptoms for >5 years had PH and this finding shows statistical significance. (Chi-square 6.19; Df=2; p value= 0.04).

Obstruction is the usual predominant ventilator defect in bronchiectasis cases because the presence of infection and inflammation is associated with increased airway

obstruction. The spirometry measurements of the patients in the present study showed that of cystic bronchiectasis have obstructive pattern. The mean values of FEV_1, FVC, FEV_1/FVC are lower in the cystic type than in the cylindrical type, though there is no statistical significance (p value = 0.27, 0.71, 0.19 respectively). 16/30 patients (33%) showed normal spirometry pattern of which six belonged to cylindrical type and ten belonged to cystic type and most of them had single lobe involvement, which can be due to milder form of disease with less extensive involvement.

Obstructive pattern is noted to be predominant in cystic type of bronchiectasis in contrast to the mixed ventilatory defect in the study by Gayatri Devi *et al*. [11]., and in the study by David A. Lynch *et al*. [12] Cylindrical type of bronchiectasis showed normal pattern in 6/8 patients and one case showed restrictive pattern and one case showed mixed pattern abnormality. In other studies by Shah *et al*. [14], Abdulaziz H. Alzeer *et al*. [13] and David A. Lynch *et al*. [31] a weekly significant correlation was observed between the type of bronchiectasis and the mean values of FEV_1, FVC, FEV_1/FVC.

Of the ABG analyses of the bronchiectasis, only 3 out of 30 cases showed hypoxemia with PaO_2 of (<60 mmHg) with 2 cases with cystic bronchiectasis and 1 with cylindrical type. 5 patients showed hypercapnia of $PaCO_2$ (>45 mmHg), all of them belong to cystic type of bronchiectasis. There is no statistically significant difference in the mean values of pH, PaO2 and $PaCO_2$ between cystic and cylindrical groups (p value 0.50, 0.15, 0.73 respectively) in contrast to the significant change in PaO2 in the study by Gayatri Devi *et al*. These findings are also different from Abdulaziz H. Alzeer *et al*. [13], study where the mean $PaCO_2$ was higher and mean PaO_2 was lower in cystic bronchiectasis group than cylindrical group and the difference had statistical significance. ($p < 0.001$).

When the correlation between RVSP and FEV1, PaO2, Pa CO_2 is analysed, the RVSP is found to have a significant negative correlation with PaO2, a strongly significant positive correlation with $PaCO_2$ and no correlation with FEVI in cystic bronchiectasis patients. Abdulaziz H. Alzee *et al*. [13] study showed that RVSP correlated negatively with FEV1 and PaO2 and positive correlation with $PaCO_2$ in cystic bronchiectasis patients. No statistically significant correlation was found between the above parameters in patients with cylindrical bronchiectasis in the study by Gayatri Devi *et al*. [11] and the study by Abdulaziz H. Alzeer *et al*. [13], whereas this study shows a slightly significant negative correlation between RVSP and PaO2 and no significant correlation with FEV1 or $PaCO_2$. However, this suggests that the cylindrical type has more favorable course when compared to cystic type of bronchiectasis. The high RVSP and lower PaO2 and a high $PaCO_2$ suggest a consequence of poor gas exchange on RVSP.

Conclusion

It is concluded that ventilatory defects, abnormal gas exchanges, development of Pulmonary Hypertension and right ventricular dysfunction are more common in cystic than in cylindrical type of bronchiectasis. The significant correlation between RVSP and PaO2 suggests that chronic hypoxia has a central role in development of Pulmonary Hypertension & RV dysfunction. Since Pulmonary Hypertension is seen more frequently with cystic bronchiectasis and therefore can be a useful marker of lung damage.

References

1. Morrissey BM, Harper RW. Bronchiectasis: sex and gender considerations; Clin Chest Med. 2004;25(2):361-72.
2. Wallace RJ. *Mycobacterium avium* complex lung disease and women. Now an equal opportunity disease; Chest. 1994;105(1):6-7 (ISSN: 0012-3692)
3. Iseman MD, Buschman DL, Ackerson LM. Pectus excavatum and scoliosis. Thoracic anomalies associated with pulmonary disease caused by *Mycobacterium avium* complex. Am Rev Respir Dis. 1991;144(4):914-6.
4. Reich JM, Johnson RE. *Mycobacterium avium* complex pulmonary disease presenting as an isolated lingular or middle lobe pattern. The Lady Windermere syndrome"; Chest. 1992;101(6):1605-9.
5. Barker AF. Bronchiectasis; N Engl J Med. 2002;346(18):1383-93.
6. King PT, Holdsworth SR, Freezer NJ, Villanueva E, Holmes PW. Characterisation of the onset and presenting clinical features of adult bronchiectasis; Respir Med. 2006;100(12):2183-9.
7. Flume PA, Yankaskas JR, Ebeling M, Hulsey T, Clark LL. Massive hemoptysis in cystic fibrosis; Chest. 2005;128(2):729-38.
8. Naidich DP, McCauley DI, Khouri NF, Stitik FP, Siegelman SS. Computed tomography of bronchiectasis. J Comput Assist Tomogr 1982;6:437-444.
9. M.R. Miller *et al*., ATS/ERS Task Force: Standardisation of Lung Function Testing, 2005 update. Eur Respir J. 2005;26:319-338.
10. Yock PG, Popp RL. Non invasive estimation of right ventricular systolic pressure by Doppler ultrasound in patients with tricuspid regurgitation. 1984 Oct;70(4):657-62.
11. Yellapu Gayatri Devi, Allena Prem Kumar, Namballa Usha Rani, Sarella Joshua. Correlation between HRCT chest findings, Spirometry, ABG and 2D ECHO in patients with bronchiectasis.; IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) Ver. VII 2015 Aug;14(8):62-67.
12. Lynch D, Newell J, Hale V *et al*. correlation of CT findings with clinical evaluation in 261 patients with symptomatic patients.
13. Right and Left Ventricular Function and Pulmonary Artery Pressure in Patients with Bronchiectasis; Alzeer, Abdulaziz H. *et al*., CHEST, 133(2), 468-473.
14. Shah *et al*. Severity of bronchiectasis correlated with the FEVI and FVC with pearson correlation coefficients.