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ORIGINAL ARTICLE

Clinical and Radiological Assessment of Bronchiectasis

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ABSTRACT

Background: *Bronchiectasis is relatively common disease in developing countries, High-resolution computed tomography (HRCT) is the preferred technique for assessing the structural characteristics of individuals with bronchiectasis.*

Objective: *The objective of this study is to analyse the clinical characteristics of patients diagnosed with bronchiectasis and determine the significance of high-resolution CT scan results in relation to their clinical presentation.*

Methods: *A cross sectional study of 50 consecutive adult patients with bronchiectasis in respiratory department of Baghdad teaching hospital between 1st of September 2015 and end of April 2016, The clinical characteristics of bronchiectasis and the findings of high-resolution computed tomography (HRCT) were evaluated and compared.*

Results: *The average age of the participants, with 70% being men and 30% being females, was 53.44 ± 9.6 years. Additionally, 52% of the individuals were non-smokers throughout their lifespan. The predominant aetiologies of bronchiectasis were tuberculosis (48%), pneumonia (18.4%), and cystic fibrosis (4%). The most common symptoms observed were a productive cough (82%), difficulty breathing (94%), fever (74%), and chest pain (72%). Crackles were observed in 86% of chest examinations, while wheezing was observed in 74%. Types of bronchiectasis in HRCT were cystic in 62%, varicose in 32%, tubular 6%, Involvement was multilober in 46%, diffuse in 18%and right upper lobe in 18%. Of 50 patients, 92% have bronchial wall thickening, whereas 62% show small air way abnormalities, 56%have mosaic pattern. Patients with cystic disease have significant association with productive cough with large amount of sputum, hemoptysis, Crackle and Clubbing ($p < 0.05$), patients with small air way abnormalities in HRCT have significant correlation with chest pain, dyspnea and amount of sputum ($p < 0.05$). Patient with diffuse lobe distribution on HRCT have daily significant quantities of sputum production ($P < 0.05$), while multilober distribution have a significant association with dyspnea and wheeze ($P < 0.05$).*

Conclusion: *Clinical finding in patients with bronchiectasis have significant correlation with HRCT chest finding which be used for monitoring activity of disease.*

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Keywords: *bronchiectasis, HRCT, amount of sputum , bronchial wall thickening, mosaic pattern. Lobes distribution*

1. INTRODUCTION

Bronchiectasis is characterised by the permanent enlargement of one or more bronchi, accompanied by persistent inflammation of the airways, chronic generation of sputum, frequent chest infections, and restriction of airflow (1). It signifies the final phase of several pathological processes that result in the death of the bronchial wall and its surrounding supportive tissues. In the time before antibiotics, it was a frequently occurring and deadly ailment, and it continues to be more prevalent in places of the world with limited access to medical care (2). The condition is becoming less common, with a reported prevalence of 4.2 cases per 100,000 individuals aged 18 to 34 years and 272 cases per 100,000 individuals in the United States. among individuals aged 75 years or older. The decrease in the occurrence may be attributed to the timely management of mild instances and the extensive utilisation of high-resolution chest CT (HRCT) scanning, efficient anti-tuberculous treatment, and immunisation against pertussis and measles (3-7). The global incidence of bronchiectasis is undetermined. Bronchiectasis remains common in specific communities in Hong Kong, characterised by elevated incidence of respiratory tract infections during childhood and limited availability of healthcare facilities (8). The frequency of bronchiectasis in Saudi Arabia has not been extensively researched. However, it has been shown that bronchiectasis accounts for only 5% of the cases with chronic persistent cough in the adult population, as reported at a pulmonary clinic (9). The exact cause of bronchiectasis is unknown in many cases, and in others it may differ depending on the underlying cause, resulting in a descriptive understanding of the disease's mechanisms. The gross pathology findings indicate long-term alterations, making it uncommon to observe the first injury-related changes that are believed to cause the initial blockage of the airway. Bronchiectasis primarily causes aberrant dilation of the medium-sized bronchi, but it often extends to the distal bronchi and bronchioles (10). The pathophysiology of bronchiectasis involves an initial insult, typically of viral nature, that causes damage to the airways. Disrupted anatomical structure results in the subsequent colonisation of bacteria, which continues the inflammatory process and harms the mucociliary escalator. This hinders the elimination of microorganisms and results in additional harm to the airways. The major airways and bronchioles are affected, exhibiting mucosal

edoema, inflammation, and ulceration. Secretions cause blockage in the terminal bronchioles, resulting in a decrease in volume. An ongoing and persistent inflammatory response occurs in the host, accompanied by the creation of harmful free radicals and the release of neutrophil elastase, which exacerbates the inflammation. Intermittent haemoptasis can occur due to bronchial neovascularization, characterised by the enlargement and twisting of the bronchial arteries, which are under systemic pressure (1). Bronchiectasis is microscopically linked to changes in the airway epithelium, specifically the transformation of mucus cells and a reduction in ciliated cells. Cuboidal and squamous metaplasia are more common in other places. Frequent and significant infiltration of the bronchial wall with neutrophils, lymphocytes, and monocytes is a typical occurrence. Additionally, there is an enlargement of the bronchial glands and an excessive growth of lymphoid tissue (10).

2. METHODOLOGY

Patients (study subjects):

This hospital based cross sectional study included 50 consecutive adult patients with bronchiectasis in respiratory department of Baghdad teaching hospital in medical city between 1st of September 2015 and end of April 2016.

The diagnosis of bronchiectasis was based on clinical history and confirmed by HRCT scanning of chest after review by a consultant radiologist.

Data collection:

All 50 participants underwent a comprehensive clinical evaluation at the respiratory outpatient department of Baghdad teaching hospital. This evaluation included a questionnaire to document their general and pulmonary health information.

The information collected consisted of demographic data (age and sex) as well as smoking habits. A smoker was defined as an individual who, during the study, consumed any tobacco product on a daily or occasional basis. An ex-smoker was defined as someone who used to smoke daily but currently does not smoke at all. A never-smoker was defined as an individual who has never smoked at any point in their life.

Clinical characteristics (including the presence of cough and sputum volume) The sputum volume was estimated by comparing it with the volume of a teacup. Additional information

was gathered on the occurrence of rhinosinusitis, chest discomfort, haemoptysis, fever, fatigue/lethargy, and the frequency of exacerbations over the preceding 5 years. Exacerbations were defined as a sustained deterioration in the patient's clinical condition, characterised by an increase in sputum volume, dyspnea, or fever.

Participants were queried regarding the initiation and advancement of their symptoms, any respiratory illnesses experienced during childhood such as pneumonia, measles, or inhalation of foreign objects, as well as their medical history pertaining to pulmonary tuberculosis and bronchial tumours. Observations from the physical examination were also documented.

Radiologic diagnosis:

After doing a chest HRCT scan, it was determined that all the patients had bronchiectasis. The scan involved obtaining high-resolution images while the patients were lying down and taking deep breaths. The images were taken at 1 mm intervals and 10-mm intervals from the top to the bottom of the lungs. The patients were also scanned while lying face down and exhaling fully. The HRCT images were separately analysed by radiologists and pulmonologists. The existence of bronchiectasis was determined using the accepted criteria:

• Specific anomalies involve the widening of an airway lumen, making it more than 1.5 times wider than an adjacent blood artery.

• Lack of tapering of an airway toward the periphery.

• Varicose constrictions along airways and ballooned cysts at the end of a bronchus.

Nonspecific findings include:

• Consolidation or infiltration of a lobe with dilatation of the airways.

• Thickening of the bronchial walls was defined by an internal diameter of bronchus < 80% of its external diameter.

• Mucous plugs and a reduction in vascular markings similar to that seen in emphysema.

• The mosaic pattern of lung attenuation is characterised by areas of varied parenchyma attenuation in a lobular or multilobular distribution during the expiratory phase.

The extent of the bronchiectasis was evaluated according to the number of pulmonary lobes affected to lober, multilober (2-3 lobes), diffuse (more than 3 lobes).

3. RESULTS

There were 50 patients diagnosed with bronchiectasis included in the study. The demographic information and smoking habits of the patients are displayed in (**Table 1**). The mean age of the patients was 53 ± 9.61 years, ranging from 11 to 98 years. The age range of 40 to 70 years encompassed the majority of patients as presented in (**Figure 1**). The male population constituted the majority, accounting for 70%. Out of the total of 50 patients who had a history of smoking, 24 of them, which accounts for 18% of the total, were still smoking at the time they were presented. The majority of individuals had a history of chronic productive cough (**Table 2**). 36.4% of the patients exhibited cystic type bronchiectasis as observed in HRCT scans. Among these patients, the majority (82%) also reported daily sputum production, which was typically mucopurulent and averaged at 1.4 cups (about 336 ml) each day. Out of all the patients, 94% reported experiencing dyspnea, which was mostly of mild intensity. Approximately 72% of the patients (36 individuals) had chest pain, which was typically either pleuritic or musculoskeletal in origin. Fever was observed in about 37 patients, accounting for 74% of the total. Hemoptysis, primarily characterised by blood streaks, was reported in 12 patients, representing 24% of the cases. However, only two of these patients were admitted due to experiencing significant hemoptysis. Twenty-two percent of the patients (11 individuals) reported a history of recurrent sinusitis. The majority of patients (68 percent, or 34 individuals) experienced exhaustion or lethargy that significantly impacted their quality of life. A significant percentage of these patients considered this symptom to be the most prominent. The mean duration of disease was 2.26 ±0.925 years, while the frequency of exacerbations was 2.26 ± 1.103 as show in (**Table 3**). The most common outcome of the physical inspection was crackles (86%); wheezes (74%) and (52%) of patients had finger clubbing as presented in (**Table 4**). It was revealed that 78.4% of the patients had an identifiable underlying cause, with post-infectious bronchiectasis being the most prevalent (49.7%) due to tuberculosis (48%) severe pneumonia (18.4%) and childhood infections as measles (4%), there were two patients with cystic fibrosis, one with bronchial tumor and one with Inhalation of foreign body; cystic fibrosis, bronchial tumor and inhalation of foreign body was diagnosed according patient medical recodes (**Table 5**). The high-resolution computed tomography (HRCT) revealed

significant and widespread bronchiectasis, as seen in (**Table 6**). Around 92% of cases exhibit bronchial wall thickening, which is frequently observed alongside bronchiectasis. it but is a variable non-diagnostic feature. Sixty tow percent of cases with small air way involvement and about half of cases 28(56%) with mosaic pattern. The radiologic examination using HRCT, as shown in (**Figure 2**), revealed that the most common kind of bronchiectasis was cystic in 31 instances (62%), followed by varicose (32%) and tubular (6%). Of the 50 patients,9 (18%) had bronchiectasis in more than three lobes(diffuse). Thirty-two patients (46%) had 2-3 lobes with bronchiectasis(multilober), and 18 (36%) had bronchiectasis in a single lung lobe. Bronchiectasis was predominantly observed in the right upper lobe, with a prevalence of 9 individuals (18%). Left upper lobe bronchiectasis was observed in 5 patients (10%), while right middle lobe bronchiectasis was observed in 2 patients (4%).Bronchiectasis was observed in the left lower lobe in 2 patients (4%), while no cases were found in the right lower lobe, as indicated in (**Table 7**). When we study correlation between radiological and clinical finding in patients with bronchiectasis; we found patients with small air way abnormalities, diffuse lobe distribution of bronchiectasis in HRCT usually complained of daily significant quantities of sputum production ($P < 0.05$) as shown in (**Table 8 & Figure 3,4**). Dyspnea was found significantly more in patients with small air way abnormalities, also in patients with multilober distribution of bronchiectasis ($P < 0.05$) as exposed in (**Table 8 & Figure 5**). Chest pain was identified significantly more in patients with small air way abnormalities ($P < 0.05$). We found that duration of illness in patient with bronchiectasis did not modify the distribution of disease in HRCT as shown in (**Figure 6**); also the frequency of Exacerbations per year didn't effected by the disease distribution in HRCT as presented in (**Figure 7**). On examination wheezes as auscultation findings was recognized significantly more in patients with multilober distribution of bronchiectasis ($P < 0.05$) as exposed in (**Table 9 & Figure 8**); while clubbing didn't related to disease dissemination in HRCT as revealed in (**Figure 9**). In this study we found there is significant correlations between the degree of morphologic types of on bronchiectasis CT and the age of patient ($P < 0.05$) mainly in cystic type that was common in age more than 50 years as shown in (**Figure 10**). Patients who complain from chronic productive cough 36.4% of them have cystic type bronchiectasis in HRCT ($P < 0.05$) as presented in (**Table 9**). The patients typically reported a substantial

amount of sputum production on a daily basis, with an average of 6.2±5.16 cups per day. In contrast, patients with non-cystic kinds (tubular or varicose types) only complained of sputum during respiratory tract infections, as shown in (**Figure 11**) ($P < 0.05$). Haemoptasis was significant associated to cystic type bronchiectasis in HRCT ($P < 0.05$) as presented in (**Figure 12**). Crackles, as a finding during auscultation, and finger clubbing were more frequently observed in the cystic variety of the disease ($P < 0.05$), as shown in (**Figures 13 and 14**), respectively.

Table 1. Demographic data on patients with bronchiectasis

Variable		No.	%
Age (years) (mean ± SD)		53.44 ± 9.616	-
Gender	Male	35	70.0
	Female	15	30.0
Smoking History	Non-smoker	26	52.0
	Ex-smoker	15	30.0
	Smoker	9	18.0

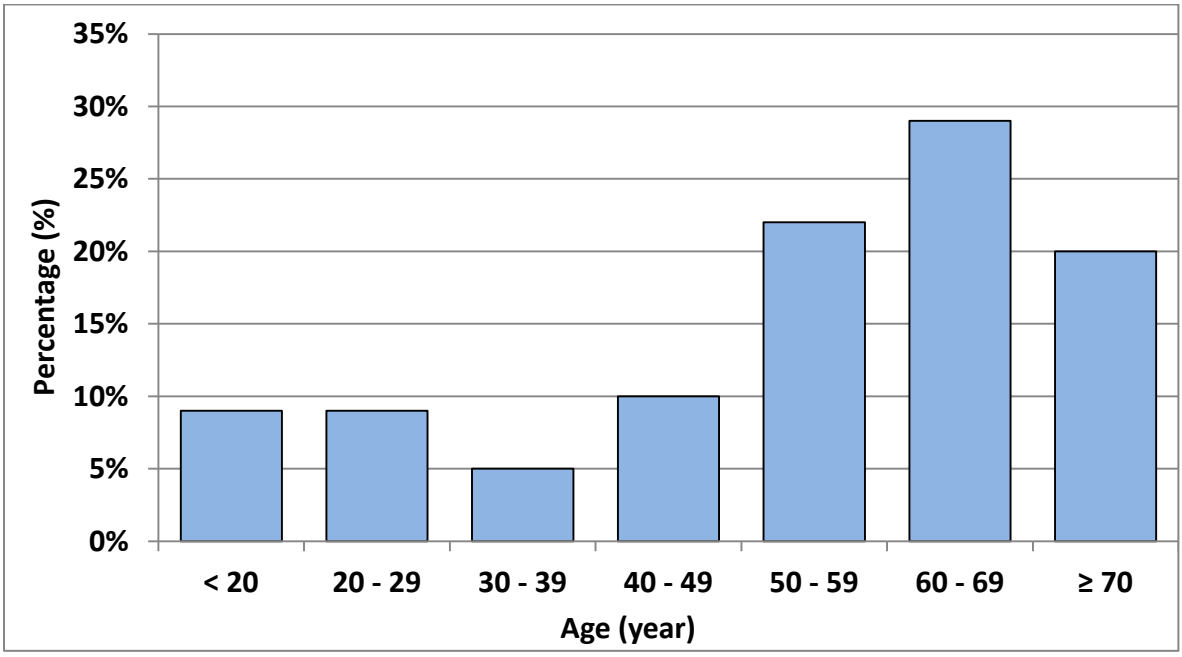

Figure 1. Age distribution of patients.

Table 2. Clinical Findings in patients with bronchiectasis.

Symptoms		No.	%
Cough		50	100.0
Productive cough		41	82
Dry cough		9	18
Sputum volume (cup/ day)	One or less	21	42
	Two	14	28
	Three	3	6
	More than three	3	6
	Mean ± SD	1.4± 1.049	-
Chest pain		36	72
Dyspenia		47	94
Hemoptysis		12	24
Rhinosinusitis		11	22
Fever		37	74
Fatigue		34	68

Table 3. History of illness in patients with bronchiectasis.

History of illness		No.	%
Duration of illness, years	≤1	16	32.0
	2-4	14	28.0
	5-10	11	22.0
	≥10	9	18.0
	Mean ± SD	2.26 ±0.925	-
Frequency of Exacerbations	≤1	5	10.0
	2-4	20	40.0
	5-6	15	30.0
	≥7	10	20.0
	Mean ± SD	2.26 ± 1.103	-

Table 4. Signs in patients with bronchiectasis.

Signs	No.	%
Crackles	43	86.0
Wheeze	37	74.0
Clubbing	26	52.0

Table 5. Etiology of bronchiectasis.

Past medical history	No.	%
Tuberculosis	24	48.0
pneumonia	9	18.4
Cystic fibrosis	2	4.0
Measles	2	4.0
Inhalation of foreign body	1	2.0
Bronchial tumor	1	2.0

Table 6. Radiological findings (HRCT) in patients with bronchiectasis

CT Finding	No.	%
Bronchial wall thickening	46	92.0
Small air way abnormalities	31	62.0
Mosaic pattern	28	56.0

Table 7. Radiologic distribution of bronchiectasis based on HRCT findings*.

Localization	No.	%
Multilobar	23	46.0
Diffuse	9	18.0
Right upper lobe	9	18.0
Left upper lobe	5	10.0
Right middle lobe	2	4.0
Left lower lobe	2	4.0
Right lower lobe	0	0.0

*HRCT = High-resolution computerized tomography; *Frequency of each lobe involvement was calculated separately.

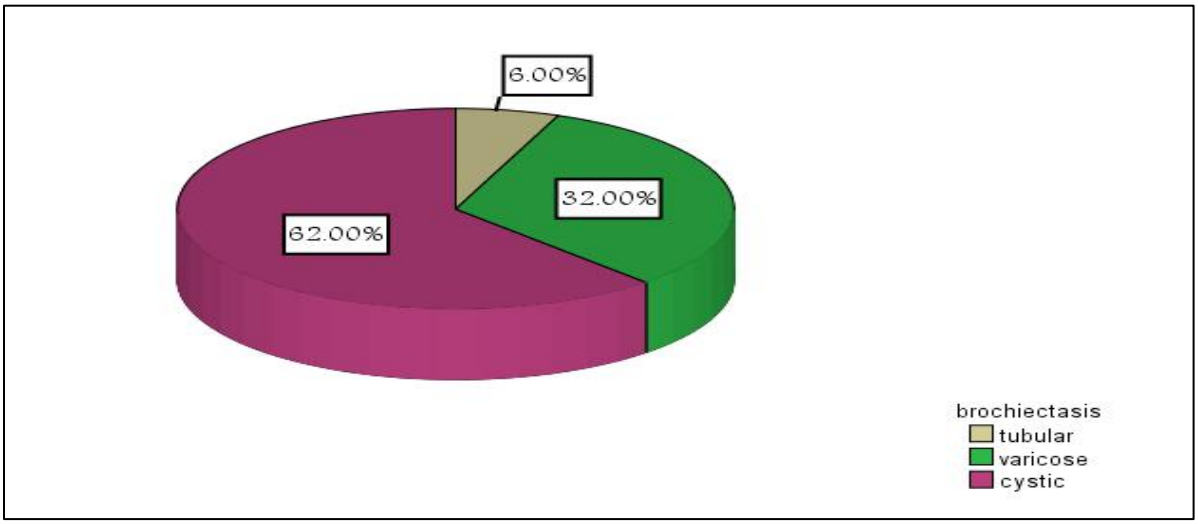

Figure 2. Morphological types of bronchiectasis.

Table 8. Correlation between radiological and clinical finding in patients with bronchiectasis.

Clinical finding	P. value			
	Small air way abnormalities	Bronchial wall thickening	Mosaic pattern	Lobe distribution of bronchiectasis
Cough	0.6	0.3	0.4	0.1
Dyspnea	0.024	0.8	0.7	0.01
Chest pain	0.018	0.9	0.9	0.1
Fever	0.9	0.9	0.6	0.2
Hemoptysis	0.3	0.4	0.8	0.1
Sputum	0.04	0.4	0.02	0.04
Rhinosinusitis	0.9	0.4	0.9	0.4
Duration of illness	0.2	0.6	0.6	0.6
Frequency of Exacerbations	0.4	0.8	0.5	0.27
Crackles	0.26	0.7	0.09	0.6
Clubbing	0.9	0.9	0.7	0.2
Wheeze	0.9	0.9	0.4	0.04

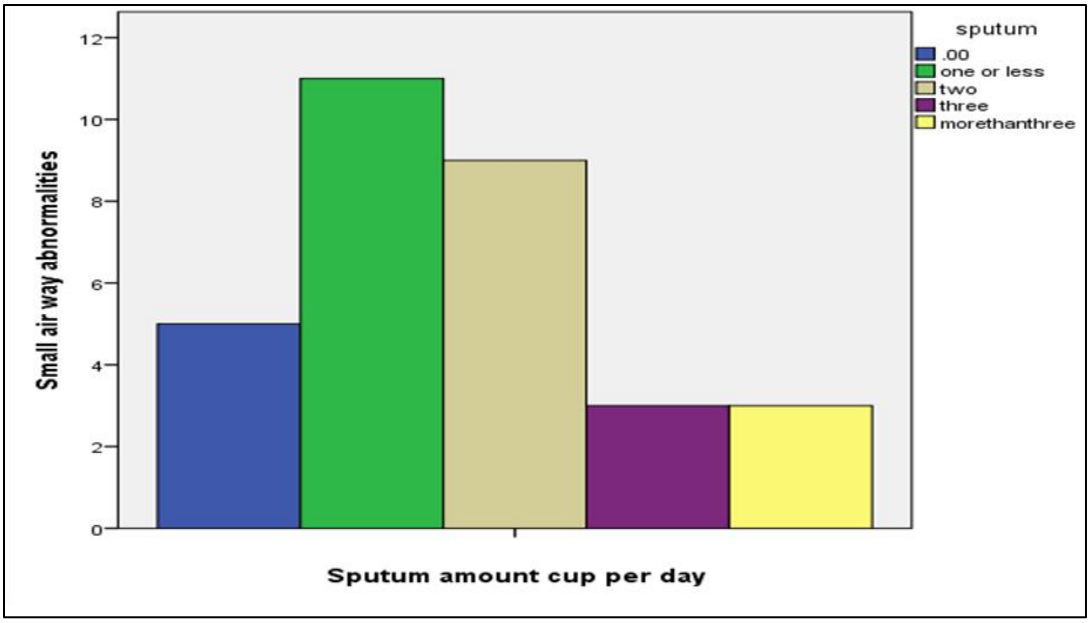

Figure 3. Correlation between sputum amount per day and Small air way abnormalities distribution of bronchiectasis in HRCT.

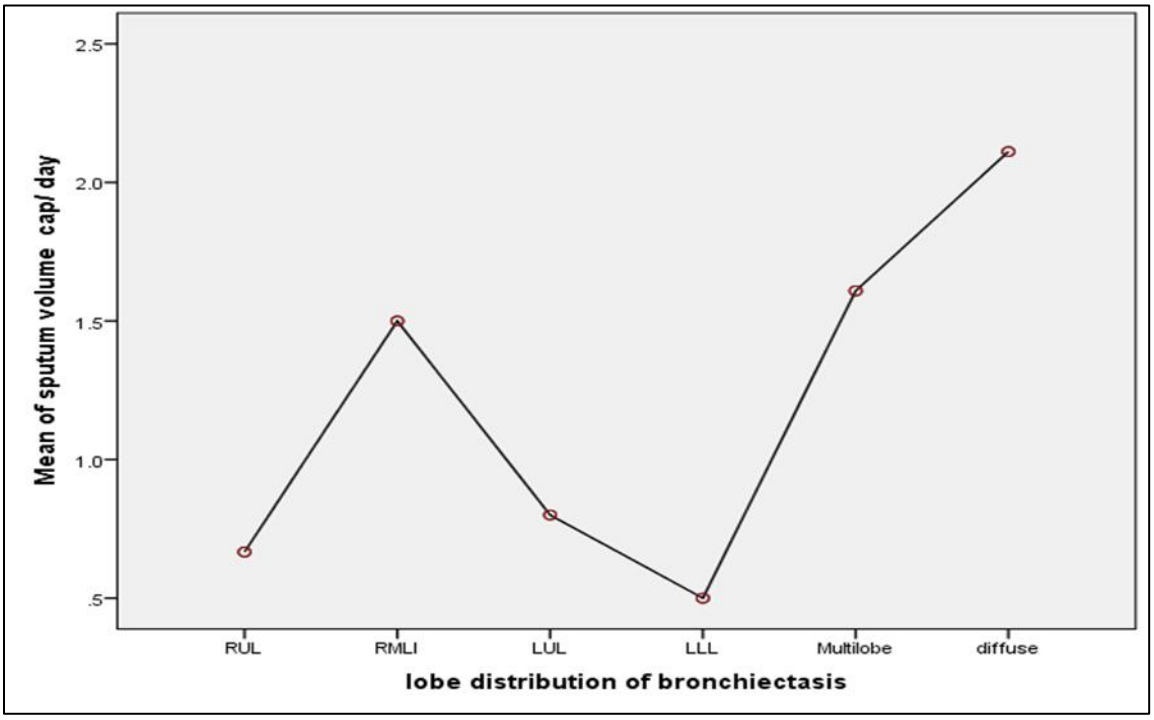

Figure 4. Correlation between sputum per day amount and lobe distribution of bronchiectasis in HRCT. *RUL=Right upper lobe, RML=Right middle lobe, RLL=Right lower lobe, LUL= Left upper lobe , LLL= Left lower lobe

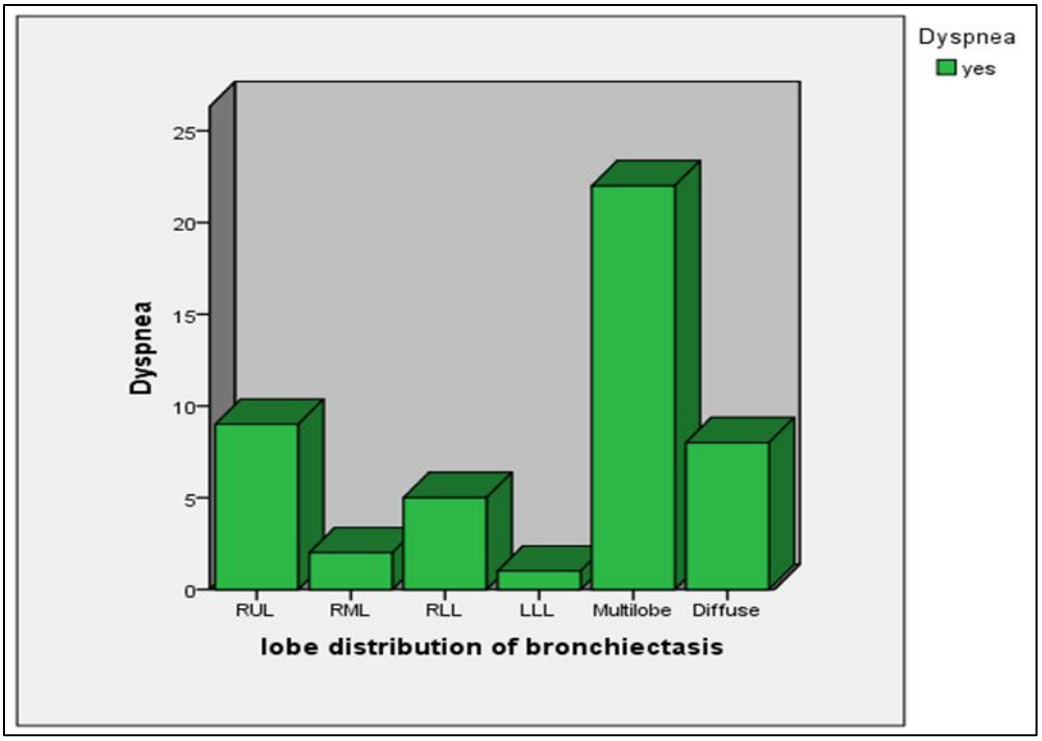

Figure 5. Correlation between dyspnea and lobe distribution of bronchiectasis in HRCT.

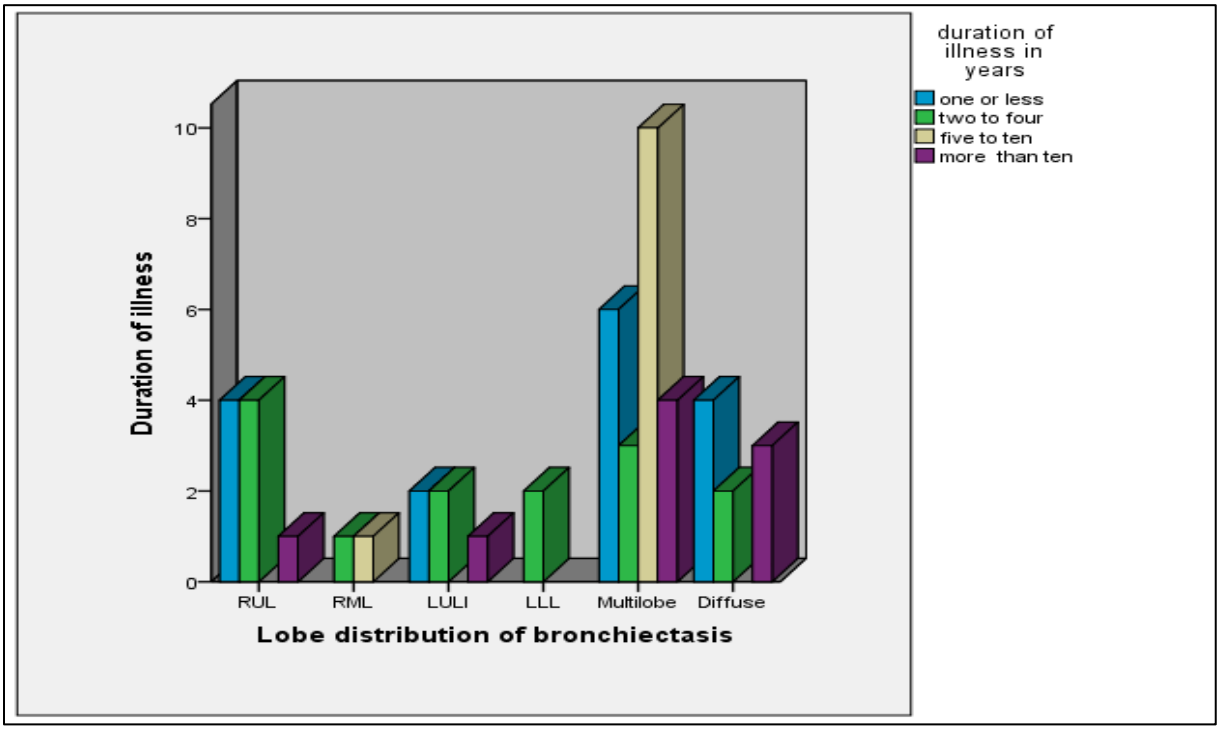

Figure 6. Relationship between duration of illness (years) and lobe distribution of bronchiectasis in HRCT.

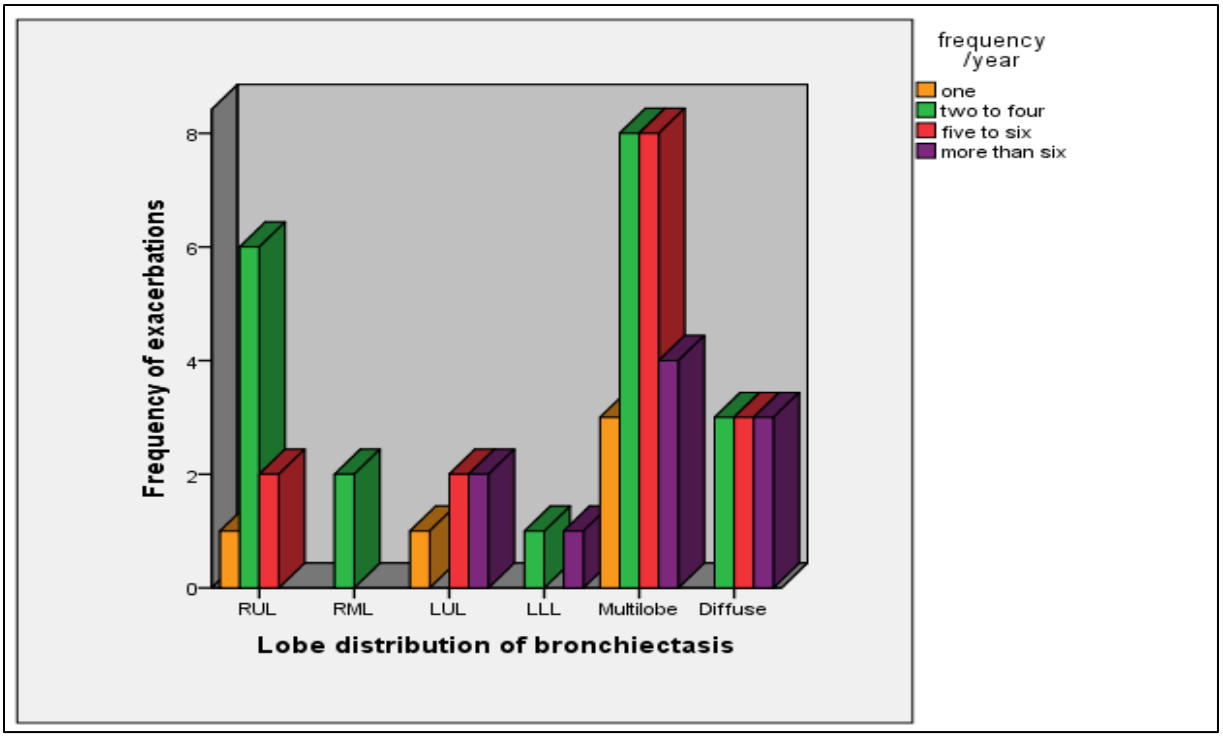

Figure7. Relationship between frequency of Exacerbations per year and lobe distribution of bronchiectasis in HRCT.

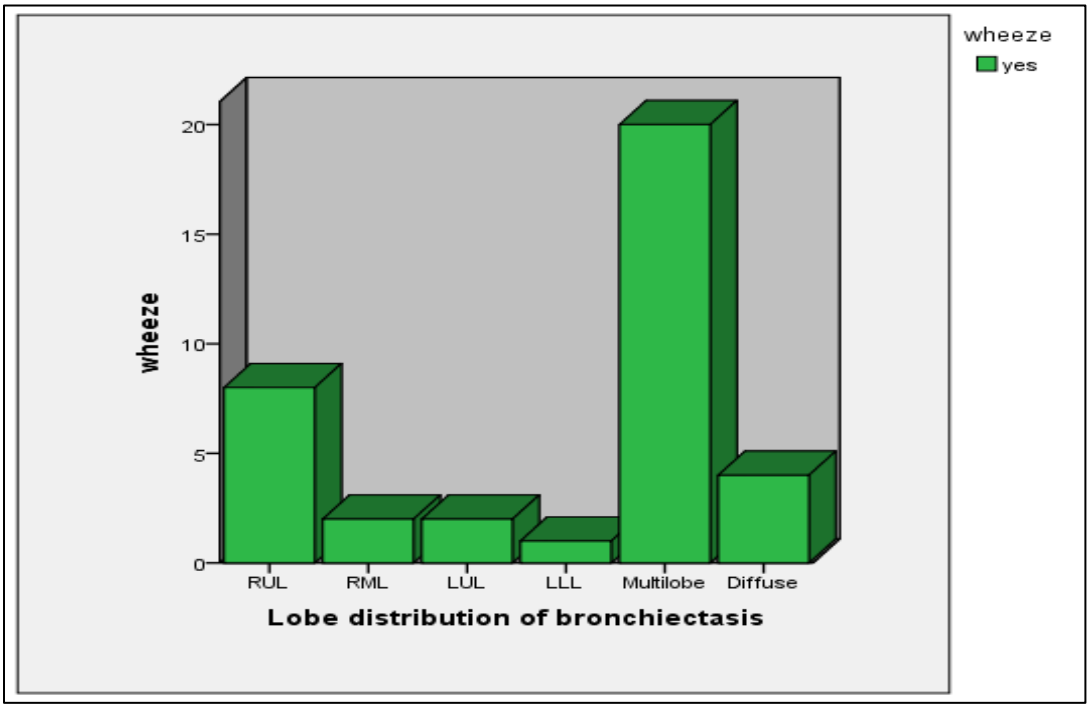

Figure 8. Correlation between wheeze and lobe distribution of bronchiectasis in HRCT.

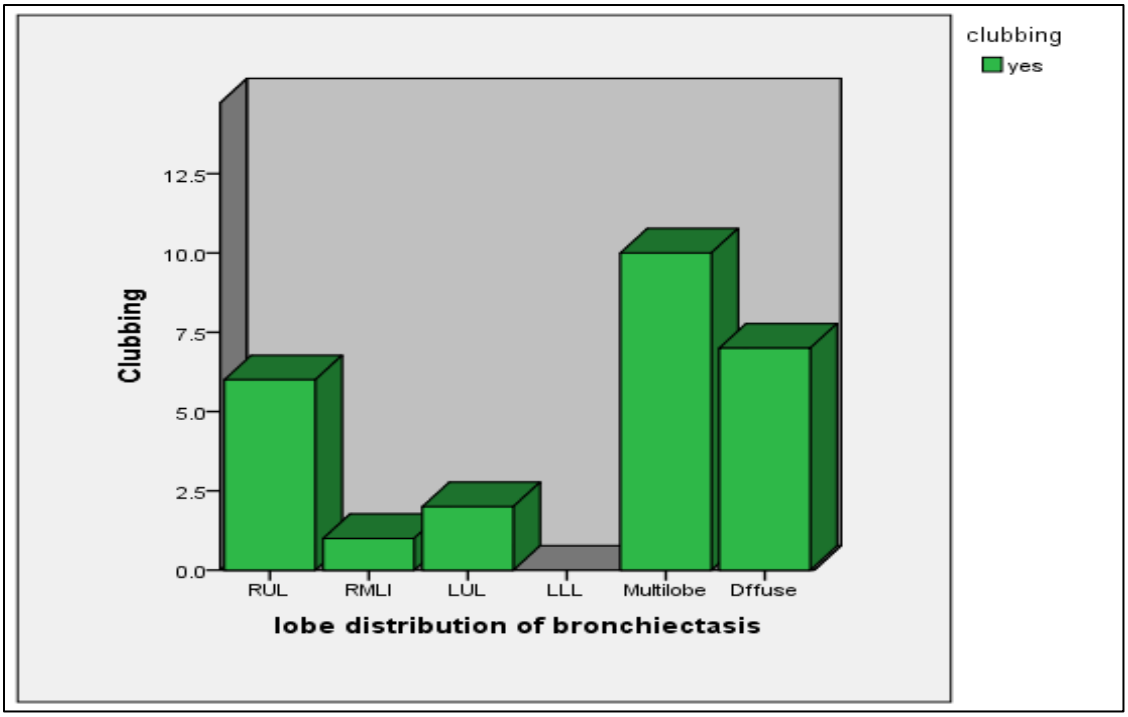

Figure 9. Correlation between clubbing and lobe distribution of bronchiectasis in HRCT.

Table 9. Clinical finding according to bronchiectasis types in HRCT in patient with bronchiectasis.

Clinical finding		Bronchiectasis types			P. value
		Cystic N=31	Varicose N=16	Tubular N=3	
Cough	Dry	5	2	2	0.05
	Productive	26	14	1	
Dyspnea		28	16		0.3
Chest pain		23	11	2	0.9
Fever		23	12	2	0.9
Hemoptesis		7	3	2	0.01
Sputum		6.2 ± 5.16	3.2 ± 2.3	1.5 ± 0.7	0.02
Rhinosinusitis		5	5	1	0.4
Crackles		28	13	2	0.04
Wheeze		31	16	3	0.9
Clubbing		13	12	1	0.03

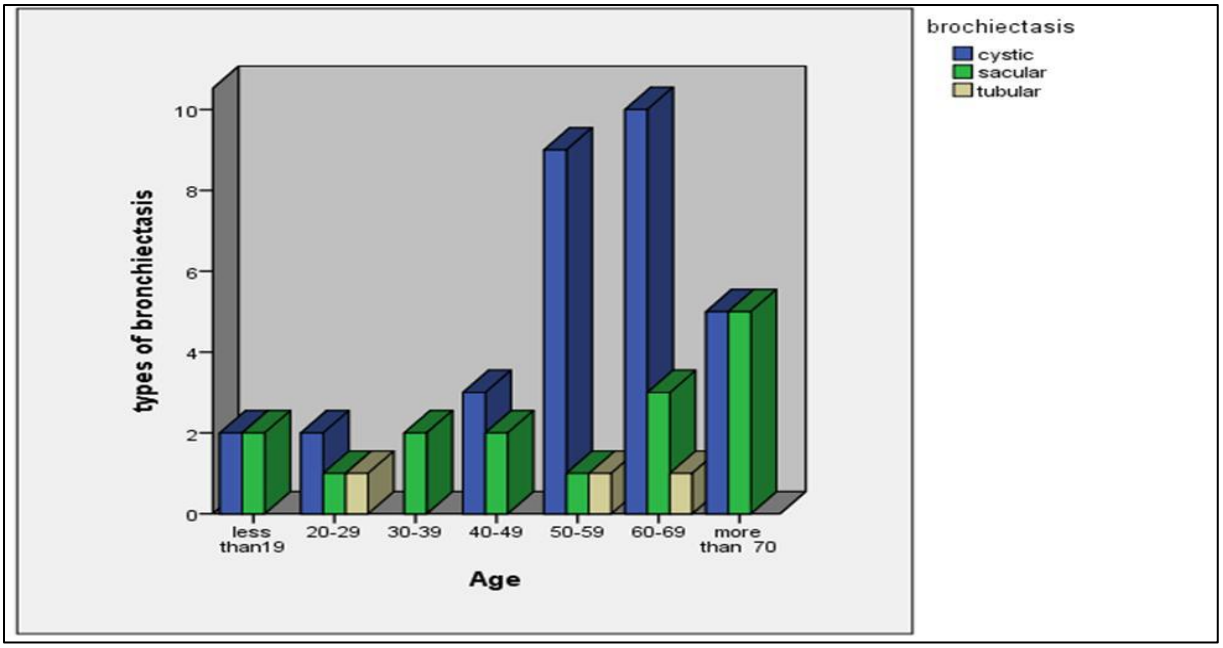

Figure10. Age distribution according to morphological types of bronchiectasis.

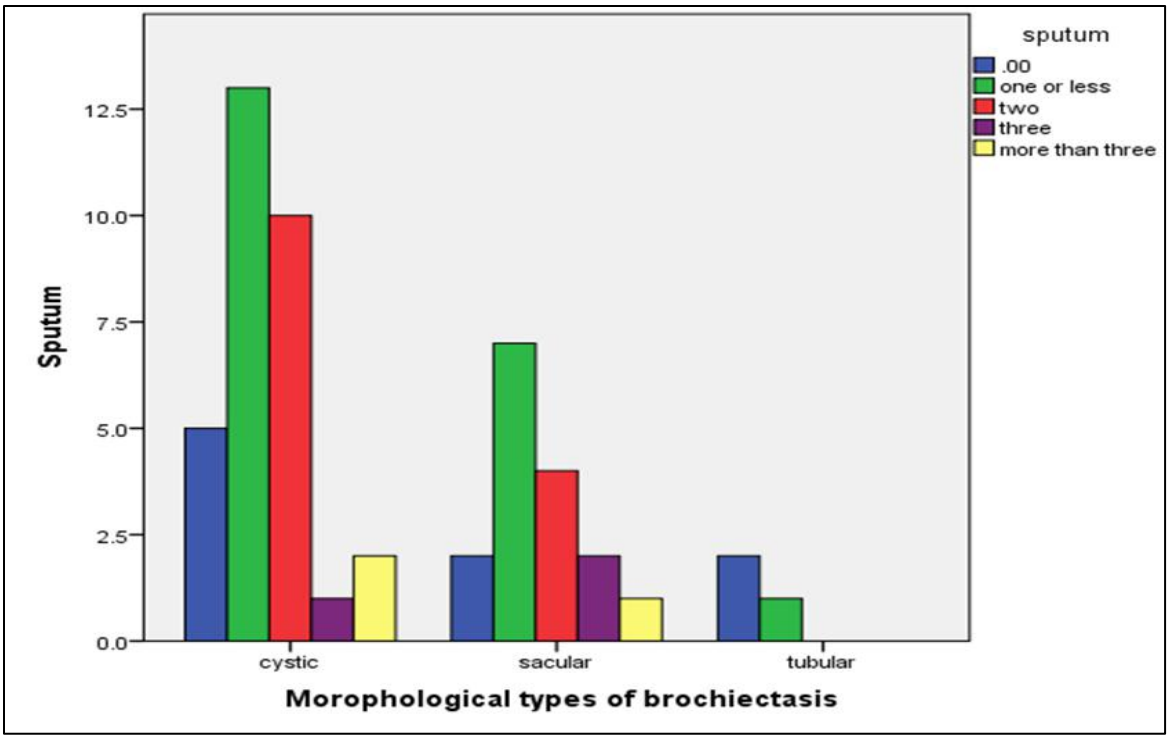

Figure 11. Correlation between amount of sputum per day and types of bronchiectasis in HRCT.

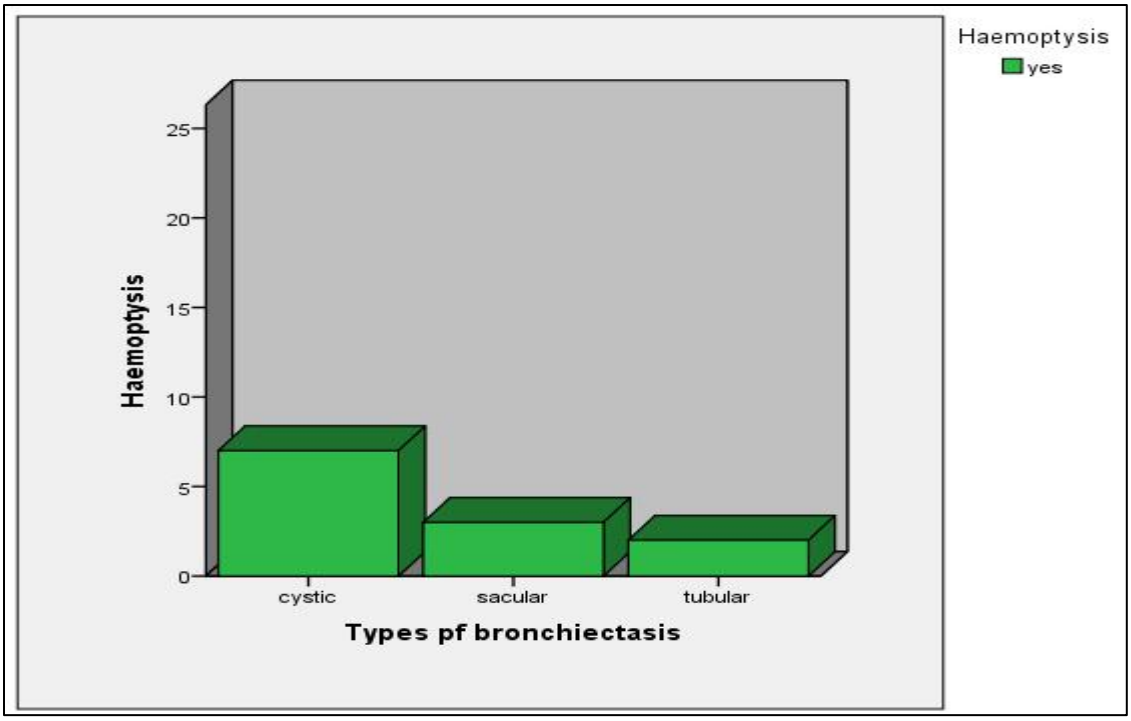

Figure 12. Correlation between haemoptasis and types of bronchiectasis.

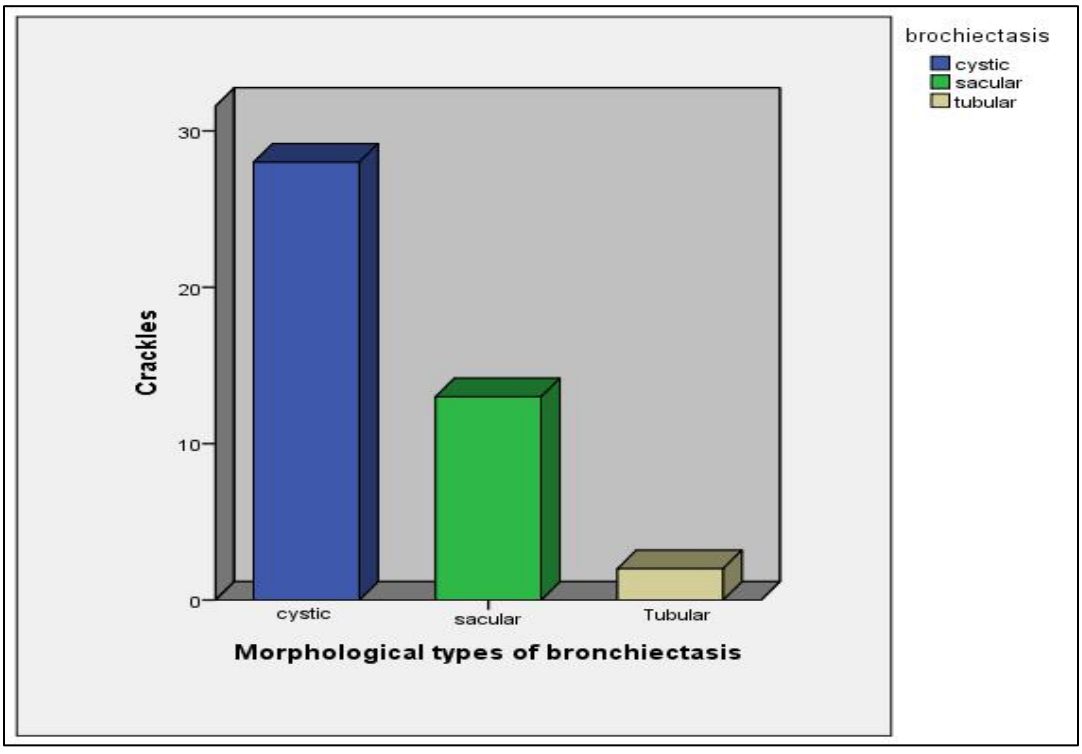

Figure 13. Correlation between crackles and types of bronchiectasis

4. DISCUSSION

The purpose of this study was to assess the structural alterations observed in bronchiectasis using HRCT scanning in patients, and to establish their correlation with other clinical indicators. We conducted a comprehensive evaluation of 50 individuals diagnosed with adult bronchiectasis in order to establish the common symptoms associated with this condition and gain insight into the progression of the disease. Additionally, we aimed to establish a correlation between the clinical course of bronchiectasis and the structural changes observed in the bronchiectasis by high-resolution computed tomography (HRCT) scans. The majority of our patients were found to exhibit symptoms during middle age, primarily as a result of childhood infection. This finding is consistent with previous research conducted by Habesoglu M.A and Onen Z. P, et al. (11,12). Two-thirds of the subjects in this study were male. The cause for this disparity in sex distribution remains unclear. This finding is consistent with previous studies (13,14) but differs from other investigations (12,15-17). The study revealed a substantial proportion of smokers, accounting for 48% of the participants, which is consistent with findings reported in other articles. (18-20); The reason for this may be that many patients have had a productive cough since infancy, which worsened when they started smoking. There is no proof that smoking alone causes bronchiectasis. However, smoking has a harmful effect on both the clearance of mucus and the balance of proteases and antiproteases in the lungs (21). The cause of bronchiectasis in a large number (49.7%) of our patients was postinfectious, which included tuberculosis. The elevated prevalence of postinfective causes that we observed may be attributed to inadequate childhood vaccination and the endemic presence of tuberculosis in our country. This aligns with findings from other research (16,17). This study identified dyspnea as a prominent symptom of bronchiectasis. Previous research has also indicated that dyspnea can serve as a prognostic factor in patients with bronchiectasis. This is because bronchiectasis causes increased airway resistance and reduced elastic recoil, resulting in heightened breathing effort (12). The patients consistently reported a productive cough upon initial examination, with daily production of sputum that was often mucopurulent. The majority of patients, 75% of them, also experienced recurrent fever. At the time of diagnosis, 72% of respondents experienced chest pain, which was either pleuritic or musculoskeletal in character. However,

the symptom that most typically troubled patients was persistent exhaustion or lethargy, with 68% of subjects reporting this. This finding is consistent with prior research (18). Rhinosinusitis is seen in 22% of patients, and although it has not historically been recognised as a main characteristic of bronchiectasis, it has also been reported to be highly prevalent in another study (18). 24% of the patients had a history of hemoptysis. Hemoptysis is occasionally identified as the primary cause of presentation, posing a life-threatening complication, comparable to findings from other studies (11). The typical finding on chest examination was the presence of crackles by auscultation. Wheezing was less common, that due to wheeze occurs as result of airflow obstruction associated with mucous plugging or distorted airway. Clubbing often thought of as being a classic sign in bronchiectasis was found in only 26 patients and this is consistent with another recent study (22), possibly reflecting the milder spectrum of disease didn't reach late stage at time of study. In our study most of the patients have 2-4 exacerbation per year (2.26 ± 1.103), that match with recent studies (23-25). The duration of illness in patients with bronchiectasis in this study was 2.26 ±0.925 years, this dissimilar other study in which duration of illness more longer (26), this possibly due to late diagnosis of disease and small sample of study. Once HRCT has gold standard diagnostic method in bronchiectasis, so it arranged to all patients involved in this study, it showed variety of changes and the most frequent CT finding was bronchial wall thickening, this coincide with other studies (27-29). The main morphological type of bronchiectasis was cystic, this identical to recent studies (11, 15, 27), this due to cystic type is most severe form of disease that usually need medical fallow up.

In this study the extent and severity of bronchiectasis based on HRCT findings show multilober involvement with right side dominant that matching with other studies (11,18,30) We evaluated the relationships between the extent, types and severity of bronchiectasis on CT and clinical symptoms, we found significant correlations between morphologic types on CT and variety of clinical finding mainly productive cough with large amount of sputum, hemoptysis, Crackle and Clubbing. patients with cystic bronchiectasis often complained of significant quantities of sputum this may be due, this result equivalent to other studies (30,31). The dyspnea in patients of our study was significant correlations with multilober involvement in HRCT, while dyspnea in bronchiectasis is probably a multidimensional

phenomenon with airflow obstruction, mucus retention or psychological factors, that resemble to other study (32). The production of sputum in patients with bronchiectasis significantly related to the diffuse extent of bronchiectasis, this matching with a study by Currie et al.(33) but different from study showed that sputum obtained from patients with bronchiectasis induces an intense secretory response in tracheal mucosal cells. Therefore, the overall volume of sputum production may be related more to the intensity of this secretory response than to the extent of underlying bronchiectasis (34). Mosaic attenuation was significantly associated with large daily amount of sputum , whereas small-airway abnormalities were significantly associated with 24-hour sputum volume, dyspnea and chest pain ,but High-resolution CT parameters were not related to the frequency of acute exacerbation, that to comparable to study of Gaik C.et al (35). The study found a connection between the amount of sputum produced in a 24-hour period and the high-resolution CT scan results in patients with bronchiectasis. This suggests that there is a linkage between the morphological features seen on the CT scan and the activity of the disease.

5. CONCLUSIONS

Clinical conclusion: The main cause of bronchiectasis is typically post-infectious, with tuberculosis being the primary infectious cause. There is a weak link between the parameters observed in high-resolution computed tomography (HRCT) and the frequency of exacerbations and duration of disease.

Radiological findings: Morphometric high-resolution CT is a useful tool for assessing disease activity and airway structure in patients with bronchiectasis. Additionally, this imaging technique can assist in the diagnosis of bronchiectasis.

Ethical Approval:

All ethical issues were approved by the author. Data collection and patients enrollment were in accordance with Declaration of Helsinki of World Medical Association , 2013 for the ethical principles of researches involving human. Signed informed consent was obtained from each participant and data were kept confidentially.

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