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The Role of Multi-Slice Computed Tomography for the Assessment of Bronchiectasis

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ABSTRACT

Background: Bronchiectasis is pathological, irreversible dilatation of the bronchi due to destruction of the bronchial wall and the elastic connective tissue. Recurrent infection and inflammation and the resulting chemical and cellular cascade lead to permanent architectural changes in the airways. Bronchiectasis can confer substantial potential morbidity, usually secondary to recurrent infection.

Objective: The aim of the current work was to evaluate the role of Multi-Slice Computed Tomography (MSCT) examination in detection and diagnosis of pulmonary bronchiectasis.

Patients and methods: This study included 60 patients with bronchiectasis detected in their MSCT of the chest referred from the Chest Diseases Hospital to the Radiology Department, Mit Khalaf Hospital Complex, Al-Menoufia.

Results: The most common etiology was post inflammatory bronchiectasis 26 patients (43.3%), followed by traction bronchiectasis 21 patients (35%). The distribution of bronchiectasis in post inflammatory cases was mostly affecting the lower lobes 16 (61.4%) of 26 patients. Regarding traction bronchiectasis, affection was mostly in the upper lobes including 10 (47.4%) of 21 patients. In chronic obstructive pulmonary disease, distribution was mostly in lower lobes with 4 (50%) of 8 patients. In aspiration, distribution was in bilateral lower lobes. In cystic fibrosis, it affected the bilateral upper lobes and in Kartagener syndrome, the distribution was on bilateral lobes. The most common morphological type of bronchiectasis was the cylindrical type which was detected in (25%) of cases followed by the signet ring type with (23.3%) of the cases.

Conclusion: It could be concluded that the role of MSCT in the diagnosis of the pulmonary bronchiectasis is central, accurate and non-invasive.

Keywords: Multi-slice computed tomography, Bronchiectasis.

INTRODUCTION

Bronchiectasis is a permanent irreversible diffuse or localized dilatation of the airways [(1)]. Long-term architectural changes in the airways triggering bronchial dilatation related to many etiologies mainly caused by recurrent infection and inflammation[(2)].

Clinical diagnosis of bronchiectasis is dependent on a history of daily viscid excessive sputum production, so that it is generally misdiagnosed as bronchial asthma or chronic obstructive pulmonary disease (COPD) because of the similarities in clinical findings [(2)]. Bronchiectasis can be caused by different pathological conditions. Acquired causes are more common, such as infection, pulmonary fibrosis, recurrent or chronic aspiration, stenosis, or obstruction of airways by neoplasm, granulomatous disease, broncholithiasis, and asthma. Congenital conditions that cause bronchiectasis include, cystic fibrosis, and cartilage development disorders [(3)]. Bronchiectasis could be a part of numerous multi-systemic diseases, such as cystic fibrosis (CF), immunodeficiencies, alpha 1-antitrypsin deficiency, primary ciliary dyskinesia (PCD), rheumatoid arthritis and inflammatory bowel diseases, especially ulcerative colitis [(2)].

It helps to identify the cause, as it is useful in the management decision, minimizing further damage to the airways through inflammation reduction, infection prevention, and bronchopulmonary hygiene. Bronchiectasis may cause potential morbidity secondary to recurrent infections and in severe conditions, death could occur from massive hemoptysis [(4)]. Characteristic computed tomography (CT) scan findings is the main differentiating factor [(2)].

Multi detector computed tomography (MDCT), is the most sensitive imaging modality for the identification and diagnosis of bronchiectasis. MDCT findings in bronchiectasis include bronchial wall thickening with dilatation of the bronchi to a diameter greater than that of the accompanying artery (the signet-ring sign); lack of normal tapering of bronchi [(5)].

The aim of this study was to evaluate the role of MSCT examination in detection and diagnosis of pulmonary bronchiectasis.

PATIENTS AND METHODS

This study included a total of 60 patients with different age and residence, presented with productive cough and dyspnea with bronchiectasis in their Multi-slice computed tomography referred from the Chest Diseases Hospital to the Radiology Department, Mit Khalaf Hospital Complex, Al-Menoufia for doing MSCT of the chest. This study was conducted between July 2020 to February 2021.

Ethical consent:

An approval of the study was obtained from Menoufia University academic and ethical committee. Written informed consent of all the subjects was obtained.

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The 60 patients were 35 females and 25 males, age ranged 19–75 years old (average of 54. 2 years).

Inclusion criteria: The cases who are complaining from dyspnea and productive cough with bronchiectasis in their Multi-slice computed tomography.

Exclusion criteria: The patients with computed tomography contraindications as pregnancy.

All patients were subjected to:

1) Thorough clinical examination with history taking, general and chest examination.
2) Pulmonary function test was done to the cases suspected of having chronic lung diseases (CDILD or COPD).
3) MSCT chest was done to all patients using 16 channels MSCT in Mit Khalaf Hospital Complex.

Table (1): MSCT Technique.

	Toshiba MSCT- 16 slice
Scout	Kv 110- mA 25 Holding breath
Scan type	Helical
Detector Row	16
Helical Thickness	1. 0 mm
Interval	1. 0 cm
FOV	351 mm
Kv	110
mA	25
Total exposure time	0. 8 sec

Assessment of CT chest:

Bronchiectasis was evaluating for the following:

1. Distribution:
- Laterality: right lung, left lung or bilateral.
- Lobar: right upper, right middle or right lower.
- Left upper, lingual or left lower.
2. Types of bronchiectasis: Signet ring, Cylindrical, Cystic or Varicoid.
3. Bronchial wall thickening.
4. According to these CT findings together with the clinical data and laboratory results, the etiologies of bronchiectasis were considered.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi 2$) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value < 0.05 was considered significant.

RESULTS

This study included 60 patients had bronchiectasis in their MSCT of the chest as follow:

Table (2): Distribution of the males, females, age group, bronchiectasis per lung, right, left and bilateral lung bronchiectasis.

Parameters		**No.**	**%**
Gender	Male	25	41. 7
	Female	35	58. 3
Age groups (years)	10 – 19	1	1. 7
	20 – 29	3	5. 0
	30 – 39	5	8. 3
	40 – 49	9	15. 0
	50 – 59	16	26. 7
	60 – 69	22	36. 7
	70 – 79	4	6. 7
Bronchiectasis per lung	Right lung only	20	33. 3
	Left lung only	12	20. 0
	Bilateral	28	46. 7
Right lung bronchiectasis	Upper lobe	4	20. 0
	Middle lobe	6	30. 0
	Lower lobe	10	50. 0
Left lung bronchiectasis	Upper lobe	4	33. 3
	Lingula	2	16. 7
	Lower lobe	6	50. 0
Bilateral lung bronchiectasis	Upper lobe	9	32. 1
	Lower lobe	12	42. 9
	Bilateral lobes	7	25. 0

In this study, bronchiectasis was more common in females. In this study, bronchiectasis was more common in age group of 60-69 years. Throughout our study, bronchiectasis was more common bilaterally. In this study, bronchiectasis of the right lung was more common in the lower lobes. In our study, bronchiectasis affecting the left lung was more common in the lower lobes. In this study, bronchiectasis affecting the lung bilaterally was more common in lower lobes.

Table (3): Shows the state of bronchial wall in cases, morphological types and Different causes of bronchiectasis.

		No.	%
Bronchial wall thickening	Present	32	53. 3
	Absent	28	46. 7
Morphological types	Cylindrical	15	25. 0
	Cystic	12	20. 0
	Signet ring	14	23. 3
	Varicose	3	5. 0
	Signet ring & Cystic	3	5. 0
	Cylindrical & varicose	4	6. 7
	Signet ring & varicose	2	3. 3
	Cystic & varicose	5	8. 3
	Signet ring & Cylindrical	2	3. 3
Different causes of bronchiectasis	Post inflammatory	26	43. 3
	Traction bronchiectasis	21	35. 0
	COPD	8	13. 3
	Aspiration	3	5. 0
	Cystic fibrosis	1	1. 7
	Kartagner syndrome	1	1. 7

Bronchial wall thickening, in our study, was present in most of the cases. In our study, the most common type of bronchiectasis was the cylindrical type. Throughout our study, the most common cause of bronchiectasis was post inflammatory.

Table (4): Shows different bronchiectasis etiologies among different age groups.

Etiologies	**N**	**Age group (years)**													
		10 – 19		**20 – 29**		**30 – 39**		**40 – 49**		**50 – 59**		**60 – 69**		**70 – 79**	
		No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Post inflammatory	**26**	0	0. 0	2	7. 69	1	3. 85	4	15. 38	7	26. 92	8	30. 77	4	15. 38
Traction bronchiectasis	**21**	0	0. 0	1	4. 76	3	14. 29	4	19. 05	5	23. 81	8	38. 10	0	0. 0
COPD	**8**	0	0. 0	0	0. 0	0	0. 0	0	0. 0	4	50. 0	4	50. 0	0	0. 0
Aspiration	**3**	0	0. 0	0	0. 0	0	0. 0	1	33. 33	0	0. 0	2	66. 67	0	0. 0
Cystic fibrosis	**1**	1	100. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0
Kartagner syndrome	**1**	0	0. 0	0	0. 0	1	100. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0
Total	**60**	**1**		**3**		**5**		**9**		**16**		**22**		**4**	

In this study, the most common etiology among different age groups was as follows: Post inflammatory was more common among age group of 60-69 years old. **Traction bronchiectasis** was more common among age group of 60-69 years old. **COPD** was distributed equally between the age groups of 50-59 years old and 60-69 years old. **Aspiration** was more common among the age group of 60-69 years old. **Cystic fibrosis** affects the age group of 10-19 years old. **Kartagner syndrome** affects the age group of 30-39 years old.

Table (5): Shows distribution of different etiologies of bronchiectasis.

Etiologies	N	Distribution																	
		Right						Left						Bilateral					
		Upper lobe		Middle lobe		Lower lobe		Upper lobe		Lingula		Lower lobe		Upper lobe		Lower lobe		Diffuse	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Post inflammatory	**26**	2	7. 69	2	7. 69	7	26. 92	1	3. 85	1	3. 85	3	11. 54	2	7. 69	6	23. 08	2	7. 69
Traction bronchiectasis	**21**	1	4. 76	3	14. 29	2	9. 52	3	14. 29	1	4. 76	2	9. 52	6	28. 57	1	4. 76	2	9. 52
COPD	**8**	1	12. 50	1	12. 50	1	12. 50	0	0. 0	0	0. 0	1	12. 50	0	0. 0	2	25. 0	2	25. 0
Aspiration	**3**	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0	3	100. 0	0	0. 0
Cystic fibrosis	**1**	0	0. 0	0	0. 0	0	0. 0	0.	0. 0	0	0. 0	0	0. 0	1	100	0. 0	0. 0	0	0. 0
Kartagner syndrome	**1**	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0	0. 0	0. 0	0. 0	1	100
Total	**60**	**4**		**6**		**10**		**4**		**2**		**6**		**9**		**12**		**7**	

Throughout our study, the most common etiology in different lung lobes was as follows:

Post inflammatory was mostly distributed at right lower lobe. **Traction bronchiectasis** was mostly distributed at bilateral upper lobes. **COPD** was mostly distributed at both lungs diffusely and bilateral lower lobes. **Aspiration** was mostly distributed at bilateral lower lobes. **Cystic fibrosis** was mostly distributed at bilateral upper lobes. **Kartagner syndrome** was mostly distributed diffusely bilateral.

CASES:

Case (1):

Clinical Data: 67 years old female patient presenting with progressive dyspnea and productive cough.

CT finding and diagnosis: CT chest axial images shows Cystic bronchiectatic changes with right mediastinal shift and decrease in lung volume. Right lung consolidation patches.

CT diagnosis: post inflammatory bronchiectasis.

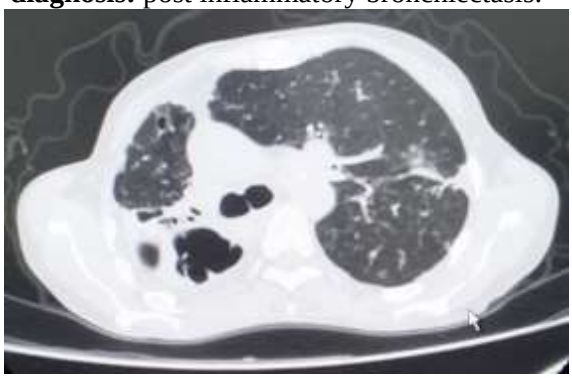

Fig. (1): This is a HRCT chest axial image lung window shows cystic bronchiectasis at right lower lobe.

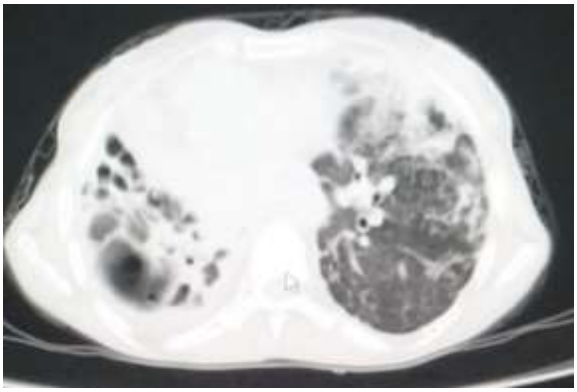

Fig. (2): This is a HRCT chest axial image lung window shows right lower lobe consolidation.

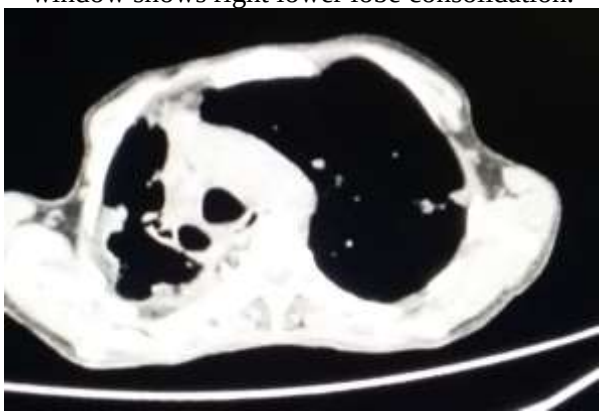

Fig. (3): This is a HRCT chest axial image mediastinal window shows the right mediastinal shift.

Case (2):

Clinical data: Female patient 60 years old with history of few months of dyspnea, productive cough and expectoration.

CT finding and diagnosis: CT axial image shows multiple consolidation patches of the left lung with bronchiectatic changes on the right lung.

CT diagnosis: Post inflammatory bronchiectasis.

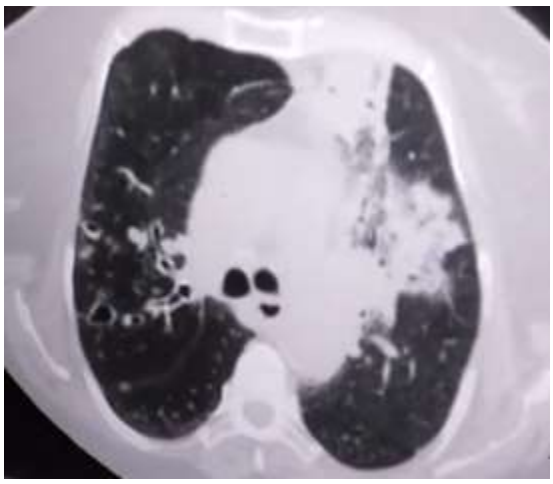

Fig. (4): This is a HRCT chest axial image lung window shows signet ring and cystic bronchiectasis at the right upper and lower lobes and the consolidating areas at both upper and lower lobes of left lung.

Case (3):
Clinical data: Male patient 44 years old presenting with productive cough and dyspnea.

CT finding and diagnosis: CT chest axial images shows bilateral apical ground glass opacities with areas of subsegmental consolidation with lobular interstitional thickening and traction bronchiectasis likely interstitial pulmonary disease. Cavitary lesion is seen in left upper lung.

CT diagnosis: Traction bronchiectasis.

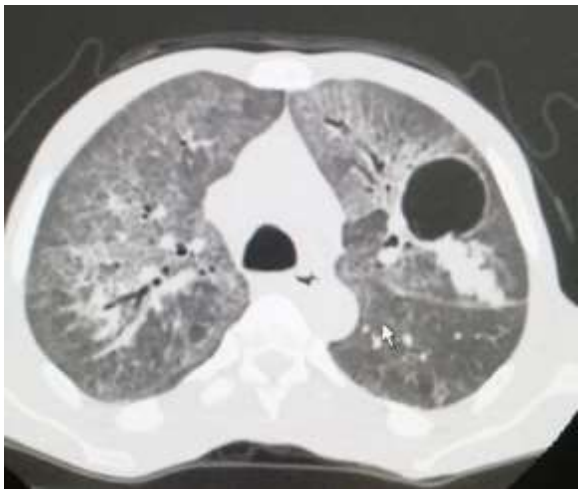

Fig. (5): This is a HRCT chest axial image lung window shows bilateral upper lobe traction bronchiectasis with ground glass opacities infiltrating lungs. There is cavitary lesion at left upper lobe measures 4x4 cm.

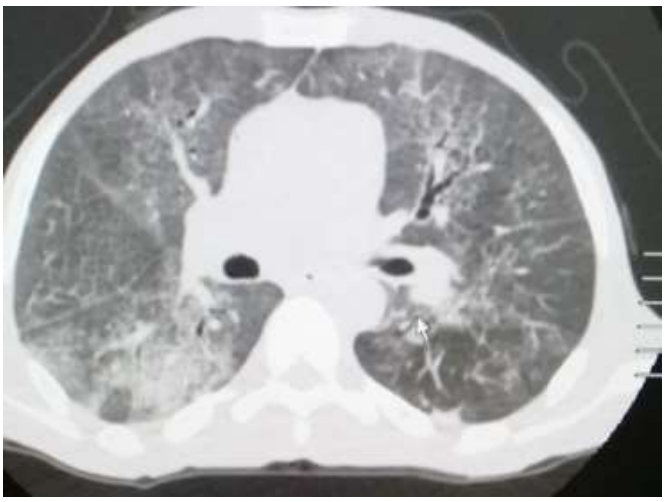

Fig. (6): This is a HRCT chest axial image lung window illustrates the lobular interstitial thickening at both lungs.

DISCUSSION

In this study, bronchiectasis was more common in females (58.3%). This agreed with **King** [6], **McDonnel *et al.*** [7] and **Tepper *et al.*** [8] and who stated that bronchiectasis was more common in females.

This study showed that pulmonary bronchiectasis are more common in age group of (60-69) years old (36.7%), followed by (26.7%) in age group of (50-59) years old among both males and females. This disagreed with **Izhakian *et al.*** [9] who stated that bronchiectasis is more common in 7th decade of life.

In this study, pulmonary bronchiectasis was classified according to the anatomic location into unilateral, bilateral and lobar bronchiectasis. **Throughout the current study**, it was found that of all cases, the unilateral bronchiectasis accounts for (53.3%) is more common in comparison with (46.7%) of bilateral bronchiectasis. This disagreed with **Palwatwichai *et al.*** [10] and **Wickremasinghe *et al.*** [11], who stated that bronchiectasis of bilateral affection (65.5%) is more common than unilateral affection (34.3%).

Also throughout the current study, bilateral lower lobes bronchiectasis was found to be more (42.9%) than that of bilateral upper lobes bronchiectasis by (32.1%). This agreed with **Izhakian *et al.*** [9], **Palwatwichai *et al.*** [10] and **King *et al.*** [12].

In this study, right pulmonary bronchiectasis were found to be more in the lower lobes (50%) than in the upper lobe (20%). This disagreed with **Izhakian *et al.*** [9] **and Palwatwichai *et al.*** [10], who stated that the right pulmonary bronchiectasis lesions were found to be more in the right middle lobe (25.9%) than in the right lower lobe (20.7%).

Throughout this study, left pulmonary bronchiectasis were found to be more in the lower lobe (50%) than that in the upper lobe (33.3%). This agreed with **Izhakian *et al.*** [9] **and Angrill *et al.*** [13], who stated

that the left pulmonary bronchiectatc lesions were found to be more in the lower lobe (20.4%) than that in the upper lobe (20%).

In this study, cylindrical bronchiectasis was found to be the most common type (25%) followed by the signet ring type (23.3%).

This agreed with **King** [6], who stated that the cylindrical (tubular) bronchiectasis, the most common identified morphologic type.

Regarding the etiology of bronchiectasis, in this study, post inflammatory was the most common cause of bronchiectasis involving 26 (43.3%) of the patients, followed by traction bronchiectasis which include 21 (35%) of patients, then Chronic obstructive pulmonary disease related bronchiectasis including 8 (13.3%) of patients. This disagreed with **Lonni *et al.*** [14], who stated that the post inflammatory related bronchiectasis represented (20%), Chronic obstructive pulmonary disease related bronchiectasis (15%), and traction bronchiectasis (10%).

Regarding the distribution of various etiologies of bronchiectasis, this study showed that, the lower lobes post inflammatory bronchiectasis was the most common site including up to 16 (61.4%) patients of 26 patients. This disagreed with **Izhakian *et al.*** [9] **and Griffith *et al.*** [15] and **Johnson *et al.*** [16], who stated that the right middle lobe showed a higher tendency to develop post inflammatory bronchiectasis (25.9%) than other lobes.

On the contrary, upper lobes was the most common site regarding traction bronchiectasis involving up to 10 (47.4%) patients of 21 patients. This agreed with **Goo *et al.*** [17] and **King** [6], who stated that the traction bronchiectasis was more common in the upper lobes.

Throughout this study, bronchiectasis caused by chronic obstructive pulmonary disease mostly affected the lower lobes involving up to 4 (50%) patients of 8 patients. This agreed with **Parr *et al.*** [18], who stated that the distribution mostly affected the lower lobe.

In this study, bronchiectasis due to aspiration was seen in three cases and was detected in bilateral lower lobes. This disagreed with **Webb *et al.*** [19] and **Milliron *et al.*** [20], who stated that bronchiectasis related to aspiration was common in the upper lobes.

In this study, bronchiectasis caused by cystic fibrosis was bilateral upper lobes bronchiectasis. This disagreed with **Milliron *et al.*** [20], who stated that bronchiectasis due to cystic fibrosis was commonly diffuse bilateral. But this agreed with **Nemec *et al.*** [21], who stated that impaired mobilization of secretions in cystic fibrosis predominantly affects the upper lobes.

Throughout this study, bronchiectasis related to Kartagener syndrome was found to affect bilateral lung lobes. This disagreed with **Lucas *et al.*** [22], who stated that the right middle lobe and lingual are the mostly affected lobes.

CONCLUSION

It could be concluded that with the aid of MSCT, it was easier to detect the presence of pulmonary bronchiectasis, its morphological type, and its distribution. The etiology of bronchiectasis could be determined by its site, distribution, shape, and the associated CT findings along with the clinical features.

In the light of the role of MSCT in the diagnosis of the pulmonary bronchiectasis, we conclude that it is being central, accurate and non-invasive.

REFERENCES

1. **Cantin L, Bankier A, Eisenberg R (2009):** Bronchiectasis**.** Am J Roentgenol., 193: 158-171.
2. **Drain M, Elborn J (2011):** Assesment and investigation of adults with bronchiectasis**.** Eur Respir Mon., 52: 32-43.
3. **Marini T, Hobbs S, Chaturvedi A *et al.* (2017):** Beyond bronchitis: a review of the congenital and acquired abnormalities of the bronchus**.** Insights Into Imaging, 8(1): 141-153.
4. **Goeminne P, Nawrot T, Ruttens D *et al.* (2014):** Mortality in non-cystic fibrosis bronchiectasis: a prospective cohort analysis**.** Respir Med., 108(2): 287-296.
5. **Smith M (2017):** Diagnosis and management of bronchiectasis. Canadian Medical Association Journal, 189(24): 828-835.
6. **King P (2009):** The pathophysiology of bronchiectasis. Int J Chron Obstruct Pulmon Dis., 4: 411-419.
7. **McDonnel M, Jary H, Perry A *et al.* (2015):** A Non cystic fibrosis bronchiectasis: a longitudinal retrospective observational cohort study of pseudomonas persistence and resistance. Respiratory Medicine, 109: 716-726.
8. **Tepper L, Caudri D, Rovir A *et al.* (2016):** The development of bronchiectasis on chest computed tomography in children with cystic fibrosis: can pre-stages be identified? European Radiology, 26: 4563-4569**.**
9. **Izhakian S, Wasser W, Fuks L *et al.* (2016):** Lobar distribution in non-cystic fibrosis bronchiectasis predicts bacteriologic pathogrn treatment. European Journal of Clinical Microbiology & Infectious Disease, 35: 791-796.
10. **Palwatwichia A, Chaoprasong C, Vattanathum A *et al.* (2007):** Clinical laboratory findings and microbiologic characterization of bronchiectasis in Thai patients. Respiratory, 7: 63-66.
11. **Wickremasinghe M, Ozerovitch L, Davis G *et al.* (2005):** Non-tuberculous mycobacteria in patients with bronchiectasis. Thorax, 60: 1045-1051**.**
12. **King P, Holdsworth S, Freezer N *et al.* (2007):** Microbiological follow-up study in adult bronchiectasis. Respiratory Medicine, 101: 1633-1638**.**
13. **Angril J, Agusti C, DeCelis R *et al.* (2002):** Bacterial colonization in patients with bronchiectasis: microbiological pattern and risk factors. Thorax, 57: 15-19.
14. **Lonni S, Chalmers J, Goeminne P *et al.* (2015):** Etiology of non-cystic fibrosis bronchiectasis in adults and its correlation to disease severity. Annals of the American Thoracic Society, 12: 1764-1770.

15. **Griffith D, Aksamit T, Brown-Elliott B *et al.* (2007):** An official ATS|IDSA statement diagnosis, treatment and prevention of non-tuberculous mycobacterial disease. American Journal of Respiratory and Critical Care Medicine, 175: 367-416.
16. **Johnson M, Odell J (2014):** Non Tuberculous mycobacterial pulmonary infections. Journal of Thoracic Disease, 6: 210-220**.**
17. **Goo J, Im J (2002):** CT of tuberculosis and non-tuberculous mycobacterial infections. Radiologic Clinics, 40: 73-87**.**
18. **Parr D, Guest P, Reynold J *et al.* (2007):** Prevelance an impact of bronchiectasis in alpha one antitrypsin deficiency. American Journal of Respiratory and Critical Care Medicine, 176: 1215-1221.
19. **Webb W (2006):** Thin section CT of the secondary pulmonary lobule: anatomy and the image the 2004 Fleiscner lecture. Radiology, 293: 322-338.
20. **Milliron P, Henry T, Veeraraghavan S *et al.* (2015):** Bronchiectasis: Mechanism and imaging clues of associated common and uncommon disease. Radiographics, 35: 1011-1030.
21. **Nemac S, Bankier A, Eisenberg R (2013):** Upper lobe predominant diseases of the lung. American Journal of Roentgenology, 200: 222-237.
22. **Lucas J, Burgees A, Mitchison H *et al.* (2014):** Diagnosis and management of primary ciliary dyskinesia. Archives of Disease in Childhood, 99: 850-856.