Prevalence, causes, and chest sonographic findings of bronchiectasis among admitted patients in tertiary care hospital: 10 years’ experience

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Abstract

Background: Bronchiectasis may be associated and/or co-exist with respiratory diseases as bronchial asthma and chronic obstructive pulmonary disease (COPD) or non-respiratory diseases. However, data about this association and/or co-existence is little. The objectives of the study were to determine the prevalence of bronchiectasis among admitted patients in the Chest Department in 10 years’ period (2008–2018) and to detect associated and/or co-existent respiratory diseases. In a retrospective cohort study, the diagnosis of bronchiectasis was based on chest HRCT. Data included the total number of hospitalized patients during this period, their final diagnosis, co-existing diagnosis associated with bronchiectasis, and sonographic and spirometric findings.

Results: The total number of patients admitted in 2008–2018 was 17,531 patients. The prevalence of bronchiectasis during this period was 9.04%. COPD was the commonest suspected cause (54.1%) followed by post-tuberculosis bronchiectasis (17.1%). On admission, 63.7% had acute type 2 respiratory failure, 21.1% had decompensated cor pulmonale, 3.8% required mechanical ventilation (MV), and 1.3% required non-invasive MV. On discharge, 9.9% required long-term oxygen therapy. The presence of B lines in chest ultrasonography was recorded in 68.2% and air bronchogram in 29.1%.

Conclusions: The prevalence of bronchiectasis among admitted patients was still increasing. COPD with bronchiectasis accounted for more than half of cases. More researches are needed to identify the impact of the COPD-bronchiectasis phenotype.

Trial registration: ClinicalTrials.gov, NCT04101448

Keywords: Bronchiectasis, Prevalence, Comorbidities, COPD

Background

Bronchiectasis—permanent dilatation of the bronchi—is characterized clinically by cough, expectoration, and recurrent exacerbations [1, 2]. There is an increase in the prevalence of bronchiectasis worldwide and in the UK; 566 per 100,000 women versus 485 per 100,000 men had bronchiectasis [3–5]. Chest high-resolution computed tomography (HRCT) is the gold standard for the diagnosis of bronchiectasis if the broncho-arterial ratio is more than 1; however, this ratio may be high in healthy patients over 65 years [6–8].

Diverse varieties of conditions lead to bronchiectasis including idiopathic form in 40% of these conditions [9]. Bronchiectasis may be associated and/or co-exist with respiratory diseases including bronchial asthma and chronic obstructive pulmonary disease (COPD) or non-respiratory diseases including HIV and rheumatoid arthritis. However, data about this association...
and/or co-existence is little [5]. To the best of our knowledge, there is no published data about the prevalence of bronchiectasis among hospitalized patients in Egypt.

The primary goal of the study was to determine the prevalence of bronchiectasis among hospitalized patients in the Chest Department over 10 years’ period from 2008 to 2018. The secondary goal was to detect associated and/or co-existing respiratory diseases.

Methods
This study has a retrospective cohort design, and the data are delivered from the database of a tertiary hospital over a 10-year period from 2008 to 2018. The study included all hospitalized patients aged ≥ 18 years. The diagnosis of bronchiectasis was based on chest HRCT [6] using Aquilion 64, Toshiba Medical Systems, Otawara, Japan. HRCT was performed by standard protocol. Scans were obtained at full inspiration from the apex to the lung base with the patients in the supine position and examined by 3 specialists separately (a radiologist and 2 pulmonologists).

The collected data included the total number of hospitalized patients in the Chest Department during this period, their final diagnosis, baseline characteristics of bronchiectasis patients, co-existing diagnosis associated with bronchiectasis, and sonographic and spirometry findings.

Gray-scale ultrasound was done by an ultrasound scanner (Aloka Echo Camera SSD 3500; Aloka Prosound; Japan) equipped with a 3.5-MHz convex probe when indicated (suspicious pneumonia, pleural effusion, pulmonary infarction).

Standard spirometry was performed on admission by means of a fully equipped computerized system using Cosmed SrL, Quark PFTs ergo, P/N Co9035-12-99, Italy. The classification of the spirometry pattern of cases was based on GOLD [10]. A single breath (using D 97723; Zan 300, Oberthulba, Germany) was used to measure diffusing capacity for carbon monoxide (DLCO).

Data availability
The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical consideration
The ethical committee of the Faculty of Medicine, Assiut University, approved this study, and written informed consent was previously taken from the participants. ClinicalTrials.gov registration ID: NCT04101448.

Statistical analysis
Number and percent (n, %) were used to describe categorical variables while mean ± standard deviation (mean ± SD) was used to describe continuous variables.

The prevalence was calculated as follows: prevalence = number of cases/population size × 100.

Results
The total number of patients admitted to the Chest Department in a tertiary hospital from the period 2008 to 2018 was 17,531 patients. The prevalence of bronchiectasis among these patients was 9.04%. However, COPD is the most common diagnosis during this period followed by interstitial lung diseases (ILD) (9.2%) as shown in Table 1. Among bronchiectasis, 25.2% of patients were nonsmokers and 11% were current smokers (Table 2).

As regards the prevalence of bronchiectasis stratified by year of diagnosis (per year), the highest prevalence was recorded in year 2018 where the number of cases was 356 giving 22.6% prevalence rate per year followed by year 2017 in which the prevalence rate was 9.5% compared to 7% in year 2008. Lower rates were recorded in years 2013 and 2014; the rates were 6.3% and 6.5%, respectively (Fig. 1).

Transthoracic ultrasonography was done for 223 bronchiectasis patients. The most common finding was B lines in 68.2% of patients followed by consolidation with air bronchogram in 29.1% (Table 3).

Table 4 shows that hypertension (10.4%) and diabetes (8.4%) were the most common associated comorbidities.

As regards the final diagnosis of bronchiectasis, COPD with bronchiectasis was the commonest (54.1%) followed by post-tuberculous bronchiectasis (17.1%). Bronchial asthma was reported in 2.2%, and alpha 1 antitrypsin deficiency was recorded in 2.6%. Systemic lupus erythematosus was noticed in 0.12%. As regards complications, chronic respiratory failure was recorded in 9.1%; hence, long-term oxygen therapy was needed in 9.1% of patients. Hemothysis was recorded in 1.3% of cases (Table 5).

Discussion
This study was a retrospective cohort design to determine the prevalence of bronchiectasis among patients admitted to the Chest Department in a tertiary care hospital over 10 years’ period from 2008 to 2018 and to detect associated and/or co-existing respiratory diseases. The main results showed a 9.04% prevalence of bronchiectasis among admitted patients with an increasing rate of prevalence over the years, COPD with bronchiectasis was the commonest (54.1%) diagnosis, and chronic respiratory failure indicating long-term oxygen therapy was described in 9.1% of patients.
In the current study, the prevalence of bronchiectasis among admitted patients was 9.04%. As regards the prevalence of bronchiectasis stratified by year of diagnosis (per year), the highest prevalence was recorded in year 2018 (the number of cases was 356 giving 22.6% prevalence) followed by year 2017 in which the prevalence rate was 9.5% compared to 7% in year 2008. However, the lower rates were recorded in years 2013 and 2014; the rates were 6.3% and 6.5%, respectively. The reasons for the increasing prevalence of bronchiectasis are unknown; it may be explained by increased awareness of the disease leading to better surveillance using HRCT over time. It is agreed that the prevalence of bronchiectasis is common and has been growing since 2004. Quint et al. [5] reported that the prevalence of bronchiectasis increased from 350.5 per 100,000 in 2004 to 566.1 per 100,000 in 2013 in women and from 301.2 per 100,000 in 2004 to 485.5 per 100,000 in men [5]. Similarly, Kwak et al. [11] by using data from private healthcare claims found a higher prevalence of bronchiectasis than expected. Weycker et al. [12] reported that the prevalence of bronchiectasis was 52.3 per 100,000 among adults aged ≥ 18 years and was 110,000 among adults of all ages in the USA. Using outpatient data, Seitz et al. [13] reported that disease prevalence was increased from 2000 to 2007 (the annual growth rate is 8.7%). A similar increase of 8% in annual growth rate and in the prevalence of bronchiectasis from 52 per 100,000 in 2001 to 139 per 100,000 in 2013 was recorded among adults of all ages in the USA [14].

The present study revealed that COPD with bronchiectasis was the commonest (54.1%) followed by post-tuberculous bronchiectasis (17.1%). Bronchial asthma

| Study population (n = 1585) | Frequency, n | Percentage |
|-----------------------------|--------------|------------|
| Gender, male/female 1055/530 | 66.5/33.5   |            |
| Smoking                    |              |            |
| Nonsmokers 400             | 25.2         |            |
| Ex-smokers 1012            | 63.8         |            |
| Current smokers 173        | 11           |            |

Table 2 Baseline characteristics of bronchiectasis in the study group

![Fig. 1 Prevalence of bronchiectasis in patients admitted in the Chest Department from 2008 to 2018 stratified by year of diagnosis (n = 1585)
was reported in 2.2% of patients. Systemic lupus erythematous was noticed in 0.12%.

Bronchiectasis is recognized as a complication of COPD and asthma [15–17]. In contrast to the current study, Quint et al. [5] demonstrated that bronchial asthma was more commonly associated with bronchiectasis (43%) than COPD (36%). HIV was reported in 7% and rheumatoid arthritis in 6%, while other connective tissue diseases in 5%. They explain this difference by the misclassification of COPD as asthma in the database. Also, some studies had bronchiectasis as an exclusion criterion leading to under-diagnosis of bronchiectasis in COPD. Moreover, most of these studies excluded patients with previously known bronchiectasis and those with bronchiectasis in only one pulmonary segment, as this circumstance can be found in a significant percentage of elderly people in the general population or in smokers with no airway obstruction [11].

Patients with rheumatoid arthritis and bronchiectasis may have increase complications due to immunosuppressive treatments. Bronchiectasis has been recorded in other connective tissue diseases including Marfans syndrome, systemic sclerosis, primary Sjogren syndrome, ankylosing spondylitis, and systemic lupus erythematous [18]. Fenlon et al. [19] demonstrated that bronchiectasis was observed in 7 of 34 patients with systemic lupus erythematous (SLE).

### Table 3 Transthoracic ultrasonography findings in the study bronchiectasis patients admitted to the Chest Department from 2008 to 2018 (n = 223)

| Chest sonar findings       | Frequency | Percentage |
|----------------------------|-----------|------------|
| Pleural effusion           | 40        | 17.9       |
| Consolidation, air bronchogram | 65       | 29.1       |
| Pleural thickening         | 7         | 3.1        |
| B lines                    | 152       | 68.2       |
| Normal                     | 15        | 6.7        |
| Mass                       | 6         | 2.7        |

More than one finding was reported in the same patient; transthoracic ultrasonography was done if indicated.

McDonnell et al. [20] reported that 81 different comorbidities were recorded during the 5-year follow-up of patients with bronchiectasis including COPD, asthma, diabetes, inflammatory bowel disease, connective tissue diseases, peripheral vascular disease, and cardiovascular disease. In their study, COPD, asthma, connective tissue diseases, and inflammatory bowel disease as comorbidities are associated with a higher mortality. Du et al. [21] in their meta-analysis demonstrated that bronchiectasis detected by chest CT was common among COPD patients. The relationship between COPD and bronchiectasis is still controversial. It may be due to chronic infection in COPD resulting in structural damage, loss of integrity of epithelial cell, mucociliary clearance impairment, hyper-secretion of mucus, and persistent inflammation of airway with tissue injury leading to bronchiectasis [22–24].

The current study revealed that alpha 1 antitrypsin deficiency was recorded in 2.6%. Other studies reported that PiZZ deficiency had radiological bronchiectasis in 94.5% of cases during the period from 1995 and 2002 [25]. In 28 Irish patients with A1AT deficiency, 14 of them had bronchiectasis [26]. Chronic respiratory failure is considered as an important complication of bronchiectasis.
The finding in this study showed that chronic respiratory failure was recorded in 9.1%, and hence, long-term oxygen therapy was described in 9.1% of patients. Hemoptysis was recorded in 1.3% of cases. In Europe, bronchiectasis database demonstrated that 86 of 1145 (7.5%) patients were using long-term oxygen therapy for chronic respiratory failure [27]: a use of long-term oxygen therapy if PaO\textsubscript{2} ≤ 55 mmHg in stable patients or 56–59 mmHg in those with hypoxic organ damage [28, 29].

In Mayo Clinic during the period from 1976 to 1993, hemoptysis was found in 63 of the lung resection group [30]. In Korea, it has been suggested that the use of inhalers may increase the risk of hemoptysis [31].

Limitations of the study
First, this was a retrospective study and there is a need for a prospective study to address the current situation. Second, not all patients were following the current guidelines for the diagnosis of bronchiectasis (the diagnosis was based on the guideline on the same year). Finally, different radiology specialists were blindly recording their findings.

Conclusions
The prevalence of bronchiectasis among admitted patients was not uncommon with increasing rate of prevalence over the years due to increase awareness. COPD was the commonest cause in the study group followed by post-tuberculous bronchiectasis. Chronic respiratory failure was recorded in 9.1%, and hence, long-term oxygen therapy was described in 9.1% of patients.

Recommendation
To follow-up patients with COPD to try to explain if the associated bronchiectasis is due to repeated bacterial infections or the patients are having de novo bronchiectasis with obstructive pulmonary function.

Abbreviations
COPD: Chronic obstructive pulmonary disease; TB: Tuberculosis; IPF: Interstitial pulmonary fibrosis; SLE: Systemic lupus erythematosus; HRCT: High-resolution computed tomography

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Authors’ contributions
Prof. AMH was responsible for the conception and design, acquisition of data, drafting of the submitted protocol, and writing and editing of the final version of the manuscript. Prof. HM participated in the conception and design; she was responsible for the analysis and interpretation of the data, critical revision of the submitted protocol, and final draft of the manuscript. All authors have read and approved the manuscript.

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Availability of data and materials
Available.

Ethics approval and consent to participate
The manuscript was approved by the ethical committee of the Faculty of Medicine, Assiut University. Written consent was previously given by all participants.

Consent for publication
All authors revised and approved the submission.

Competing interests
The authors declare they have no conflict of interest.

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References
1. Laennec RA (1834) Treatise in the diseases of the chest and on mediastinal auscultation, 4th edn. Longman, London
2. Cole PJ. Inflammation: a two-edged sword - the model of bronchiectasis. Eur. J. Respir. Dis. Suppl. 1986; 147: 6–15. 6.
3. Seitz AE, Olliver KN, Adjernian J (2012) Trends in bronchiectasis among Medicare beneficiaries in the United States, 2000 to 2007. Chest 142:432–439
4. Ringshausen FC, de Roux A, Pietz M (2013) Bronchiectasis-associated hospitalizations in Germany, 2005–2011: a population-based study of disease burden and trends. PLoS ONE 8:e71109
5. Quint JK, , Millett ERC, Joshi M, Navaratnam V, et al., Changes in the incidence, prevalence and mortality of bronchiectasis in the UK from 2004-2013: a population based cohort study. Eur Respir J 2016; 47(1): 186–193.
6. Pasteur MC, Bilton D, Hill AT. British Thoracic Society guideline for non-CF bronchiectasis. Thorax 2010; 65(Suppl 1): i1-58.
7. Tan WC, Hague CJ, Lepsic J (2016) Findings on thoracic computed tomography scans and respiratory outcomes in persons with and without chronic obstructive pulmonary disease: a population based cohort study. PLoS ONE 11:e0166745
8. Yang JW, Fan LC, Lu HW (2016) Efficacy and safety of long-term inhaled antibiotic for patients with noncystic fibrosis bronchiectasis: a meta-analysis. Clin Respir J 10:731–739
9. Gao YH, Guan WJ, Liu SX (2016) Aetiology of bronchiectasis in adults: a systematic literature review. Respirology. 21:1376–1383
10. Spirometry for health care providers. Global Initiative for Chronic Obstructive Lung Disease (GOLD), 2018.
11. Kwak HL, Moon JY, Choi YW (2010) High prevalence of bronchiectasis in adults: analysis of CT findings in a health screening program. Tohoku J Exp Med. 222(4):237–242
12. Weycker DEJ, Otter G, Tino G (2005) Prevalence and economic burden of bronchiectasis. Clin Pulm Med. 12(4):205–209
13. Polverino E et al (2018) The overlap between bronchiectasis and chronic airflow diseases: state of the art and future directions. European Respiratory Journal 52:3
14. Weycker D, Hansen GL, Seifer FD (2017) Prevalence and incidence of noncystic fibrosis bronchiectasis among US adults in 2013. Chronic Respiratory Disease 14(4):377–384
15. Ip MS, So SY, Lam WK et al (1992) High prevalence of asthma in patients with bronchiectasis in Hong Kong. The European Respiratory Journal 5(4): 418–423
16. Wedzicha JA, Hurst JR (2007) Structural and functional co-conspirators in chronic obstructive pulmonary disease exacerbations. Proc Am Thorac Soc. 4:602–605
17. Martínez-García MA, Soler-Cataluña JJ, Sanz YD (2011) Factors associated with bronchiectasis in patients with COPD. Chest 140(5):1130–1137
18. Hill T, Sullivan AL, Chalmers JD et al (2019) British Thoracic Society Guideline for bronchiectasis in adults. Thorax 74(Suppl 1):1–69
19. Fenlon HM, Doran M, Sant SM (1996) High-resolution chest CT in systemic lupus erythematosus. A JR Am J Roentgenol 166:301–307
20. Powell HA, Iyen-Omofoman B, Baldwin DR (2013) Chronic obstructive pulmonary disease and risk of lung cancer: the importance of smoking and timing of diagnosis. J Thorac Oncol. 8:6–11
21. McDonnell MJS, Aliberti S, Goeminne PC et al (2016) Comorbidities and the risk of mortality in patients with bronchiectasis: an international cohort study. Lancet Respir Med 4(12):969–979
22. Du Q, Jin J, Liu X, Sun Y (2016) Bronchiectasis as a comorbidity of chronic obstructive pulmonary disease: a systematic review and meta-analysis. PLoS ONE 11(3):e0150532
23. Adler KB, Hendley DD, Davis GS (1986) Bacteria associated with obstructive pulmonary disease elaborate extracellular products that stimulate mucin secretion by explants of guinea pig airways. Am J Pathol. 125(3):501
24. Aziz ZA, Wells AU, Desai SR et al (2005) Functional impairment in emphysema: contribution of airway abnormalities and distribution of parenchymal disease. AJR Am J Roentgenol. 185(6):1509–1515
25. Habesoglu MA, Tercan F, Ozkan U et al (2011) Effect of radiological extent and severity of bronchiectasis on pulmonary function. Multidiscip Respir Med. 6(9):284–290
26. Parr DG, Guest PG, Reynolds JH (2007) Prevalence and impact of bronchiectasis in alpha-1-antitrypsin deficiency. Am J Respir Crit Care Med 176:1215–1221
27. McMahon MA, O’Mahony MJ, O’Neill SJ (2005) Alpha-1 antitrypsin deficiency and computed tomography findings. J Comput Assist Tomogr 29:549–553
28. Aliberti S, Lonni S, Dore S (2016) Clinical phenotypes in adult patients with bronchiectasis. Eur Respir J 47:1113–1122
29. McDonald CF, Whyte K, Jenkins S (2016) Clinical practice guideline on adult domiciliary oxygen therapy: executive summary from the Thoracic Society of Australia and New Zealand: domiciliary oxygen guideline. Respirology 21:76–78
30. Agasthian T (2012) Results of surgery for bronchiectasis and pulmonary abscesses. Thorac Surg Clin 22(3):333–344
31. Lee JK, Lee J, Park SS (2014) Effect of inhalers on the development of haemoptysis in patients with non-cystic fibrosis bronchiectasis. Int J Tuberc Lung Dis 18:363–370

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