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Bronchiectasis and its Main Radiological Findings: What the General Practitioner Needs to Know

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Abstract

Introduction: Bronchiectasis is defined as an irreversible abnormal dilatation of the bronchial tree and is divided into bronchiectasis secondary to cystic fibrosis and bronchiectasis not associated with cystic fibrosis, presents with recurrent chest infections, productive cough for more than 8 weeks, production of large amounts of sputum and hemoptysis, as in many other lung diseases, there are repeated exacerbations of symptoms. High-resolution computed tomography (CT) of the chest is the most accurate modality for diagnosis.

Objective: To identify the main radiological findings related to bronchiectasis described in the literature. Methods: This is a literature review study by collecting data from bibliographic references available in the U.S. National Library of Medicine (PubMed) database. The inclusion criteria established for the selection of articles were articles that focused on the topic of bronchiectasis, radiological findings of this pathology, its causes and classification, published from 2018 to 2022. The exclusion criteria were: texts not available in full, consensus and guidelines.

Results and Discussion: After the evaluation of the studies and the application of the inclusion and exclusion criteria, 8 articles were separated, which best answered the guiding question; of these articles, 5 address well the diagnostic criteria and definition of bronchiectasis according to radiological findings, and the other studies complement additional findings found in the pathology and radiological characteristics according to its classification.

Conclusion: The present material presented the most current information on the subject, as well as the main radiological findings necessary for general practitioners to diagnose and classify bronchiectasis.

Keywords: Bronchiectasis • Radiological findings • Respiratory Tract diseases

Introduction

Bronchiectasis is defined as an irreversible abnormal dilatation of the bronchial tree. It has a variety of underlying causes, with a common etiology of chronic inflammation [1]. The prevalence is estimated to be around 500/100,000 and is slightly higher in women than men. Bronchiectasis can be seen in children and adults, and the incidence increases with increasing age [2].

In the literature, bronchiectasis is divided into bronchiectasis secondary to cystic fibrosis and bronchiectasis not associated with cystic fibrosis, which is termed non-cystic fibrosis bronchiectasis [3]. In up to half of all cases, the cause cannot be identified (idiopathic). These cases, along with several other known etiologies such as post-infectious and allergic hypersensitivity, collectively fall into the category of non-cystic fibrosis bronchiectasis (SCHAFER J et al., 2018). Two groups make up the majority of cases: post-infectious and cystic fibrosis (GAILLARD F and KUSEL K, 2022). The main genetic diseases associated with bronchiectasis include CF, primary ciliary dyskinesia (PCD, Kartagener syndrome), alpha 1-antitrypsin deficiency, primary immunodeficiencies or other rare diseases such as Williams-Campbell syndrome and Marfan syndrome [4].

Bronchiectasis usually presents with recurrent chest infections, productive cough for more than 8 weeks, production of large amounts of sputum and hemoptysis [5]. As in many other lung diseases, there are repeated exacerbations of symptoms, although this happens infrequently and sometimes very rarely [6].

High resolution computed tomography (CT) is the most accurate modality for diagnosis [7]. The widespread use of chest HRCT is probably the main factor in the increased diagnosis of bronchiectasis, as it contributes greatly to the detection and better visualization of dilated bronchi and other bronchial and bronchiolar abnormalities [8]. Cylindrical bronchiectasis, also known as tubular bronchiectasis, is the most commonly identified morphological type of bronchiectasis, where there is a uniform and smooth enlargement of the bronchi with loss of normal distal airway tapering, but without focal outflows or tortuosity [9]. The distribution of bronchiectasis can help narrow the differential diagnosis. Lower lobe bronchiectasis is the most common zonal predilection in bronchiectasis. It is mainly idiopathic [10].

This study aims to identify the main radiological findings described in the literature related to bronchiectasis. It is relevant considering that, according to Martinez-Garcia MA scientific interest in bronchiectasis has grown in recent years. This is mainly due to the increase in prevalence, data obtained from large international registries of BE, increase in the number of therapeutic clinical trials, and negative impact of the disease on the prognosis and quality of a patient's life.

Case Report

This is a literature review study by means of a survey of data from bibliographic references available in the U.S. National Library of Medicine (PubMed) database, in order to answer the following guiding question: "What evidence is available in the literature regarding the main radiological findings described about bronchiectasis? The search for studies took place from September to October 2022. The inclusion criteria established for the selection of articles were articles that focused on the topic of bronchiectasis,

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Table 1. Main findings of bronchiectasis on definition and diagnosis.

Objectives	Main findings
To discuss the main characteristics of CF-related and non-CF-related bronchiectasis regarding their pathogenesis, imaging, and clinical management.	The so-called sign of the signet ring is the primary sign for bronchiectasis representing a ring-shaped opacity, while the adjacent smaller artery lies to the signet.
Revisit the imaging features of bronchiectasis and associated imaging findings, along with pitfalls and clues to common etiologies for the respiratory clinician.	Imaging findings in bronchiectasis: Bronchial dilatation: objectively assessed by bronchial-arterial ratio >1:1 (or >1.5:1 for greater specificity), absence of bronchial thinning > 2 cm airway bifurcation length; peripheral airways visible within 1 cm in proximity to costal pleura or directly adjacent to mediastinal pleura.
Review on bronchiectasis	Chest CT diagnostic criteria for bronchiectasis include bronchial artery ratio > 1, lack of bronchial tapering, and visualization of bronchial airways within 1-2 cm of the pleura.
Focus on current issues related to the radiological diagnosis of bronchiectasis using state-of-the-art CT imaging techniques	The presence of thickened and widened airways at the periphery of the lung is an important feature of bronchiectasis.
To review diagnostic criteria and quantification methods for bronchiectasis	The most commonly used criterion for bronchiectasis was internal airway ratio ≥1.0 (42%), but no validation studies were found for this cutoff value.

Table 2. Principal additional radiological findings in bronchiectasis.

Authors (Year)	Main findings
Contarini M et al.	A predominant upper lobe distribution of cylindrical, cystic, and variceal bronchiectasis associated with airway wall thickening, mucus obstruction, and parenchymal opacities on HRCT should raise the suspicion of Cystic Fibrosis disease. Additional HRCT findings include mucus plug with a "finger in the glove" appearance, transient consolidation, centrilobular nodules associated with tree-in-bud, atelectasis, mosaicism due to air trapping on exhalation, and fibrosis in end-stage disease
Schäfer J. et al.	CT findings such as the tree-in-bud sign and centrilobular opacity are linked to small airway disease with dilatation and inflammation of the bronchiole or mucus plug in its periphery.
Bak SH et al.	Air trapping, which reflects small airway disease, is common in patients with bronchiectasis, even when mild.
Juliusson G and Gudmundsson G	Common associated findings suggestive of airway disease or inflammation: bronchial wall thickening; mucus plugging; tree-in-bud opacities.
Iman JF and Duarte AG	Additional CT radiographic features of bronchiectasis include peribronchial thickening, mucus plugs, centrilobular nodules, tree-in-bud nodules, mosaic perfusion, intra- and interlobular septal thickening, and focal atelectasis/consolidation.
Jose RJ and Loebinger MR	In cylindrical bronchiectasis, the dilated bronchus is uniform in caliber with a lack of distal airway tapering. In varicose bronchiectasis, the dilated bronchus is nonuniform and appears irregular and distorted. In cystic bronchiectasis, there is saccular dilatation of the bronchus with multiple saccular bronchi giving the appearance of cluster of cysts. Cavitation can also be seen in bronchiectasis and can represent sequelae of prior pulmonary tuberculosis, NTM, lung disease, or fungal infection.

radiological findings of this pathology, its causes, and classification, published in the period from 2018 to 2022. Exclusion criteria were: texts not available in full, consensus, and guidelines.

Results and Discussion

A total of 4,124 articles were identified in the selected databases when searching for articles. After applying the filter to select the publications from the last 5 years, available in full, this value was reduced to 458 publications. After the evaluation of the studies and the application of the other inclusion and exclusion criteria, eight articles that best answered the guiding question were separated for reading and preparation of the study. Of these, 5 articles address well the diagnostic criteria and definition of bronchiectasis according to radiological findings, as described in Table 1. The remaining studies complement additional findings found in the pathology and radiological characteristics according to its classification, as described on Table 2.

According to Schäfer J. et al. the radiological evaluation of bronchiectasis is based on the definition published in the Fleischner Society's terms for chest imaging: of bronchial tapering and identification of bronchi within 1 cm of the pleural surface. According to Tiddens HA et al. for "lack of tapering," the other definition of bronchiectasis, objective and sensitive criteria similar to the AA ratio are also lacking.

Currently, the lack of thinning is determined visually by the radiologist. As can be seen in this definition in the study by Juliusson G and Gudmundsson G in which lack of normal bronchial tapering greater than 2 cm in length, distal to an airway bifurcation, is the most sensitive sign of bronchiectasis and is useful in the evaluation of subtle cylindrical bronchiectasis. Clearly, there is a need for age- and gender-related reference values for airway and arterial dimensions

Figure 1 presentsthe imaging findings in bronchiectasis, according to Juliusson G and Gudmundsson G the arrow points to cylindrical bronchiectasis

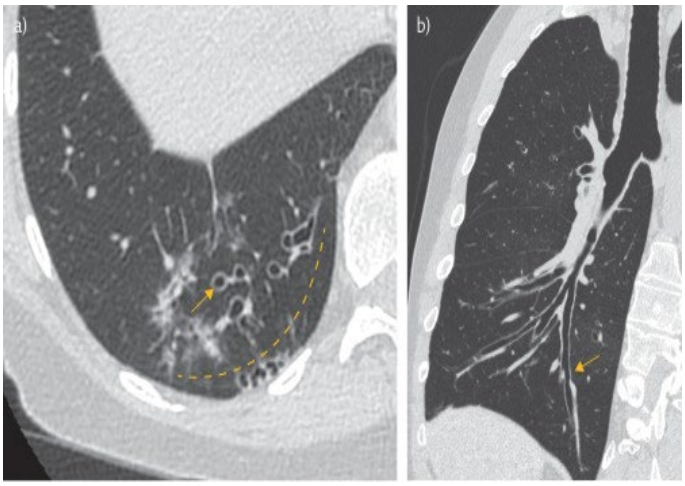

Figure 1. Image findings in bronchiectasis on chest CT.

in the right lower lobe and the bronchi are dilated in relation to the pulmonary artery, producing a sign of signet ring in the first image. The second image presents curved planar reformation showing absence of bronchial thinning in the right lower lung, consistent with cylindrical bronchiectasis. This is the earliest and most sensitive sign of bronchiectasis [11].

According to Contarini M et al. cylindrical bronchiectasis is the most common morphological pattern identified on CT scans and is recognized by abnormal dilatation of the bronchus with uniform caliber and absence of tapering at the periphery, producing a track line (tram rail sign) [12].

According to Contarini M et al. variceal bronchiectasis has no regular shape or size, with irregular distortion and bulging, while cystic bronchiectasis is a saccular dilatation with a ballooned cut line that can be traced almost to the pleura, which can be seen in Figures 2 and 3 [13-19].

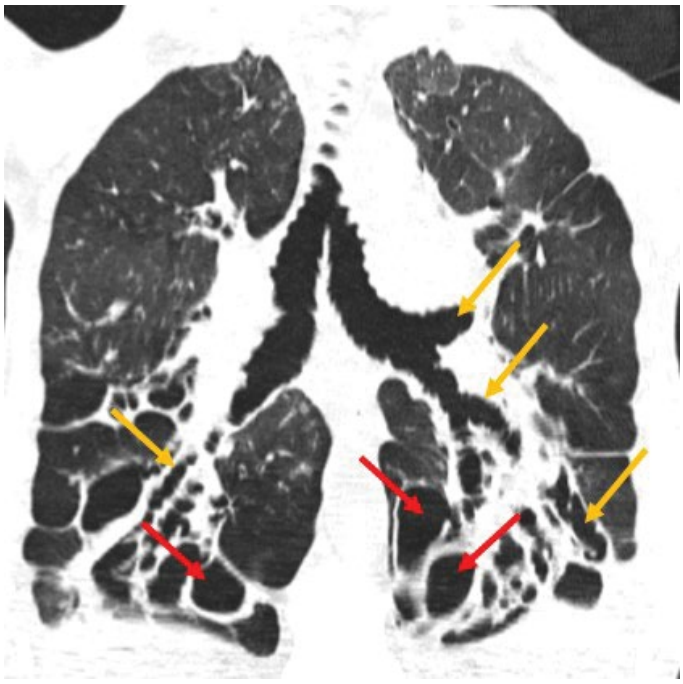

Figure 2. Chest computed tomography, coronal section, lung window. Multiple diffuse bronchial dilatations, alternating between cylindrical/varicose (yellow arrows) and cystic (red arrows - simulating pulmonary cavities).

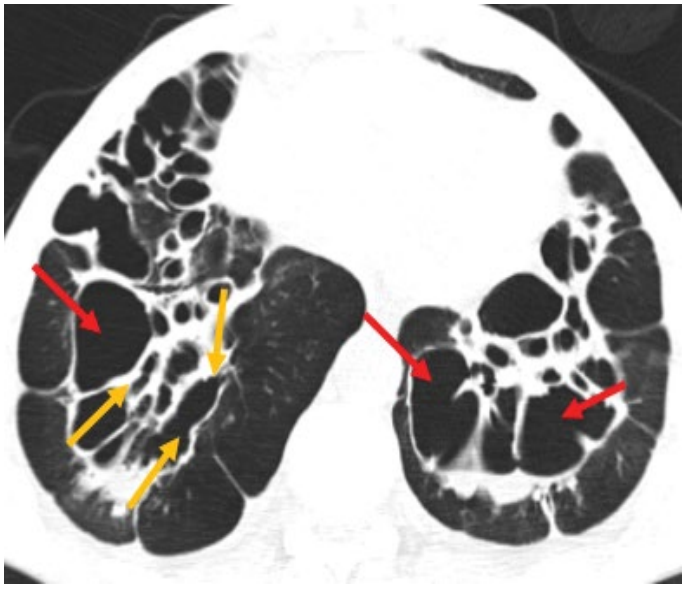

Figure 3. Chest computed tomography, axial section, lung window. Multiple diffuse bronchial dilatations, alternating between cylindrical/varicose (yellow arrows) and cystic (red arrows - simulating pulmonary cavities).

According to the Iman JF and Duarte AG (2020) study in the United States Bronchiectasis Registry, dilated airway involvement in more than two lung regions was seen in 89% of patients and 60% had budding infiltrates involving all lobes.

Conclusion

After a wide review of the main literature on the subject, the present material presents the most current and the main radiological findings necessary for general practitioners to diagnose and classify bronchiectasis. This is an increasingly relevant topic that brings avoidable consequences and, if diagnosed early, changes the prognosis.

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