



BRONCHIECTASIS: ETIOLOGY, DIAGNOSIS, AND TREATMENT

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Abstract: Bronchiectasis is a chronic, progressive respiratory disease characterized by irreversible dilation of the bronchi, persistent cough, sputum production, and recurrent respiratory infections, and it is increasingly recognized as a significant contributor to global respiratory morbidity across all age groups. This narrative review synthesizes current evidence on the etiology, pathophysiology, diagnosis, and management of bronchiectasis, drawing on the newly updated European Respiratory Society (ERS) clinical practice guideline, systematic reviews, and other peer-reviewed sources. The disease arises from a self-perpetuating “vicious vortex” of airway infection, chronic neutrophil-driven inflammation, impaired mucociliary clearance, and progressive structural airway damage, with an underlying cause identifiable in the majority of, but not all, cases. Diagnosis rests on a compatible clinical presentation confirmed by high-resolution computed tomography, followed by a structured etiologic work-up, since identifying a treatable underlying cause meaningfully changes management. Treatment is individualized around airway clearance techniques, treatment of the underlying etiology where identified, and judicious antimicrobial and anti-inflammatory therapy guided by exacerbation frequency and microbiology. Recent trial data on targeted anti-inflammatory agents such as brensocatib mark an important step toward disease-modifying therapy. A structured, guideline-based approach to identifying underlying causes and tailoring treatment to individual disease characteristics remains central to improving outcomes for patients with bronchiectasis, including within the healthcare system of Uzbekistan.

Keywords: Bronchiectasis, vicious vortex, airway clearance, bronchiectasis severity index, *Pseudomonas aeruginosa*, nontuberculous mycobacteria, exacerbation, brensocatib.





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Methods

This work was prepared as a narrative literature review. A literature search was conducted in August 2026 using PubMed, the European Respiratory Society publications database, and the websites of major respiratory medicine societies, with the search terms “bronchiectasis,” “vicious vortex,” “airway clearance,” “bronchiectasis severity index,” and “bronchiectasis exacerbation,” combined with filters for publication in English between 2016 and 2026. Priority was given to the 2025 European Respiratory Society clinical practice guideline for adult bronchiectasis, systematic reviews, and peer-reviewed original research; narrative summaries from established clinical reference sources were included for foundational background. Case reports and articles without accessible full text were excluded. A total of twelve sources meeting these criteria were selected and synthesized for this review.

Introduction

Bronchiectasis is a chronic, progressive lung disease characterized by permanent, abnormal dilation of the bronchi accompanied by chronic cough, excessive sputum production, and recurring respiratory infections [3]. Once considered a rare, orphan condition, bronchiectasis is now recognized as common and underdiagnosed, with a meta-analysis of adult populations reporting a pooled global prevalence in the range of several hundred cases per 100,000 population and a rising trend attributable in part to increased use and sensitivity of chest computed tomography [4].

Bronchiectasis represents a common structural end-point of numerous distinct disorders that predispose the airway to chronic inflammation and damage, rather than a single disease entity, which is why identifying an underlying, potentially treatable cause is now considered central to modern management [4], [5]. The newly updated 2025 European Respiratory Society (ERS) clinical practice guideline, which replaces the 2017 guideline and incorporates trial evidence through January 2024, reinforces this principle, emphasizing structured etiologic testing alongside airway clearance and individualized pharmacotherapy as the foundation of care [1], [2].

The aim of this review is to summarize current evidence on the etiology, pathophysiology, diagnosis, and stepwise management of bronchiectasis, with particular emphasis on the recently updated international guideline recommendations and their relevance to clinical practice.

Understanding the modern approach to bronchiectasis is relevant across several areas of clinical practice, including:

- Pulmonology (diagnosis, severity assessment, and long-term disease management)
- Infectious disease and microbiology (identification and treatment of chronic airway colonization, including nontuberculous mycobacteria)
- Immunology (evaluation for underlying immunodeficiency)



- Rheumatology and gastroenterology (assessment of connective tissue disease and inflammatory bowel disease as contributing causes)

- Radiology (high-resolution computed tomography as the diagnostic reference standard)
- Physiotherapy and rehabilitation (airway clearance techniques and pulmonary rehabilitation)

The pathophysiology of bronchiectasis has traditionally been described through Cole's

Because these four elements — airway infection, chronic inflammation, impaired mucociliary clearance, and structural damage — have since been shown to interact in a highly interconnected rather than strictly sequential manner, with each component capable of independently driving all of the others, the model has been revised and is now more commonly referred to as a “vicious vortex,” illustrated in Figure 1 [7], [8], [9]. Neutrophils play a pivotal role within this vortex: delayed neutrophil apoptosis and increased neutrophil necrosis sustain dysregulated airway inflammation, and pathogens such as *Pseudomonas aeruginosa* further amplify this neutrophilic response, contributing to disease progression and to the more severe phenotypes associated with chronic *Pseudomonas* colonization [7].

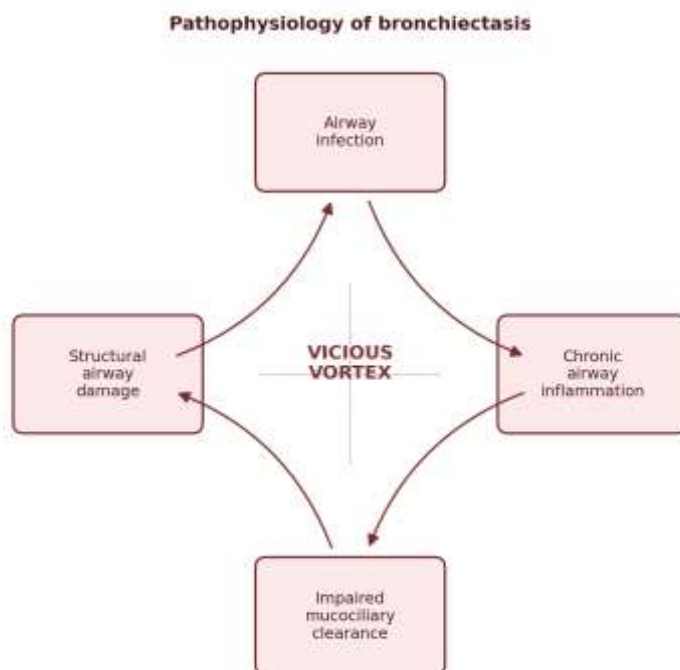


Figure 1. The “vicious vortex” of bronchiectasis pathophysiology: airway infection, chronic inflammation, impaired mucociliary clearance, and structural airway damage are

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highly interconnected, each capable of driving the others and perpetuating disease progression.

The specific “entry point” into this vortex often reflects the underlying etiology: for example, infection may be the primary trigger in post-infective or nontuberculous mycobacterial disease, whereas impaired mucociliary clearance predominates in cystic fibrosis and primary ciliary dyskinesia, and localized inflammation and structural damage may predominate in inflammatory bowel disease-associated bronchiectasis [9].

Etiology

Bronchiectasis has a wide range of recognized underlying causes, and international bronchiectasis registries consistently show that a substantial minority of cases remain idiopathic even after thorough evaluation [7]. Registry data also show geographic variation: European and North American registries report immunodeficiency, connective tissue disease, and post-infective causes as leading identifiable etiologies, whereas registries from parts of Asia report a markedly higher proportion of tuberculosis-associated disease, reflecting regional differences in the burden of mycobacterial infection [7]. The major recognized etiologic categories are summarized in Table 1.

Table 1. Major Etiologic Categories of Bronchiectasis [4], [7]

Etiologic Category	Representative Causes
Post-infective	Severe childhood pneumonia, pertussis, tuberculosis, nontuberculous mycobacterial (NTM) infection
Immunodeficiency	Common variable immunodeficiency, other primary antibody deficiencies, HIV infection
Genetic / mucociliary disorders	Cystic fibrosis, primary ciliary dyskinesia
Immune-mediated / inflammatory	Allergic bronchopulmonary aspergillosis, rheumatoid arthritis and other connective tissue disease, inflammatory bowel disease
Obstructive	Foreign body aspiration, endobronchial tumor, extrinsic airway compression
Associated chronic airway disease	Chronic obstructive pulmonary disease (COPD), asthma
Other	Gastro-oesophageal reflux and aspiration, toxic inhalation; a substantial proportion remains idiopathic despite thorough evaluation

Diagnosis



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Diagnosis of bronchiectasis is based on a compatible clinical history — typically chronic cough, daily sputum production, and recurrent lower respiratory tract infections — confirmed radiologically; high-resolution computed tomography of the chest is the diagnostic reference standard, demonstrating bronchial dilation with or without bronchial wall thickening, although standard chest radiography may occasionally be diagnostic in more advanced disease [6].

Once the diagnosis is confirmed, the updated ERS guideline strongly recommends that every patient undergo testing to identify an underlying cause, since this may reveal a treatable etiology and helps to characterize disease severity, anticipate complications, and identify relevant comorbidities; the guideline acknowledges that implementing structured etiologic testing can be resource-intensive and recommends it nonetheless, judging that the benefit of detecting treatable causes outweighs the additional cost and complexity [1], [2]. Because bronchiectasis is a multidimensional disease for which no single clinical or physiological parameter reliably predicts outcome, validated multidimensional severity scores, most widely FACED and the Bronchiectasis Severity Index (BSI), are used to stratify prognosis and guide the intensity of follow-up, as summarized in Table 2 [11]. Comorbidity assessment, including cardiovascular disease, osteoporosis, and anxiety or depression, is recommended as part of the initial and ongoing evaluation of every patient [2].

Table 2. Multidimensional Severity Scoring Systems for Bronchiectasis [11]

Score	Components	Clinical Use
FACED	FEV1% predicted, Age, chronic Pseudomonas aeruginosa Colonization, radiological Extension, Dyspnea (mMRC scale)	Simple 5-variable score; strong predictor of all-cause mortality
Bronchiectasis Severity Index (BSI)	Age, body mass index, FEV1% predicted, hospitalizations and exacerbations in the prior year, MRC dyspnea score, P. aeruginosa colonization, colonization by other organisms, radiological severity	Nine-variable score; predicts hospitalization, exacerbations, and mortality; widely used to guide follow-up intensity

Treatment

Management follows a stepwise, individualized approach centered on three pillars: treating the identified underlying cause where possible, promoting airway clearance, and using antimicrobial and anti-inflammatory therapy judiciously and only where indicated.





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The updated ERS guideline gives a strong recommendation that all patients with bronchiectasis be taught airway clearance techniques, ideally by a respiratory physiotherapist with relevant experience; no single technique has been shown to be superior to another, so the choice should be personalized to the individual patient [1], [2]. Conditional recommendations support the use of hypertonic saline, positive expiratory pressure devices, high-frequency chest wall oscillation, and structured breathing techniques as adjuncts to airway clearance, while inhaled human deoxyribonuclease is conditionally recommended against, reflecting evidence of potential harm in this population [1], [2].

Antibiotic therapy is directed at treating acute exacerbations, which are typically defined by a sustained worsening of respiratory symptoms, and at managing chronic bacterial colonization, particularly by *Pseudomonas aeruginosa*, which is associated with more severe disease and worse long-term outcomes [7], [9]. Long-term macrolide therapy may be considered in selected patients with frequent exacerbations, reflecting both antimicrobial and anti-inflammatory properties, while inhaled antibiotics are used to suppress chronic colonization in appropriately selected patients [2]. Nontuberculous mycobacterial infection, when identified, requires specific, prolonged multidrug regimens distinct from those used for other bacterial colonization [7].

Because chronic neutrophilic inflammation is now understood as a central and largely independent driver of disease progression within the vicious vortex, targeted anti-inflammatory therapy has become an active area of clinical investigation; recent phase 2 and phase 3 trial data on brensocatib, an oral inhibitor of neutrophil serine proteases, were incorporated into forthcoming North American bronchiectasis guidelines and represent an important step toward disease-modifying treatment for bronchiectasis, an area in which no therapy had previously been formally licensed [7], [12]. Tranexamic acid is conditionally recommended for patients with clinically significant hemoptysis [12].

Underlying causes should be treated specifically wherever identified: for example, immunoglobulin replacement in confirmed antibody deficiency, targeted anti-inflammatory or immunosuppressive therapy for connective tissue disease-associated bronchiectasis, and antifungal or corticosteroid therapy for allergic bronchopulmonary aspergillosis [2], [7]. Pulmonary rehabilitation, nutritional optimization, and long-term follow-up incorporating periodic reassessment of severity, comorbidities, and treatable traits are recommended for all patients with clinically significant disease [2].

Conclusion

Bronchiectasis is best understood as a common structural end-point of diverse underlying disorders that converge on a self-perpetuating vicious vortex of airway infection, chronic neutrophilic inflammation, impaired mucociliary clearance, and progressive structural damage. Effective management depends on establishing the diagnosis radiologically, pursuing a structured search for a treatable underlying cause in every patient, and using validated severity scores to guide individualized follow-up.





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Treatment should combine airway clearance techniques tailored to the individual patient, targeted management of identified underlying etiologies, and judicious antimicrobial therapy directed at exacerbations and chronic colonization. Emerging anti-inflammatory therapies targeting neutrophil-driven disease progression represent a promising step toward disease-modifying treatment.

Continued implementation of structured, guideline-based etiologic evaluation and individualized care holds the potential to reduce exacerbation frequency, slow disease progression, and improve quality of life for patients with bronchiectasis.

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