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Case Report

Excessive Dynamic Airway Collapse: An Unusual Cause of Refractory Cough

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Abstract

Expiratory central airway collapse (ECAC) is characterized by excessive narrowing of the central airways during expiration. Excessive dynamic airway collapse (EDAC), a subtype of ECAC, involves inward bulging of the posterior membranous tracheal wall with preserved cartilaginous rings and its clinical presentation closely mimics asthma and chronic obstructive pulmonary disease. EDAC is frequently underdiagnosed with spirometry and chest imaging and often requires dynamic bronchoscopy, which remains the diagnostic gold standard. We report a 63-year-old non-smoker female with hypothyroidism, treated pulmonary tuberculosis, coronary artery disease status post percutaneous transluminal coronary angioplasty, and obstructive airway disease, who presented with a three-month history of troublesome productive cough, exertional dyspnea (mMRC grade 2). Physical examination revealed bilateral polyphonic wheeze. Spirometry showed a mixed ventilatory defect with moderate obstruction and no reversibility. Despite treatment with bronchodilators and antibiotics, symptoms persisted. High-resolution computed tomography of the chest findings was not helpful in making a sound diagnosis and warranted further evaluation. Cardiac evaluation was normal. Flexible bronchoscopy performed under conscious sedation revealed significant expiratory collapse of the posterior tracheal wall, confirming EDAC. This finding explained the patient's refractory symptoms and poor response to conventional therapy. Continuous positive airway pressure was initiated as a pneumatic stenting measure, resulting in significant symptomatic improvement. This case shows that dynamic airway disorders should be considered in patients with persistent cough and wheeze, and that bronchoscopy plays a key role in making an early and accurate diagnosis and guiding proper treatment.

Keywords: Excessive dynamic airway collapse, Intractable cough, Wheezing, Bronchoscopy, Positive airway pressure therapy.

Introduction

Expiratory central airway collapse (ECAC)[1] refers to abnormal narrowing of the central airways during expiration and includes two entities: excessive dynamic airway collapse (EDAC) and tracheobronchomalacia (TBM). In EDAC, there is excessive inward bulging of the posterior membranous wall of the trachea during expiration, while the cartilaginous rings remain intact. In contrast, TBM is characterized by weakness or softening of the tracheobronchial cartilage itself. Both conditions lead to dynamic airflow limitation and may coexist with other chronic airway diseases.

ECAC is increasingly recognized as an underdiagnosed cause of chronic respiratory symptoms because its clinical presentation closely resembles common obstructive airway disorders such as asthma and chronic obstructive pulmonary disease. Patients often present with exertional dyspnea, persistent or intractable cough, wheezing that is poorly responsive to bronchodilators, difficulty in clearing secretions, recurrent respiratory infections, and occasionally respiratory failure or difficulty in ventilator weaning.[2,3]

ECAC as an entity that is often overlooked, as routine investigations and pulmonary function tests are non-specific and static chest imaging fails to detect any abnormalities. Flexible bronchoscopy performed under conscious sedation remains the gold standard diagnostic criteria[2] with a threshold of 50% reduction in airway lumen during expiration. This

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case highlights the importance of considering large airway abnormalities while treating patients presenting with refractory cough and wheezing when they don't respond to conventional therapies like cough syrups and bronchodilators. The objective of this case report is to document and create awareness among clinicians to consider the possibility of central airway collapse in patients with chronic persistent respiratory symptoms and recurrent infections.

Case Presentation

A 63-year-old non-smoker female, a homemaker, presented with complaints of troublesome productive cough, exertional dyspnea, and audible wheezing for a duration of three months. The dyspnea was graded as modified Medical Research Council (mMRC) grade 2. The cough was persistent, associated with retained secretions, and caused significant discomfort and functional limitation. There was no history of fever, chest pain, hemoptysis, orthopnea, paroxysmal nocturnal dyspnea, symptom episodicity, identifiable trigger factors, or similar illness in family members.

She was a known case of hypothyroidism, treated for pulmonary tuberculosis, coronary artery disease status post percutaneous transluminal coronary angioplasty, and was on regular follow-up. There was no history of smoking or biomass fuel exposure on physical examination. The patient was hemodynamically stable and maintained adequate oxygen saturation on room air. Respiratory system examination revealed bilateral polyphonic wheeze on auscultation, with no crackles. Cardiovascular examination was unremarkable, and no peripheral signs of heart failure were noted. Other systemic examinations were within normal limits.

Spirometry demonstrated a mixed ventilatory defect with a FEV1/FVC 89% of predicted, FEV1 57% of predicted, with no significant reversibility, and FVC of – 64% of predicted. (Figure 1a) and the patient was initially managed as an exacerbation of obstructive airway disease. Despite a trial of adequate bronchodilators with good adherence and a short course of antibiotics, her symptoms persisted and recurred, prompting repeated medical consultations.

High-resolution computed tomography (HRCT) of the chest (Figure 1b) was performed for further evaluation. The scan showed grossly normal lung parenchyma with a few non-specific ground-glass opacities in the bilateral lower lobes. A suspicious intraluminal opacity was noted in the left lower lobe bronchus, raising the possibility of a foreign body or extrinsic bronchial obstruction. There was no evidence of bronchiectasis, emphysema, significant air trapping, mediastinal lymphadenopathy, or mass lesion. Cardiac evaluation showed normal left ventricular size and systolic function with an ejection fraction of 55%, thereby excluding a cardiac cause for her symptoms.

In view of persistent symptoms and imaging findings, flexible bronchoscopy (Figure 1c and d) was performed under conscious state to evaluate for endobronchial pathology. No foreign body or intraluminal lesion was identified. However, dynamic assessment during spontaneous respiration revealed marked expiratory collapse of the posterior membranous wall of the trachea, leading to approximately 70% reduction of the tracheal lumen. These findings were consistent with expiratory dynamic airway collapse.

In the presence of underlying obstructive airway disease, this dynamic airway abnormality explained the patient's intractable cough, wheezing, retained secretions, and inadequate response to bronchodilator therapy. A diagnosis of obstructive airway disease–associated expiratory dynamic airway collapse was established, and the patient was advised continuous positive airway pressure therapy as a pneumatic stenting measure.

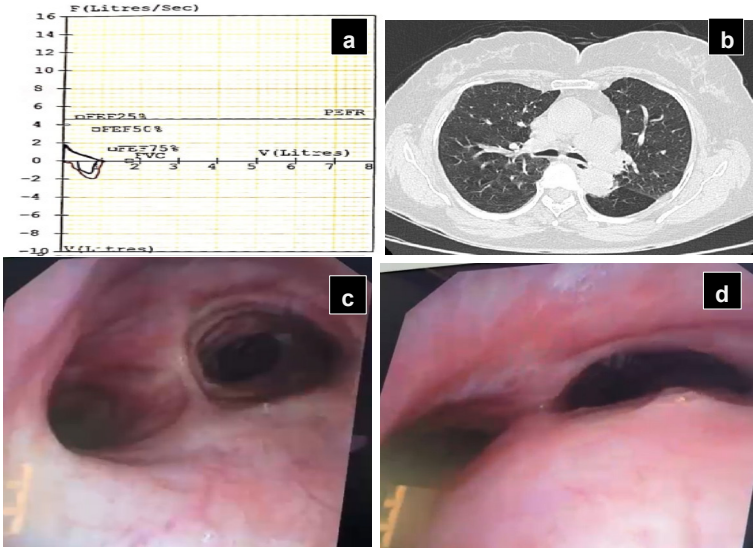

Figure 1: (a) Spirometry image showing mixed ventilatory defect. (b) Computed tomography chest axial section showing EDAC involving both primary bronchi (c) Fiber-optic bronchoscopy image of trachea showing normal luminal diameter during inspiration (d) Fiber-optic bronchoscopy image of lower trachea, Right and left main bronchus showing severe airway collapse during expiration

After a small duration trial of CPAP therapy patient responded with significant improvement in symptoms with a decrease in frequency and intensity of nighttime coughing. So accordingly, the patient was advised to continue CPAP therapy.

Discussion

Expiratory dynamic airway collapse (EDAC) is characterized by excessive invagination of the posterior membranous wall during expiration with preserved cartilaginous integrity. Reduction of more than 50% in the airway lumen during expiration has been widely accepted as a diagnostic criterion. ECAC is increasingly recognized in patients with obstructive airway diseases. In a prospective CT-based study by Leong *et al*.[4], ECAC was identified in 35% of patients with stable COPD and 39% of patients during acute exacerbations, while no healthy controls demonstrated ECAC using dynamic tidal-breathing CT imaging. Importantly, the degree of tracheal collapse did not significantly differ between stable disease and exacerbation states, suggesting that ECAC represents a chronic structural abnormality rather than an acute phenomenon of airflow obstruction. Additionally, EDAC was more common than tracheobronchomalacia in these cohorts, consistent with posterior membranous laxity as the dominant mechanism in adults with obstructive airway disease. Clinical suspicion for EDAC should arise when respiratory symptoms are disproportionate to spirometric severity or fail to respond to optimized inhaled therapy. Pulmonary function testing has limited diagnostic value, as flow–volume loop abnormalities are neither sensitive nor specific for EDAC; Leong *et al*.[4] demonstrated that spirometric parameters and FEV_1 did not significantly differ between COPD patients with and without ECAC Similarly, static imaging may appear normal or show only non-specific findings, as dynamic airway collapse is often missed unless expiratory imaging or bronchoscopy is specifically performed. This diagnostic limitation explains why EDAC is frequently misclassified as refractory asthma or COPD.

Our case is clinically noteworthy because the patient exhibited persistent cough, wheeze, and secretion retention despite appropriate bronchodilator therapy, while spirometry and HRCT failed to reveal an explanatory pathology. The detection of approximately 70% expiratory posterior tracheal wall collapse on conscious bronchoscopy was consistent with clinically significant EDAC and provided an explanation for the symptoms. Recognition of EDAC has important implications for routine clinical practice. In the Mayo Clinic bronchoscopy-based CPAP titration study,[5] successful pneumatic stabilization of the airway was achieved in 84% of patients, defined by both endoscopic airway patency and symptomatic improvement, with a median effective CPAP pressure of 12 cm of H_2O. This approach offers a less invasive alternative to airway stenting trials, which are associated with procedural risks and complications. The chest review also emphasizes that noninvasive positive airway pressure acts as a "pneumatic stent," improving expiratory airway diameter. A case report published in Lung India[6] described a middle-aged woman presenting with severe intractable cough and normal spirometry, in whom bronchoscopy demonstrated >70% expiratory collapse of the trachea and main bronchi. Similar to the present case, the patient showed significant symptomatic improvement with noninvasive positive-pressure ventilation, reinforcing the functional relevance of EDAC and the therapeutic role of positive airway pressure.

Management of ECAC is individualized and stepwise, beginning with optimization of associated conditions and airway clearance. Continuous positive airway pressure acts as a pneumatic stent to keep the airway open and is effective in selected symptomatic patients. In severe refractory cases, invasive options such as airway stenting or surgical tracheobronchoplasty may be considered after careful evaluation.

Importantly, biphasic dynamic CT of the chest is a valuable noninvasive adjunct for evaluating suspected EDAC, particularly for mapping disease extent and excluding extrinsic compression; however, bronchoscopy remains the diagnostic gold standard. In our case, non-expiratory protocol CT was performed due to less suspicion initially and directly clinical judgement, bronchoscopy and relief to positive airway pressure therapy anchored the diagnosis.

Conclusion

This case highlights the importance of looking into the airways when every common cause of cough has been ruled out. Non-responding cases should go under a dynamic CT chest/ fiber optic bronchoscopy; timely intervention will help in initiating the right therapy and avoid unnecessary escalation of other treatment options.

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