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Upper Airway Wheezing: Inducible Laryngeal Obstruction vs. Excessive Dynamic Airway Collapse

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Introduction

- Excessive dynamic airway collapse (EDAC) describes focalized collapse of the trachea or main bronchi
- Commonly the posterior trachea invaginates while the cartilaginous tracheal ring structure is maintained
- Combination of posterior membrane laxity, airway and pleural pressures
- Typically observed in COPD, bronchiectasis and asthma
- Inducible laryngeal obstruction (ILO), previously called 'vocal cord dysfunction,' describes vocal cord closure with inspiratory wheezing
- Can be exercise induced and believed to occur in up to 10% of incorrectly diagnosed cases of asthma

Case

Past Medical History

- 31 year old male with past medical history significant for GERD
- Dyspnea upon exertion developed after a nine month deployment to Iraq

History of Present Illness

- Non-reactive methacholine challenge with 9% reduced FEV1
- Exercise laryngoscopy found ILO/VCD by ENT
- Vocal cord relaxation training with speech pathology yielded symptomatic improvement
- Continued to be intermittently dyspneic upon exertion with hoarseness over the next two years
- Developed dyspnea at rest with symptomatic response to bronchodilators and non-invasive positive pressure ventilation (NIPPV)
- Pulmonary function testing unremarkable **(Table 1)**
- Repeat exercise laryngoscopy found laryngeal edema and no ILO
- Noted to have expiratory wheezing best heard over upper airway
- Exercise bronchoscopy found EDAC of the distal trachea with 50% collapse continuous into left and right mainstem bronchi and 90% collapse of right superior bronchus **(Figures 1&2)**
- All foci of collapse resolved with return of minute ventilation
- Subglottic protuberation upon forceful exhalation of unknown etiology overlying tracheal ring in region of upper airway wheezing

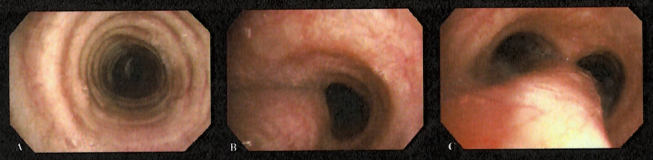

Figure 1. Bronchoscopic imaging of the trachea with maintained cartilaginous ring structures at rest (A). Upon forceful exhalation (B), a greater than 50% dynamic airway collapse was observed at the proximal trachea that continued down to and bifurcated to the left and right mainstem bronchi at the level of the carina (C).

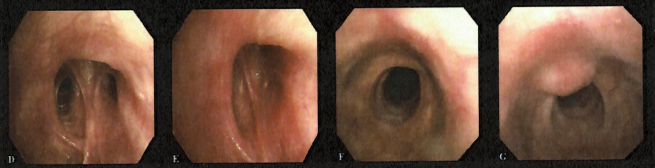

Figure 2. The right upper lobe with visible patency of the posterior and anterior segments (D) with near complete collapse of all segments during exercise (E). A dilation of the proximal trachea with focal tracheal ring (F) was observed during exercise bronchoscopy. An intermittent subglottic protuberation (G) was seen during expiration phases with resolution upon cessation of exercise.

Pulmonary Function Testing	
FVC (predicted %)	4.73 (96%)
FEV1 (predicted %)	3.69 (91%)
FEV1/FVC	78%
TLC (predicted %)	6.36 (98%)
RV (predicted %)	1.63 (97%)
DL_{CO} (predicted %)	22.9 (71%)
DL_{CO}/VA	4.32 (87%)

Table 1. Pulmonary function testing.

Causes of Upper Airway Wheezing
Vocal cord edema or paralysis
Paradoxical vocal cord motion
Laryngeal stenosis
Laryngocele
Tonsillar hypertrophy
Post nasal drip syndrome
Anaphylaxis

Discussion

Excessive Dynamic Airway Collapse

- EDAC is a weakening and narrowing of the posterior trachea associated with obstructive lung diseases and found in 6% of COPD patients
- Believed to be caused by chronic inflammatory destruction of elastic fibers of the posterior tracheal membrane
- Hyperbolic invagination of the posterior trachea occurs during exercise or forceful exhalation
- Diagnosed based on clinical symptoms, auscultatory findings, CT imaging and foci of collapse localized by bronchoscopy
- Treatments include bronchodilators, NIPPV, tracheostomy, airway splinting, tracheal resection

Inducible Laryngeal Obstruction

- ILO is an inspiratory closure of the vocal cords associated with noisy breathing, often confused with asthma
- May be caused by anxiety irritants or exercise
- Diagnosed with exercise laryngoscopy
- Speech-language therapy is cornerstone of treatment along with GERD management

Conclusion

- EDAC is a rare cause of dyspnea without underlining pulmonary disease
- Defined by a >50% collapse of the airway lumen due to laxity of the posterior membrane with maintained tracheal cartilage integrity
- ILO is associated with inspiratory wheezing and is inspiratory closure of the vocal cords, often during exertion
- Expiratory wheezing suggests EDAC; inspiratory wheezing suggests ILO
- This case highlights one of the few presentations of EDAC in a young, otherwise healthy patient and is amongst first with reported concurrent tracheal ring of unknown etiology

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