Exercise-Induced Laryngeal Obstruction—An Overview

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KEYWORDS

• Exercise • Larynx • Airway obstruction • Exercise-induced laryngeal obstruction
• Continuous laryngoscopy during exercise

KEY POINTS

- Exercise-induced laryngeal obstruction (EILO) is a prevalent cause of exertional dyspnea and is frequently noted in adolescent girls.
- Advances in EILO diagnostics have led to the distinction of EILO from other forms of inducible laryngeal obstruction.
- Although multiple anatomic phenotypes of EILO have been visually identified, understanding of EILO pathophysiology and mechanism remains limited.

BACKGROUND AND HISTORICAL OVERVIEW

Exercise-induced laryngeal obstruction (EILO) describes conditions in which the laryngeal inlet closes partially or completely during exercise. Patients with EILO clinically present with exertional dyspnea with or without stridor. Although frequently mistaken for, or coexistent with, exercise-induced asthma, it is a distinct entity,[1,2] and its importance and improved recognition have only really become apparent over the past few decades.

Inducible laryngeal obstruction (ILO) unrelated to exercise was first described in the nineteenth century. For more than 100 years, in part due to a lack of diagnostic modalities that could easily characterize anatomy during periods of respiratory distress, publications devoted to the condition focused on case reports and speculative theories about disease mechanism. Initially described as "hysterical croup in women" and "Munchausen stridor," psychological mechanisms were widely accepted as the cause of stridor and dyspnea.[3–6]

The development of fiber-optic endoscopic technology in the 1960s facilitated examination of the larynx in patients suffering from laryngeal symptoms. In 1982, Chung[7]

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reported that laryngeal symptoms could mimic the presentation of acute asthma. This was followed by descriptions from Christopher and colleagues,[8] who coined the term, *vocal cord dysfunction* (*VCD*), and Lakin and colleagues,[9] who detailed inappropriate laryngeal closure occurring in relation to exercise based on a fiber-optic laryngeal evaluation after exercise. This early work, which relied on visual findings, highlighted the anatomic contribution to disease and led to the recognition of ILO as an entity distinct from asthma.

More than a decade later, in the mid-1990s, Smith and colleagues,[10] followed by Bent and colleagues,[11] Beaty and colleagues,[12] and Naito and Niimi,[13] visualized the larynx during exercise. By studying the larynx during exercise, new insights into subtypes of EILO were attained. In addition to other case reports and series describing inappropriate glottic adduction during exercise, visual data obtained during exercise led to the realization that the supraglottic structures could partially or fully obstruct the laryngeal inlet with little or no involvement of the vocal folds. This specific phenomenon was termed, *exercise-induced laryngomalacia*, due to the anatomic resemblance with congenital laryngomalacia.[10]

In 2006, Heimdal and colleagues[14] presented a formal description of a novel clinical methodology, describing continuous laryngoscopy during a standardized treadmill exercise test. This test, termed, *continuous laryngoscopy exercise* (*CLE*) *test*, provided researchers and clinicians with a procedural framework for EILO diagnosis and enabled laryngeal video recording during exercise. The CLE test has been subsequently adapted to different exercise modalities[15–17] and is now considered the gold standard for the diagnosis of EILO.[18] This is important because descriptions and future studies of EILO epidemiology, conditions associated with the disease, mechanism, and response to various therapies depend on robust objective diagnostic methodologies.

The CLE test has facilitated improved understanding of different anatomic phenotypes of EILO (**Fig. 1**A). Recent work has demonstrated that laryngeal obstruction can occur at the glottic level (ie, the vocal folds adduct [**Fig. 1**C]) or at the supraglottic level (ie, closure caused by prolapse of the arytenoid cartilages aryepiglottic fold [**Fig. 1**B]). At times, the obstruction is caused by a combination of glottic and supraglottic obstruction (**Fig. 1**D) and in rare cases, a retroflexion of the epiglottis may occlude the laryngeal inlet (**Fig. 1**E).[19]

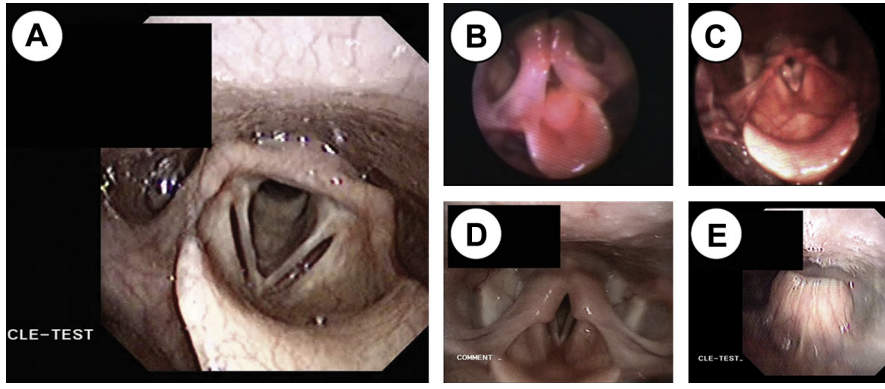

Fig. 1. Examples of EILO. Panel A depicts Normal. All images depict the larynx in inspiration during exercise. (*B*) Supraglottic. (*C*) Glottic. (*D*) Combined glottis and supraglottic. (*E*) Retroflexing epiglottis.