

Speech-Language Pathology as a Primary Treatment for Exercise-Induced Laryngeal Obstruction



Monica Shaffer, MA, CCC-SLP^{a,*}, Juliana K. Litts, MA, CCC-SLP^b,
Emily Nauman, MA, CCC-SLP^a, Jemma Haines, CertMRCSLT^c

KEYWORDS

- Speech-language pathology (SLP) • Exercise-induced laryngeal obstruction (EILO)
- Paradoxical vocal fold motion (PVFM) • Vocal cord dysfunction (VCD)
- Pursed lip breathing • Laryngeal control therapy

KEY POINTS

- Exercise-induced laryngeal obstruction responds well to behavioral therapy guided by a speech-language pathologist.
- Traditional therapy techniques include education, relaxation, and instruction on various breathing techniques, such as pursed lip breathing or sniffing.
- Paced exercise with applied breathing techniques can prevent and alleviate symptoms of exercise-induced laryngeal obstruction.
- Many individuals experience near full resolution of exercise-induced laryngeal obstruction symptoms with traditional therapy techniques, although there are refractory cases requiring additional intervention approaches.

INTRODUCTION

Exercise-induced laryngeal obstruction (EILO) is a pattern of glottic and/or supraglottic closure that restricts an individual's ability to inhale and exhale comfortably in response to exercise. Historically, EILO has been identified by many names such as vocal cord dysfunction or paradoxical vocal fold motion.

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^a Rehab Department, National Jewish Health, 1400 Jackson Street, Denver, CO 80206, USA;

^b Department of Otolaryngology, University of Colorado Hospital, 12631 East 17th Avenue, B-205, Aurora, CO 80045, USA; ^c Department of Respiratory Medicine, North West Lung Centre, Wythenshawe Hospital, Manchester University National Health Service Foundation Trust, Southmoor Road, Manchester, M23 9LT, UK

* Corresponding author.

E-mail address: Shafferm@njhealth.org

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Regarding treatment, EILO responds well to behavioral therapy and respiratory retraining. Since it was first described in the nonpsychiatric literature, speech-language pathologists (SLPs) have been involved in the assessment and treatment of patients with EILO.¹ SLPs are formally trained in the assessment and treatment of disorders of the aerodigestive tract and facilitating behavioral change via patient education, relaxation, and respiratory retraining. In treating EILO, SLPs use various approaches of breathing and relaxation techniques to guide the patient through symptom prevention, control, and rescue breathing during their dyspneic episodes. The literature suggests positive patient response to behavioral intervention for EILO.^{1–14} It has been reported that behavioral intervention by SLPs may prevent up to 90% of patient visits to the emergency room for symptoms attributable to inducible laryngeal obstruction, although this finding is not specific to patients with exercise-induced symptoms.¹⁵

In this review, guidelines for treatment approaches in patients with EILO using behavioral interventions are outlined. Traditional approaches to therapy are discussed, as well as additional interventions for refractory EILO, and future directions for research and therapy.

TREATMENT OVERVIEW

Speech-language intervention for EILO is a short course of guided therapy (2–3 sessions) by SLPs specializing in voice and respiratory disorders. Treatment involves various approaches and should be tailored to the patient. Traditional treatment approaches include patient education, patient counseling, relaxation techniques, and training in specific breathing techniques that optimize laryngeal relaxation, respiratory pace, and patient comfort. Medical interventions for comorbid diagnoses should also be considered by the referring doctor and may include treatment for asthma, sinonasal disease, laryngopharyngeal reflux, allergic rhinitis, and anxiety.

Education and Reassurance

The first goal of treatment is educating the patient on their diagnosis and goals of therapy.^{10,12–14,16,17} Often, patients are frustrated and confused by the time a correct diagnosis and treatment plan is established, because EILO is commonly misdiagnosed.^{18,19} It is our experience that many adolescent athletes with EILO are not allowed to participate in competitive sports given observer fear of noisy laryngeal stridor. The treating SLP plays an important role in educating the patient and those involved in the patient's activity or sport of choice (including coaches, teachers, and parents). Reassurance that EILO is not life threatening helps to alleviate fear for both the patient and observers.^{6,12}

It is our experience that patient understanding of laryngeal anatomy and physiology aids the patient in independent symptom control. If available, images from the patient's diagnostic laryngoscopy may be used to enhance patient understanding.^{9,12,20} Alternatively, laryngeal models or artist depictions of the anatomy are useful teaching tools.²¹ It is our experience that patients benefit through learning relevant respiratory physiology. Keys to anatomic/physiologic teaching are summarized in [Table 1](#).

Helping patients to characterize and describe their symptoms is important for the prevention and control of dyspneic episodes. It is our experience that the sooner patients can identify the initial onset of symptoms during exercise, the easier the symptoms are to control. Simple questions to stimulate this conversation with a patient are summarized in [Table 2](#). Along with anatomy and physiology teaching, it is also important to teach safety with patients who may have more severe episodes ([Box 1](#)).

Table 1
Key teaching points for patient education

Teaching Point	Description
Anatomic	Vocal cords sit on top of the trachea and lungs
Physiologic	Normal vocal cord movement: open with breathing, close with speech for vibration, close for protective behaviors (coughing, throat clearing, breathholding) Biological function of the vocal folds is protective; coughing and throat clearing are behaviors to eject irritants from the larynx and require vocal cord closure Vocal cords are built to open with air pressure from the lungs below; this is how voice is produced
Respiratory physiology	Rapidly moving air through a restricted area (larynx) can produce turbulence, causing a sensation of restricted airflow If the patient has spirometry demonstrating truncated inspiratory flow, discuss how the larynx or pharynx may be contributing to this
EILO specifics	Speed of inspiratory or expiratory airflow can be irritating to a hypersensitive system and can precipitate or prolong the symptoms of EILO Bring the patient's attention to importance of breath out, as well as the breath in, which is not intuitive when patient is feeling symptoms of dyspnea Patients with dyspnea during exercise often cause worsened symptoms by not allowing enough time for a full exhale to empty lungs and allow for complete inspiration Impart idea of patient control over respiratory and laryngeal mechanisms

Abbreviation: EILO, exercise-induced laryngeal obstruction.

Traditional Rescue Breathing: Pursued Lip Breathing and Laryngeal Control Therapy

Traditional modes of treatment for EILO aim to adjust oropharyngolaryngeal aperture during exercise and symptomatic episodes via various breathing and relaxation techniques, often grouped under the term “laryngeal control therapy.”² Effective treatment

Table 2
Questions to establish description and characterization of EILO symptoms

Questions	Rationale
What specific activities, sports, and exertional levels trigger your episodes?	If a patient engages in multiple sports, one may be more bothersome to EILO symptoms than others.
Can you predict when you are going to have an episode? What do you feel leading up to the episode?	Initial symptom presentation is described differently between patients. Establish language with the patient to understand and identify these early symptoms.
How quickly do symptoms begin when you start exercising? How quickly do symptoms resolve when you stop exercise?	Characterizing bouts in the context of exercise timeframe will allow the patient to better predict onset, and to better pace exercise based on symptom severity.
What do you do to make the episode better?	Using appropriate strategies devised by the patient may further therapeutic progress. It may be necessary to educate patient on avoiding inappropriate strategies (eg, hyperventilating).

Abbreviation: EILO, exercise-induced laryngeal obstruction.

Box 1**Educating safety in patients with severe EILO**

EILO will not cause death by asphyxiation.

With loss of consciousness, respiratory patterns will return to normal, although loss of consciousness is a greater safety hazard in certain sports (eg, swimming).

When feeling lightheaded or dyspneic, stop operating heavy machinery (eg, car), sit down in a safe location without objects that could cause injury (eg, coffee table, book shelf, stairs, etc).

Attempt to use some breathing techniques, as instructed in therapy, to regain control of respiratory system.

If an ER visit is necessary, develop a plan for communication to the ER providers; avoid extreme measures for EILO treatment, such as tracheotomy, in favor of other interventions such as heliox.

Abbreviations: EILO, exercise-induced laryngeal obstruction; ER, emergency room.

is tailored to each patient based on clinical discussions and the patient's symptom severity ratings when using various techniques. Specific breathing techniques that may be used are described herein; primary approaches and their initial publication are summarized in [Table 3](#).

First described by Christopher and colleagues (1983),¹ pursed lip breathing is centered around giving the patient control over the breathing mechanism by producing restriction in the oral cavity during exhalation to match any laryngeal impedance during inhalation. Exhalation can be taught in a variety of different forms ([Table 4](#)).

Inhalation using a sniff technique (short and forceful nasal inhalation) has been suggested to maximize glottic opening.^{5,16,21,22} Under laryngeal control therapy, Chiang and colleagues (2013)² suggested sniff inhalation with controlled exhalation as described. Other theories of respiratory retraining have emphasized the importance of silent inhalation that is relatively short (1–2 seconds) compared with the longer exhalation cycle.¹² This decreases the chance of prolonging the dyspnea episode owing to high-velocity air irritating the laryngeal mechanism.

A core foundational skill for EILO symptom management is diaphragmatic breathing, no matter what specific technique is being implemented. All approaches emphasize the importance of abdominal breathing, versus thoracic or clavicular patterns. With athletes in particular, an increased focus on lower rib excursion can prove more functional than a sole focus on abdominal breathing. This allows the patient to engage abdominal muscles for core support during exertion, while still using diaphragmatic breathing patterns. The mechanism through which diaphragmatic breathing may improve EILO is unclear at the current time.

Breathing techniques instructed in the clinic setting typically require adjustment for application during exercise, given the increased demand on the respiratory system. During exercise with high respiratory drive, it may not be possible or comfortable for the patient to breathe in through the nose, as with the sniff technique, or to use diaphragmatic breathing. Teaching pursed lip or oral inspiration may be necessary. It is important that the inspiratory phase of the breath cycle remains controlled and almost silent. The treating SLP should encourage the patient to find a mechanism of breath control that feels most comfortable for them, because there is no ubiquitous treatment that works for all patients.

At first onset of EILO symptoms, patients are instructed to implement a form of “release breathing.” The patient may alternate between a more natural breathing

Table 3
Primary approaches to respiratory retraining

Approach/Technique	Description	Publication(s)
Laryngeal control therapy	• Focus on low abdominal movement • Audible nasal sniffing on inhalation • Controlled exhalation through the mouth with continuous or pulsed bursts via puckered lips • Goal is to improve awareness, perform slow breathing, and increase force on exhalation	Chiang et al, ² 2013; Marcinow et al, ⁷ 2014
Pursed lip breathing	• Focus attention away from larynx and inspiration • Active expiration via abdominal muscles • Relaxed oropharyngeal muscle groups	Christopher et al, ¹ 1983
Release breathing	• Focus on midabdominal movement with instruction to lower shoulders • Quick, 1-s inhale through nose or mouth • Exhale through tightly pursed lips for 2–3 s • Also provides strategies for cough and throat clearing elimination	Hicks et al, ¹⁶ 2008
Wide-open throat breathing or relaxed throat breathing	• Focus on openness and relaxation • Closed lips, tongue lies flat on floor of mouth behind lower front teeth, jaw is gently released • Use of diaphragm for inhalation and exhalation, with conscious attention away from laryngeal area • Also focuses on slow direction, increased self-awareness, and interruption of effortful breathing	Martin et al, ⁹ 1987

Table 4
Teaching exhalation

Approaches to exhalation	Short puffs of air through pursed lips like blowing out a candle repeatedly. Repeated bursts of voiceless sounds (<i>s</i>, <i>f</i>, <i>sh</i>) that are repeated 3–4 times before returning to inhalation. Long continuous exhalation through restriction with pursed lips. Continuous voiceless sounds (<i>s</i>, <i>f</i>, <i>sh</i>) lasting about 4 s. Exhalation through a straw held between the lips; however, this is not a functional option for most athletes.
Additional considerations	Degree of pursed lip opening is adjusted based on activity level and patient preference (eg, for running, a more rounded lip posture may be preferable, whereas a more tightly pursed posture is appropriate for walking or jogging) owing to presumed differences in the degree of laryngeal constriction between high respiratory drive in running vs walking. Metered exhalation during exercise or stair climbing with the patient experimenting with a rhythm for breathing that feels comfortable and controlled. For example, when climbing stairs, 4–5 steps for a breath out using a pursed lip technique and 2–3 steps for a breath in through nose. Different meters may be used for running vs walking.

pattern with a rounded lip exhale when asymptomatic, to a more pursed lip rescue breathing pattern when symptomatic. Resolution of symptoms should take less than 1 minute. In some cases, it is only necessary to do a few rescue breathing cycles before the symptoms abate. Lightheadedness can occur when the patient performs rescue breathing for a prolonged period of time. Slowing the pace of exertion at first onset of EILO symptoms can also help the patient to attend to their breath cycle and better resolve the episode. The patient may resume a faster pace of exertion and return to their more normal breathing pattern once symptoms have resolved. Learning appropriate pacing of exercise can be difficult for patients individually, and often therapeutic techniques have to be applied incrementally in a hierarchical structure with the SLP. Therefore, functional practice with the clinician present as the patient exercises in their preferred manner (eg, running, swimming, gymnastics, etc) will improve progress in therapy.^{7,12,14} This practice can be challenging in a clinic setting without access to appropriate exercise equipment.

Recently, a new series of breathing techniques called the Olin EILOBI breathing techniques were described as a potential option for patients that remain symptomatic despite adequate performance of conventional respiratory retraining techniques during high-intensity exercise.²³ The principle behind these techniques is that sudden changes in airflow seem to positively affect inspiratory laryngeal configuration. The initial discovery of the techniques was largely visual and preliminary data suggest that these techniques are worthy of further study.^{23,24}

Relaxation Techniques

In certain patients with EILO, excessive tension in the upper body, shoulders, neck, jaw, or face can contribute to worsened symptom severity in our experience. Improving patterns of diaphragmatic breathing is the first step in reducing excessive tension. Other techniques that help to relieve undue tightness are summarized in **Box 2**.

ADDITIONAL TREATMENT APPROACHES FOR REFRACTORY EXERCISE-INDUCED LARYNGEAL OBSTRUCTION

Many patients experience great benefit from traditional therapy approaches, with 75% to 80% experiencing improved or complete resolution of symptoms after respiratory

Box 2
Strategies for releasing excessive upper body tension

Instruction on voice therapy techniques of lip trills, tongue trills, or voiced sounds of /z, v, ʒ/.

Stretching targeted neck or shoulder muscles both in front and back to relieve tension.

Instruction on visualization of an open and relaxed airway. Referring back to laryngoscopy images may be helpful for certain patients.

Negative practice of creating a tight/closed feeling in their throat and then releasing muscles to create a more relaxed feeling.¹⁰

Verbally highlighting possible areas of tension and stress in shoulders and back of neck during exercises (eg, holding shoulders up while running); visual feedback via a mirror may be useful for some patients.

Instruction on breath awareness of difference between thoracic/clavicular breathing and abdominal breathing.

Instruction on avoidance of breathholding, which can frequently occur in activities such as weight lifting.

retraining.^{2,25,26} However, there are patients for whom traditional approaches do not fully alleviate symptoms. The treating SLP may opt to implement additional tools for improvement in those patients that continue to struggle under traditional therapy approaches alone.

Inspiratory Muscle Training

Inspiratory muscle training (IMT) involves systematic periods of resistive breathing maneuvers designed to improve inspiratory muscle strength. Patients with EILO often present with symptoms including tachypnea as well as laborious breathing during periods of maximal exertion. These symptoms are similar in presentation to those with inspiratory muscle weakness.²⁷

There have been numerous studies validating the role of IMT in patients with known respiratory impairments, in trained athletic populations and in typical, healthy aging adults.^{27–33} Mathers-Schmidt and Brilla (2005)¹¹ revealed IMT improved inspiratory muscle strength and decreased a patient's overall exertional dyspnea rating in an 18-year-old female soccer player with EILO. In this study, the patient was initially provided traditional therapy techniques (education and relaxed throat breathing) before the implementation of an IMT protocol.

Biofeedback

The use of biofeedback has been demonstrated to improve patient control over the laryngeal mechanism.^{2,3,6,7,20} It has been established that individuals can change laryngeal movements and postures using visual feedback of their own real-time laryngeal video as a learning tool.³⁴ Olin and colleagues (2016)³⁵ reported the first systematic use of therapeutic laryngoscopy during exercise (TLE) in individuals with EILO refractory to treatment, despite receiving a range of behavioral therapies. During TLE, EILO symptoms are provoked. This process allows individuals and clinicians to visualize, tailor therapy, and apply techniques incrementally to improve laryngeal aperture in real-time. Olin and colleagues (2016)³⁵ reported that three-quarters of participants agreed or strongly agreed that their breathing during exercise had improved with TLE and, of those participants, 85% felt TLE was the most important therapy leading to breathing improvement.

Heliox

Heliox is a mixture of helium and oxygen, which has no bronchodilating nor anti-inflammatory properties and can be used safely in most individuals.³⁶ Compared with room air and oxygen, heliox has different laminar flow characteristics.³⁷ Its lower density means that it can pass through partial upper airway obstruction with ease,³⁸ reducing turbulent airflow³⁹ and facilitating better free-flowing laminar flow. The resulting reduction in airway resistance⁴⁰ decreases the individual's sense of dyspnea and effort.³⁶

Although heliox has been reported as efficacious in the treatment of acute episodes of upper airway obstruction,⁴¹ administration concurrently with exercise is an unlikely approach owing to the prescribed mode of delivery: 5 to 10 minutes through a nonre-breather facemask until symptoms resolve.³⁷ Heliox maybe more appropriately used as a tool to aid quicker recovery of an EILO attack and facilitate return to a high respiratory drive in competitive events. Further investigation and research are required to understand the use of heliox in EILO management. Randomized, blinded, and controlled prospective research is necessary to determine the true therapeutic potential of this treatment.

FUTURE CONSIDERATIONS

Much of the currently available literature is composed of case studies, retrospective chart reviews, or descriptive articles outlining the signs and symptoms of EILO. High-quality research studies on specific treatment approaches are needed to improve our understanding of this disorder to fully ascertain if complete resolution of symptoms across all patients is achievable. Additionally, although recreational athletes are generally able to manage symptoms via traditional therapy approaches and paced exercise, it is our experience that high-performance athletes may experience more refractory symptoms. For professional athletes or highly competitive athletes, a slower pace for symptom resolution is often not an option. Research of additional breathing techniques for high-performance athletes or maximum-level exertion is needed as an alternative for this population.

SUMMARY

SLPs have been shown to be appropriate providers to facilitate behavioral change and patient control over EILO symptoms. Further research is needed to understand the mechanism of SLP intervention and the most critical elements of teaching protocols.

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