Paediatric Respiratory Reviews 21 (2017) 86–94

Contents lists available at ScienceDirect

Paediatric Respiratory Reviews

Review

Exercise inducible laryngeal obstruction: diagnostics and management

Ola Drange Røksund PhD[1,2,*], John-Helge Heimdal MD, PhD[3,4], Hege Clemm MD, PhD[2,5], Maria Vollsæter MD, PhD[2,5], Thomas Halvorsen MD, PhD[2,5]

[1] The Faculty of Health and Social Sciences, Bergen University College, Bergen, Norway
[2] Department of Paediatrics, Haukeland University Hospital, Bergen, Norway
[3] Department of Otolaryngology & Head and Neck surgery, Haukeland University Hospital, Bergen, Norway
[4] Department of Clinical Medicine, University of Bergen, Norway
[5] Department of Clinical Science, Section for Paediatrics, University of Bergen, Norway

EDUCATIONAL AIMS

The reader will be able:

- To highlight the importance of exercise induced inspiratory symptoms (EIIS) in young people complaining of exercise intolerance.
- To emphasize differences between EIIS and symptoms of exercise induced asthma.
- To highlight that EIIS is usually due to exercise induced laryngeal obstructions (e-ILO).
- To discuss why objective diagnostic test methods are important in patients with EIIS.

ARTICLE INFO

Keywords:
Larynx
Respiratory Sounds
Exercise Induced Asthma
EIA
Exercise Induced Laryngeal Obstruction
EILO
Exercise Induced Inspiratory Symptoms
EIIS
Vocal Cord Dysfunction
VCD.

SUMMARY

Obstruction of the central airways is an important cause of exercise-induced inspiratory symptoms (EIIS) in young and otherwise healthy individuals. This is a large, heterogeneous and vastly understudied group of patients. The symptoms are too often confused with those of asthma. Laryngoscopy performed as symptoms evolve during increasing exercise is pivotal, since the larynx plays an important role in symptomatology for the majority. Abnormalities vary between patients, and laryngoscopic findings are important for correct treatment and handling. The simplistic view that all EIIS is due to vocal cord dysfunction [VCD] still hampers science and patient management. Causal mechanisms are poorly understood. Most treatment options are based on weak evidence, but most patients seem to benefit from individualised information and guidance. The place of surgery has not been settled, but supraglottoplasty may cure well-defined severe cases. A systematic clinical approach, more and better research and randomised controlled treatment trials are of utmost importance in this field of respiratory medicine.

EXERCISE INTOLERANCE; IS IT ASTHMA OR WHAT?

Exercise related breathing complaints are not uncommon in young people, and a scenario all clinicians must be prepared to encounter. Asthma is common in this age group, and a well-established cause of exercise induced bronchoconstriction (EIB), which untreated leads to exercise intolerance [1]. Despite guidelines prescribing objective test methods [2], studies suggest that asthma and EIB are often diagnosed simply based on symptoms [3–5]. However, all exercise related wheeze is not asthma [6], and

* Corresponding author. Ola Drange Røksund, Bergen University College, Postboks 7030, N-5020 Bergen, Norway. Tel.: +47 55585579; fax: +47 5597 5147.
E-mail address: odro@hib.no (O.D. Røksund).

Abbreviations: CLE-test, Continuous Laryngoscopy Exercise - test; EIB, Exercise induced bronchoconstriction; EIIS, Exercise induced inspiratory symptoms; e-ILO, Exercise induced laryngeal obstruction; FEV_1, Forced Expiratory Flow in the first second; PCA-muscle, The Posterior Cricoarytenoid Muscle; VCD, Vocal cord dysfunction.

http://dx.doi.org/10.1016/j.prrv.2016.07.003

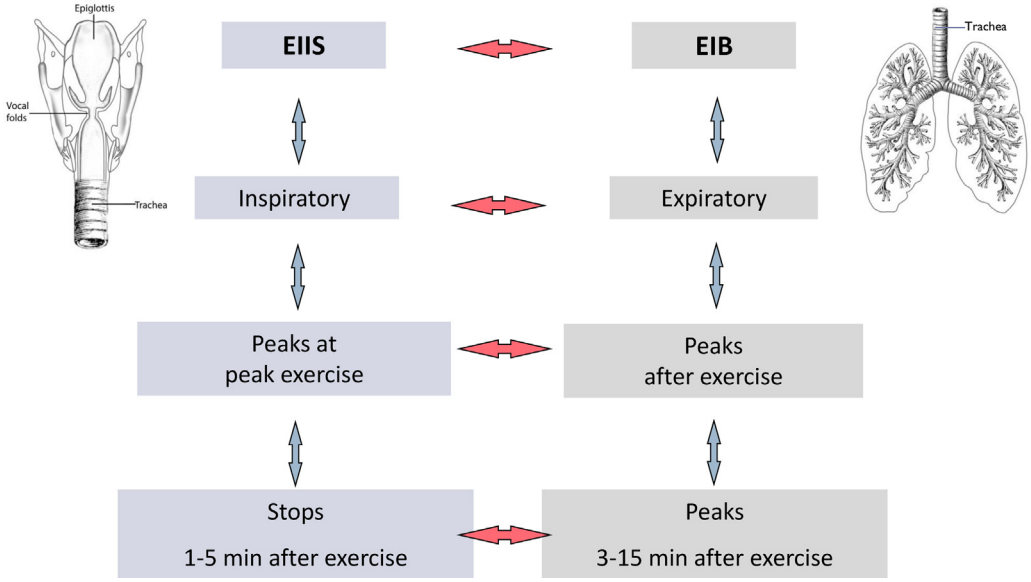

Figure 1. Characteristics of exercise induced inspiratory symptoms(EIIS) versus symptoms of exercise induced bronchoconstriction (EIB).

recent studies have suggested that laryngeal obstruction to airflow might be just as important [7,8].

Physicians' interpretation of symptoms presented by patients will strongly influence subsequent work-up, treatment and follow-up. Principally, airway obstruction inside the thoracic cage produces expiratory symptoms (as in asthma) while obstruction outside the thoracic cage produces inspiratory symptoms. Moreover, EIB is a *response* to increased ventilation induced by high intensity exercise, with symptoms typically peaking 3-15 minutes after stopping [9]. This pattern contrasts symptoms from upper airway obstructions that typically peak *during* exercise or just after stopping (Figure 1). Easy as this might seem, the literature nevertheless indicates that EIB is vastly overdiagnosed in patients with upper airway obstruction [10,11]. One factor that might have contributed to this untenable situation, is the prevailing notion in the literature that upper airway obstruction equals "vocal cord dysfunction" (VCD) and that VCD has been so strongly linked to psychological factors and mental health problems [12–16]. As most patients with exercise related respiratory problems appear as otherwise healthy young people, this misconception might discourage primary care physicians from initiating the correct work-up.

The purpose of this article is to provide state of the art knowledge on diagnostics and management of patients presenting with *Exercise-Induced Inspiratory Symptoms* (EIIS). The article focuses primarily on the role played by the larynx, the highly sophisticated "entrance valve" to the lungs and also the narrowest passage of the airway tree.

METHODS

We searched PubMed for relevant and published research, using the key word "exercise" combined with: Vocal cord dysfunction, paradoxical vocal fold motion, laryngomalacia, laryngeal obstruction, and laryngeal dysfunction. The search was quality-checked by scrutinizing the reference lists of the included studies. Systematic assessment of relevance, design and quality were complicated by large variations (or lack of statements) regarding diagnostic methods, patient inclusion, evaluation and treatment. Particularly, studies tended to mix patients with exercised-induced symptoms and patients with symptoms presenting primarily at rest; two conditions that are likely to represent different disease domains [12]. Stating clearly in the text when doing so, we also express our personal views and opinions, based on a cumulative experience from more than 1000 patients with EIIS examined endoscopically during exercise over the past 18 years [17].

The joint "*Task Force on Inducible Laryngeal Obstructions*" established by the European Respiratory Society (ERS), European Laryngology Society (ELS) and American College of Chest Physicians (ACCP) was the first attempt to institute an authoritative nomenclature in this field of respiratory medicine. The statement published in 2015 proposed an umbrella term for laryngeal obstructions; Inducible Laryngeal Obstructions (ILO) causing breathing problems [18]. The inducer of the symptom should proceed this term, so in the case of exercise the label becomes e-ILO [18]. The nomenclature underlines what is evident also from the laryngeal anatomy; that obstructions can occur on principally two levels within the larynx: At the supraglottic level due to anteromedial rotation of the cuneiform tubercles or medial movements of the aryepiglottic folds or retroflex repositioning of the epiglottis, or at the glottic level due to vocal fold adduction. Considering the complexity of the larynx, combinations seem plausible.

POSSIBLE AIRWAY ORIGINS OF EXERCISE INDUCED INSPIRATORY SYMPTOMS (EIIS)

EIIS is due to airflow obstruction situated in the upper parts of the airway tree. Based on the presenting symptoms alone, authors have related EIIS to distinct diagnoses, conditions or dysfunction in particular structures, most often the vocal folds. Hence, the term vocal cord dysfunction (VCD) has become widely used. However, the link between EIIS and the vocal folds is based on weak evidence and rarely verified by objective methods [19,20]. The literature revels a plethora of diagnostic terms used to label relatively similar clinical entities, and vice versa, similar labels have been assigned to conditions that may very well represent different diseases [21]. There has been no agreement on important issues like diagnostic work-up, aetiology, and treatment. This unfortunate situation may be related to heterogeneities within the patient populations, so far not properly acknowledged. Thus, patients