



Scientific letter

Adaptation in Pediatric Population of the Continuous Laryngoscopy Exercise Test for Diagnosis of Exercise-inducible Laryngeal Obstruction



Adaptación de la prueba de esfuerzo con fibrolaringoscopia continua para la valoración de la obstrucción laríngea inducible por ejercicio en pediatría

Dear Editor:

The *European Respiratory Society* (ERS), the *European Laryngological Society* (ELS) and the *American College of Chest Physicians* (ACCP) have defined exercise-inducible laryngeal obstruction (EILO) as a condition that produces sudden respiratory problems due to obstruction of the upper airway during sports, associating episodes of dyspnea, laryngeal stridor, cough, or dysphonia.¹

Diagnostic certainty in EILO is based on provocation studies with physical exercise to achieve suggestive symptoms, with the concurrent demonstration of laryngeal obstruction by direct laryngoscopy.¹ To perform continuous laryngoscopy during physical exercise (CLE), a laryngoscope attached to a device on the head is used, allowing real-time visualization of the larynx.²

Nowadays, there are no commercialized systems for the adequate performance of CLE in pediatric age. Therefore, the goal of this publication is to report the experience in our Pediatric Pulmonology Unit on the applicability of CLE in children using a device of our own manufacture, as well as its tolerance and usefulness in the diagnosis of EILO.

Patients with clinical suspicion of EILO who underwent CLE were collected retrospectively from November 2019 to March 2020. Informed consent from parents and patients was required to perform the test and for using images.

A basal spirometry was performed on all patients with a Vyntus Body model spirometer, using the reference values of the Global Lung Function Initiative (GLI) 2012. Subsequently, lidocaine was instilled using a nasal spray. After 5 min, a disposable, lightweight fiber optic laryngoscope, Ambu® aScope™ 4 RhinoLaryngo Slim, was inserted through the nostril to visualize the vocal cords.

The laryngoscope was set with tape at the nostril and attached to a helmet shaped device of our own elaboration. The device is composed of a webcam support attached to a light bicycle helmet, using epoxy resin to glue both parts. An anatomical model was set up to use as a reference for the device's height where we glued the webcam support into the helmet. Nevertheless, this model had to be adapted after being tested on the first patients (Video 1). Using an Ambu® aView™ brand portable monitor, the patient's vocal cords were visualized throughout the CLE.

Afterward, they underwent a progressive stress test on a treadmill with a Burdick® Treadmill T600™ electric motor, following

the protocol of the Spanish Society of Pulmonology and Thoracic Surgery (SEPAR). Serial spirometries were repeated after completion. The effort test was considered positive for EILO when symptoms were reproduced, and epiglottis drooping or paradoxical vocal cord/arytenoid abduction was visualized during inspiration.^{2,3} The tolerability of the test and the side effects during the test were assessed.

Twelve CLE test were indicated in patients with suspected EILO from November 2019 to March 2020. Fifty percent male, with a median age of 12 years (range 8–14 years).

A baseline spirometry was performed before starting the exercise, all of them in normal range of GLI values. Nine patients (75%) completed the full CLE test. Three patients could not complete it due to respiratory symptoms (mainly dyspnea, distress, and cough) that prevented them from continuing. The most frequent side effects were tearing and vagal symptoms, presented in 4 cases. During the test, it was necessary to adjust the helmet position in most patients to achieve an adequate image. Once the CLE test was done, serial spirometries were performed at 1, 5, 10 and 15 min in all patients.

EILO was confirmed in 5 children (41.6%) after CLE test. Clinical suspicion persisted in 4 patients (33%) since the test was not conclusive due to the inability to see the laryngeal obstruction with direct laryngoscopy visualization. One of the patients was diagnosed with exercise-induced bronchospasm (EIB) without EILO.

Post-effort spirometry performed on the 5 patients with confirmed EILO showed morphological changes, consisting of flattening of the inspiratory loop in 1 patient and flattening of both inspiratory and expiratory loops in the other 4 patients.

In EILO confirmed cases, relaxation techniques were taught to use them every time that the symptoms appear.⁴

It is known that the availability of a dynamic diagnostic method such as CLE facilitates the diagnosis of EILO, as described by Heimdal et al.² The device used for CLE was a specially developed head set and a modified face mask serving to fixate the laryngoscope and camera in position. It was made to be used with adults, so it was necessary to adapt the device to the pediatric population.

There are previous studies of CLE in pediatric age, such as Christensen et al.,⁵ which included 97 patients, between 14 and 24 years of age, in which 82 (84.5%) were diagnosed with EILO. Buchvald et al.⁶ found that 98% of the 54 children between 9 and 18 years of age who studied, tolerated CLE well.

In our series, the test has not been as well tolerated as in other studies.^{6,7} This may be due to the report of mild side effects that do not prevent the performance of the test, as well as the younger age of our patients compared to other publications.^{6,7}

Additionally, CLE test associating with serial spirometries should be used for the diagnosis of EIB. This disease is important to rule out, since most of the patients in our series were referred for symptoms that could be confused with that pathology.^{8,9}

Furthermore, we should highlight that EILO is not uncommon in asthmatic patients.

As limitations, our study has a retrospective cohort, with a small sample of patients, and includes cases from the initial optimization phase of the test.

In conclusion, the CLE appears to be a safe and applicable test in routine clinical practice with a low-cost, self-made device. In addition, it allows to confirm the diagnosis of EILO in pediatric patients, as well as ruling out other diagnoses such as EIB (if combined with serial spirometry after the stress test). For this reason, we consider that it is a very useful test, and it would be available in Pediatric Pulmonology Units.

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Conflict of interest

The authors have no conflicts of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.opresp.2021.100092](https://doi.org/10.1016/j.opresp.2021.100092).

References

- Halvorsen T, Schwarz Walsted E, Bucca C, Bush A, Cantarella G, Friedrich G, et al. Inducible laryngeal obstruction: an official joint European Respiratory Society and European Laryngological Society statement, n.d. Available from: <https://doi.org/10.1183/13993003.02221-2016>
- Heimdal JH, Røksund OD, Halvorsen T, Skadberg BT, Olofsson J. Continuous laryngoscopy exercise test: a method for visualizing laryngeal dysfunction during exercise. *Laryngoscope*. 2006;116:52–7. <http://dx.doi.org/10.1097/01.mlg.0000184528.16229.ba>.
- Santiago VS, Neyra AL, Gil EA, Villa JR. Patrones espirométricos en la disfunción de cuerdas vocales. *An Pediatr*. 2013;78:3–7. <http://dx.doi.org/10.1016/j.anpedi.2012.07.001>.
- Johnston KL, Bradford H, Hodges H, Moore CM, Nauman E, Olin JT, et al. Breathing techniques: description and initial case series of novel respiratory retraining strategies for athletes with exercise-induced laryngeal obstruction. *J Voice*. 2018;32:698–704. <http://dx.doi.org/10.1016/j.jvoice.2017.08.020>.
- Christensen P, Thomsen SF, Rasmussen N, Backer V. Exercise-induced laryngeal obstructions objectively assessed using EILOMEA. *Eur Arch Oto-Rhino-Laryngology*. 2010;267:401–7. <http://dx.doi.org/10.1007/s00405-009-1113-6>.
- Buchvald F, Phillipsen LD, Hjulter T, Nielsen KG. Exercise-induced inspiratory symptoms in school children. *Pediatr Pulmonol*. 2016;51:1200–5. <http://dx.doi.org/10.1002/ppul.23530>.
- Røksund OD, Heimdal JH, Clemm H, Vollsæter M, Halvorsen T. Exercise induced laryngeal obstruction: diagnostics and management. *Paediatr Respir Rev*. 2017;21:86–94. <http://dx.doi.org/10.1016/j.prrv.2016.07.003>.
- Low K, Ruane L, Uddin N, Finlay P, Lau KK, Hamza K, et al. Abnormal vocal cord movement in patients with and without airway obstruction and asthma symptoms. *Clin Exp Allergy*. 2017;47:200–7. <http://dx.doi.org/10.1111/cea.12828>.
- Caraon P, O'Toole C. Vocal cord dysfunction presenting as asthma. *Ir Med J*. 1991;84:98–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/6406891/>

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