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Prevalence of inducible laryngeal obstruction among patients diagnosed as bronchial asthma

Abstract

Introduction: Inducible laryngeal obstruction (ILO) is an important cause of a variety of respiratory symptoms and can mimic bronchial asthma (BA). This study was planned to measure the prevalence of ILO among patients diagnosed with BA and to detect its effect on BA control and severity.

Material and methods: Patients aged 18 years or older who were previously diagnosed with BA were enrolled. Laryngeal obstruction was induced using the patient's specific trigger (e.g. exercise). Visualization of vocal folds was accomplished using a 70-degree rigid laryngoscope (Karl Storz). A visual grade score was utilized to determine the severity of laryngeal obstruction.

Results: Results showed that 38.3% (n = 46) of the patients had ILO with the majority being classified as grade 2 (80.4%) (n = 37). The most common subtype was glottic ILO (63%). Bronchial asthma duration, level of control, and severity were not associated with ILO (P values: 0.2, 0.3 and 0.8 respectively).

Conclusion: Asthma and ILO commonly co-exist. An accurate classification of patients is very important and must be considered in order to determine whether the symptoms are directly related to ILO or whether they are caused by BA. Ceasing inappropriate treatment may be necessary. Objective diagnostic modalities of ILO are essential.

Key words: inducible laryngeal obstruction; bronchial asthma; bronchial asthma control and severity

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Introduction

Inducible laryngeal obstruction (ILO), otherwise referred to by many other terms including vocal cord dysfunction and paradoxical vocal fold motion, describes an inappropriate, transient, reversible narrowing of the larynx in response to external triggers. ILO is an important cause of a variety of respiratory symptoms and can mimic bronchial asthma (BA) [1, 2]. Typical clinical features of ILO include wheezing, dyspnea, and cough, but these symptoms are highly variable. In most cases, individuals with ILO will exhibit inspiratory breathing difficulties, although a pure expiratory form of ILO has also been described [1].

Exercise-induced ILO can impair patients ability to exercise and can be confused with BA. This can lead to unnecessary treatment with BA medications and can result in increased healthcare resource utilization. It is characterized by attacks of shortness of breath and noisy breathing that generally occur during high work rates [2].

A definitive diagnosis of ILO is dependent on laryngoscopic visualization of abnormal glottic or supraglottic collapse resulting in airway narrowing during a spontaneous event or provocation challenge [2, 3].

Treatment modalities of ILO include removal of the irritant, voice therapy, physiotherapy and psychological support [1].

Although ILO has long been recognized as mimicking BA, it is increasingly becoming recognized as coexisting with BA as well [1]. As a result, this study was conducted in order to measure the prevalence of ILO among patients diagnosed with BA and to detect its effect on BA control and severity.

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Table 1. The 12-item vocal cord dysfunction questionnaire (VCDQ)

Question	Disagree Strongly	Disagree	Neither Agree nor Disagree	Agree	Agree Strongly	Score
	1	2	3	4	5	
1. My symptoms are confined to my throat/upper chest						
2. I feel like I can't get breath past a certain point in mythroat/ /upper chest because of restriction						
3. My breathlessness is usually worse when breathing in						
4. My attacks typically come on very suddenly						
5. I feel that there is something in my throat that I can't clear						
6. My attacks are associated with changes in my voice						
7. My breathing can be noisy during attacks						
8. I'm aware of other specific triggers that cause attacks						
9. My symptoms are associated with an ache or itch inmy throat						
10. I am frustrated that my symptoms have not beenunderstood correctly						
11. I am unable to tolerate any light pressure around the neck, e.g. tight clothes or bending the neck						
12. The attacks impact on my social life						
Total						(12–60)

Patients will replay on a 12-item questionnaire and their final score will be recorded. Total score ranges from 12 to 60; higher scores suggest VCD.

Material and methods

Study design: cross-sectional study. Patients enrolled in the study attended the outpatient clinic of the chest medicine department at Mansoura University Hospitals between May 2018 and December 2019. These patients were previously diagnosed with BA and were 18 years or older. Patients who refused to participate in the study, patients who were pregnant, patients with a known history of vocal fold immobility, patients with acute exacerbations of BA, and patients who were current smokers were excluded.

Enrolled patients were submitted to:

— thorough history taking and clinical examination;
— assessment of the level of BA control and severity according to GINA 2018;
— vocal cord dysfunction questionnaire (VCDQ, Table 1) [4]. Patients responded to a 12-item questionnaire and their final score was recorded. Total scores ranged from 12 to 60; higher scores suggest VCD [1];
— induction of laryngeal obstruction by the patient's specific trigger (e.g. exercise) with visualization of vocal folds using 70-degree rigid laryngoscope (Karl Storz) interfaced with a camera (LEMKE MC 204). A visual grade score was utilized to determine the severity of the laryngeal obstruction [5]. This scoring system grades laryngeal closure at both the glottic and supraglottic levels; scores ranged between 0 (complete patency) and 3 (almost complete closure) [6].

Fibroptic-nasoendoscopy using Henke-Sass-Wolf type 10 was used in patients with high gag reflex.

Statistical analysis

Data was analyzed using SPSS V. 16. Categorical data were presented in the form of numbers (percent), while continuous data were presented either as mean (SD) or median (min-max) depending on the results of Shapiro-Wilk test which was used to test the assumption of normal distribution of data. The associations of different parameters with ILO were tested using the Chi^2 test or Fisher's exact test in case of categorical data (with respect to the minimal expected values in the contingencies tables), Welch's t-test in case of continuous data with normal distribution due to unequal variance of the groups, and the Mann-Whitney U test for continuous data with non-normal distribution. Paired data (pre/post treatment data of ILO cases) was compared using the paired t-test for continuous variables with normal distribution and the Wilcoxon Signed

Table 2. Characteristics of the participants (n = 120)

Age mean (SD)	36 (11)
Sex [n%]	
Male	26 (21.7%)
Female	94 (78.3%)
Marital status [n%]	
Currently married	94 (78.3%)
Not currently married	26 (21.7%)
Occupation [n%]	
Non-working	77 (64.2%)
Manual work	17 (14.2%)
Professional/administrative work	26 (21.7%)
BMI mean (SD)	30.2 (7.2%)
Comorbidities* [n%]	
No	72 (60)
Allergic rhinitis	31 (25.8)
Others	17 (14.2)
Asthma duration median (min–max)	4 (0.2–32) years
Asthma control [n%]	
Uncontrolled	20 (16.7%)
Partly controlled	69 (57.5%)
Well controlled	30 (25%)

*Classes are not mutually exclusive; Others: DM (4), HTN (7), Adenoid (2), peptic ulcer (2), GERD (6), OSA (1). BMI — body mass index

Ranks Test for ordinal variables (ILO grade: none, grade 1, grade 2, grade 3; severity of asthma: mild, moderate, severe; control of asthma: uncontrolled, partially controlled, well controlled). The correlation of asthma control with ILO control was tested using Spearman's correlation. Significance level was set at 0.05.

Results

The study included 120 patients previously diagnosed with BA. 78.3% of them were females. Their mean age was 36 years (± 11). About a quarter of the patients had allergic rhinitis, and 60% of them had no comorbidities. More than half of the patients were partly controlled while 16.7% were uncontrolled as per BA (Table 2).

Prevalence of ILO among studied patients

Results showed that 38.3% (n = 46) of the patients had ILO, mostly grade 2 (80.4%) (n = 37) with the most common manifestation being glottic ILO (63%) (Table 3, Figure 1).

Many provocation techniques have been used to induce ILO for diagnosis. Most of our patients (about 100 patients) reported exercise as a trigger for their symptoms. However, GERD, uncontrolled allergic rhinitis with posterior nasal discharge and emotional stress were reported in other cases.

Table 3. Prevalence of ILO among studied patients

ILO [n%]	46 (38.3%)
Sites of ILO (n = 46) [n%]	
Supraglottic	8 (17.4%)
Glottic	29 (63%)
Supraglottic and glottic	9 (19.6%)
Severity of ILO (n = 46) [n%]	
Grade 1	5 (10.9%)
Grade2	37 (80.4%)
Grade 3	4 (8.7%)

ILO — inducible laryngeal obstruction

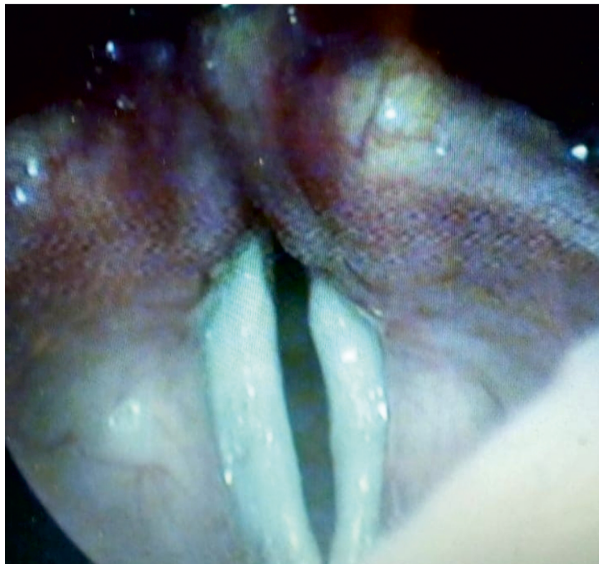

Figure 1. Grade 2 glottic inducible laryngeal obstruction

The association of ILO with different epidemiological characteristics of the patients

Table 4 shows that ILO increased with age with significant differences between age groups. For example, patients aged between 31 and 50 had significantly different results from those below 30 years of age (p = 0.023 and 0.038, respectively). However, there was no significant difference in people aged over 50 years of age. Also, being married was associated with a higher risk of ILO. Other parameters such as sex and occupation were not associated with ILO. Similarly, ILO was not associated with BMI of patients or with other comorbidities.

Table 4. The association of ILO with different epidemiological and clinical parameters of the patients (n = 120)

Parameter	ILO absent n = 74	ILO present n = 46	Significance
Age			
≤ 30	29 (74.4)	10 (25.6)	R
31–40	22 (50)	22 (50)	$\chi^2 = 5.18$, p = 0.023*
41–50	10 (47.6)	11 (52.4)	$\chi^2 = 4.2$, p = 0.038*
≥ 50	13 (81.2)	3 (18.8)	P = 0.734**
Sex [n%]			
Male	15 (57.7)	11 (42.3)	
Female	59 (62.8)	35 (37.2)	
Marital status [n%]			
Currently not married	21(80.8)	5(19.2)	$\chi^2 = 5.12$, p = 0.02*
Currently married	53 (56.4)	41(43.6)	
Occupation [n%]			
Non-working	49(63.6)	28(36.4)	$\chi^2 = 0.86$, p = 0.649*
Manual work	11(64.7)	6 (35.3)	
Professional/administrative work	14(53.8)	12 (46.2)	
BMI mean (SD)	29.7 (5)	31 (5.9)	T = -1.23, p = 0.219***
Comorbidities [n%]			
No	43 (59.7)	29 (40.3)	$\chi^2 = 1.79$, p = 0.407*
Allergic rhinitis	22 (71)	9 (29)	
Others	9 (52.9)	8 (47.1)	

*Chi² test; **Fisher's exact test; ***Welch's t-test.
BMI — body mass index; ILO — inducible laryngeal obstruction; r — reference

The association of ILO with the vocal cord dysfunction questionnaire

Mean of VDCQ was 44 in ILO patients and 35.5 in non-ILO patients. These values had no clinical significance despite its statistical significance (P value < 0.001).

The association of ILO with BA duration, severity and control

Bronchial asthma duration, level of control and severity were not associated with ILO (P values = 0.2, 0.3 and 0.8 respectively; Table 5).

Discussion

Inducible laryngeal obstruction (ILO), an induced, inappropriate adduction of the vocal cords, can coexist with bronchial asthma. Accurate differentiation has been challenging because of overlapping symptoms and the absence of sensitive diagnostic criteria for either condition. Although challenging, an accurate diagnosis of patients is very important due to the differing treatment modalities for asthma and ILO [7].

This study included 120 patients previously diagnosed with bronchial asthma and receiving asthma medications for many years. About 38.3% of them were diagnosed with ILO for the first time [80.4% were grade 2 with the most common presentation being glottic ILO (63%)]. The diagnostic difficulty in this study is demonstrated by a mean delay of about 4 years before reaching an ILO diagnosis. Accurate classification of patients is very important to differentiate if symptoms are directly related to ILO or to BA. Ceasing inappropriate treatment may be needed.

The presence of comorbidities, abnormal vocal cord dysfunction questionnaire results, bronchial asthma duration, level of bronchial asthma control, and level of bronchial asthma severity could not aid in the diagnosis of ILO in studied patients. Therefore, objective diagnostic modalities are essential. Lee *et al.* also concluded that clinical assessment, questionnaire scores, and presence of comorbidities were not sufficient enough to diagnose ILO [7].

Table 5. The association of ILO with BA duration, severity and level of control

Parameter	ILO absent n = 74	ILO present n = 46	Significance
Duration of asthma (median, min-max)*	4 (0.1–32)	5 (0.2–30)	Z = -1.2, p = 0.226
Severity of asthma**			
Mild	42 (62.7)	25 (37.3)	X^2 = 0.02, p = 0.898
Moderate/sever	32 (61.5)	20 (38.5)	
Control of asthma**			
Uncontrolled	15 (75)	5 (25)	X^2 = 1.84, p = 0.399
Partly controlled	42 (60.9)	27 (39.1)	
Well controlled	17 (56.7)	13 (43.3)	

*Mann-Whitney U test; **Chi^2 test.

ILO — inducible laryngeal obstruction

Conclusion

Asthma and ILO commonly co-exist. Accurate classification of patients is very important in order to determine whether symptoms are directly related to ILO or to BA. Ceasing inappropriate treatment may be necessary.

The presence of comorbidities, abnormal vocal cord dysfunction questionnaire results, BA duration, and its BA level of control/severity could not aid in diagnosing ILO in studied patients. Therefore, objective diagnostic modalities are essential.

Conflict of interest

None declared.

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