Original Article

Spirometric evaluation of gastroesophageal reflux disease (gerd) associated cough and asthma

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Abstract:

Background: Gastroesophageal reflux disease can lead to esophageal complications, including esophagitis, ulceration, stricture, hemorrhage, and Barrett's esophagus. However, the spectrum of problems associated with GERD has expanded to extra esophageal sites. Chronic cough and asthma are two clinical problems caused or triggered by GERD. Spirometric changes among GERD associated cough and asthma still a topic of ongoing research.

Objectives: This study was designated to evaluate the spirometric picture of GERD associated cough and asthma subjects in relation to different clinical aspects of the disease including body mass index (BMI), disease duration, presence or absence of symptoms as well as endoscopic findings.

Subjects and methods: Ninety adult subjects (90) of either sex with a mean age of 40.5±12 year are involved in this study. Fifty five (55) GERD associated cough and asthma subjects served as test group while the remaining (35) served as control group. Each subject underwent spirometry and gastric endoscopy in Pulmonary Function and Endoscopy Units respectively at Ibn-Sina Teaching Hospital /Mosul.

Results: Spirometric data of the control group were within the normal predicted range (80-120%) thus excluding the possibility of any asymptomatic obstructive airway disease. Whereas, the measured spirometric parameters (forced vital capacity (FVC), forced expiratory volume in 1 second ratio (FEV1%), peak expiratory flow (PEF), and forced mid expiratory flow(FMF) are significantly reduced in the test group with a clear restrictive pattern among the overweight subjects. In addition, neither the presence nor duration of symptoms affected the spirometric picture of the GERD associated cough and asthma subjects, unlike those with positive endoscopy findings who revealed significant obstructive pattern when compared to those with negative endoscopy findings.

Conclusions: GERD associated cough and asthma subjects with positive endoscopy findings showed obstructive pattern of spirometry irrelevant to the presence or absence of symptoms or duration of the disease.

Key words: Gastroesophageal Reflux Disease, chronic cough, asthma.

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Introduction:

Gastroesophageal reflux disease (GERD) is a condition that develops when the reflux of stomach contents causes troublesome symptoms and/or complications(1).

The true prevalence of GERD in the population is underestimated and the disease is often misdiagnosed. Approximately 20–40% of the adult population in Western countries suffer from heartburn and/or regurgitation, that have a negative impact on the patient's daily activities, sleep and working life, irrespective of the presence or absence of esophagitis (2,3). According to the Montreal Definition of GERD, concomitant gastroesophageal reflux symptoms is "aggravating factor" to extraesophageal symptoms and lesions like reflux cough, reflux laryngitis and viewed as an reflux asthma(4). Gastroesophageal reflux is a potential trigger of asthma. Approximately 77% of asthmatics report heartburn (5). There is a cause effect relationship between asthma and gastroesophageal reflux which can turn into a vicious cycle (6).

The basic motivation behind conducting the present work was an attempt to answer the questions: can GERD cause an abnormal spirometry test? an issue of ongoing research.

Subjects and Methods:

Ninety adult subjects (90) of either sex aged 40.5±12 years (19-65years) volunteered in this cross-sectional study, from whom a written consent plus data sheet, including all necessary personal and health information were obtained.

They were classified as:

A): Control group: included 35 apparently healthy subjects recruited from patient companions, relatives, and friends in

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addition to hospital health staff workers after fulfilling the following criteria:

1. Never smokers.
2. No history of any significant pulmonary or cardiac diseases.
3. Clear chest on physical examination.
4. Absence of any musculoskeletal, neuromuscular disorders, or any other condition which could affect spirometry test.

B): Test group: included 55 subjects with gastro-esophageal reflux disease associated cough and/or asthma approved by history, clinical examination and other necessary investigations. Subjects were recruited from outpatient subjects referred to the Endoscopy Unit and Pulmonary Function Unit of the Consultation Clinic in Ibn-Sina Teaching Hospital in Mosul, during the period from January 2014 to April 2014. Table 1, clarified their distribution with clinical data.

Table(1): Distribution and clinical data of the Test group.

BMI		GERD Symptoms		GERD duration		Endoscopy	
Normal body wt BMI (18.9-25)	Over body wt \ BMI>25	present	Absent	<3 months	>6 months	-ve	+ve
N=14	N=41	N=40	N=15	N=21	N=34	N=18	N=32

Anthropometric measurements: Height, weight were measured using standard techniques as follows: height to within 0.5 Cm, without shoes; weight to within 100g,without heavy clothing (table 2). Body mass index (BMI) was calculated by the following formula:

BMI= weight (kg) / [height (m)]^2 (7)

Table(2): Demographic and anthropometric data of the studied groups.

Parameter	Control group(N=35)			Test group (N=°°)		
	Minimum	Maximum	Mean ± SD	Minimum	Maximum	Mean ± SD
Age(year)	19	58	39 ± 11	20	65	42± 13
Height(m)	1.6	1.86	1.68 ± 0.06	1.47	1.80	1.64±.08
Weight(Kg)	49.5	98.5	75.3 ±13	52.8	117.5	87.7± 19.45
BMI	18.6	33	24.2 ± 5.27	17.9	42	28.2 ± 6.14

Spirometry: percent predicted forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1 %) ratio, peak expiratory flow (PEF), and the forced mid expiratory flow (FMF) were measured using computer based spirometer (Masterscope-Carefusion-USA). Standard procedure were adopted following the recommendations of the American Thoracic Society (ATS)(8).

The forced expiratory vital capacity procedure was described and demonstrated to the subject before the test while encouraging to breathe out as long and forcefully as possible. The best of three technically satisfactory maneuvers was recorded.

Statistical analysis: The data obtained in the current study were analyzed using the IBM SPSS statistics version 21 for data analysis. Standard statistical methods were used to determine the mean and standard deviation. Descriptive data analysis was used to describe different variables in addition to the Independent Sample T-test to compare different means.

Results:

Table (3) shows the % predicted spirometric values of the control and test groups. The healthy control group are within the normal predicted range (80-120%) regarding all measured spirometric values, unlike the test group who showed highly significant reduction in the FEV_1%, PEF and FMF ($p<0.01$) revealing a clear obstructive airway pattern in addition to a significant reduction in FVC (restrictive index, $p<0.05$).

Table (4) compares the % predicted spirometric parameters between normal body weight and overweight groups. The overweight group showed significant reduction in the FVC as compared to the normal weight group ($P<0.05$) while other spirometric parameters (FEV1%, PEF and FMF) does not show significant difference.

Table (5) compares the % predicted spirometric parameters between asymptomatic and symptomatic GERD groups. All measured spirometric parameters (FVC, FEV1%, FPEF and FMF) were not found to be significantly different between the two groups.

Table (6) shows the % predicted spirometric parameters when compared between the test group with short duration of GERD symptoms, less than 3 months and those with longer than 3 months duration of GERD symptoms. No significant differences were found between the two groups regarding again all measured spirometric parameters.

Table (7): Shows the spirometric parameters within the test group with negative endoscopic findings as compared with those of positive endoscopic findings for GERD. No significant difference was observed regarding the FVC while there is a statistically significant reduction in the FEV_1% , FMF ($p<0.01$) and PEF ($p<0.05$) among the group with positive endoscopic finding. However, 5 out of 50 symptomatic GERD subjects referred to the pulmonary function unit refused to do gastric endoscopy.

Table (3): Comparison of Spirometric parameters between test and control groups.

Parameter (% predicted)	Mean ± SD(minimum-maximum		P value
	Control group (n=35)	Test group (n=55)	
FVC	99.76±9.35 (80.8-115.5)	93.66±15.44 (50.1-101.0)	<0.05
FEV_1%	89.56 ±8.51 (82.3-116)	78.19±11.86 (49-84.9)	<0.01
PEF	96.69 ± 11.84 (84.7-118.8)	82.22 ±17.41 (41.5-91.08)	<0.01
FMF	90.11± 10.21 (82.8-119.9)	68.93 ±18.86 (41.2-83.02)	<0.01

Table(4): Comparison of Spirometric parameters between normal body weight and overweight groups.

Parameter (% predicted)	Mean ± SD		P value
	Normal body weight (BMI=18.9-25) n=14	Over body weight (BMI=>25) n=41	
FVC	98.67±(6.36)	90.38± (17.11)	P<0.05
FEV_1%	71.10±(10.18)	72.23±(11.54)	NS
PEF	84.69±(13.99)	81.64±(18.01)	NS
FMF	58.82±(11.58)	63.12±(13.07)	NS

Table(5): Comparison of Spirometric parameters between asymptomatic and symptomatic GERD groups.

Parameter (% predicted)	Mean ± SD		P value
	Asymptomatic GERD n=15	Symptomatic GERD n=40	
FVC	89.23± (14.53)	93.71±(15.83)	NS
FEV_1%	77.31±(11.62)	75.93±(9.02)	NS
PEF	82.93±(15.7)	80.56±(15.56)	NS
FMF	64.94±(14.97)	63.93±(13.27)	NS

Table(6): Spirometric values of test group in respect to the duration of GERD symptoms.

Parameter (% predicted)	Mean ± SD		P value
	GERD duration (< 3 months) n=21	GERD duration (> 3 months) n=34	
FVC	91.12±(18.12)	93.34±(12.51)	NS
FEV_1%	74.96±(11.62)	72.73±(9.71)	NS
PEF	85.50±(17.04)	78.55±(14.05)	NS
FMF	65.00±(12.05)	63.72±(14.65)	NS

Table (7): Spirometric values of test group in respect to endoscopic findings.

Parameter (% predicted)	Mean ± SD		P value
	GERD (negative endoscopy) n=18	GERD (positive ndoscopy) n=32	
FVC	94.03±(18.06)	93.38±(13.37)	NS
FEV_1%	84.79±(8.95)	73.07±(11.39)	P<0.01
PEF	87.25±(18.01)	78.32±(16.15)	P<0.05
FMF	84.07±(18.51)	57.21±(7.23)	P<0.01

Discussion:

When spirometric measurements were compared between the age and height matched studied groups (table 2), the GERD associated cough and asthma group with an overweight BMI (table1) showed significant reduction in all measured spirometric variables, signifying the growing body of evidence relating overweight and obesity with a wide range of health conditions including chronic obstructive lung disease(COPD) and asthma (9,10,11). While the test group further subgrouped on the basis of BMI in an attempt to rationalize the restrictive pattern, the results revealed significant reduction in the % predicted FVC ($p<0.05$) among the overweight group in respect to those with normal weight group (table 3); this finding has two implications, first, it could further confirm the fore mentioned relation between overweight and obstructive

spirometric pattern, second, it can reinforce the role of gastroesophageal reflux in chronic cough and asthma(12).

Concerning the link between gastric acid reflux and respiratory symptoms (cough, dyspnea and wheezes), the test group was classified according to the presence of symptoms (symptomatic and asymptomatic) and to the duration of reflux symptoms into short duration (<3 months) and long duration subgroups (>3 months) (table 4 and 5). The obtained data (tables 4 and 5) of the nonsignificant differences in all measured spirometric values, revealing that neither the presence nor the duration of GERD symptoms could affect spirometry. These findings might be attributed to the control of acid reflux with medications for example, a proton pump inhibitor.

Consequently, the obstructive spirometric pattern (table 6) in the GERD subjects with positive endoscopic finding could be due to the effect of the acid reflux on the respiratory passageways. Though the cause-effect relationship between asthma and acid reflux isn't clear why, acid reflux can worsen asthma and asthma can worsen acid reflux (6). However, Chan WW and co-workers, 2011 claimed that gastroesophageal reflux disease occurs frequently among patients with asthma, Despite that the therapy with proton pump inhibitors to improve asthma control remains controversial (13). Moreover, two proposed mechanisms involved in the pathogenesis of GERD-associated cough: (1) acid in the distal esophagus stimulating an esophageal-tracheobronchial cough reflex, and (2) micro or macroaspiration of esophageal contents into the larynx and tracheobronchial tree. Dual-probe esophageal pH testing with pH electrodes in the proximal and distal esophagus, esophageal acid infusion studies, and evaluation of agents inhibiting cough have added significantly to the understanding of GERD-associated cough(12).

Conclusions:

This study conclude that Gastro esophageal reflux associated cough and asthma subjects showed an obstructive spirometric pattern irrelevant to the presence or absence of symptoms or duration of the disease. On the other hand, the same obstructive spirometric pattern was reported in those with positive endoscopic findings when they were compared with subjects with negative findings .

Author contribution:

Afraa M. AL-Ameen (Auther): suggested the subject, study design, acquisition of data, analysis and drafting of manuscript.

Amjad F. Ahmad: study conception with critical revision.

Shaimaa A. H. Jassim: participate in data and references collection.

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