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Impulse Oscillometry System in Patients with Stable COPD: A Retrospective Study in Tehran-Iran

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Abstract: This study was aimed to evaluate the impulse oscillometry (R /X in patients with COPD in Tehran, Iran. In a retrospective cross sectional study, we selected patients who had PFT and impulse oscillometry records. We considered three groups for patients on the basis of spirometric findings: mild (FEV > %), moderate (FEV = %- %), and severe (FEV < %) with FEV /FVC < % in all the groups. The analysis of variance (ANOVA) showed the statistically significant difference among mild and severe groups as well as among moderate and severe groups. But there was no significant difference between mild and moderate patients (p > .). There was a significant positive correlation between R , X and FEV , FVC, PEF, TLC (p < .). R was significantly correlated with FVC (r= . for the moderate group and r=- . for the severe group), FEV (only in mild group r= .) and FEVl/FVC (r=- . for the mild group and r= . for the moderate group). X was correlated with FEV (only in the mild group r= .), and FEVl/FVC(r= . for the mild group and r= . for the severe group). Sensitivity for X in severe COPD group was % and in mild group, sensitivity of R was %. IOS can be used as an alternative of spirometry to assess COPD severity in patients with minimal cooperation.

Key words: COPD, Spirometry, Impulse, oscillometry.

INTRODUCTION

COPD is a major cause of disability and it's the third leading cause of death in the United States. More than million people are currently diagnosed with COPD. Many more people may have the disease and not even know it (Rabe *et al*.,). COPD develops slowly; symptoms often worsen over time and can limit the ability to do routine activities. Severe COPD may prevent patients from doing even basic activities like walking, cooking, or taking care of themselves. Most of the time, COPD is diagnosed in middle-aged or older people. The disease isn't passed from person to person. COPD has no cure yet, and scientists don't know how to reverse the damage to the airways and lungs. However, treatments and lifestyle changes can help patients feel better, stay more active, and slow the progress of the disease (Rabe *et al*., ; Halbert *et al*.,).

Spirometry is the method of choice for evaluating obstructive lung disease such as COPD. The diagnosis of COPD was confirmed by having a positive history and FEV /FVC less than % after applying bronchodilator in spirometry according to GOLD guidelines (Rabe *et al*.,). Forced Expiratory Volume in the st second is one of the diagnostic and severity indicators of obstructive lung diseases. Evaluation of this parameter depends on patient's cooperation (Rabe *et al*., ; Ko sum *et al*.,).

Impulse Oscillometry system (IOS) was introduced to resolve previous problems. The measurement of airflow resistance during normal breathing requires no maximal forced expiratory efforts and does not subject patients to bronchoprovocation from forced expiration. Resistance is distributed between large airways and smaller more peripheral airways, with distinct patterns attributable to each. This technique is applied when the patient is breathing normally (Laprad and Lutchen,). Previous reports have studied Impulse Oscillometry for evaluation of chronic respiratory disease in children and adults. Ios shows airway resistance (R) and reactance (X) values at multiple frequencies of Hz(- Hz) (Kanda *et al*., ; Kubota *et al*.,).

This study was aimed to evaluate the IOS (R /X) in patients with COPD in Tehran, Iran.

MATERIALS AND METHODS

This is a retrospective cross sectional study. We reviewed the all documents of patients suffering from COPD who had been referred to the Azimi's private clinic of pulmonary disorders between and in Tehran.

We selected patients who had PFT and impulse oscillometry records. Spirometry and impulse oscillometry had been evaluated using "Master Screen -IOS; Master lab Erich Jaeger, Germany". We considered

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three groups for patients n the basis of spirometry findings: mild (FEV > %), moderate (FEV = %- %), and severe (FEV < %) with FEV /FVC < % in all the groups. A quantitative variables described by mean±SD. Analysis of variance (ANOVA) was used for evaluating of relationship between impulse oscillometry values and different stage of COPD. The Pearson's test was analyzed the correlation between impulse oscillometry values and functional parameters. We used the healthy group data from GOLD guidelines; cut off points of impulse osillometry parameters were determined for calculating the sensitivity, specificity, negative and positive predictive values of IOS for COPD severity detection. P value <= . was considered as statistically significant.

Results:

Table shows the demographic data and PFT values.

Table ۱: Characteristics of Patients.

	Mild	Moderate	Severe	All groups	p value*
Number					
Age	68±18	74±11	76±12	73±16	p > .
Weight	64±5	70±8	67±9	66±10	p > .
IOS(R)	0.31±0.14	0.38±0.19	0.41±0.08	0.35±0.22	p < .
IOS(X)	-0.15 ± 0.26	-0.20 ± 0.19	-0.34 ± 0.44	-0.27 ± 0.41	p < .
FEV %	90±6	63±8	39±6	64±31	p < .
FVC %	94±5	74±8	64±13	76±11	p < .
PEF %	92±9	70±21	44±18	68±29	p < .
TLC %	98±8	97±12	97±20	97±46	p < .
*Analyzed by analysis of variance (ANOVA).					

Table ۲: Correlation factors between X , R and PFT.

	X r*	R r
FEV	.	.
FVC	.	.
PEF	.	.
TLC	.	.
r = Coefficient of determination		

A significant increase in R was seen in severe group in comparison with others, while X had a decrease in groups. The analysis of variance (ANOVA) showed the statistically significant difference among mild and severe groups as well as among moderate and severe groups. But there was no significant difference between mild and moderate patients (p > .). There was a significant positive correlation between R , X and FEV , FVC, PEF, TLC (p < .) (Table).

R was significantly correlated with FVC (r= . for the moderate group and r=- . for the severe group), FEV (only in mild group r= .) and FEVl/FVC (r=- . for the mild group and r= . for the moderate group).

X was correlated with FEV (only in the mild group r= .), and FEVl/FVC(r= . for the mild group and r= . for the severe group).

Sensitivity, specificity, negative and positive predictive values of IOS for COPD severity detection are described in Tables .

Table ۳: Sensitivity, specificity, negative and positive predictive values of lOS and spirometry in COPD groups.

	-PV	+PV	-LR	+LR	%CI	Specificity	%CI	Sensitivity	Variable
Mild	.	.	.	.	. - .	.	. - .	.	R
	.	.	.	.	. - .	.	. - .	.	X
Moderate	.	.	.	.	. - .	.	. - .	.	R
	.	.	.	.	. - .	.	. - .	.	X
Severe	.	.	.	.	. - .	.	. - .	.	R
	.	.	.	.	. - .	.	. - .	.	X
LR: Positive likelihood ratio, -LR: Negative likelihood ratio, +PV: Positive predictive value, -PV: Negative predictive value.									

Discussion:

This study compared the accuracy of IOS with spirometry measurements for detection of COPD severity. In our study among COPD patients, sensitivity for X (the best value in IOS measurements in severe COPD group) was % and in mild group, sensitivity of R (the best value in IOS measurements in the mild group) was %.

In , Al-Mutairi *et al*, showed . % sensitivity for conventional pulmonary function tests. They revealed . % sensitivity for IOS in COPD and . % sensitivity for conventional pulmonary function tests. The sensitivity of IOS was . % for detecting healthy people, and was superior to that of PFT (. %). There was . % specificity for IOS and . % for cPFT in detecting healthy people (A -Mutairi *et al*.,). In

contrast with Al-Mutairi study, our findings showed greater sensitivity and specificity for IOS.

In , Winkler *et al*. detected - % of COPD patients by using different IOS measurements (Winkler *et al*.,).

IOS resistance values can be useful for mild COPD diagnosis and small-airway changes after bronchodilator and bronchoprovocation challenges (Winkler *et al*., ; Kanda *et al*.,) but reactance values would do better for detecting the progression of COPD (Kubota *et al*., ; Paredi *et al*.,). Increased Rrs at a higher frequency (Hz) reflects an increased resistance in central airways (Park *et al*.,). This study found higher sensitivity of resistance compared to reactance measurements in mild group, but sensitivity of reactance measurements was greater in moderate and severe COPD patients. The present study confirms the considerable sensitivity of IOS for detection of mild COPD.

Recent studies suggest that X analysis can differentiate mild COPD patients better than whole-breath IOS; Inspiratory evaluation of IOS is more accurate than expiratory evaluation (Cooper *et al*., ; Park *et al*., ; Kanda *et al*.,).

Conclusion:

Over all, IOS can be used as an alternative of spirometry to assess COPD severity in patients with minimal cooperation. In new patients suspected to COPD, IOS is a useful measurement for obtaining further details regarding lung function and mild COPD.

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Abbreviations:

COPD: Chronic Obstructive Pulmonary Disease
FEV : Forced Expiratory Volume in one second
FVC: Forced Vital Capacity
IOS: Impulse Oscillometry system
R : Resistance at Hz
X : Reactance at Hz
PEF: Peak Expiratory Flow
RV: Residual Volume
TLC: Total Lung Capacity

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