30 درصد تخفیف نوروزی ویژه کارگاه‌ها و فیلم‌های آموزشی

اصول تنظیم قراردادها
پروپوزال نویسی
آموزش مهارت های کاربردی در ندوین و چاب مقابله

پش
Comparison of Impulse Osillometry System and Spirometry for Diagnosis of Obstructive Lung Disorders

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ABSTRACT
Background: Obstructive lung disease is a growing health problem, especially in developed countries. This study aimed to compare Impulse Osillometry System (IOS) and Spirometry for evaluation of Chronic Obstructive Pulmonary Disease and asthma.

Materials and Methods: The study groups contained 87 healthy people, 87 asthmatic patients and 56 COPD patients. Spirometry (FVC, FEV1, FEV1/FVC) and IOS (R5, R20, X5) measurements were performed for all the healthy subjects and patients. The results of IOS were compared with spirometric results.

Results: Significant differences were detected among the 3 groups (control, COPD and asthma) in terms of all the spirometric parameters (FVC, FEV1, FEV1/FVC) and some parameters of IOS (R5,R20,X5) measurements (p<0.05). Among COPD patients, sensitivity for X5 (the best value of IOS measurements in the COPD group) was 76%. Also, in asthmatic patients, sensitivity for R20 (the best value of IOS measurements in the asthma group) was 77%. We found a correlation between R5, R20 and X5 with FEV1 in asthmatic patients, but only R5 had this correlation with FEV1 in COPD patients.

Conclusion: We concluded that IOS can be an alternative for spirometry in the diagnosis of obstructive lung disease in patients with minimal cooperation. R5 can represent COPD severity. *(Tanaffos2011; 10(1): 19-25)*

Key words: Impulse Osillometry System (IOS), Spirometry, Asthma, COPD.

INTRODUCTION
Obstructive lung disease is a growing health problem, especially in developed countries. Obstructive lung disease includes asthma and Chronic Obstructive Pulmonary Disease (COPD) and is the 4th cause of overall mortality (1).

COPD should be concerned in all patients suffering from dyspnea, cough or chronic sputum, or those who have a history of exposure to hazardous agents. COPD is confirmed by spirometry when FEV1/FVC is less than 70% after using bronchodilator. Forced Expiratory Volume in the 1st second of expiration (FEV1) decreases with disease severity progression (2).
Asthma is a growing health problem as well (3) which is confirmed by taking history, physical examination, and pulmonary function tests according to the Global Initiative for Asthma (GINA) Guideline (4).

Spirometry evaluates the diagnosis of asthma, its severity, and reversibility of airflow obstruction. Spirometry is the method of choice for evaluating obstructive lung disease. A 12% or 200 cc increase in FEV1 after bronchodilator administration confirms asthma diagnosis (5).

FEV1 is one of the diagnostic and severity indicators of obstructive lung diseases. Evaluation of this parameter depends on patient’s cooperation (5).

In 1956, Forced Oscillation Technique (FOT) was introduced to resolve previous problems. This technique is applied when the patient is breathing normally (6).

FOT determines the relation between external forces in a respiratory disease and air flow conduction (7). FOT does not need forced expiratory maneuvers, or mouthpiece. It requires minimum patient cooperation (8).

FOT underwent some modifications and was computerized to assess breathing impedance, total airway resistance (Rrs) and reactance (elastic properties of the lung) (Xrs) in specific oscillation frequencies during a measurement lasting several seconds and normal forced breathing. This technique is known as Impulse Oscillation System (IOS) (1).

It showed similar airway resistance and reactance values as those measured by body plethysmography and forced oscillation in adults (9, 10).

Also, IOS has shown to be more sensitive than FEV1 for evaluating bronchodilators’ effects (11-13).

Impulse Osillometry was studied in children, and suggested as an alternative for spirometry (14-19).

Previous reports have studied Impulse Osilometry for evaluation of chronic respiratory disease in adults (20-29).

This study was conducted to compare IOS with conventional pulmonary function tests (spirometry) in Iranian adults with obstructive lung disease.

MATERIALS AND METHODS

In this cross sectional study, 230 new adult patients (87 healthy subjects, 87 asthmatic patients and 56 COPD patients) presenting to Bamdad respiratory and sleep research center were evaluated.

An informed consent was obtained from all patients. The study protocol was approved by Isfahan University of Medical Sciences Ethics Committee, Isfahan, Iran.

Patients’ demographic variables, history and physical examination were obtained by a trained physician.

Subjects were divided into 2 groups of healthy and obstructive lung disease (asthma and COPD) based on their medical history, physical examination, GOLD and GINA guidelines.

COPD was diagnosed by having a positive history of dyspnea (progressive, exertional or persistent), chronic cough (may be intermittent or non productive), chronic sputum and history of exposure to tobacco, occupational dusts, chemicals or other smokes after the age of 40. The diagnosis of COPD was confirmed by having a positive history and FEV1/FVC less than 70% after applying bronchodilator in spirometry according to GOLD guidelines (2).

Asthma was defined as having history of recurrent wheezing, cough, chest tightness or difficult breathing, in accordance with other allergic symptoms which may have a seasonal pattern or may exacerbate in night or by common allergens, exercise or smoke. Diagnosis of asthma was confirmed by finding airway obstruction reversible by bronchodilator in spirometry based on GINA guidelines (4).

Then, one time spirometry (FVC, FEV1, FEV1/FVC) and IOS (R5,R20, X5) measurements were performed for all patients and healthy subjects.

Spirometry and Impulse Osilometry were evaluated using “Master Screen -IOS; Master lab Erich Jaeger, Germany”.

Pulmonary function tests were done with the findings of the ATS/ERS Task Force 2005 by a
The results of IOS were compared with those of spirometry in 3 groups.

Statistical analysis was done using SPSS version 17 software (Chicago; USA). Data were represented as mean± Standard Deviation (SD) in this article. The Kolmogorov-Smirnov test was used to determine the normal dispersal of the values. X5 and R5 were nonparametric values. The 3 groups were compared using ANOVA and chi-square tests. Specificity, sensitivity, positive and negative predictive values were evaluated by ROC curve. The relation between IOS and Spirometry measurement was determined by Pearson (for normal distribution) or Spearman correlation (for not normal distribution) . P≤0.05 was considered significant.

RESULTS

The study comprised 230 participants including 87 healthy people, 87 asthmatic patients and 56 COPD patients. The mean age was 45(±19) yrs. There were 88 males and 142 females. Baseline characteristics, spirometry (FVC, FEV1, FEV1/FVC) and IOS (R5,R20,X5) measurements in 3 groups (control, asthma and COPD) are summarized in Table 1.

COPD patients were older, and the male proportion in the COPD group was greater than in the other 2 groups.

A significant increase in R5 and R20 was seen in COPD and asthmatic patients in comparison with controls, while X5 had a considerable decrease in patients group.

Sensitivity, specificity, negative and positive predictive values of IOS for asthma and COPD detection are described in Tables 2 and 3. For the gold standard diagnosis of asthma and COPD based on GINA and GOLD guidelines, cut off points of Impulse Osillometry parameters were determined.

Table 1. Baseline characteristics, spirometry and IOS measurements in 3 groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>Asthma</th>
<th>COPD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>87</td>
<td>87</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Age (year)</td>
<td>37.6 ± 17.8</td>
<td>41.4 ± 15.5</td>
<td>64.1 ± 15.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Male / Female</td>
<td>38 / 49</td>
<td>23 / 64</td>
<td>27 / 29</td>
<td>0.01</td>
</tr>
<tr>
<td>FVC (L)</td>
<td>3.2 ± 0.9</td>
<td>2.2 ± 0.6</td>
<td>2.2 ± 0.9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td>88.2 ± 5.3</td>
<td>72.1 ± 10.1</td>
<td>63.6 ± 9.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>FEV1 / FVC (%)</td>
<td>69.8</td>
<td>75.8</td>
<td>60.5</td>
<td>0.001</td>
</tr>
<tr>
<td>R5 (kpa.s/l)</td>
<td>0.40 ± 0.30</td>
<td>0.71 ± 0.42</td>
<td>0.66 ± 0.40</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>R20 (kpa.s/l)</td>
<td>0.32 ± 0.16</td>
<td>0.40 ± 0.13</td>
<td>0.40 ± 0.21</td>
<td>0.001</td>
</tr>
<tr>
<td>X5 (kpa.s/l)</td>
<td>-0.12 ± 0.24</td>
<td>-0.20 ± 0.24</td>
<td>-0.33 ± 0.46</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

LR: Positive likelihood ratio, -LR: Negative likelihood ratio, +PV: Positive predictive value, -PV: Negative predictive value.

Table 2. Sensitivity, specificity, negative and positive predictive values of IOS and spirometry in asthmatic patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cut off point</th>
<th>Sensitivity</th>
<th>95% CI</th>
<th>Specificity</th>
<th>95% CI</th>
<th>+LR</th>
<th>-LR</th>
<th>+PV</th>
<th>-PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5</td>
<td>&gt;0.51</td>
<td>68.97</td>
<td>58.1 - 78.5</td>
<td>86.05</td>
<td>76.9 - 92.6</td>
<td>4.94</td>
<td>0.36</td>
<td>83.3</td>
<td>73.3</td>
</tr>
<tr>
<td>R20</td>
<td>&gt;0.33</td>
<td>77.01</td>
<td>66.8 - 85.4</td>
<td>65.88</td>
<td>54.8 - 75.8</td>
<td>2.26</td>
<td>0.35</td>
<td>69.8</td>
<td>73.7</td>
</tr>
<tr>
<td>X5</td>
<td>&lt;=-0.2</td>
<td>41.38</td>
<td>30.9 - 52.4</td>
<td>90.80</td>
<td>82.7 - 95.9</td>
<td>4.50</td>
<td>0.65</td>
<td>81.8</td>
<td>60.8</td>
</tr>
</tbody>
</table>

Table 3. Sensitivity, specificity, negative and positive predictive values of IOS and spirometry in COPD patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cut Of Point</th>
<th>Sensitivity</th>
<th>95% CI</th>
<th>Specificity</th>
<th>95% CI</th>
<th>+LR</th>
<th>-LR</th>
<th>+PV</th>
<th>-PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5</td>
<td>&gt;0.53</td>
<td>58.93</td>
<td>45.0 - 71.9</td>
<td>89.53</td>
<td>81.1 - 95.1</td>
<td>5.63</td>
<td>0.46</td>
<td>78.6</td>
<td>77.0</td>
</tr>
<tr>
<td>R20</td>
<td>&gt;0.39</td>
<td>41.07</td>
<td>28.1 - 55.0</td>
<td>82.35</td>
<td>72.6 - 89.8</td>
<td>2.33</td>
<td>0.72</td>
<td>60.5</td>
<td>68.0</td>
</tr>
<tr>
<td>X5</td>
<td>&lt;=-0.16</td>
<td>76.79</td>
<td>63.6 - 87.0</td>
<td>81.61</td>
<td>71.9 - 89.1</td>
<td>4.18</td>
<td>0.28</td>
<td>72.9</td>
<td>84.5</td>
</tr>
</tbody>
</table>

LR: Positive likelihood ratio, -LR: Negative likelihood ratio, +PV: Positive predictive value, -PV: Negative predictive value.
R5 was significantly correlated with FVC (r=-0.327 in the asthma group and r=-0.285 in the COPD group), FEV1 (r=-0.478 in the asthma group and r=-0.292 in the COPD group) and FEV1/FVC in asthmatic patients (r=-0.369).

R20 was significantly correlated with FVC (r=-0.342 for the asthma group and r=-0.289 for the COPD group), FEV1 (only in asthmatic patients r=-0.401) and FEV1/FVC (r=-0.240 for the asthma group and r=0.263 for the COPD group).

X5 was correlated with FEV1 (only in the asthmatic group r=0.267), and FEV1/EVC (r=0.470 for the asthma group and r=0.349 for the COPD group) (Figure 1 a,b,c).

DISCUSSION

This study compared the accuracy of IOS with spirometry measurements for detection of asthma and COPD. There was a remarkable increase in R5 and R20 and also a considerable decrease in X5 in COPD and asthmatic patients in comparison with the control population.

In our study among COPD patients, sensitivity for X5 (the best value in IOS measurements in COPD group) was 76% and in asthmatic patients, sensitivity of R20 (the best value in IOS measurements in the asthmatic group) was 77%.

In 2007, Al-Mutairi et al, showed a 31.3% sensitivity for IOS for asthma and 19.6% sensitivity for conventional pulmonary function tests. They revealed 38.95% sensitivity for IOS in COPD and 47.4% sensitivity for conventional pulmonary function tests. The sensitivity of IOS was 45.8% for detecting healthy people, and was superior to that of PFT (28.8%). There was 80.5% specificity for IOS and 86.2% for cPFT in detecting healthy people (7). In contrast with Al-Mutairi study, our findings showed greater sensitivity and specificity for IOS.

In 2009, Winkler et al. detected 87-94% of
asthmatic and COPD patients by using different IOS measurements (30). These rates were greater than those of ours. It can be attributed to the method of study, which included established COPD and asthmatic patients.

IOS resistance values can be useful for mild COPD diagnosis and small-airway changes after bronchodilator and bronchoprovocation challenges (31-33) but reactance values would do better for detecting the progression of COPD (33).

Similar to previous reports(5), this study found higher sensitivity of reactance compared to resistance measurements in asthmatic patients, but sensitivity of resistance measurements was greater in COPD patients.

Resistance components increased in COPD and asthma, while X5 had a significant decrease in comparison with the control group. These findings are comparable to previous findings (31).

The present study confirms the considerable sensitivity of IOS for detection of obstructive lung disease.

When comparing IOS measurements (R5,R20,X5) and spirometry in asthmatic and COPD patients , we found a correlation between IOS parameters and FEV1 in asthmatic patients (Fig 1,a-c), but only R5 had such correlation with FEV1 in COPD patients. It shows that the severity of COPD is correlated with R5. R5 and X5 were previously shown to be related with FEV1 (5, 19).

Kanda et al. demonstrated larger within-breath changes of Xrs5 in advanced COPD patients (31).

Recent studies suggest that inspiratory-expiratory X5 analysis can differentiate COPD and asthmatic patients better than whole-breath IOS (32). Inspiratory evaluation of IOS is more accurate than expiratory evaluation (33).

In conclusion, IOS can be a good alternative of spirometry for the diagnosis of obstructive lung disease in patients with minimal cooperation. In new patients complaining of acute attack of dyspnea exacerbation, IOS is a suitable measurement for obtaining further details regarding lung function. These patients cannot perform favorable breathing maneuvers; therefore, IOS is suggested for them.

Gaining further knowledge about IOS can greatly improve the process of disease evaluation.

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