

impulse oscillometry(IOS)

= Abstract =

Clinical usefulness of impulse oscillometry(IOS) in bronchial asthma

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Background : Impulse oscillometry(IOS) is a method to characterize the mechanical properties of respiratory system over wide range of frequency. It's most important advantage is to require minimal cooperations from subject. Therefore it is used to estimate pulmonary function of young children and to study epidemiology of occupational asthma. This study was performed to evaluate the usefulness for the clinical applications of IOS in bronchial asthmatics by estimating the associations between asthma severity and IOS parameters, and the relationships between IOS parameters and conventional spirometry.

Methods : 216 subjects with bronchial asthma were enrolled in this study. Subjects were grouped to 3 different groups according to their symptoms and pulmonary functions. Respiratory impedance, resistance (at 5Hz, 20Hz, 35Hz) and resonant frequency were measured by IOS. FEV1, FVC and MMEF were measured with conventional spirometry.

Results : There were significant difference of resonant frequency, resistance at 5Hz and 20Hz, resistance difference at 5Hz and 20Hz according to asthma severity($p < 0.05$, respectively). Resonant frequency, resistance at 5Hz, impedance were significantly correlated with FEV1 ($r = -0.55, 0.48, 0.49$, $p < 0.05$, respectively). And resistance at 5Hz had similar reproducibility compared to FEV1 (resistance at 5Hz, $r = 0.78$ vs FEV1, $r = 0.79$).

Conclusion : IOS is an useful and alternative method to evaluate clinical status of bronchial asthmatics. And further studies will be needed to clarify its values for wide range of clinical applications. (Korean J Med 59:522- 528, 2000)

Key Words : Asthma; Oscillometry

1).

body plethysmography

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2. 216

impulse oscillometry(IOS) 1950 114 (52.8%) . 102 (47.2%),
 Dubois body plethysmography II II) NHLBI expert pannel
 가 1970 microprocessor (mild group) 111 (51.3%), (moderate persistent
 가 3). 27 (12.6%), (severe persistent group)
 IOS (resistance(Rrs)) 가 77 (35.6%) .
 (reactance(Xrs)) impedance 8 1 , 50 .
 (Zrs) 가 가가 2. Spirometry IOS
 가 가 4. IOS Spirometry IOS Jaeger company MS- IOS
 가 Digital Instrument .
 Fourier mouthpiece 가
 2.5. monitor .
 1968 Grimby IOS 가 30 IOS
 (resonant frequency)가 , 3
 가 가 .
 가, , TV, FVC, FEV1 MMEF
 , IOS impedance(Zrs), 5Hz,
 가 69. 20Hz, 35Hz (R5Hz, R20Hz, R35Hz), 5Hz
 IOS (X5Hz) (Fres) .
 가 3. IgE
 4 9 10. 3M PRIST Kit IgE
 , FEV1, PEFR .
 가 가 methacholine
 가 II). . Methacholine chloride 0.075 mg/mL
 25 mg/mL 9 5
 (FVC) 3
 IOS FEV1 20%
 , IOS 가 (PC2M) .
 IOS 4.
 IOS
 Peason , ,
 1. IOS ANOVA .
 1997 7 1999 6 가 2

Table 1. Clinical characteristics of subjects according to asthma severity

| | Group | | |
|-----------------------|-----------------|--------------------|------------------|
| | Mild (n=111) | Moderate (n=78) | Severe (n=27) |
| M/F | 61/50 | 32/46 | 9/18 |
| Age (yr) | 44.1 ± 13.8 | 47.5 ± 14.3 | 50.7 ± 14.8 |
| Height (cm) | 164.8 ± 8.2 | 161.5 ± 7.6 | 160.2 ± 8.1 |
| Weight (kg) | 63.9 ± 9.1 | 62.5 ± 10.5 | 59.8 ± 9.4 |
| Sputum eosinophil (%) | 32.8 ± 33.7 | 37.8 ± 35.6 | 23.8 ± 28.9 |
| Total IgE (U/mL) | 588.8 ± 11.2 | 741.5 ± 8.3 | 501.0 ± 10.0 |
| M-PC20 (mg/mL)* | 4.3 ± 5.8 | 2.0 ± 4.4 | 1.2 ± 5.1 |
| PEFR (pred %)* | 88.7 ± 11.9 | 80.1 ± 12.1 | 61.9 ± 17.1 |
| FEV1 (pred %)* | 98.1 ± 16.3 | 83.2 ± 15.3 | 57.6 ± 20.0 |
| FEV1/VC (pred %)* | 76.1 ± 10.8 | 68.8 ± 12.2 | 59.9 ± 13.9 |
| MMEF (pred %)* | 65.9 ± 24.4 | 47.9 ± 28.1 | 26.6 ± 16.6 |

**p*<0.05: between each groups
Total IgE, M-PC20 geometric mean

Table 2. Comparison of IOS parameters according to asthma severity

| | Group | | |
|-------------------------------------|-----------------|--------------------|------------------|
| | Mild (n=111) | Moderate (n=78) | Severe (n=27) |
| Resonant frequency (Fres, Hz)* | 16.1 ± 4.7 | 18.1 ± 5.8 | 24.0 ± 6.9 |
| Impedance (Zrs, pred %) † | 115.6 ± 53.2 | 137.2 ± 61.4 | 191.9 ± 90.5 |
| Resistance at 5Hz (R5Hz, pred %)* | 108.1 ± 49.9 | 130.1 ± 59.7 | 171.5 ± 78.2 |
| Resistance at 20Hz (R20Hz, pred %)* | 90.3 ± 34.5 | 100.6 ± 37.3 | 112.8 ± 42.1 |
| Resistance at 35Hz (R35Hz, pred %) | 42.4 ± 4.0 | 47.7 ± 5.4 | 51.0 ± 9.8 |
| R5Hz- R20Hz (hPa/l/s)* | 1.2 ± 1.1 | 2.4 ± 1.1 | 3.3 ± 2.1 |

* *p*<0.05: between each group
+ *p*<0.05: between mild and severe group
R5Hz- R20Hz: difference of resistance at 5Hz and 20Hz

IOS (reproducibility) Pearson SPSS 8.0 *p* 0.05

MMEF (Table 1).

PC20, PEFR, FEV1, FEV1/VC (Table 1).

IOS, 5Hz, 20Hz

1. (*p*<0.05)(Table 2). Impedance (*p*<0.05), 35Hz

IgE 가 가 (*p*>0.05)(Figure 1). IOS 가 , 가

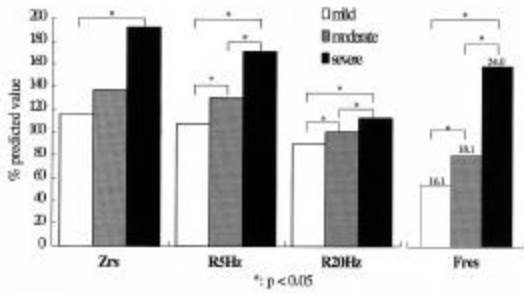


Figure 1. Comparisons of IOS parameters according to asthma severity. Impedance(Zrs), resistance at 5Hz and at 20Hz are described as % predicted value. Value of resonant frequency(Fres) is marked at the top of each bar.

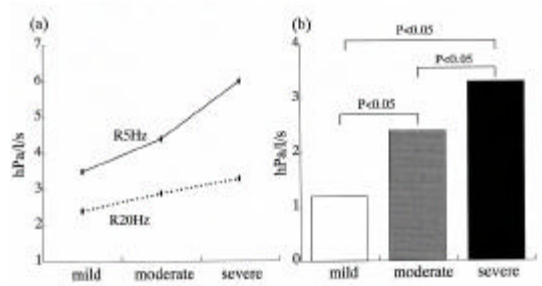


Figure 2. Resistance difference at 5Hz and 20Hz. Resistance is increased according to asthma severity both at 5Hz and at 20Hz(a). There is significant difference of resistance difference at 5Hz and 20Hz between each groups(b).

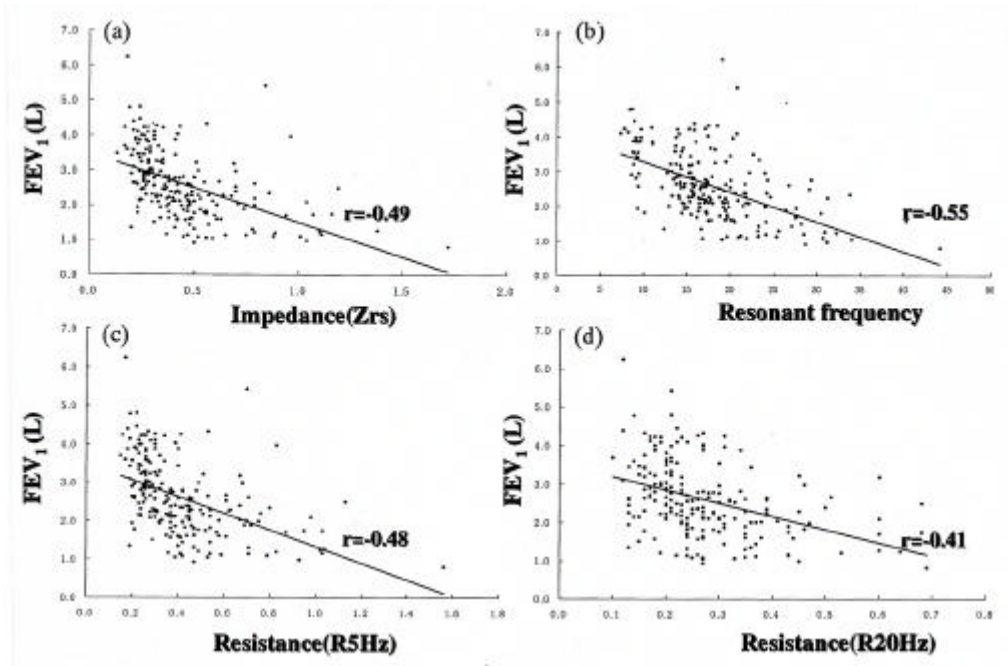


Figure 3. Correlation between FEV1 and impedance(a), resonant frequency(b), resistance at 5Hz(c), and resistance at 20Hz(d). Each correlation show statistically significant relationship($p < 0.05$).

가 가 가 3. IOS
 가
 9. IOS FEV1
 5Hz 20Hz (5Hz 가 (r= -0.55, p<0.01), 5Hz, 20Hz,
 - 20Hz) . 5Hz 20Hz 35Hz 5Hz 20Hz
 가
 가 (p<0.05)(Figure 2). (p<0.05)(Figure 3).
 FEV1 80% 156 IOS

Table 3. Correlation between IOS and spirometry parameters

| | FEV1 (n=216) | MMEF † (n=156) |
|----------------------------|-----------------|-------------------|
| Impedance (Zrs) | - 0.49* | - 0.34* |
| Resonant frequency (Fres) | - 0.55* | - 0.37* |
| Resistance at 5Hz (R5Hz) | - 0.48* | - 0.35* |
| Resistance at 20Hz (R20Hz) | - 0.41* | - 0.36* |
| Resistance at 35Hz (R35Hz) | - 0.35* | - 0.32* |

* : $p < 0.05$

†: measured for subjects with normal pulmonary function (FEV1 80%)

Table 4. Reproducibility of IOS parameters in subjects with no severity change

| | Correlation coefficient | p-value |
|-------------------------------------|-------------------------|---------|
| FEV1 (L) | 0.79 | < 0.01 |
| Impedance (Zrs, hPa/l/s) | 0.49 | < 0.05 |
| Resonant frequency (Fres, Hz) | 0.47 | < 0.05 |
| Resistance at 5Hz (R5Hz, hPa/l/s) | 0.78 | < 0.01 |
| Resistance at 20Hz (R20Hz, hPa/l/s) | 0.65 | < 0.01 |
| Resistance at 35Hz (R35Hz, hPa/l/s) | 0.81 | < 0.01 |
| Reactance at 5Hz (X5Hz, hPa/l/s) | 0.18 | > 0.05 |

n = 20, mean time interval of repeated test : 6 month

MMEF, FEV1 (Table 3). 가, MMEF, FEV1 (Table 3). 가, FEV1 (Table 3). 가, IOS, 가, 10%, IOS, FEV1, 가, 가, 가, body plethysmography, 가, PEFR, FEV1, MMEF, IOS, 1956, PC α , eosinophil cationic protein, Dubois, body plethysmography

IOS

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: Impulse oscillometry(IOS)

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IOS

: 216

FEV1

IOS

impedance,

5Hz, 20Hz 35Hz

FEV1, FVC, MMEF

20Hz

, 5Hz
($p < 0.05$),

, 5Hz

, impedance FEV1

($r = -0.55, -0.48, -0.49, p < 0.05$).

5Hz

FEV1

($r = 0.78$ vs FEV1: $r = 0.79$).

: IOS

가

IOS

가

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