OSZILLATION MECHANICS AND MAXIMAL VOLUNTARY VENTILATION UNDER STATIC RESISTIVE LOADS IN HEALTHY MOUNTAINEERS AT REST – A PILOT STUDY

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The ability of ventilatory adaptation to both exercise and altitude is an important physiologic response which may be influenced by heavy backpack loads. The objective of this study was to measure changes in respiratory impedance (R_5) and reactance (X_5) in response to three incremental resistive loads (10, 20, and 30% of the individual body weight), and to correlate these results to the ventilatory parameters tidal volume (V_t) and maximal voluntary ventilation (MVV) in 39 clinically healthy subjects, experienced in moutaineering (10 female, 19 male; mean age 30 ± 14 yrs). Impulse-oscillometry *(Master Screen IOS, Jaeger)* was performed and the Z_5 and X_5 at 5 Hz, the resistance at 5 and 20 Hz (R_5 , R_{20}), the resonance frequency (F_{res}), and central as well as peripheral airway resistance (R_z, R_p) were assessed. Results indicate significant increases in R_5 and R_p concomitant to the decreases in X_5 and MVV, respectively, which demonstrates an important negative influence of backback weights greater than 10% of body weight mainly on peripheral airways.

FORCED OSCILLATION TECHNIQUE VS SPIROMETRY AND BODY PLETHYSMOGRAPHY TO ASSESS BRONCHODILATOR RESPONSE IN ADULT ASTHMA PATIENTS.

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Introduction: Change in airway resistance can be demonstrated by forced oscillation technique (FOT). Bronchodilator response (BDR) assessed by FOT, has not been compared to spirometry (SP) and body plethysmography (BP). The aim of this study was to compare bronchodilator (BD) induced changes in FOT measurements in adult asthma patients, who had no BDR (group I), those who had BDR by SP (group II), and those who had no BDR by SP, but had BDR by BP (group III).

Methods: Seventy-six adult nonsmoker asthma patients without restrictive lung disease on BP were included in the study. Patients were divided in three groups (I, II, III and n=24,27,25 respectively) based on BDR as explained. Changes in FOT measurements were compared between these three groups.

Results: Resistance at 5 Hz frequencies (R5), bronchial compliance and impedance of respiratory system were significantly different between group I and III (p values=0.008, 0.0009 and 0.011 respectively). Change in R5 after BD was significantly different between group I and II, group II and III and group I and III (p values=0.02,0.002 and 0.0002 respectively).

Conclusion: FOT measurements are significantly different in patients with different severity of asthma. BD induced changes in FOT measurements significantly correlate with BDR, defined by SP and BP. Since FOT is rapid, and requires minimal patient cooperation, it can be used as an alternative method to judge BDR in asthma patients

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STANDARDS FOR PERFORMING THE MAXIMUM VOLUNTARY VENTILATION (MVV)

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The MVV is a spirometric measurement used to detect pulmonary limitation in exercise and neuromuscular disorders. The ATS standards for performing the test are 2 trials within 10% of the mean, and the best MVV comparable to 35 to 40 times the FEV_1. Recommendations for performing the test are a frequency (f) between 70 and 150 bpm and a tidal volume (V_t) between 25% and 75% of the best vital capacity (Sensormedics, Yorba Linda, CA). To test whether the same results are obtained throughout this range, we tested the MVV in 15 subjects with normal spirometry using a high *vs.* low f/V_t, while meeting the standards and recommendations in each set. We had calculated that this sample size is sufficient to detect at least a 10% difference with a power of 0.9 using the paired t-test. The results are as follows:

	High f/V_t	Low f/V_t	P value
f/V_t (b•L/min)	107	52	< 0.05
S.E.M. (b•L/min)	8	4	
MVV (L/min)	147	148	> 0.76
S.E.M. (L/min)	8	8	

The above recommendations should be adapted as standards for MVV.

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NON-LINEAR DYNAMICS AND FORCED EXPIRATORY MEASUREMENTS

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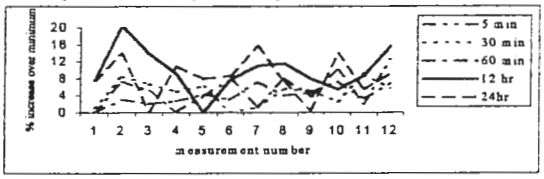
Introduction Variability of measured airflow obstruction in asthmatic individuals and populations may have periods of apparent predictability, but is still difficult to forecast. This may be explained if airflow obstruction is defined by a non-linear dynamic system. Self-similarity, a feature of this, is that a fragment appears similar to the whole.

Methods Forced expiratory measurements, FEV1, FVC and PEF, were made in an individual without bronchial hyperresponsiveness. These measurements were made on 12 occasions for time-intervals of every: 5 minutes; 30 minutes; 60 minutes; 12 hours; 24 hours. Each measurement was plotted as the % above the lowest value for that time interval against the measurement number.

Results All of the graphs, 3 measurements for 5 time intervals, depicted a line of peaks and troughs, the variability increasing with time-interval. The PEF chart is shown.



Conclusions In this individual, measurements of airflow obstruction demonstrate self-similarity, possibly indicating a non-linear dynamic system. Several factors influence these measurements such as reproducibility of the measurements, environmental factors, diurnal and annual variations. Further evaluation is needed. If verified the degree of variability on a short term small scale would predict that long term on a larger scale.

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TEST PERFORMANCE OF ELECTRONIC RECORDING PEAK FLOW METERS.

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RATIONALE: Electronic recording peak flow meters (EPFM) are increasingly being used for ambulatory monitoring of asthma. The EPFM's decrease errors associated with manual entry of time and peak expiratory flow rate (PEFR) data into diaries. However, only limited data documents the performance of these devices in measuring PEFR.

METHODS: Four types of EPFM were evaluated. A computer-controlled piston pump was used to deliver the 26 flow-time waveforms recommended by the ATS for assessing performance in PEFR measurement. An algorithm accounting for EPFM resistance and gas compression was used to assure accurate delivery of waveforms. For 2 types of EPFM we assessed 10 devices and for the other 2 types we assessed 3 devices. Accuracy, intradevice precision, and interdevice precision were calculated as recommended by the ATS. Correlation between delivered and measured PEFR and coefficient of variation (CV) in measurement at each waveform was also assessed for each type of EPFM.

RESULTS: All 4 types of meters met ATS standards for accuracy. Within the limits of numbers of devices studied, all meters met standards for intradevice precision and 2 of the 4 meters met standards for interdevice precision. Delivered and measured PEFR for all 4 meters were strongly correlated, with r values ranging between 0.987 and 0.999. CV's over the range of PEFR studied for the various EPFM ranged between 0.2% and 9.5%.

CONCLUSIONS: The EPFM studied performed well from the standpoint of accuracy in measuring PEFR. They were more variable in their precision. However, the tested EPFM have performance characteristics that appear sufficient for ambulatory monitoring of PEFR.

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SIGNIFICANCE OF A REDUCED FEV_1/FVC RATIO IN THE SETTING OF A FEV_1 GREATER THAN 100% OF PREDICTED

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Rationale: To determine whether a reduced FEV1/ FVC ratio in the setting of a FEV1 > 100% predicted is indicative of disease.

Methods: Retrospective study of consecutive spirometry tests done between 7/96 and 9/00, retrieved from the database of the Cleveland Clinic Foundation and analyzed relative to race, gender, smoking status and reported presence or absence of clinical diagnosis of asthma. NHANES III limits of normal were utilized. Chi square test was used to determine statistically significant differences.

Results:

FEV1 > 100% of Predicted

	FEV1/FVC reduced	FEV1/FVC normal	
	N=101	N=1477	
Asthma	38 (38%)	286 (19%)	P<0.001
Smoking history	13 (13%)	114 (7%)	P=0.179

Conclusion: The presence of a reduced FEV1/FVC ratio in the setting of a FEV1>100% predicted may be indicative of disease, such as asthma. A larger sample size is needed to better evaluate the effect of smoking. Further studies are needed to better characterize the significance of such findings.

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ABSTRACTS

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