Pulmonary Function Tests Of AsymptomaticAsthmatic Children

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Asthma is the disease of small airways, while large airways become obstructed in addition to small airways during an attack. This study was aimed at testing asymptomatic asthmatic subjects by determination of large and small airway function. Forty symptom free asthmatic children and 40 healthy school children were evaluated for their pulmonary functions. The flow-volume data showed statistically significantly (P<0.05) reduced MMEF (maximum mid-expiratory flow) and MEF_{50} (maximum expiratory flow at 50% of forced vital-capacity).in asthmatic children, indicating small airway obstruction. FRC (functional residual capacity) was found higher than healthy children, in asthmatics (P<0.05) while arterial blood gases were normal in both the groups.We conclude that small airway obstruction may persist in asthmatic children during asymptomatic period. Flow-volume curves are found to be a sensitive measurement of bronchial obstruction during the symptom-free period.
Key words: Pulmonary function; Flow-volume loop; Blood gas; Asthma

Asthma in childhood is a disease characterized by wide variations in resistance to flow in intrapulmonary airways . It manifests by recurrent attacks of cough and wheeze separated by symptom-free intervals. The airflow obstruction and clinical symptoms are largely or completely reversed with appropriate therapy[2]. Asthma is the disease of small airways, while large airways become obstructed in addition to small airways during an attack[3,4]. Minor abnormalities in airway function of asthmatic children are found when examined during symptom-free period[5]. The persistent small airway obstruction in young mild to moderate asthmatics, which is not evident by clinical history, might not be detected by routine lung function testing[6].

The study was undertaken to determine large and small airway function and to investigate blood gas tension in asymptomatic asthmatic children.

Materials And Methods

The study population comprised of 40 asthmatic and 40 normal school children, between the age of 10 and 16 years. In the asthmatic group were 18 girls and 22 boys while in the control group were 19 girls and 21 boys. The asthmatic group had mild to moderate asthma, were selected from asthma follow-up clinic Mayo Hospital, Lahore and studied (while they were symptomatic).

Age, sex, standing height to the nearest centimeter without shoes and weight in kilograms were recorded for all subjects before testing. Pulmonary function tests were carried out with rolling seal dry spirometer (Fudac 50-Fukuda Sangyo, Japan) All measurements were made with nose clips applied and in the sitting position.. The subjects were demonstrated and trained in forced expiratory maneuver, inhaling to total lung capacity (TLC) and then exhaling forcefully and maximally to residual volume (RV). At least three manoeuvres were performed by each subjects. These were recorded in form of a maximum expiratory volume-time and flow-volume curve. The results were analyzed to give FVC, FEV_1, PEF, MMEF and MFF^{50}

The FRC was measured by closed circuit helium dilution technique. Arterial capillary blood samples were obtained from the ear lobe. The sampling site was prepared by massaging the ear lobe for two minutes and then wrapping in moist cloth soaked in water at 40°C. A stab was made in the lateral surface of ear lobe with a pointed scalapel blade to enter the pulp. Blood samples were taken into heparinized glass capillary tubes, whose ends were immediately closed with sealing substance. Blood gases and pH were determined immediately by blood gas analyzer (Eschweiler-System 2000, Germany).

Statistics

Students `t' test for unpaired observations was used to compare the results with control subjects. The term significant is used to imply a `p' value of less than 0.05. The data included in the text and tables are presented as the mean±SD.

Results

The mean FVC, FEV_1, FEV_1% and PEF were lower in asthmatics than controls. The comparison of these values in two groups showed a non-significant (P>0.05) difference (Table 1). MMEF values were 3.16±0.54 and MEF_{50} 3.28±0.52 for control group whereas the values were 2.80±0.57 and 2.87±0.57 respectively for asthmatic group. The difference in two groups was statistically significant (P<0.05).

Table 1Flow-volume data in control and asthmatic group

	Control (n=40) Mean±SD	Asthmatic (n=40) Mean±SD	P value
FVC(Litres)	2.69±0.40	2.50±0.50	NS
FEV_1 (Litres)	2.17±0.45	1.99±0.44	NS
FEV_1(%)	80.49±2.33	79.83±2.63	NS
PEF(Litres/sec)	4.64±0.76	4.31±0.75	NS
MMEF(Litres/sec)	3.16±0.54	2.80±0.57	<0.05*
MEF 50%(Litres/sec)	3.28±0.52	2.87±0.57	<0.05*

NS = Non-significant * = Significant

The comparison of mean static lung volumes is presented in Table 2. Asthmatic children had a higher FRC values than healthy ones, the values being 1.62±0.30 and 1.85±0.40 for controls and asthmatics respectively. The difference was statistically significant (P<0.05). TLC

showed non-significant difference (P>0.05) in both groups.

Table 2 Static lung volumes in control and asthmatic group

	Control (n=40) Mean±SD	Asthmatic (n=40) Mean±SD	P value
FRC(Litres)	1.62±0.30	1.85±0.40	<0.05*
TLC(Litres)	3.33±0.59	3.53±0.71	NS

NS = Non-significant * = Significant

Table 3 shows the comparison of blood gas analysis in control and asthmatic group. The mean pO_2, pCO_2 and pH were non-significantly different in the study groups.

Table 3 Comparison of blood gas analysis in control and asthmatic group

	Control (n=40) Mean±SD	Asthmatic (n=40) Mean±SD	P value
PaO_2(mmHg)	95.61±1.11	95.39±1.04	NS
$PaCO_2$ mmHg)	37.55±0.41	37.67±0.48	NS
pH	7.38±0.01	7.38±0.01	NS

NS = Non-significant * = Significant

Discussion

The diagnosis of asthma requires relevant symptoms and the presence of airflow limitation that is partially or completely reversible either spontaneously or after treatment[7]. An important goal of therapy in children is to achieve not just freedom from wheezing but normal spirometry[8].

The spirometric data revealed that FVC, FEV_1, FEV% and PEFR show no signs of bronchial obstruction in asthmatic group, although the effort independent part of the flow-volume curve i.e., MMEF and MEF_{50} deviated from data in healthy children. This may indicate that MMEF and MEF_{50} are sensitive parameters in measuring bronchial obstruction. Normal FEV_1 and decreased MEF_{50} in symptom free asthmatics has been reported in the literature[9,10]. It is interpreted as a sign of sustained airway obstruction[9]. Asthmatic children have FEV_1 1.5-3% lower than children who never had asthma. A normal FEV_1 and a reduced $FEF_{25-75\%}$ is consistent with small airway disease[12]. MMEF is a sensitive indicator of sustained airway obstruction during symptom-free period and a better representative of small airway function[13]. It is considered as a better measure for following the disease in children whose other tests are normal.

The presence of small airway inflammation with consequent peripheral airway obstruction causes the reduction in forced expiratory flow and may be responsible for increase in static lung volumes[14]. Our results show statistically significant (P<0.05) difference in FRC measurements of asthmatic subjects. Weng, Langer, Featherby and Levison reported a decrease in mean MMEF and hyperinflation of lungs in asymptomatic patients[15]. These residual aberration affected the blood gases in their study, as some children were hypoxemic because of imbalance in ventilation and perfusion. Although mean FRC of asthmatics shows a statistically significant difference from control, hyperinflation was observed in only few cases. Blood gases are within normal limits in our study because the degree of residual pulmonary function abnormalities in clinically asymptomatic patients may vary. Normal FRC and normal blood gases during symptom-free period of asthmatic children has been reported by Hedlin et al[9].

Our study shows that a mildly obstructive process in small airways can cause no clinical symptoms and only a few pulmonary functions like flow-volume loop can detect such an abnormality.

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