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The Effect of Age on the Change of Pulmonary Performance for Normal Individuals and Patients with Asthma

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Abstract: ***Background: Many respiratory diseases can be diagnosed by spirometer such as asthma chronic obstructive pulmonary disease COPD and upper air way obstruction UAO. Asthma is a common disease and in severe cases are life threatening (1), it becomes more sever if mixed with infection other respiratory disease (2). Aim: In this work we are aiming to investigate asthma disease in relation to age using spirometer. The work involved Spirometric measurements of some related parameters such as vital capacity VC, forced vital capacity FVC, forced expiratory volume in one second FEV1, and peak expiratory flow PEF. Results: Results reveals that the younger age group show higher values for all parameters for VC, FVC, FV1, and PEF by (26%, 26.3% , 40 % and 31.8%) respectively, and for patient group is also higher for the same parameters (42.4%,37.1%, 42.3%, and 37.3%) respectively. Conclusion: 1- Old patients > 50 year old with asthma show more profound change on respiratory parameters than the young patient < 50 year old and this is caused by an additive effect of deterioration in pulmonary function caused by old age and the asthmatic effect on the respiration function. 2- Normal young individuals has higher values for all parameters than the old normal***

Keywords: Asthma, Respiratory diseases, Vital capacity, Forced vital capacity, Forced expiratory, Pulmonary function

1. Introduction

Spirometers are widely used in the diagnosis of pulmonary diseases such as emphysema upper air obstruction, and asthma (3). The instrument is simple easy to use and not expensive (4). It can measure the volumes and the flow rates at different time intervals which can provide vital information on the pulmonary performance stiffness and to diagnose many diseases

Airways Obstruction can be very serious in severe cases may lead death (5). Asthma is common respiratory disease is, it causes a restriction in ventilation caused by the narrowing of small airways characterized by hyper-responsiveness (6). During acute asthma attack different inflammation of variable severity may occur which augment the air way resistance leading to bronchospasm (2, 3). These can be monitored by the measurements of respiratory parameters measured by Spirometer. It can reduce the vital capacity VC also reduces the expiratory flow in one second FEV1. the narrowing or obstruction of the airways (in asthma disease) trap the air inside after complete expiration, and the functional residual capacity is increased, causing that patient breathing on the top of the PV curve this means that the lung is still partially inflated at the end of the expiration because the air trapped in the occluded or narrowed small airways making the inspiration difficult with low tidal volume and increased functional residual capacity (FRC) and reduced compliance as the compliance = dv / dp,
To make more accurate comparison of the impact of asthma on patients of the two age groups we have compared between the parameters (VC, FVC, FEV1, and PEF) for normal elderly group >50 and young patients < (50) normal individuals and between patients and normal of the same age group. This to avoid the effect of age such as the change in stiffness, and muscles strength due to aging.

2. Patients & Method

Thirty six Patients (22male and 14 female) suffering from asthma and 28 controls individuals (19 male and 9 female) were enrolled in the study. All patients were tested to be free from other diseases.

The study was conducted at two hospitals (Baghdad Teaching Hospital & Al-Yarmouk Teaching Hospital) in Baghdad. The test parameters involved in the measurements were VC, PEF, FEV1 and FVC from which the ratio of FEV1/FVC % was calculated.

In order to get a clear picture the effect of asthma on age we have divided the patients and normal into two age groups > 50 and < 50 year old at the same time we compared between the two age groups for normal and patients using excel program data were expressed as percentage of averages ± standard deviation, test for significance was performed using two tailed student test t tests and the value for probability p value was < 0.5 as the lowest limit of significance.

3. Results

Results show changes in parameters of patients from normal for age <50 years old these changes appeared on all parameters. The change in VC 26% and in FVC and FV1 26.3% and 40% and all values were significant giving P value < 0.01. The change in FEV1/FVC% is lower in normal individual than in patient giving change of 20.55 % also significant p value is < 0.01. The value of PEF for normal is also higher than patients by 31.8 % with significant p value table (1).

Table 1: The change % between patients and normal individuals for the young group < 50 year old

Parameter	P	N	Change%	P value
VC in (L)	2.96	4.0	26	< 0.05
FVC (L)	3	4.07	26.3	< 0.05
FEV1 (L)	2.2	3.67	40	< 0.05
FEV1/FVC%	73.3	90.2	20.55	< 0.05
PEF	4.5	6.6	31.8	< 0.05

As for the second group age >50 the percentage change is also lower in patients for VC the change was 42.4% and 37.1% for FVC both were statistically significant (P<0.01). FEV1 is reduced by 42.3% (P <0.05) and a slight insignificant reduction in the ratio of FEV1/FVC by 6.85% (P > 0.05). The peak expiratory flow PEF is also lower in patient by 37.3% of the normal individual with p value <0.01.

Table 2: The change % between patients and normal individuals for elderly group >50 years old

Parameter	*P*	*N*	*Change%*	*P value*
VC in (L)	1.92	3.3	42.4	< 0.05
FVC(L)	1.95	3.1	37.1	< 0.05
FEV1(L)	1.5	2.6	42.3	< 0.05
FEV1/FVC%	76.9	83.8	6.85	> 0.05
PEF	3.57	5.7	37.3	< 0.05

Table 3: The difference in parameters due to age for normal individuals

Parameter	<50	>50	difference	Change %
VC in (L)	4.0	3.3	0.7	17.5
FVC (L)	4.07	3.1	0.97	23.8
FEV1(L)	3.67	2.6	1.07	29.15
FEV1/FVC%	90.5	84.6	5.9	6.5
PEF	6.6	5.7	0.9	13.6

It can be seen that there is a clear difference between old normal >50 years and younger normal <50 years and the difference appear on all parameters table (3)

Table 4: Patients deviation from normal for the two gropes >50 and<50

Parameter	Change%<50	Change%>50	*Difference%
VC in (L)	26	42.4	16.4
FVC (L)	26.3	37.1	10.8
FEV1 (L)	40	42.3	2.3
FEV1/FVC%	16.9	6.9	-10
PEF	31.8	37.3	5.5

* is the difference between the two percentages <50 - > 50 year

It can be seen that the impact of asthma disease is more apparent on the older group as the change from normal is more for all parameters table (4) as we have the change of difference between the percentage values for normal is 16.4% and 10.8 % for VC and FVC respectively and the difference in the change percent is less between the two groups for the values of FEV1 which is 2.3% and a slightly higher deference between PEF of 5.5%. In case of in FEV1/FVC% the difference in the change percent is -10% and the minus sign because the younger group is less than the older group.

4. Discussion

As we have presented earlier results that there were decreases in all the studied parameters (VC, FVC, FV1, and PEF) in patients compared to normal for both age groups (>50 and <50). The changes were more apparent in the older group than in the younger group for all parameters as it gives higher change percent for each parameter tables (1, and 2). In this regard we have compared between the two healthy age groups (>50 and <50 years) and this can show that the parameters of the normal younger group is always higher than the older group tables (1, 2) the difference in the change % between the healthy individuals for the two groups was presented in table 3. These results may be attributed to that the older healthy group have already weakened muscles as the lung muscles loses strength with age leading to lose of parenchyma strength and a consequent reduction in the supporting lung structure causing dilation of air space. during asthma attack an increased muscle tone in addition to that the disease induces small airway narrowing these asthmatic effects causing a large volume of air trapped in the alveoli for this reason the patient spend much effort for breathing (8).

The increased air resistance induced by narrow airways causes a reduction in FEV1, FVC, PEF tables (3and 4), the ratio of FEV1/FVC % is also reduced and the change is more apparent in the younger group as the elderly shows less change than the younger group this is may be caused mainly by the change in FVC as it has changed by (37.3% for the younger group versus 23.8 for the elderly) the younger group is less stiff than the elderly group this makes the reduction in the air ways performance less than the elderly patient because of the older group patients have already reduced pulmonary performance due to reasons mentioned above, i.e. the values of the change in the parameters because of asthma is added to the effect of age for the elderly, for this reason parameters for both patients and normal are higher in the young patients and the change is also higher. The ratio of FEV1/FVC % is slightly lower for the young group indicating better performance.

This can be caused by the dilated alveoli in the elderly patients due to age so it is expected that more air to be trapped during asthmatic attack as it causes smooth muscle contraction leading to air trapping in the alveoli (9). This effect makes the patient spend much more effort by forcing the air outside during expiration and breathing will be near the top of PV curve. As a result all parameters (FVC, FV1, and PEF) were reduced for both groups but the reduction was more significant seen on the elderly group.

It is important to mention here that a small narrowing in the airways may have a grate effect on the flow, according to poiseuille's law the effect (10) on the air flow rate is proportional to the power of four to the radius of the pipe i.e. if the radius is reduced to half the flow rate will be reduced sixteen times when the pressure stays constant and this is one reason causing the patient exert high pressure for expiration so the difference between the patient PEF and the normal PEF is reduced.

The higher change in the older group table (1, and 2) indicate that the performance is better in the younger group particularly the change was taken with respect to normal individual as they have higher values than the older counterparts.

These results lead to a conclusion that asthma has greater impact on elderly this appeared primarily on VC and FVC also on the ratio (FEV1/FVC) where the change is highest and to a lesser extent appeared on FEV1and PEF.

It appears to be that effect of asthma on elderly is close to additive effects of respiratory deterioration due to age plus the effect of the asthmatic disease.

References

[1] Enright, PL, Studnicka, M, Zielinski, J. Spirometry to detect and manage COPD and asthma in the primary care setting. EurRespir Mon 2005; 31:1
[2] Gershon AS, Warner L, Cascagnette P, et al. Lifetime risk of developing chronic obstructive pulmonary disease: a longitudinal population study. Lancet 2011; 378:991.
[3] Lamprecht B, McBurnie MA, Vollmer WM, et al. COPD in never smokers: results from the population-based burden of obstructive lung disease study. Chest 2011; 139:752
[4] http://www.surgeryencyclopedia.com/Pa-St/Spirometry-Tests.html.
[5] Oh YM, Bhome AB, Boonsawat W, et al. Characteristics of stable chronic obstructive pulmonary disease patients in the pulmonology clinics of seven Asian cities. Int J Chron Obstruct Pulmon Dis 2013; 8:31.
[6] Global Strategy for the Diagnosis, Management and Prevention of COPD, Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2017 Report www.goldcopd.org (Accessed on February 10, 2017.(
[7] Siddiqui SH, Guasconi A, Vestbo J, et al. Blood Eosinophils: A Biomarker of Response to Extrafine Beclomethasone/Formoterol in Chronic Obstructive Pulmonary Disease. Am J RespirCrit Care Med 2015; 192:523.
[8] Woodruff PG, Barr RG, Bleecker E, et al. Clinical Significance of Symptoms in Smokers with Preserved Pulmonary Function. N Engl J Med 2016; 374:1811.
[9] Harkness LM, Kanabar V, Sharma HS, et al. Pulmonary vascular changes in asthma and COPD.PulmPharmacolTher 2014; 29:144.
[10] Pfitzner J. Poiseuille and his law. Anaesthesia. 1976;31(2):273–275.