

## Changes in Lung Function Tests in Patients with Bronchial Asthma in Response to 60 Degree Upright Tilting.

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### الخلاصة:

أجريت هذه الدراسة لبيان تأثير تغيير وضع جسم الإنسان من وضع الاستلقاء إلى الوضع المائل (٦٠ درجة) على وظائف الرئتين (FEV1, FVC و FEV1) (السعة الحيوية القسرية و الحجم الزفيري ألقسري في الثانية الأولى والنسبة المئوية للحجم ألقسري في الثانية الأولى إلى السعة الحيوية القسرية) لمرضى الربو القصبي.

أ- مقارنة بين الأصحاء والمصابين بالربو القصبي بسبب تغيير وضع جسم الإنسان إلى الوضع المائل بدرجة ٦٠°.

أظهرت النتائج وجود انخفاض معنوي لكل من (FVC,FEV1,PEFR) بسبب تغيير وضع جسم الإنسان للوضع المائل بدرجة ٦٠° عن المرضى المصابين بالربو القصبي ولا يوجد فرق معنوي في (%FEV1).

ب- أظهرت النتائج أن هناك زيادة معنوية في وظائف الرئتين (FVC,FEV1,PEFR) بينما لا توجد زيادة معنوية في (%FEV1) عند تغيير وضع جسم الإنسان للوضع المائل بدرجة ٦٠° عند جميع مرضى الربو القصبي.

د- الفرق بين القيمة التقديرية والقيمة المحسوبة لمجموعة السيطرة، أظهرت النتائج أن هناك زيادة معنوية في القيمة التقديرية لوظائف الرئتين (FVC, FEV1, PEFR) عن القيمة المحسوبة لمجموعة السيطرة.

### Abstract:

This study was carried out to investigate the effect of 60° upright tilting on lung function test in patients with bronchial asthma.

A-Effect of changing of posture to 60°upright tilting on normal (control) subjects indicates that the FVC, FEV1&PEFR were significantly higher in 60°upright tilting than that of supine values and no significant difference in FEV1%, and the differences between supine and 60°upright tilting values of FVC, FEV1&PEFR were significantly higher in asthmatic patients with no significant change in FEV1%.

B- Effect of changing of posture to 60°upright tilting on all the asthmatic patients indicates that the FVC, FEV1&PEFR were significantly higher in 60°upright tilting than that of supine values, while there was no significant changes in FEV1 %.

C- The effect of changing of posture to 60°upright tilting in both age groups i.e. group1(20-39year) and group2 (40-60year) indicates that there was significant increase in FVC, FEV1 and PEFR in 60°upright tilting with no significant change in FEV1%.

On comparison between group1 &group2 in supine & 60°upright tilting FVC, FEV1& FEV1% were significantly higher in group1 than group2 but no significant difference was found in PEFR between group1& group2 in both supine and 60°upright tilting.

D-The difference between the normal control subjects in this study and that of predicted values in both male and female of FVC, FEV1, and PEFr indicate that the predicted value in both male and female is slightly higher than that of the control values.

### **Introduction:**

There are numerous sources for the development of chronic airway diseases within the workplace and these sources have been investigated by many researchers to identify specific etiological relationships among chronic airway diseases and certain types of occupational exposure to which the workers are subjected in the workplace (1) (2).

The forced expiratory volume ratio (FEV1%) which is the percentage of FEV1 (Forced expiratory volume in the first second of expiration) to the FVC (Forced vital capacity) is of clinical usefulness and when its value becomes abnormal usually indicates the presence of respiratory abnormality (3) and so it is regarded as a relatively sensitive and specific indicator for respiratory obstructive impairment (4) (5).

This ratio(FEV1%) is variable because it is a percentage of two parameters (FEV1 and FVC ), its normal value is around (80%) in healthy subjects, and becomes (65%) or less in patients with obstructive pulmonary diseases whereas in restrictive pulmonary diseases it either remains around (80%) or increase up to 90% or even more (6)(7).Many researchers study the effect of exercise on lung function test (8) ;however many investigators study lung function test in patients with bronchial asthma (9) effect of exercise on bronchial asthma (10)(11) or relation of blood group with asthma (12)(13). Other research made on normal subjects show the effect of changing of posture from the supine position to 60° upright tilting (14).Others study the effect of changing of posture from the supine position to 60°upright tilting on vagal tone and respiratory indices in asthma (15)(16), but very little research has been made to study the effect of changing of posture on lung function test in patients with bronchial asthma ;Therefore this study was carried out to study the effect of 60° upright tilting on lung function test in patients with bronchial asthma .

### **Materials and method:**

#### **1.Subjects:**

Group I: The normal subjects include the twenty five normal subjects that participated in the Comparison between predicted and normal (control) values of FEV1, FVC, FEV1% and PEFr and comparison between normal subjects and asthmatic patients in response to 60°upright tilting.

Group II: The asthmatic patients, these patients can be divided into:

Age group I (20-39) years old patients and Age group II (40-60) years old patients.

2.spirolabII spirometer (produced by Medical International Research (MRI), Roma-Italy. a well evaluated spirometer ,dry (waterless), supplied with turbine, Height and Weight Measuring Apparatus Peak Flow Meter Tilting Table (Siregraph CF™)

A nose clip fitted mouth piece was inserted in the mouth and the subject asked to take maximal inspiration followed by a forceful maximal expiration through the mouth piece to determine FEV1, FVC and FEV1%. Then the spirolabII mouth piece was replaced by peak flow meter, and the subject was asked to blow forcefully and the peak flow meter measurement was recorded.

The subject was then tilted by 60°upright (head up) and after nearly 5 minutes, (steady state) the same procedure made in supine position was repeated.

**Result**

**A-Difference between Predicted and Control Values:**

The differences between the normal control subjects in this study and that of predicted values in both male and female of FVC, FEV1, and PEFR; the comparison of FVC, FEV1, and PEFR indicate that the predicted value in both males and females slightly higher than that of the control values (Table 1).

**B-Comparison between Normal Subjects and Asthmatic Patients in Response to 60°Upright Tilting:**

Effect of changing of posture to 60°upright tilting on normal (control) subjects indicates that the FVC, FEV1&PEFR were significantly higher than that of supine values and no significant difference in FEV1%. The differences between supine and 60°upright tilting values of FVC, FEV1&PEFR were significantly higher in asthmatic patients than in normal (control) subjects with no significant change in FEV1% (Table 2, 3,Figure1).

**Table (1):  
Comparison between Predicted and Normal (Control) Values of FVC, FEV1and PEFR**

Parameter	Normal Control Group	Predicted value
FVC(litre)	3.96±0.31	4.82±0.10
FEV1(litre)	3.19±0.34	3.97±0.16
PEFR(litre/min)	496±92.10	563±3.69

**Table (2):  
Changes in FEV1, FVC, FEV1%and PEFR during Changing of Posture from Supine to 60° Upright Tilting in the Asthmatic Patients.**

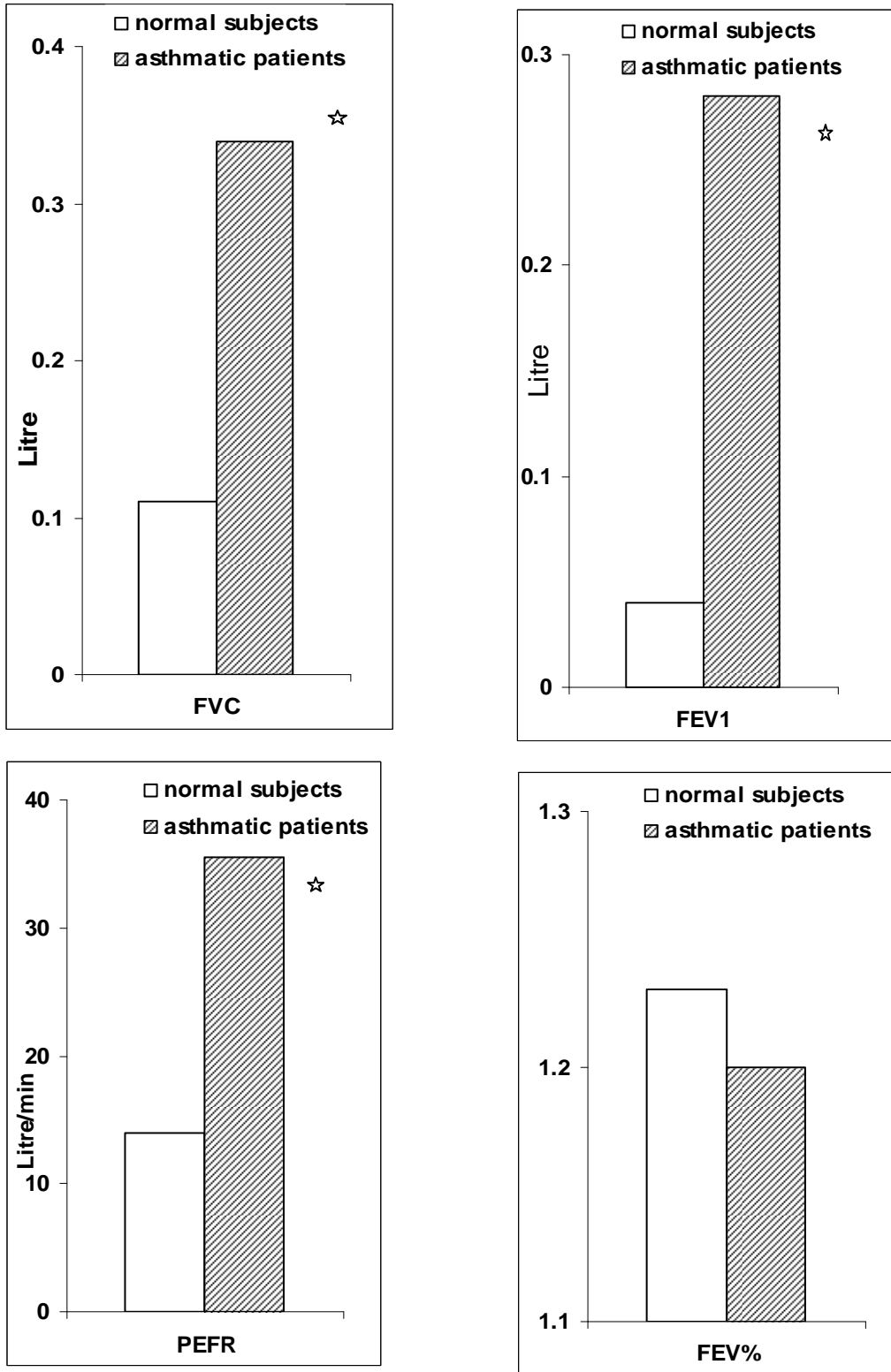
Parameter	Supine	60° Upright tilting	Difference	P. Value
FEV1 (litre)	1.69±0.78	1.97±0.86	0.28	<0.05
FVC (litre)	2.57±1.09	2.91±1.37	0.34	<0.05
FEV1%	64.96±12.66	66.15±12.72	1.20	>0.05
PEFR (L/min.)	284.23±149.82	319.73±158.30	35.5	<0.05

**Table(3):  
Changes in FEV1, FVC, FEV1%and PEFR During Changing of Posture from Supine to 60° Upright tilting in the Normal Subjects.**

Parameter	Supine	60° Upright Tilting	Difference	P. Value
FEV1 (litre)	3.15±0.35	3.19±0.34	0.04	<0.05
FVC (litre)	3.85±0.33	3.96±0.31	0.11	<0.05
FEV1%	81.61±4.39	80.83±4.57	1.23	>0.05
PEFR (L/min.)	483±93.3	496±92.10	14.00	<0.05

**Table (4):  
The Changes in the Difference between Normal Subjects and Asthmatic Patients in Response to 60° Upright Tilting.**

Parameter	Asthmatic Patients	Normal Subjects	Difference	P. Value
FEV1 (litre)	0.28	0.04	0.24	<0.05
FVC (litre)	0.34	0.11	0.23	<0.05
FEV1%	1.20	1.23	0.03	>0.05
PEFR (L/min.)	35.50	14.00	21.50	<0.05



**Figure-1-:**  
**The Changes in the Difference between Normal Subjects and Asthmatic Patients in Response to 60° Upright Tilting.**  
☆=p<0.05

C- Effect of changing of posture to 60°upright tilting on all the asthmatic patients indicates that the FVC, FEV1&PEFR were significantly higher than that of supine values. While there was no significant changes in FEV1 % (Table4) (Figure2).

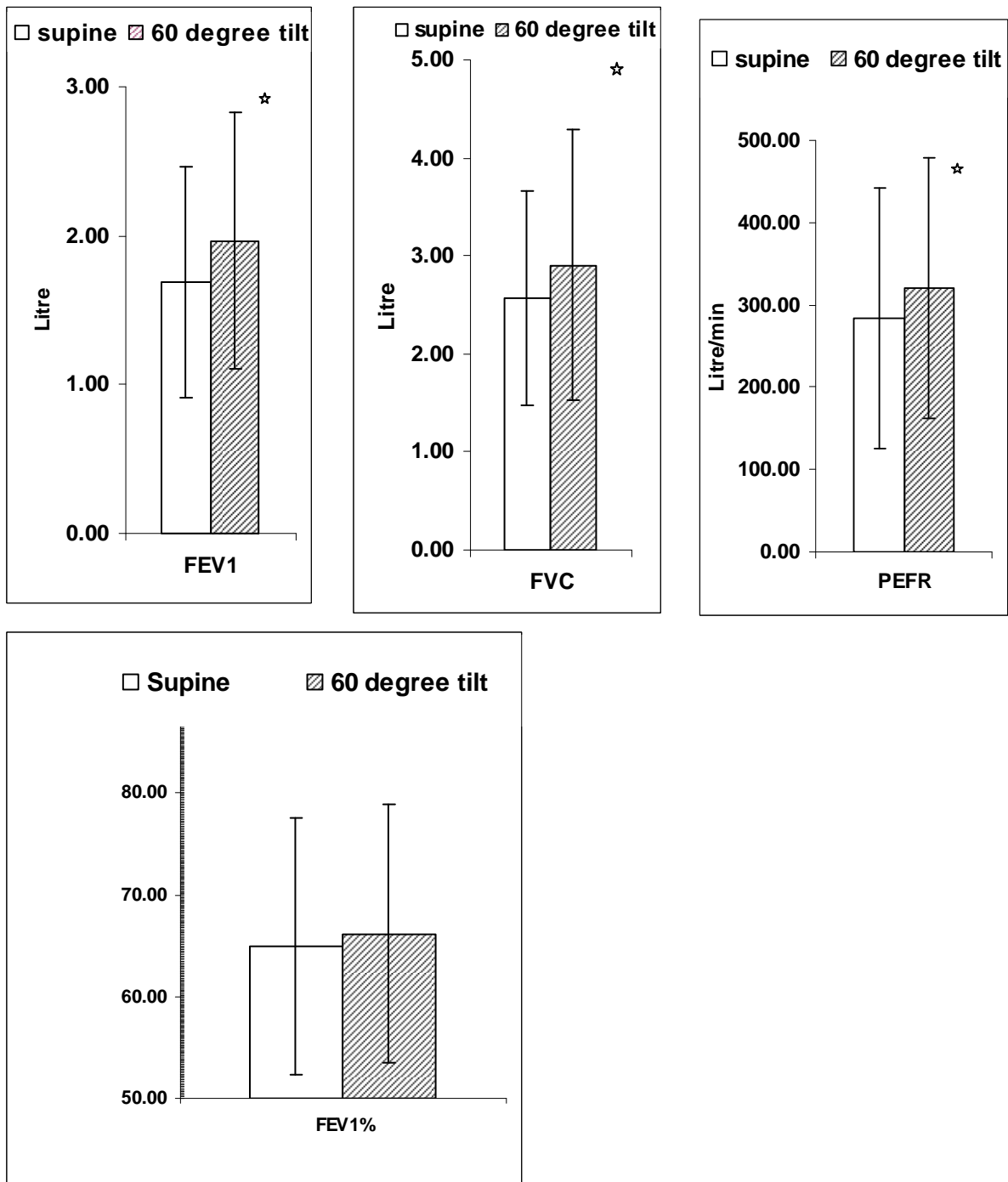


Figure (2): The Effect of Change in Posture from Supine to 60°Upright Tilting on FEV1, FVC, PEFR & FEV1% in all Asthmatic Patients.

☆ = p<0.05

m±S.D., n=40

D- The effect of changing of posture to 60°upright tilting in both age groups, i.e. group1 (20-39year) and group2 (40-60year) indicates that there was significant

increase in FVC, FEV1 and PEFR with no significant change in FEV1%. (Table 5&6, Figure3, 4&5).

Table (5):

Changes in FEV1, FVC, FEV1%and PEFR during Changing of Posture from Supine to 60° Upright Tilting in Age Group1(20-39).

Posture	Number	FEV1 (litre)	FVC (litre)	FEV1%	PEFR(L/min)
Supine	19	2.00±0.94	2.88±1.34	70.11±14.82	324.79±181.63
Tilting60°	19	2.38±1.00	3.15±1.36	72.08±13.44	372.37±183.75
P.Value		<0.05	<0.05	>0.05	<0.05

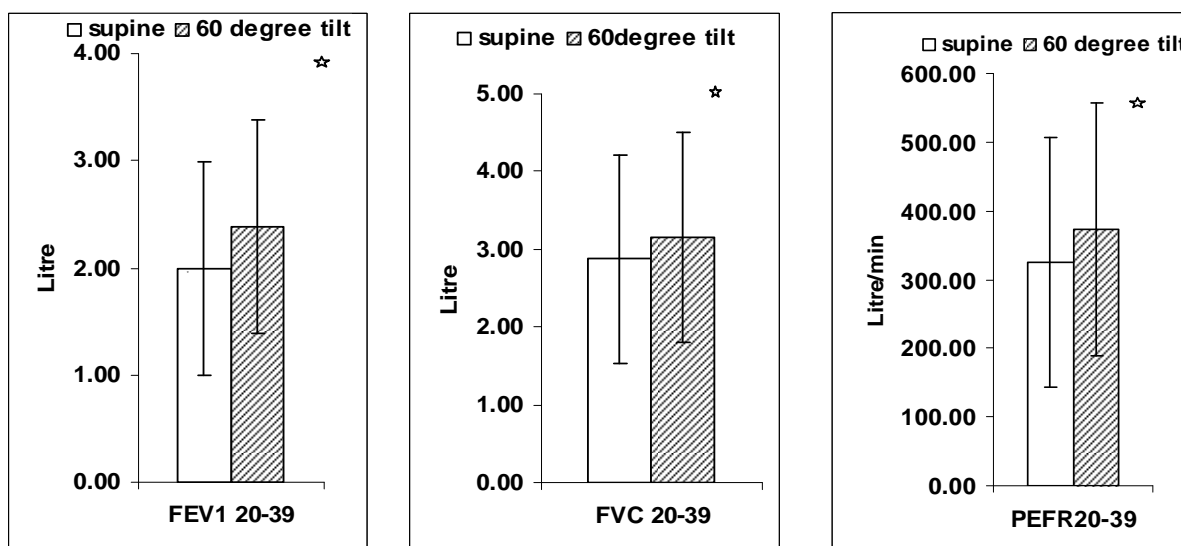
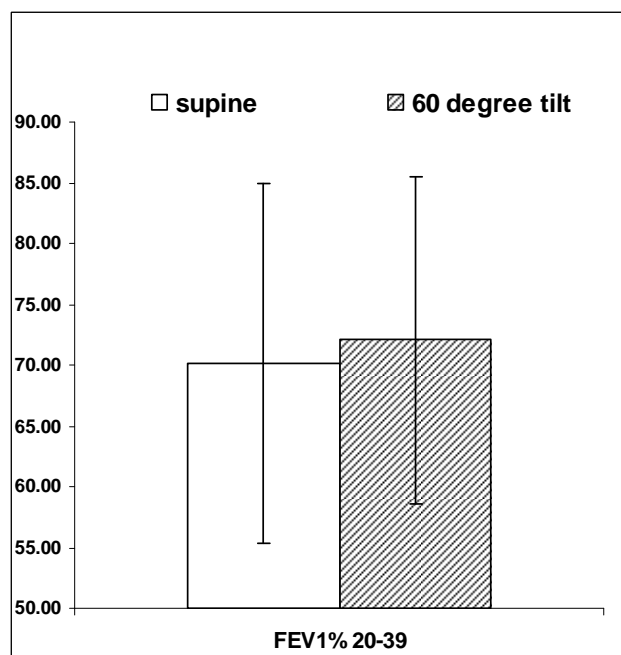


Figure (3): The Effect of Change in Posture from Supine to 60° Upright Tilting in Age Group1 (20-39 year) on FEV1, FVC&PEFR, n=19 (☆ =p<0.05) m±SD



**Figure (4): The Effect of Change in Posture from Supine to 60°Upright Tilting on FEV1%in Age Group1 (20-39year) m±SD, n=19, p>0.05.**

**Table (6):**

**Changes in FEV1, FVC, FEV1%and PEFr during Changing of Posture from Supine to 60° Upright Tilting in Age Group2(40-60).**

Posture	Number	FEV1 (litre)	FVC (litre)	FEV1%	PEFR(L/min)
Supine	21	1.41±0.44	2.34±0.69	60.15±8.15	249.57±103.53
Tilting60°	21	1.59±0.49	2.73±1.35	60.93±9.46	268.19±113.99
P.Value		<0.05	<0.05	>0.05	<0.05



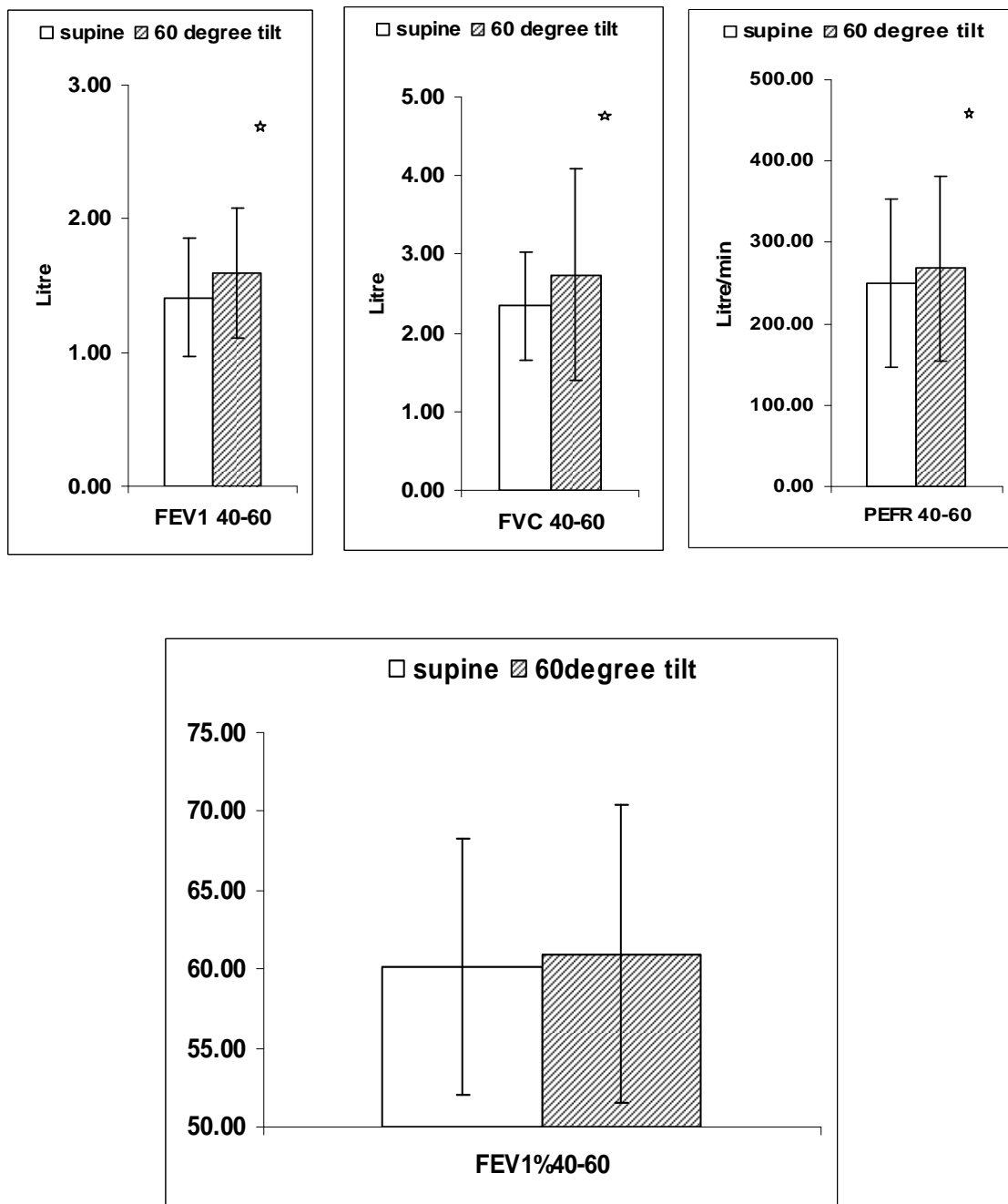
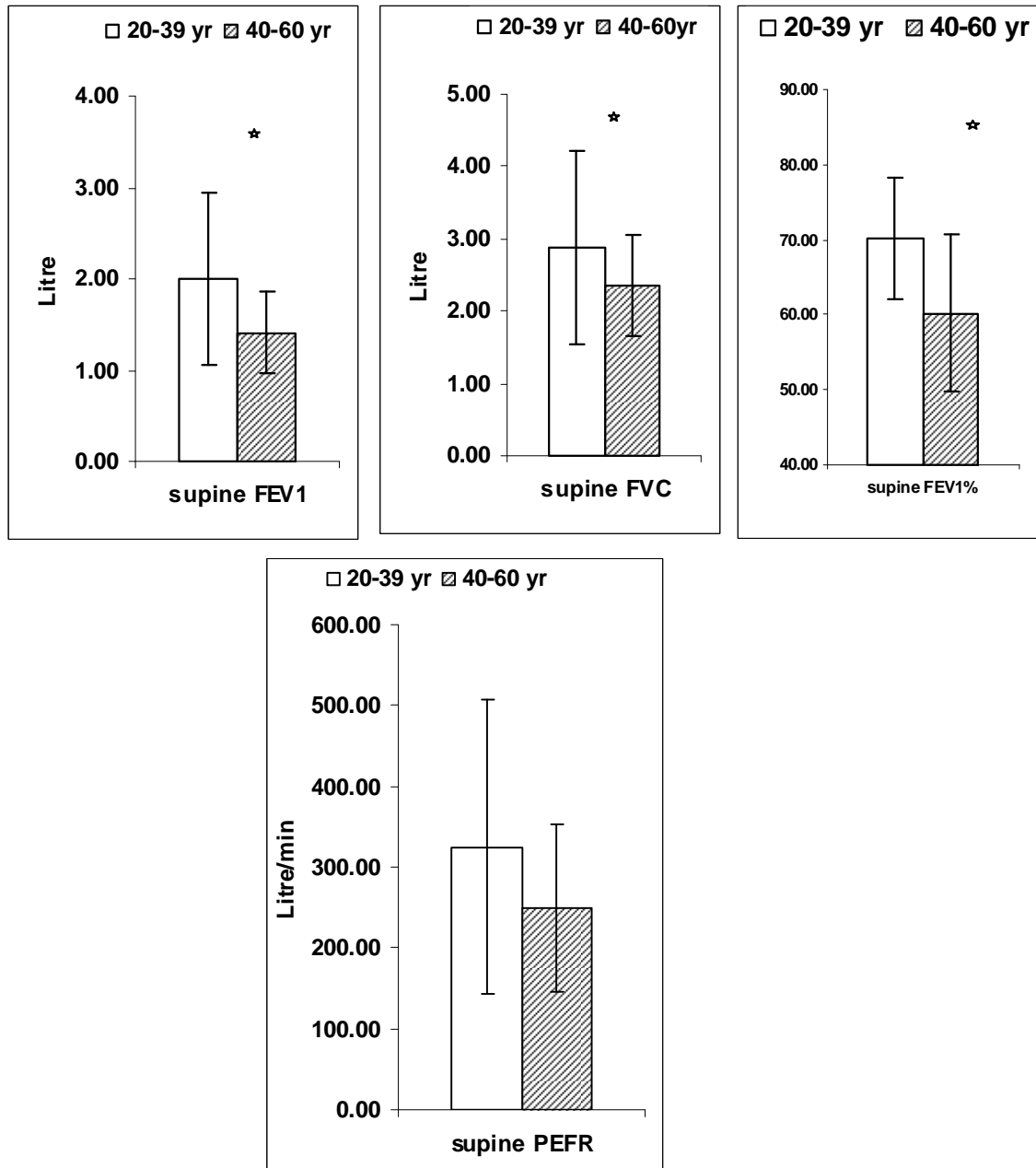


Figure (5): The Effect of Change in Posture from Supine to 60° Upright Tilting in Age Group 2 (40-60 year) on FEV1, FVC, PEFR & FEV1%, n=21 (☆ = p < 0.05) m ± SD.

In the comparison between group 1 & group 2 in supine & 60° upright tilting, FVC, FEV1 & FEV1% were significantly higher in group 1 than group 2 but no significant difference was found in PEFR between group 1 & group 2 in both supine and 60° upright tilting (Table 7, Figure 6 & 7).

Table (7): Differences in Values of FVC,FEV1,FEV1% and PEFR in Supine and 60 Degree Upright Tilting in both Group1(20-39year) and Group2(40-60year).

	FVC			FEV1			FEV1%			PEFR(L/min)		
	G1	G2	Dif. Pvalue	G1	G2	Dif. pvalue	G1	G2	Dif. pvalue	G1	G2	Dif. pvalue
Supine	2.88 ±1.34	2.34 ±0.69	<0.05	2.00 ±0.94	1.41 ±0.44	<0.05	70.11 ±14.82	60.15 ±8.15	<0.05	324.79 ± 181.63	249.57 ± 103.53	>0.05
60°Upright Tilt	3.15 ±1.36	2.73 ±1.35	<0.05	2.38 ±1.00	1.59 ±0.49	<0.05	72.08 ±13.44	60.93 ±9.46	<0.05	372.37 ± 183.75	268.19 ± 113.99	>0.05



**Figure (6): Comparison between the Changes in FEV1, FVC, PEFR & FEV1% in Age Group1 (20-39yr) and Age Group2 (40-60yr) in Supine Position m±SD. ☆ =p<0.05**

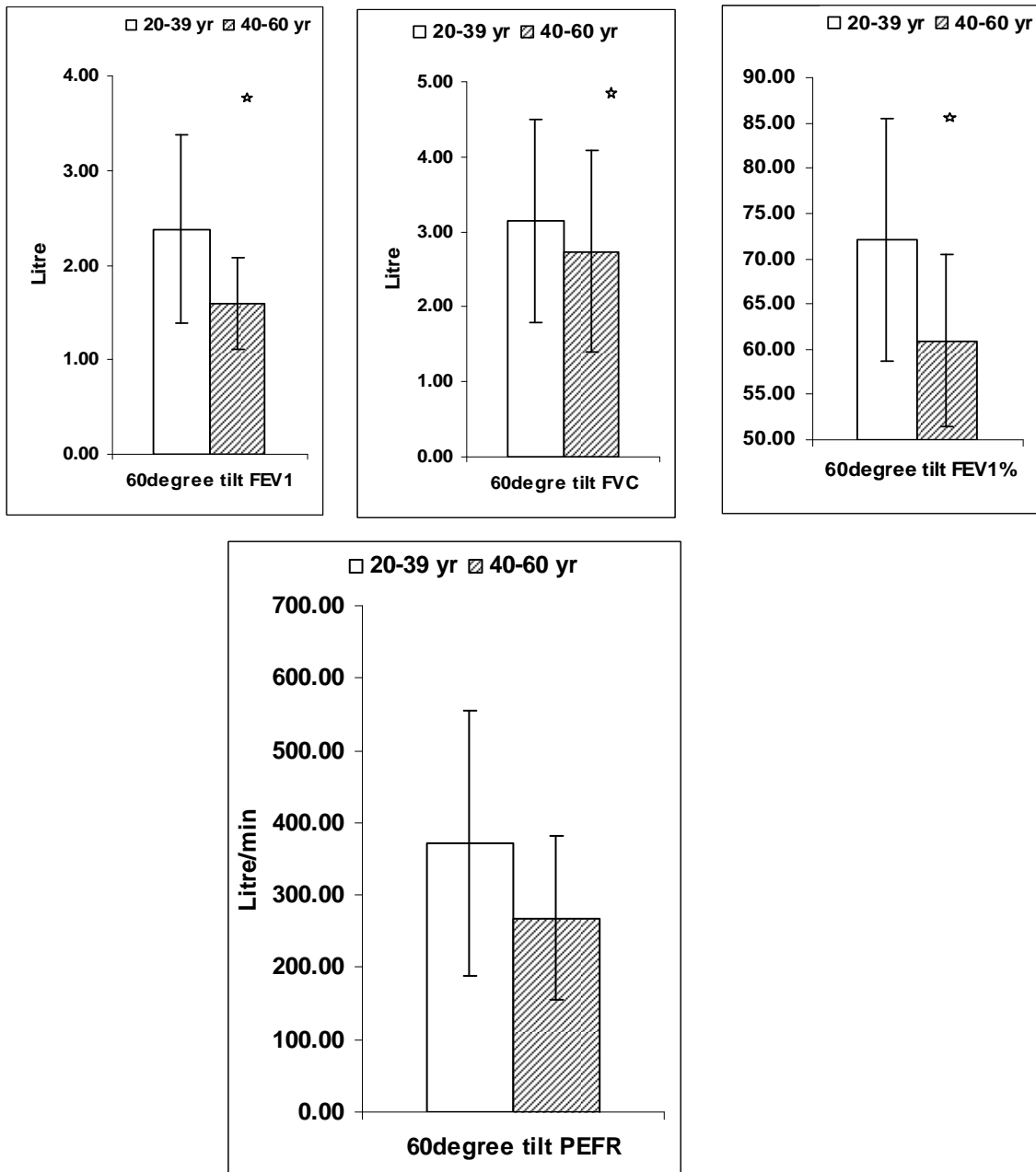


Figure (7): Comparison between the Changes in FEV1, FVC, PEFR & FEV1% in Age Group1 (20-39yr) and Age Group2 (40-60yr) in 60°Upright Tilting Position m±SD. =p<0.05

**Discussion**

A- Comparison between Predicted and Normal (Control) Values of FEV1, FVC, FEV1% and PEFR:

The result of this comparison indicates that the predicted values of FEV1, FVC, FEV1% and PEFR are slightly higher than that of the normal (control) values in this study. This may be due to the difference in race since most of the predicted values depend on European communities where as our normal (control) subjects were Iraqi subjects. Moreover the reason may be due to environmental and genetic differences between the European and the Iraqi people <sup>(17)</sup>.

B-Comparison between Normal Subjects and Asthmatic Patients in Response to 60°Upright Tilting:

The result of this study as shown in Table (1,2,3), Figure (1) indicates that the FEV1, FVC, FEV1% and PEFR are significantly lower in asthmatic patients than that of normal subjects both in supine and upright position. This is more likely due to bronchospasm and narrowing of bronchioles in asthmatic patients which resulted in a decrease in the function of the lungs which in turn may be due to less vagal tone in asthmatic patients <sup>(16)</sup>.

However the difference in the responses to 60°upright tilting between asthmatic and normal subjects indicates that FEV1, FVC and PEFR are significantly higher in asthmatic patients than that of normal subjects with no significant change in FEV1%. This most likely due to uneven distribution of blood in the lungs of asthmatic patients, in addition to uneven ventilation and greater dead space volume in asthmatic patients in assuming the upright position. Therefore the ventilation/perfusion ratio is significantly higher in asthmatic patients (hyperventilation/hypo perfusion) partly due to great dead space value and partly due to great regional difference in perfusion of lung due to pooling of blood to the lower part of the body in upright position. <sup>(18)</sup>

C-Effect of Changing of Posture from Supine Position to 60°Upright Tilting in all Asthmatic Patients on FVC, FEV1, FEV1% & PEFR.

The effect of changing of posture to 60°upright tilting on all the asthmatic patients indicates that the FVC, FEV1 & PEFR were significantly higher than that of supine values. While there was no significant changes in FEV1 %.

The significant increase in values of FVC, FEV1 & PEFR in 60°upright tilting rather than in supine position could be due to pooling of blood in the lower limbs area which will lead to free movement of lung tissue in 60°upright tilting position more than in supine position <sup>(14)</sup>.

The increase in values of FVC, FEV1 & PEFR in 60°upright tilting rather than in supine position may be also due to fall of Parasympathetic (vagal) tone in tilting position <sup>(16)</sup>.

FEV1% is not significantly changed due to mathematical change in FEV1 and FVC because both of them increased in 60°upright tilting. <sup>(14)</sup>

D- The Effect of Changing of Posture to 60°Upright Tilting in Different Age Groups.

This effect shows that there was significant increase in FVC, FEV1 and PEFR in both age groups, i.e. Group1 (20-39year) and Group2 (40-60year), with no significant change in FEV1%. This may also be explained due to pooling of blood in the lower limbs area or to fall of vagal tone in tilting position <sup>(16)(19)</sup>.

In the comparison between group1 & group2 in supine & 60°upright tilting, FVC, FEV1 & FEV1% were significantly higher in group1 than group2. This is because the rate of blood pooling to the lower part of the body in old subjects is great than that of

younger subject due to decrease of distensibility of venous capacitance blood vessel in elderly people <sup>(20)(21)</sup>. This resulted in a great regional difference in pulmonary blood distribution in lung in upright position.

It is more telling that the autonomic nervous system is less active in elderly than younger people so that the sympathetic tone is less active in elderly people remarkably. Moreover the vagal tone will be greatly decreased in old age group in assuming the upright position <sup>(16)</sup>.

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