

## PULMONARY PERFORMANCE IN ASYMPTOMATIC YOUNG NIGERIAN POPULATION FOLLOWING THE ADMINISTRATION OF ASCORBIC ACID AND SALBUTAMOL

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**Summary:** The relationship between vitamin C and pulmonary function has been reported to be a protection against pulmonary dysfunction. Sympathomimetics like salbutamol are respiratory smooth muscle relaxants. This study is aimed at investigating the roles of vitamin C and salbutamol on pulmonary function in a Nigerian population. Undergraduate medical students who gave their informed consent were clinically screened and thirty (30) selected. The subjects were grouped, and given Ascorbic acid and Salbutamol. Spirometry and peak flow measurements were done on each subject. Ascorbic acid was given orally at a dose of 1.50 mg /kg body weight; and salbutamol at a dose of 70 µg/kg body weight, orally. Measurements were taken an hour after each administration of the drugs. Results show mean PEFr in male and female control as 485.76 ± 51.40 L/min, and 329.87 ± 34.90 L/min respectively. Ascorbic acid increases PEFr much more than salbutamol V<sub>T</sub>, ERV, IC, VC and IRV were increased by ascorbic acid while Salbutamol decreased ERV, IC, VC and IRV. The study supports the performance – enhancing role of ascorbic acid, more pronounced in the males than females. There do not seem to be any beneficial roles of salbutamol in asymptomatic individuals.

**Key Words:** Lung function, Ascorbic acid, Salbutamol

### Introduction

Lung volume is a determinant of the vascular resistance in the pulmonary bed. The mechanism of breathing involves interplay of forces supporting and moving the lungs with the chest wall, in addition to overcoming resistance. The elasticity of the lungs is conventionally believed to be dependent on the surfactant (West, 1990, Gala et al, 1998).

Analysis of static pressure – volume data could be useful in the identification of pulmonary function abnormality, and in the probable categorization of the dominant mechanism for restrictive ventilatory defects (Aggarwal et al, 2000). Topulos et al (2001) posited that pressure volume characteristics of the lungs microcirculation are important determinants of pulmonary perfusion. It is however, not yet clear, whether muscle function can be used to predict respiratory changes in exercise limitations (Mayer et al, 2000). Exercise limitation is usually associated with reversible lung restriction and inefficient ventilation at rest and during exercise (Aggarwal et al, 2000).

The β-agonists has relaxant effects on respiratory smooth muscles, acting through the

calcium cyclic adenosine monophosphate (cAMP) mechanism. They also have anti – permeability effects preventing histamine – induced microvascular efflux of protein and fluid (Anderson and Johnson, 1979). The effects of ascorbic acid on pulmonary function have been investigated (Hu et al, 1998, Ibadin and Osubor, 1999). Weber et al (1996) reported that ascorbic acid protects against pulmonary dysfunction. Ascorbic acid is an antioxidant (Grievink et al, 1998). Sympathomimetics (e.g. Salbutamol) are being used in the treatment of obstructive pulmonary diseases following the Henry – Perrson's discovery of the β - adrenoceptor selectivity (Lands et al, 1997).

The support of baseline absolute lung volumes on clinical decision – making is claimed not to be necessarily great (Walamies, 1998). However, the implication of pulmonary function defects on several clinical conditions can only but justify the value of lung volume studies in clinical decision making (Igneo et al 1998; Yap et al, 2000; Cassino et al, 2001; Fuyita et al, 2001). In our environment, ascorbic acid and sympathomimetics are frequently used clinically, and even on self

medications. Therefore, the study is carried out to compare the effects of ascorbic acid and salbutamol on lung function of asymptomatic subjects.

### Materials and Methods

The study was carried out on volunteer undergraduate medical students who gave their informed consent. The subjects were interviewed and physically examined. Those with respiratory and or cardiovascular disorders were excluded. Thirty (30) subjects made up of fifteen (15) males and females each were randomized to control, ascorbic acid, and salbutamol groups.

Each subject had peak flow measurements and spirometry done. The Spirometer was filled with water to level mark, and the recorder adjusted to 4.5L mark. The age, weight and height of the subjects were taken. Each subject was comfortably seated, and connected to the apparatus. Recordings were taken at a drum speed of 2.5 mm/sec.

#### Drug Administration:

The ascorbic acid was given orally at a dose of 1.5 mg/kg body weight, and salbutamol at a dose of 70 µg/kg body weight, also orally. Measurements were taken after one hour of the administration of drugs.

#### Data Analysis:

The data was analyzed using the statistical package for Social Sciences, version 8.0. The student's t-test was employed. The level of significance was taken to be 95% confidence limit ( $P < 0.05$ ).

### Results

#### Subject Characteristics:

The mean age of the male subjects was 22.87 years and for the female, 22.01 years. The mean weights were 63.46 kg and 61.09 kg male and female respectively. The mean heights were 1.71 m for males and 1.68 m for females. These are shown in Table I.

#### Peak flow measurements:

The peak flow rate in the control groups for males and females were  $485.78 \pm 51.45$  L/min and  $329.87 \pm 34.90$  L/min respectively. The PEFr in the male was significantly higher than in the female control group ( $P < 0.05$ ). The PEFr for the ascorbic acid groups were  $571.00$

$\pm 37.16$  L/min and  $333.00 \pm 36.42$  L/min for males and females respectively. The male ascorbic acid group was significantly higher than the control group ( $P < 0.05$ ) and the female group ( $P < 0.05$ ). The PEFr in the salbutamol groups were  $513.26 \pm 31.96$  L/min in the male and  $389.66 \pm 16.05$  L/min in the female groups respectively. PEFr was raised in the salbutamol groups, but not significantly higher than the controls ( $P < 0.05$ ). The male salbutamol group differs significantly from the female group (Table 2).

The results for the spirometry are shown in Table 3. Tidal Volume ( $V_T$ ) in the control groups are  $0.60 \pm 0.11$ L and  $0.55 \pm 0.11$  L in the males and the females respectively. The expiratory reserve volume (ERV) was significantly higher ( $P < 0.05$ ) in the male ascorbic acid group, and lower ( $P < 0.05$ ) in the male salbutamol group. There are no significant changes in the female group. The inspiratory capacity (IC) was not significantly different in the male group on ascorbic acid ( $P < 0.05$ ), but Salbutamol significantly lowers IC in the females ( $P < 0.05$ ). Vital capacity (VC) is significantly ( $P < 0.05$ ) raised in the male by ascorbic acid, and in the female by salbutamol. The inspiratory reserve volume (IRV) did not show any significant difference from the control for any of the test groups.

Table I: Some Anthropometric data of subjects used in the study

	Mean Age (Years)	Mean Height (m)	Mean weight (kg)
Male	22.87	1.71	63.46
Female	22.01	1.68	61.09

Table 2: Mean Peak Expiratory Flow Rate following the administration of Ascorbic acid and Salbutamol (L/min)

	Male	Female
Control	$485.76 \pm 51.45$ L/min	$329.87 \pm 34.90$ L/min
Ascorbic acid	$571.00 \pm 37.16$ L/min	$333.00 \pm 36.42$ L/min
Salbutamol	$513.26 \pm 31.96$ L/min	$389.66 \pm 16.05$ L/min

Table 3: Mean Lung Volumes and capacities following the administration of ascorbic acid and salbutamol (L)

	Control		Ascorbic Acid		Salbutamol	
	Male	Female	Male	Female	Male	Female
$V_T$	0.60 ± 0.11	0.55 ± 0.11	0.76 ± 0.12	0.65 ± 0.12	0.79 ± 0.15	0.63 ± 0.12
ERV	1.2 ± 0.18	0.98 ± 0.13	1.72 ± 0.23	1.02 ± 0.11	0.82 ± 0.17	0.92 ± 0.14
IC	3.66 ± 0.22	2.64 ± 0.15	3.93 ± 0.24	3.39 ± 0.10	2.63 ± 0.16	2.39 ± 0.21
VC	4.66 ± 0.15	4.18 ± 0.18	5.59 ± 0.33	4.91 ± 0.05	3.56 ± 0.02	3.45 ± 0.30
IRV	2.82 ± 0.17	2.58 ± 0.12	2.97 ± 0.12	2.73 ± 0.13	2.13 ± 0.10	2.01 ± 0.25

**Key**

$V_T$	-	Tidal Volume
ERV	-	Expiratory Reserve Volume
IC	-	Inspiratory Capacity
VC	-	Vital Capacity
IRV	-	Inspiratory Reserve Volume

**Discussion**

The standard value for peak expiratory flow rate (PEFR) is between 510 and 560 L/min (Slonim and Hamilton, 1987). In our study, the PEFR value of 485 L/min is lower than this range. Ascorbic acid (Vitamin C) improved the PEFR to 571 L/min. This study does not corroborate the study of Ibadin and Osubor (1999) which reported a lack of effect of vitamin C on pulmonary function. Vitamin C protected against loss of pulmonary function (Hu et al, 1998) Grievmik et al, (1998) also supported the beneficial role of vitamin C in respiratory dysfunction.

In the present study, the male PEFR values are expectedly higher than female values (485 L/min and 329 L/min respectively). The vitamin C effect shows a significant ( $P < 0.05$ ) increase in PEFR, indicating a minimal response of smooth muscle to sympathomimetics. Lands et al (1967) posited that the  $\beta$ -adrenoceptor agonists actually become important in obstructive pulmonary disorders. The report of Perrson (1979) that the effect of  $\beta$ -agonist is more pronounced in healthy lungs compared to diseased lungs, is not corroborated by the present study.

The tidal volume in the control group (0.6L and 0.55 L for males and females respectively) corroborated the standard values of 0.5L to 0.6L. Ascorbic acid and salbutamol did not significantly increase the  $V_T$  in both sexes ( $P > 0.05$ ). Expiratory reserve volume (ERV) in our study population was lower for all groups than the standard values of 1.0L to

1.2L. Vitamin C increased ERV in males but not in females, while Salbutamol decreased ERV in males ( $P < 0.05$ ) but not in females ( $P > 0.05$ ). ERV reflects the thoracic and abdominal muscles strength, thoracic mobility and a balance of elastic forces affecting spontaneous expiration (Gelb and Zamel, 2001). Our subjects have less reserve expiratory capabilities. This might be due to the fact that most medical students are not engaged in active regular bodily exercises.

The inspiratory reserve volume IRV in our study is significantly lower than the standard values. Ascorbic acid increases IRV in both sexes while salbutamol decreases it. IRV describes a balance between lung and chest elasticity, muscle strength and thorax mobility.

Vital capacity (VC) describes the physical unit of the rising tidal volume during maximal ventilatory effort. Our study shows a reduced VC in controls and in the salbutamol group. Ascorbic acid significantly ( $P < 0.05$ ) increases VC. VC is usually reduced in severe respiratory muscle weakness (Syabbalo, 1998).

Discrepancies in IRV and ERV may be explained by a lack of parenchymal airway narrowing (Stanescu et al, 2000). The IC is more frequently used than IRV. At low volumes, it is expected that the vasculature would strain and stiffen (Topulos et al, 2000; Schulz et al, 1999). Our study shows IC rising with ascorbic acid and falling with salbutamol. The exact mechanism of action is yet to be elucidated. It however corroborates the hypothesis that ascorbic acid protects against

the loss of pulmonary function. Hu et al, (1998) have indeed reported an inverse relationship between vitamin C and cough. The relatively lower value in females in the present study corroborated the report that progesterone reduces fatigue and lowers exercise tolerance (Van-Haren et al, 1998).

The Salbutamol response in this study supports earlier works (Pillet et al, 1998) which reported that  $\beta$  - agonist bronchodilators induce hypoxic vasoconstriction with no significant influence on ventilation parameters.

*Ascorbic acid indeed has beneficial effect on pulmonary function.*

Our study has the limitation of sample size, being a preliminary study. It is intended that in subsequent work, the sample size would be increased, and we would attempt to define the mechanism of ascorbic action effect on ventilatory efforts.

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