

DIURNAL VARIATIONS IN LUNG TRANSFER FACTOR AND ITS COMPONENTS

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Abstract : Serial measurements of transfer factor of lung and its constituent components along with FVC and $EFR_{25-75\%}$ were undertaken in 20 healthy nonsmoker adult males thrice on the same day. All the lung transfer components decreased as the day advanced, though reduction was statistically significant for $Tlco$ and V_A only. These changes were present in association with reduction in FVC and $EFR_{25-75\%}$ indicating that patency of airways influences diffusion function of lung. Variations during the day are less than 7.4% and are hence unlikely to influence their diagnostic value, but serial estimation of these functions should preferably be carried out at the same time specially in the morning when these values are maximum.

Key words : diurnal variations

lung transfer factor and its components

INTRODUCTION

Assessment of pulmonary functions is useful in evaluation of patients with pulmonary disorders. Functions of lung exhibit seasonal and diurnal variations (1-3). Reproducibility, observer error and intraindividual variability have been extensively studied for spirometric measurements (4-7). A few reports for lung transfer factor (TI) variations during the day time are available (2, 8), but its constituent components which reflect adequacy of diffusion process have not been studied for the diurnal variations.

The purpose of the present study was to determine the extent of variations in lung transfer factor for CO ($Tlco$) and its constituent components like effective alveolar volume (V_A), diffusion capacity across pulmonary membrane (Dm) and alveolar capillary blood volume (Vc). The aim was also to find out the extent to which these parameters vary per unit effective alveolar volume (V_A) between 8 AM to 5 PM which are usual laboratory working timings.

METHODS

Twenty healthy nonsmoker male subjects 20-40 years of age participated in the study. They belonged to medical and paramedical staff and were familiar with $Tlco$ measurements. They had no history of respiratory or cardiac disease. Morgan transfer test Model 'C' and computer Magna 88 (P.K. Morgan Ltd. Kent, U.K.) were used to study and analyse different parameters: viz forced vital capacity (FVC), expiratory flow rate at 25-75% of FVC ($EFR_{25-75\%}$) and transfer factor for CO ($Tlco$) by single breath technique (9). $Tlco$ measurements were standardised to a haemoglobin concentration of 14.86%. Dm and Vc were derived graphically (9) with the help of computer. In order to exclude the effect of variable PAO_2 , measured $Tlco$ was corrected to $Tlco$ at 120 mmHg (10). The cooperation and willingness to perform maximally in successive efforts was ensured. Average of two tests was reported. These tests agreed within 10% or 2 ml/min/mmHg of each other for $Tlco$. Intraindividual serial measurements for $Tlco$ and its components were undertaken 3 times a day i.e. 8-9

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AM, 12-1 PM and 4-5 PM on the same day. The study was undertaken in the month of September and October in an airconditioned laboratory at a temperature of $24 \pm 2^\circ\text{C}$ and subjects were allowed to carry on their routine activities during the period of their investigations.

RESULTS

The age of twenty subjects studied was 30.05 ± 6.48 years and their surface area was $1.65 \pm 0.11 \text{ m}^2$. All the pulmonary parameters are reported at BTPS. In order to avoid inter observer variability, all the tests were conducted and analysed by the same observer. The values of pulmonary functions recorded at three different timings of the day are given in Table I.

TABLE I: Comparative study of Pulmonary Functions at different timings of the day.

Parameter	Time of the day		
	Morning 8-9 AM	Afternoon 12-1 PM	Evening 4-5 PM
FVC (L)	3.99 ± 0.67	$3.91 \pm .63$	$3.89 \pm .58$
EFR _{25-75%} (L/sec)	4.34 ± 1.30	3.88 ± 1.08	3.76 ± 0.98
V _A (L)	5.19 ± 0.52	5.09 ± 0.58	$4.91 \pm 0.51^*$
Tlco (ml/min/mmHg)	31.07 ± 3.26	30.18 ± 4.29	$29.67 \pm 4.07^*$
Dm (ml/min/mmHg)	55.96 ± 10.04	54.82 ± 10.97	53.61 ± 10.05
V _c (ml)	71.66 ± 15.39	68.04 ± 12.02	66.34 ± 10.61
Tlco/V _A (ml/min/mmHg/L)	5.94 ± 0.65	5.95 ± 0.84	5.99 ± 0.72
Dm/V _A (ml/min/mmHg/L)	10.79 ± 1.81	10.73 ± 1.01	10.88 ± 1.72
V _c /V _A (ml/L)	13.77 ± 3.29	13.47 ± 2.61	13.53 ± 2.04
V _c /Dm (ml/L)	1.33 ± 0.47	1.28 ± 0.31	1.27 ± 0.30

Values are Mean \pm SD, Tlco represents Tlco₁₂₀

Statistical difference of afternoon and evening parameters from morning parameters is calculated by using paired 't' test.

* = P < 0.05

DISCUSSION

Tlco is considered as one of the most valuable tests to assess pulmonary functions in health and disease. Posture, habitual physical activity, age, meals, haemoglobin levels, body dimensions, anxiety, altitude, PAO₂ and tobacco smoking influence Tlco by affecting its one or the other subdivision (9).

In order to minimise the effect of these parameters we selected the subjects carefully. All of them, well familiar with the Tlco measurement, were made to rest for 10 min in the laboratory before each test. The test was performed in sitting position at least one hour after light breakfast or lunch. Duration of breath holding, inspired volume and wash out volume were controlled electronically in the equipment so that observed diurnal variations in measured Tlco were not influenced by these procedural artifacts.

In this study variable observations were recorded for pulmonary functions in different individuals at different timings of the day. Overall observation was, decrease in each parameter as the day advanced, though significant reduction was present only in V_A (P < 0.05) and Tlco (P < 0.05) in the evening. Cinkotai and coworkers (8) have reported diurnal variation at a rate of 1.2% per hour while Lawther et al (11) reported as much as 20% difference in Tl measured at different timings of the day. In this series the fall was only 4.5% for Tlco, 4.2% for Dm and 7.4% for V_c from morning to evening. The decrease in transfer factor (Tlco) and its components was accompanied by decrease in FVC and EFR_{25-75%} as well. It may be decrease in airways conductance, as postulated by Panda and Mchardy (2) which is responsible for changes in pulmonary ventilation and perfusion causing a fall in Tlco, Dm, and V_c as the day advances. In the present study per unit V_A Change in Tlco, Dm and V_c has definitely shown a decreasing trend as there was 4.2% fall from morning to evening as the fall in V_c (7.4%) was more than that in Dm (4.2%).

This study shows the magnitude of change in airways and pulmonary diffusion functions between different timings of the day in normal healthy subjects. It can be concluded that biological diurnal variations are present in pulmonary functions even when the subject is well trained and performs the test co-operatively and standard measurement procedures are strictly adopted. Therefore though for diagnostic purposes pulmonary functions of a subject can be studied in the laboratory at any time of the day according to the convenience of the patient

and the observer, as variations from morning to evening are only 4.2% to 7.4% but serial estimation of these functions, either to study the effect of

drug or disease, should preferably be performed at the same time i.e. in the morning when these values are at their peak.

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