

## Gas transfer and pulmonary function tests in women with disseminated lupus erythematosus

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### Abstract

**BACKGROUND:** Systemic lupus involves different body organs including lungs. However, there is limited information on the systemic lupus without respiratory symptoms. The aim of this study was to investigate the diffusing capacity of the lung for carbon monoxide in women with disseminated lupus erythematosus and to compare it with a control group.

**METHODS:** This prospective study was conducted during 2005 in the Rheumatology Clinic of Alzahra Hospital, Isfahan, Iran. The diffusing capacity of the lung for carbon monoxide and pulmonary parameters were measured using the unrelated samples in 76 female patients with systemic lupus.

**RESULTS:** Mean diffusing capacity of the lung for carbon monoxide in patients with lupus was lower than the control group ( $P \leq 0.001$ ). The amount of corrected volumetric capacity of carbon monoxide in lungs of patients was significantly different from the control group ( $P \leq 0.001$ ). Residual volume and total capacity of lungs in the female patients with lupus were higher than the control group ( $P \leq 0.001$ ).

**CONCLUSION:** Decreased diffusing capacity for carbon monoxide in lungs of females with systemic lupus without respiratory symptoms is prevalent. It indicates alveolar capillary membrane involvement in these patients. Increased residual volume and total capacity of lungs in these patients can be caused by bronchiolitis.

**Keywords:** Lupus Erythematosus, Transfer Capacity, Carbon Monoxide in Lungs, Total Capacity of Lungs.

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### Introduction

Systemic lupus erythematosus is an autoimmune disease which involves many body organs.<sup>1</sup> Respiratory abnormality is a prevalent finding in patients with systemic lupus.<sup>1</sup> The most common pulmonary presentations in patients include pleuritis, acute pneumonitis, chronic pulmonary interstitial disease, diaphragm weakness, and alveolar hemorrhage.<sup>2,3</sup> Mild cases of pulmonary involvement without clinical presentation which can remain hidden from the patient and the physician are not rare.<sup>4</sup> Using more sensitive tests of lung function is a valuable assessment method for investigating lung involvement without clinical symptoms.<sup>4</sup> The results of lung function tests in patients with systemic lupus demonstrate various disorders.<sup>4-6</sup> However, the previously conducted studies have generally focused on symptomatic patients and almost always examined simple spirometry with

forced vital capacity. Only some more recent studies have measured the capability of gas transfer in lungs with an emphasis on carbon monoxide (lung transfer factor) and its decrease in patients suffering from lupus with pulmonary symptoms.<sup>7</sup> However, there are no strong reports on the total capacity of lungs and residual air. In addition, there are contradictory pieces of evidence on the relationship between tests of lung function and serological and chronic findings in the lupus disease.<sup>8-10</sup> Lung investigations in patients suffering from lupus are always limited to a small number of patients which has undoubtedly affected the obtained results. Therefore, more studies on a large number of patients can be more revealing in terms of evaluating disorders through lung function tests, especially diffusing capacity of carbon monoxide in lungs. The aim of the present study was to measure the capacity of gas transfer in the lungs of female patients

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suffering from disseminated lupus erythematosus.

### Materials and Methods

All patients with disseminated lupus who referred to Alzahra Rheumatology Clinic (Isfahan, Iran) in 2005 and had the diagnostic criteria of American College of Rheumatology<sup>11</sup> entered this study. These patients had at least one of the symptoms of acute lupus including lupus nephritis, skin symptoms, muscle involvement, fever, or blood disorders. Patients with acute pulmonary events or respiratory distress were excluded from the study. Moreover, patients who had the history of asthma or chronic bronchitis or had the respiratory symptoms which indicated suffering from pulmonary disorders were omitted. The qualified patients were introduced to the lung clinic in order for their pulmonary transfer capacity, total volume of lung, and volume of residual air to be measured. In the initial investigation, physical examination of the chest and chest radiography were performed on all patients. To make a comparison, the same number of healthy people with similar age and, if possible, similar height, were selected in order to determine the typical amounts of the measured factors among the residents of Isfahan.<sup>12</sup> To do pulmonary experiments, the diffusing capacity of the lungs for carbon monoxide and corrected diffusion capacity based on alveolar volume were measured using a ZAN 500 system (Germany). Total capacity of lungs and the volume of residual air were measured using the methane gas dilution technique. Diffusing capacity of the lungs for carbon monoxide was measured by the single-breath method based on the criteria of the American Thoracic Society.<sup>13,14</sup> In order to analyze the data, the results were stated as mean  $\pm$  standard deviation (SD) and the unrelated sample t-test was used for comparisons. P values less than 0.05 were considered significant.

### Results

Since the number of qualified male patients was very

low (4 people), no results could be obtained by adding them to the study and their consideration may distort the results. Therefore, only female patients were considered in all analyses. As a result, 76 female patients with systemic lupus and the mean age of  $31.34 \pm 11.48$  years (range: 16-69 years) were selected. None of them had the history of asthma, bronchitis, or bronchiectasis. Mean disease duration was 3.5 years (range: 3 months to 19 years).

Table 1 shows the physical characteristics and physiologic information of the patients and the control group. Diffusing capacity of the lungs for carbon monoxide and corrected carbon monoxide transfer capacity based on alveolar volume were lower among the patients compared to the control group ( $P \leq 0.001$ ). In addition, the volume of residual air and total capacity of lungs were significantly higher in patients than in the control group ( $P \leq 0.001$ )

### Discussion

Several previously published investigations have studied the properties of lung function tests including forced vital capacity maneuver in patients with symptomatic systemic lupus.<sup>4-6</sup> In addition, the disorders of diffusing capacity for carbon monoxide in new lungs have been mentioned in some cases.<sup>4,7</sup> However, there is no information on the gas transfer capacity, total capacity of lungs, and residual pulmonary air among lupus patients with no pulmonary symptoms. The present study attempted to measure the diffusing capacity of lungs in female Iranian patients. The prevalence of decreased diffusing capacity in this study confirmed the findings of the previous studies. Moreover, it proved pulmonary involvement even in patients without respiratory symptoms, which is the new finding of this study since previous investigations have demonstrated decreased gas transfer capacity only in patients with symptomatic pulmonary lupus.<sup>4</sup>

**Table 1.** Physical characteristics and lung volumes and diffusing capacity of lungs for carbon monoxide gas among the studied subjects

	Patients (n = 76)	Control group (n = 78)	P
Age	31.34 $\pm$ 11.48	31.94 $\pm$ 12.05	0.750
Height (cm)	161.33 $\pm$ 6.28	160.41 $\pm$ 4.91	0.310
Female	76	78	--
DLCO	9.31 $\pm$ 2.95	9.82 $\pm$ 1.17	0.001
DLCO/VA	1.93 $\pm$ 0.33	2.09 $\pm$ 0.14	< 0.001
FRC	3.47 $\pm$ 1.06	2.93 $\pm$ 0.44	< 0.001
RV	2.42 $\pm$ 0.68	1.64 $\pm$ 0.40	< 0.001
TLC	4.99 $\pm$ 1.11	4.96 $\pm$ 0.46	< 0.001

DLCO: Diffusing capacity of the lung for carbon monoxide

DLCO/VA: Diffusing capacity of the lung for carbon monoxide corrected for alveolar volume

FRC: Functional residual capacity; RV: Residual volume; TLC: Total lung capacity

In a similar more recent study, the same investigation was conducted. The activity of lupus disease was found to be inversely proportional to the amount of diffusing capacity of the lungs for carbon monoxide among patients suffering from lupus disease with pulmonary involvement.<sup>9</sup> Furthermore, no difference could have been detected in older studies in terms of clinical and laboratory findings between lupus patients with and without pulmonary function test abnormalities including easy maneuvering of respiratory vital capacity.<sup>9</sup> The differences in the results of these studies are due to the differences in the number and method of studies.

The present study proved the pulmonary vascular bed involvement in patients with disseminated lupus before the revelation of pulmonary clinical symptoms, which was a new finding. Other findings of this study included relative increases in the total capacity of lungs and the volume of residual air in lungs. Traditionally, increased values of these two parameters represented air trapping in the lungs and were assumed to be resulted from an obstructive phenomenon in small respiratory airways.<sup>15</sup> Therefore, it should be stated that lupus erythematosus also involves an obstructive disease with the priority of small airways (bronchiolitis). This finding has not been reported in previous studies and can expand the domain of pulmonary involvement of lupus to small airways if confirmed by other studies. The importance of this finding will be more evident considering that patients may develop chronic obstructive pulmonary disease if lupus has enough longevity.

### Conclusion

Involvement of pulmonary vascular bed and small airways in patients with lupus is a widespread finding which should be investigated in lupus patients even without respiratory symptoms. It should be treated immediately after being proved.

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### Conflict of Interests

Authors have no conflict of interests.

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