

Association of Pulmonary Functions and HbA_{1c} in Diabetics

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ABSTRACT

Aim: To find the association of pulmonary functions and HbA_{1c} in diabetes.

Study design: Prospective study

Place of study: Department of Physiology, Basic Medical Sciences Institute (BMSI), in collaboration with the Department of Chest Medicine and Department of Medicine, JPMC.

Duration of study: The study was conducted from September 2005-june 2006

Patients and methods: A total of 60 known subjects of diabetes of either sex age range between 40-60 years were selected for this study.

Results: The two main findings of the study were: (1) the pulmonary function test results in diabetics were significantly altered; (2) the pulmonary dysfunction was more pronounced in patients with long standing diabetes mellitus

Keywords: Pulmonary functions, Diabetic patients, Hemoglobin A_{1c}

INTRODUCTION

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin. Lack of insulin affects the metabolism of carbohydrate, protein and fat and causes a significant disturbance of water and electrolyte homeostasis¹.

Hemoglobin A_{1c} is a minor Hemoglobin component, which is known to be elevated in the diabetic state. The normal values range from 5-7%, but they are increased 2-3 fold in uncontrolled diabetes.² Glucose is attached to N terminal amino group of the β -chain by a ketoamine Linkage. HbA_{1c} is formed slowly and continuously throughout the 120 days life span of the red cell. Measurement of HbA_{1c} produces an index of average blood glucose level over the preceding 2-3 months i.e., 60-90 days. Thus HbA_{1c} has proved to be useful in assessing diabetes mellitus and perhaps in screening people for diabetes³. Measurement of glycosylated hemoglobin is the standard method for assessing long term glycemic control. When plasma glucose is consistently elevated, there is an increase in the nonenzymatic glycation of hemoglobin. This alteration reflects the history of the previous 2-3 months, since erythrocytes have an average life span of 120 days⁴.

Patients with type 1 and type 2 diabetes mellitus have been found to have pulmonary function abnormalities in addition to other better known complications of diabetes such as retinopathy, sores and ulcers on the feet⁵.

MATERIAL AND METHODS

This study was carried out in the Department of Physiology, Basic Medical Sciences Institute (BMSI), Jinnah Postgraduate Medical Centre (JPMC), Karachi, in collaboration with the Department of Chest Medicine and Department of Medicine, JPMC. A total of 60 known subjects of diabetes of either sex age range between 40-60 years were selected for this study. Subjects were subdivided into male and female subgroups and further divided into two groups according to their Hb A1c content. Subjects with known cardiac and respiratory diseases, Family history of asthma, Subjects with gross abnormality of vertebral column and thoracic cage, who have undergone abdominal or chest surgery, having history of respiratory infection within last one month, gross anemia and smokers were excluded from study. Expiratory spirometry was performed on auto spirometer (compact vitalograph). Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV₁), Forced Expiratory Ratio (FEV₁/FVC) and Peak Expiratory Flow (PEF) were carried out at the fixed time of the day (9am -1pm) to avoid the diurnal variation.

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RESULTS

Table 1 show comparative analysis of the pulmonary function tests: Forced vital capacity (FVC), Forced expiratory volume in one second (FEV₁), FEV₁: FVC and Peak expiratory flow (PEF) between the diabetics with normal HbA_{1c} (<6) and raised HbA_{1c} (>6). Mean±S.E.M. for FVC were 3.41±0.15 in males with normal HbA_{1c}, 2.14±0.11 in females with normal HbA_{1c}, 2.32±0.15 in males with raised HbA_{1c} and 1.71±0.08 in females with raised HbA_{1c}. The differences were highly significant in males with raised HbA_{1c} as compared to the males with normal HbA_{1c}. In females the values were significantly greater (P<0.05) in those with raised HbA_{1c} as compared to those with normal HbA_{1c}. Mean±S.E.M. for FEV₁ were 3.01±0.10 in males with normal HbA_{1c},

1.93±0.07 in females with normal HbA_{1c}, 2.04±0.17 in males with raised HbA_{1c} and 1.50±0.07 in females with raised HbA_{1c}. The differences were highly significant (P<0.001) in diabetics (males and females) with raised HbA_{1c} as compared to the diabetics (male and female) with normal HbA_{1c}. Mean±S.E.M. for PEF were 7.9±0.15 in males with normal HbA_{1c}, 4.9±0.12 in females with normal HbA_{1c}, 6.7±0.21 in males with raised HbA_{1c} and 4.5±0.09 in females with raised HbA_{1c}. In males and females the values were significantly greater (P<0.05) in those with normal HbA_{1c} as compared to those with raised HbA_{1c}. However no differences were observed in FEV₁: FVC between diabetics (male and female) with raised HbA_{1c} and the diabetics (male and female) with normal HbA_{1c}.

Table 1: Comparison of pulmonary function tests: forced vital capacity (fvc), forced expiratory volume in one second (fev₁), fev₁/fvc and peak expiratory flow (pef) in diabetics with normal hba_{1c} (≤6) and diabetics with raised hba_{1c} (≥6)

Pulmonary Function		HbA _{1c} ≤ 6		HbA _{1c} ≥ 6	
		No.	Mean ± SEM	No.	Mean ± SEM
FVC (litres)	Male	15	3.41 ± 0.15	15	2.32 ± 0.15**
	Female	14	2.14 ± 0.11	16	1.71 ± 0.08*
FEV ₁ (litres)	Male	15	3.01 ± 0.10	15	2.04 ± 0.17**
	Female	14	1.93 ± 0.07	16	1.50 ± 0.07**
FEV ₁ /FVC (%)	Male	15	88.7 ± 2.37	15	86.8 ± 2.27
	Female	14	90.6 ± 1.89	16	88.7 ± 1.76
PEF (litres/sec)	Male	15	7.9 ± 0.15	15	6.7 ± 0.21*
	Female	14	4.9 ± 0.12	16	4.5 ± 0.09*

*P < 0.05 when compared with the normal HbA_{1c}

** P < 0.001 when compared with the normal HbA_{1c}

DISCUSSION

The two main findings of the study were: (1) the pulmonary function test results in diabetics were significantly altered; (2) the pulmonary dysfunction was more pronounced in patients with long standing diabetes mellitus. The present study shows significantly reduced lung function parameters (FVC, FEV₁ and PEF) in diabetics. The ratio of FEV₁ to FVC was greater in diabetic patients. Hence a general reduction of lung volume and a possible restrictive defect was found, whereas no evidence of airway obstruction was found. The decline in the pulmonary function was also found to be associated with the increased duration of the disease. The pulmonary functions were more impaired in patients with long standing diabetes (>10 years). Primhak et al⁶ report decreased lung function in diabetes. Our results correlate with these results. However Primhak et al⁶ did not find associations of diminished functions with either duration of diabetes or glycosylated hemoglobin.

Several other studies show reduced pulmonary functions which are in accordance to our results; like Schnapf et al⁷ conducted a study in type 1 diabetic

patients with limited joint mobility and showed significantly decreased FVC and FEV₁. Who concluded that this decline in lung function could be due to decreased lung compliance or restriction of chest wall expansion.

Schuyler⁸ and associates postulated that premature aging of collagen and elastin might possibly be responsible for the decreased lung elasticity and hence reduced lung volumes in diabetic patient. Schnack et al⁹, Ofulue et al¹⁰ and Hsia¹¹ have also suggested a reduction of lung volumes in diabetic patients. Our study is also in agreement with the views of Goldman¹² who suggests that lung is a target organ of diabetes; and Philips and Baker¹³ who suggest that hyperglycemia affects the lungs by damaging capillaries and by the non enzymatic glycosylation of collagen.

Davis et al¹⁴ carried out a study and determined the association between diabetes mellitus and reduced lung function. They reported reduced FVC, FEV₁, VC, and PEF when expressed as a percentage of those predicted for age, sex and height. They also established a significant association of the duration of the disease with FEV₁ and PEF. This study also

related the reduced pulmonary functions to the glycemic exposure, in the form of higher updated mean HbA_{1c}. Our study is in agreement with the findings of Davis et al¹⁵.

The present study was undertaken in an attempt to clarify the relationship of the pulmonary functions and diabetes. We conclude that a decrease in FVC, FEV₁ and PEF impairs lung functions in diabetic patients. We also show that longer the duration of the disease, greater is the impairment of the lung functions. Furthermore we also conclude that the glycemic exposure is a determinant of reduced lung function.

Our data thus supports the suggestions that the lung is a target organ in diabetes. The findings are of importance in that they demonstrate the need for prevention of lung impairment. We advise therefore that diabetic patients undergo periodic spirometry test to assess the severity of lung function impairment. Spirometry will identify more susceptible diabetic patients so they can take additional preventive measures.

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