Assessment of lung function parameters in Nigerian males with diabetes

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Abstract

Despite scarce information on the implications of diabetes for pulmonary function, existing evidence suggests that the respiratory system might also be affected by diabetes. We therefore conducted a cross-sectional study of pulmonary function in male Nigerian diabetes patients using spirometric indices.

Seventy-six male diabetes patients aged 27–80 years were studied at the Endocrinology and Diabetes Clinic at the Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria.

Overall, all lung function parameters/ volumes studied were significantly lower in the diabetes patients compared with predicted values p=0.000. Patients' ages correlated negatively with all spirometric indices but there was no significant relationship between lung function and fasting blood sugar, body mass index, or diabetic microvascular complications.

The implications of abnormal lung function parameters for respiratory disease in diabetes are unclear. Routine tests of pulmonary function are not presently indicated in Nigerian diabetes patients.

Introduction

Pulmonary function and complications in diabetes mellitus have not been fully characterised. It is debatable whether the lung is a target organ in diabetes. However, abnormal pulmonary function has been detected in some diabetes patients; the most consistent abnormalities being reduced lung volumes,[1] reduced pulmonary elastic recoil, and impaired diffusion due to reduced pulmonary capillary blood volume.[2] Non-enzymatic glycosylation-induced alteration of lung connective tissue is the most likely pathogenetic mechanism underlying pulmonary dysfunction.[3]

Ventilatory control is impaired in some diabetes subjects. It has been demonstrated that ventilatory responses to hypoxaemia are lower in diabetes subjects than in healthy controls, particularly those with autonomic neuropathy.[4] Pulmonary infections, including chronic bronchitis (in non-smokers), bronchiectasis, and lung abscess have been attributed to impaired phagocytic function induced by hyperglycaemia.[5]

We have therefore conducted this study to assess some pulmonary function parameters in male patients attending the Diabetes Clinic of the Obafemi Awolowo University Teaching Hospital, Ile-Ife, south-western Nigeria.

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Methods

Seventy- six male patients attending the Endocrinology and Diabetes Clinic of the Obafemi Awolowo University Teaching Hospital, Ile-Ife, were recruited in to the study after obtaining their informed consent. Subjects were accepted into the study if they were life-long non-smokers, had no history of serious cardiopulmonary diseases and had no history of exposure to dusts.

Anthropometric data – standing height in metres and bodyweight in kilogrammes – were measured and body mass index calculated in all subjects. Other data – age, fasting blood sugar, blood pressure, and the presence or absence of diabetic microvascular complications – were also recorded.

Spirometry

The forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) were obtained using a wedge-bellows spirometer that was calibrated in the factory and at regular intervals during the study. Peak expiratory flow rate (PEFR) was obtained from a calibrated peak flow meter. In each case, the procedure was explained and demonstrated to the subject. All measurements were made in the upright seated position and without nose clips. The highest of each three technically acceptable measurements was taken as being representative of the subjects' lung function. The FEV1 and FVC were reported at body temperature and pressure saturated (BTPS) with water vapour. The FEV1/FVC was calculated for the best recorded FEV1 and best recorded FVC regardless of which manoeuvre produced them.

Data analysis

Data were analysed on a computer using the statistical package for social sciences (SPSS) software. Expected/ predicted pulmonary function measures of PEFR, FEV1, FVC, and FEV1/FVC were determined using a reference equation obtained from healthy men in the same locality.[6] Values obtained in the index population were then compared with expected/predicted values using correlated or paired samples t-test. Bivariate correlation (Pearson) was used to determine the relationship between

between each pulmonary function index and other clinical parameters. The significance of these relationships was determined by analysis of variance (ANOVA) as applied to correlation. Mean pulmonary function parameters in subjects with and without diabetic microvascular complications were compared using one-way ANOVA. The 5% probability level was accepted as significant. Other data are presented as mean±SD.

Results

Seventy-six male diabetics were investigated. Their ages ranged from 27 to 80 years, mean 55.4±12.6 years. Mean body mass index, fasting blood sugar, systolic and diastolic blood pressures were 25±3.7 kg/m^2, 8.9±4.8 mmol/l, 130.2±28.6 mmHg and 79.6±16.3 mmHg, respectively (see Table 1).

Table 1 Clinical characteristics of study subjects (n = 76)

Parameter	Mean	Standard deviation
Age (years)	55.4	12.6
Body mass index (kg/m^2)	24.9	3.7
Fasting blood sugar (mmol/l)	8.9	4.8
Systolic blood pressure (mmHg)	130.2	28.6
Diastolic blood pressure (mmHg)	79.6	16.3
PEFR (l/min)	398.4	102.9
FEV1 (l)	1.92	0.68
FVC (l)	2.6	0.69
FEV1/FVC (%)	71.6	13.1
EPEFR	496.3	28.0
EFEV1	2.4	0.43
EFVC	3.1	0.41
EFEV1/EFVC (%)	80.9	2.7

PEFR = peak expiratory flow rate
FEV1 = forced expiratory volume in 1 second
FVC = forced vital capacity
EPEFR = expected peak expiratory flow rate
EFEV1 = expected forced expiratory volume in 1 second
EFVC = expected forced vital capacity

Table 2 Correlation matrix showing relationships between age, body mass index, fasting blood sugar, and lung function parameters

Parameter	Age		Body mass index		Fasting blood sugar	
	r	p	r	p	r	p
PEFR	−0.26*	0.02	−0.17	0.15	0.34*	0.007
FEV$_1$	−0.327*	0.004	−0.12	0.31	0.08	0.51
FVC	−0.334*	0.003	−0.19	0.11	0.13	0.31
FEV1/FVC	−0.15	0.18	−0.22	0.86	-0.07	0.96

* = Significant
PEFR = peak expiratory flow rate
FEV1 = forced expiratory volume in 1 second
FVC = forced vital capacity

When compared, mean observed and predicted values for the pulmonary function parameters studied (PEFR, FEV1, FVC and FEV1/FVC) were significantly lower than expected/predicted p=0.000 in all cases. Table 2 shows the relationship between age, body mass index, fasting blood sugar, and the lung function indices studied. Age correlated negatively with all lung function parameters but only reached statistical significance for PEFR, FEV1 and FVC. Body mass index also correlated negatively with lung function indices but this did not reach statistical significance. Fasting blood sugar correlated positively with PEFR: r=0.34, p=0.007; FEV1: r=0.08, p=0.51; FVC: r=0.13, p=0.31 but negatively with FEV1/FVC: r=−0.07, p=0.96.

Comparisons between mean pulmonary function indices in subjects with and without associated diabetic microvascular complications are shown in Table 3. There was no statistically significant difference in mean values obtained for all indices except mean FEV1/FVC which was significantly higher in patients without complications (67±13.2 vs 74.8±12.2, p=0.01).

Discussion

We have assessed pulmonary function in our male diabetes subjects using spirometric indices. Predictably, all function parameters studied were significantly lower than expected/predicted. There was no significant difference in the pulmonary function of subjects with and without diabetic complications while pulmonary functions tended to correlate negatively with patient age.

Peak expiratory flow rate is the measurement of flow

Table 3 Comparisons between mean pulmonary function parameters in subjects with and without diabetic complications (one-way ANOVA)

Parameter	Diabetic complications	n	Mean±SD	p value
PEFR	Present	31	416.6±87.5	0.207
	Absent	45	386±111.5	
	Total	76	398.4±102.9	
FEV1	Present	31	1.9±0.8	0.667
	Absent	45	1.9±0.6	
	Total	76	1.9±0.7	
FVC	Present	31	2.7±0.7	0.331
	Absent	45	2.6±0.7	
	Total	76	2.6±0.7	
FEV1/FVC (%)	Present	31	67±13.2	0.01*
	Absent	45	74.8±12.2	
	Total	76	71.6±13.1	

* = Significant
PEFR = peak expiratory flow rate
FEV1 = forced expiratory volume in 1 second
FVC = forced vital capacity

on maximal respiratory effort.[7] It is a simple, quick, and inexpensive way measuring airflow obstruction. It usually detects a narrowing of large and medium-size airways. The FEV1 is the integrated airflow in 1 second while the FVC is the total volume of air that can be exhaled from maximal inhalation to maximal expiration.[8] The FEV1/FVC percentage is the ratio of FEV1 to FVC expressed as percentage. The FEV1 and FVC are expressed in absolute values in litres or as percentage of predicted values for that individual depending on age, height, gender, and ethnic origin. These lung function parameters are increasingly being used to assess the effects of disease and exposure to environmental pollutants on lung function.[9,10] Moreover, the use of global reference equations is useful, though not without limitations. It is recognised that the best reference equations are those derived locally.

Although the lung is not considered a target organ in diabetes, similar to our findings, some authors have also reported abnormalities in lung volumes in diabetics. In a study of 50 diabetic Japanese subjects, without overt lung disease, Asanuma et al,[11] observed that FVC and timed vital capacity were lower than in healthy controls. Also, Boulbou et al,[2] had showed reduced total lung capacity and diffusing capacity compared with predicted values in a sample of Greek type 1 diabetics. In a study of Israeli diabetes patients, however, Benbassat et al[12] observed that FVC/FEV1 and forced expiratory flow rate were within the predicted range but the residual volume/total lung capacity ratio was slightly elevated. The pathogenesis of these abnormalities is thought to involve the non-enzymatic glycosylation of tissue proteins inducing an alteration in lung connective tissue.[3] Histopathologic evidence of lung involvement in subjects with diabetes includes thickened alveolar epithelial and pulmonary capillary basal laminae, suggesting existing pulmonary microangiopathy.[1]

The relationship of pulmonary function test parameters to factors such as the presence of microangiopathy, glycaemic control, disease duration and age is variable. As in this present study, many studies have failed to demonstrate any significant relationship between them.[2,12,13] Marvisi et al,[14] assessed pulmonary function by performing global spirometry and measuring diffusion capacity. They found a significant reduction in lung diffusion capacity for carbon monoxide (DLCO) in patients with diabetic microangiopathy and a significant correlation between DLCO and the grade of albuminuria. Furthermore, standardised indices for peripheral airflow in male diabetics decreased significantly as the patients' age increased ($p>0.005$) in another study.[11] In that study, diabetic patients showed abnormal lung function in the peripheral airways which increased with age. Minor reductions in total lung capacity have been reported in non-smoking insulin dependent diabetes patients, especially those over the age of 35 years. The carbon monoxide transfer coefficient (KCO) was found to be higher in the group than expected. Respiratory muscle weakness or limited thoracic expansion was speculated as the cause of reduced total lung capacity observed in these diabetic patients.[15] We have also observed a negative correlation between age and pulmonary function in this present study.

The finding of abnormal lung function in some diabetes subjects suggests that the lung should be considered a target organ in diabetes. Whether these findings have clinical implications in terms of respiratory disease is still debatable. Though some studies have recommended routine chest radiography in diabetes patients with clinical symptoms,[3,16] routine spirometry may not be appropriate for all. It is however useful in certain risk groups such as diabetes patients with associated chronic obstructive pulmonary disease (COPD), patients with diabetes over 35 years who also smoke, and those with chronic chest infections.

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