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SHORT COMMUNICATION

REDUCTION IN LUNG FUNCTIONS IN TYPE-2 DIABETES IN INDIAN POPULATION : CORRELATION WITH GLYCEMIC STATUS

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Abstract : The purpose of this study was to evaluate pulmonary functions in patients with Type-2 diabetes mellitus and to determine their correlation with glycemic status of diabetes in Indian population. Forty Type-2 diabetic patients, aged 30-60 years, with diabetic duration of 1-20 years, were included in the study. FVC, FEV1, & FEV1% are recorded by Benedict's Roth spirometer. PEFR and MEP were recorded by Wright's Peak flow meter & Modified Black's apparatus. Glycemic status of subjects was determined by FBS & PPBS by Glucose oxidase & peroxidase methods. And results were analyzed by calculating Mean±SD, using Student's t test, and Pearson correlation. All the respiratory parameters are reduced in Type-2 diabetic patients compared to control of which FEV1, FEV1%, & MEP show very highly significant reduction (P=0.000). Lung functions are negatively correlated with glycemic status & duration of diabetes. ($r = -0.390$, & -0.342)

Reduction in dynamic lung functions and its negative correlation to glycemic status might be due to respiratory muscle weakness as indicated by highly significant reduction in MEP. Hence strict glycemic control and breathing exercises to strengthen the respiratory muscles may improve lung function in diabetics.

Key words : type-2 diabetes FVC FEV1 FEV1% PEFR MEP Lung function tests FBS PPBS

INTRODUCTION

The pulmonary function tests are age old, time tested parameters for assessing respiratory health of a person and are important for clinical, diagnostic and

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prognostic values. This work is intended to study the effect of Type-2 Diabetes Mellitus on dynamic Pulmonary function tests & its correlation to glycemic status of diabetes.

There is alarming increase in the incidence and prevalence of Diabetes Mellitus particularly in Asian Indians. The prevalence of diabetes for all age groups worldwide was 2.8% in 2000 and is estimated to reach 4.4% by 2030. The total number of diabetics is projected to rise from 171 million in 2000 to 366 million in 2030 (1).

In Type-1 Diabetes lung function has been investigated in several clinical studies & evidenced reduced elastic recoil (2, 3), reduced lung volume (2, 3, 4, 5), diminished respiratory muscle performance (6), decrease in pulmonary diffusion capacity for carbon monoxide (2, 4, 5, 7, 8). But there are very few data concerning pulmonary function abnormalities in patients with Type-2 diabetes mellitus (9) especially of Indian population.

Several respiratory alterations have been reported in association with Diabetes Mellitus, including respiratory muscle dysfunctions, chest wall abnormalities & autonomic neuropathy (10).

MATERIAL AND METHODS

The study group include 40 Type-2 diabetic patients (males n=25, Females n= 15), aged 30-60 years (mean 52.3±7.7 years), with diabetic duration of 1-20 years (mean=6.4±5.2 years), taken from Diabetic clinic of B.L.D.E.A.'s Shri B. M Patil Medical College, Hospital and Research centre, Bijapur using simple random sampling. Spirometric recordings were taken 3 hrs after breakfast at 11 am. The study group was compared with 40 Non diabetic age & sex matched subjects taken from teaching and non teaching employees of B.L.D.E'S Shri B.M. Patil Medical College Bijapur. The ethical clearance was obtained. Glycemic status of a diabetic patient was determined by

1. Fasting blood sugar (FBS), by glucose oxidase and peroxide method (GOD-POD), after 12 hours of fast. Value >126 mg% is diagnostic of diabetes.

2. Post prandial blood sugar (PPBS), by glucose oxidase and peroxidase method. After 2 hours of meal. Value >200 mg% is diagnostic of diabetes.

Inclusion criteria :

Apparently healthy individuals with Type-2 diabetes mellitus are included in study. The apparent health status of the subjects was determined by thorough clinical examination and history taking.

Exclusion criteria :

Subjects with a history of smoking and alcohol, recent/remote history of cardio respiratory diseases, history of respiratory allergy & with acute respiratory infection in the previous three months are excluded from the study.

The following Pulmonary function parameters are recorded in the subjects :

The subject was informed about the procedure, and consent has been taken before recording. The highest reading of 3

trials in a sitting posture at room temperature, at 11 am (3 hours after breakfast) was recorded.

a. FVC (Forced Vital Capacity, ml): By using Benedict-Roth's recording spirometer.

b. FEV1 (Forced Expiratory Volume at the end of First Second, ml): By using Benedict-Roth's recording spirometer.

c. FEV1% (Percentage of Forced Expiratory Volume at the end of one second):

$$FEV1\% = \frac{FEV1 \times 100}{FVC}$$

d. PEFR (Peak Expiratory Flow Rate, L/min): By using mini Wright's Peak flow Meter.

e. MEP (Maximum Expiratory Pressure, mm of Hg): By using Modified Black's Apparatus.

Statistical analysis

All the data are presented as Mean±SD. The level of significance by Student's t test.

RESULTS

All the values of FVC- forced vital Capacity (ml), FEV1-Forced vital capacity in first second (ml), FEV1%, PEFR-Peak expiratory flow rate (L/min), MEP-Maximum expiratory pressure (mm Hg) are reduced in Diabetic group compared to Control group. Statistically very highly significant reduction is seen in FEV1, FEV1%, & MEP (P<0.001).

TABLE I: Age and Anthropometric parameters of subjects of Control and Diabetic groups.

Parameters	*Control group (n=40)*	*Diabetic group (n=40)*	*P value*
Age (years)	52.32±7.66	52.3±7.6	0.9
Height (cms)	159.57±7.75	161.05±9.13	0.44
Body Weight (kg)	58.70±11.68	58.71±10.12	1
BMI (kg/m^2)	23.18±3.87	22.69±3.41	0.55

Data presented are Mean±SD.
* P<0.05 Significant, **P<0.01 Highly significant, *** P<0.001 very highly significant.

TABLE II: Respiratory parameters of subjects of Control and Diabetic groups.

Parameters	*Control group (n=40)*	*Diabetic group (n=40)*	*P value*
FVC in ml	1877.5±572.0	1742.0±664.0	0.33
FEV1 in ml	1680.0±460.0	1160.0±496.0	0.000***
FEV1%	90.94±8.19	67.44±16.51	0.000***
PEFR in L/min	364±150.4	310±96.66	0.059
MEP in mm Hg	64.25±34.33	31.75±15.34	0.000***

Data presented are Mean±SD.
* P<0.05 Significant, **P<0.01 Highly significant, *** P<0.001 very highly significant.

TABLE III: Fasting and Postprandial Blood Glucose of subjects of Control and Diabetic groups.

		Control group	*Diabetic group*	*P value*
Whole group	Fasting (mg/dl)	81.5±10.32	148.25±65.84	0.000***
	Postprandial (mg/dl)	95.15±13.30	229.57±76.19	0.000***
Males	Fasting (mg/dl)	82.36±12.36	138.48±60.22	0.0001***
	Postprandial (mg/dl)	95.64±12.69	217.24±76.08	0.000***
Females	Fasting (mg/dl)	80.06±5.56	164.53±73.51	0.0005***
	Postprandial (mg/dl)	94.33±14.69	250.13±74.33	0.000***

Data presented are Mean±SD.
*P<0.05 Significant, **P<0.01 Highly significant, ***P<0.001 very highly significant.

In diabetics the decrease in FVC is 135 ml (7.2%), FEV1 is 520 ml (30.95%), FEV1% is 23.50% (25.84%), PEFR is 54 L/min (14.83%), & MEP is 32.50 mmHg (50.58%), compared to control subjects.

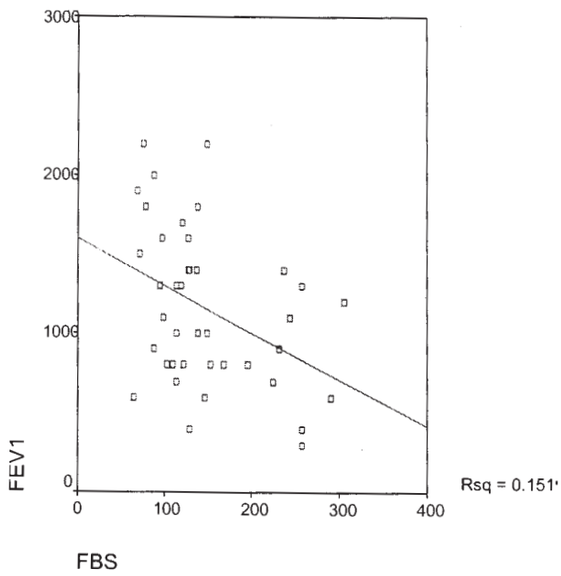

Fig. 1 : Graph showing the correlation of between Fasting blood glucose and FEV1.

FBS – Fasting blood sugar (md/dl)

FEV1 – Forced expiratory volume in first second (ml)

DISCUSSION

Davis Wendy A (2004) et al, demonstrated decline of >10% of FVC & FEV1 in the 125 prospectively studied patients. Absolute measures continued to decline at an annual rate of 68, & 71 ml/year for FVC, FEV1 respectively (1 l). According to them reduced spirometric measurements do not identify a specific underlying pathology, but there had been preliminary reports of histopathologic changes in the lungs of diabetic patients, including basal lamina thickening & fibrosis (12). Other possible contributory factors include glycation of chest wall or bronchial tree protein (3, 13). Autonomic and/or phrenic neuropathy causing alterations in bronchial reactivity & respiratory muscle function (14). They also said that air flow limitation was an important predictor of mortality in type-2 diabetic patients, 10% decrease in FEV1 was associated with a 12% increase in all cause mortality in them.

Devis Timothy ME, et al (2000) (15), demonstrated that diabetes is associated with reduced lung function. Each of FVC, FEV1, & PEFR were an average of >9.5% lower than predicted values derived from, age, gender, & height matched non diabetic population data.

In their study duration of diabetes was independently predictive of reduced lung function where as HbA1c was not. They gave explanation that since HbA1c is relatively short term marker of glycaemic control, a relationship between glycaemia & impaired lung function could still be present in diabetes, but duration of glycaemic exposure may be more important than its magnitude According to them mechanism for impaired lung function in diabetes include glycosylation of proteins such as collagen in the chest wall & pulmonary tree.

P. Lange (2002) in their longitudinal analysis of ventilatory capacity in diabetic and nondiabetic adults participants of the Copenhagen City Heart study, which included 266 individuals with diabetes found that in both sexes, FEV_1 & FVC were consistently lower in diabetic individuals compared with healthy individuals with an average reduction of nearly 8% of the predicted value (16).

Bell & Colleagues (1988) observed proportional reductions in FEV_1 & FVC in 28 young individuals with diabetes compared with age & height matched control subjects. These changes were more pronounced among those with diabetes who smoked tobacco (17). The cardiovascular health study (1993) in determining reference standards for a healthy population, found diabetes to be significantly associated with decreased FEV1 (18).

The very highly significant reduction in MEP (50.58%) is in accordance with the following studies.

Sanjeev Sinha et al, demonstrated statistically comparable decrease in MEP in Type-2 diabetes patients. They suggest that hyperglycemia and dyslipidaemia might have a contributory role in its pathogenesis (19). A number of biochemical and functional changes of skeletal muscles, including respiratory muscles, have been reported in diabetes (20).

Several studies demonstrating decrease in pleural & transdiaphargmatic pressure during maximum sniff maneuver indicating a reduced respiratory muscle force in part responsible for the decrease in vital capacity they noted. The mechanism of impairment of respiratory muscle function may be related to neuropathy, myopathy or both (6, 20, 21).

In our study respiratory parameters are negatively correlated with Fasting blood sugar, & post prandial blood sugar. FEV1, FEV1% are significantly & negatively correlated with FBS, & PPBS (r=–0.39, –0.399, –0.326, –0.322). Our finding is in accordance with the following studies.

In a study Wendy Davis A et al (2004), demonstrated that declining lung function measures were consistently predicted by poor glycemic control & duration of diabetes (11).

A large Danish cross-sectional population study Lange P (1989) showed a negative association between plasma glucose & both FVC & FEV1 (16).

In a small scale six years study by Ramiriez LC, et al (1991) demonstrated that intensive treatment by subcutaneous insulin infusion improved both FVC & FEV1 percentage predicted values (22).

Conclusion

1) We found that FEV1, FEV1% & MEP are significantly reduced (p=5.953E-06, 4.19E-07, &1.206E-06). FVC & PEFR are insignificantly reduced in type-2 diabetics. 2) We also found that all respiratory parameters are negatively correlated with glycaemic status. FEV1, & FEV1% are significantly & negatively correlated with glycaemic status of the diabetic patients (r=–0.390, & r=–0.399).

The possible mechanism for highly significant reduction in FEV & FEV1% in study group may be due to respiratory muscle weakness, as confirmed by significantly reduced MEP in our study & also by other workers. The mechanism of muscle weakness in diabetic patients may be due to glycosylation of proteins such as collagen in the chest wall & pulmonary tree.

Hence, we propose

1) Repeated recording of simple, non invasive, dynamic lung function tests like

(FVC, FEV1, FEV1%, PEFR, MEP) may help to assess the prognosis of type-2 diabetes in clinical practice.

2) Strict glycemic control & regular breathing exercises to strengthen the respiratory muscles may improve the pulmonary function tests in Type-2 diabetic patients & requires further study.

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