Effect of diabetes mellitus on pulmonary function

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Abstract: *The effect of diabetic mellitus in lung function has been described for many years. Being one of the most leading countries with diabetic mellitus as a potential epidemic only few studies were reported in India focusing this fact. Hence the current study was designed with the aim to investigate the pulmonary function in individuals with diabetic mellitus. 50 participants diagnosed with diabetes mellitus and 50 healthy age and gender matched controls were recruited for the study. Pulmonary functions including forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and FEV1/FVC ratio were measured using spirometer (RMS Helios 401). Maximum phonation duration (MPD) was also recorded from all the participants. Participants with diabetes mellitus showed a significant reduction in FVC and FEV1. MPD and FEV1/FVC were also found to be reduced in participants with diabetes mellitus. Thus it can be concluded that impaired lung function is a one of the chronic complications of diabetes mellitus.*

Key Words: *Diabetes mellitus, pulmonary function, spyrometry, vital capacity, MPD, SVC, FVC, FEV1*

1. INTRODUCTION:

Diabetes mellitus (DM) is described as a metabolic disorder of multiple etiology characterized by chronic hyperglycemia. Along with hyperglycemia disruption of carbohydrate, protein and fat metabolism were also reported in DM as a result of defects in either insulin secretion or insulin action or both. It is a systemic disorder with debilitating effect on many organs. DM results in macro vasular and micro vascular damages of target organ [1]. This leads to long term complications like diabetic neuropathy, nephropathy and retinopathy.

According to the survey by WHO in 2011 deterioration of pulmonary functions in DM is predicted to be 80% of all individuals with DM in the world. The extensive microvascular circulation and rich connective tissue in lungs rendered it as a target organ of DM. This raises the possibilty that lung tissue get affected by microangiopathy process and non enzymatic glycosylation of tissue proteins, induced by hyperglycemia. The integrity of lung connective tissue and microvasculature influence the normal mechanism of lungs and exchange of gases. Thus abnormalities in any of these two pulmonary components may lead to the abnormalities of lung function that can be measured clinically [2].
The effect of diabetes mellitus in lung function has been described for many years. Impaired pulmonary function due to reduced elastic recoil and reduced lung capacity were reported in patients with diabetes mellitus [3]. Diminished respiratory muscle performance and autonomic neuropathy involving respiratory muscles were also accounted as the reason for reduced pulmonary function [4,5]. Severe low grade inflammation and decrease in pulmonary diffusion capacity for carbon monoxide are some of the other significant changes occurring in DM [6,7]. In type 2 diabetic patients glycemic exposure is reported to be a key factor of reduced pulmonary function. According to Ljubic et.al [8] pulmonary complications are due to the collagen and elastin changes. Another theory suggested that increased non enzymatic glycation of proteins and peptides of the extra cellular matrix at chronic high circulatory glucose levels may also be responsible for the pathological changes in diabetic mellitus patients[9].

The incidence and prevalence of DM in Asian Indians are increasing over years. The prevalence of DM is predicted to double globally from 171 million in 2000 to 366 million in 2030 with a maximum increase in India [10]. It is predicted that by 2030 DM may afflict up to 79.4 million individuals in India [11,10].

Even though the detrimental effect of DM on lung function is reported in the literature over years the results were conflicting. Only few researches give emphasize to the role of pulmonary function test and spirometry in DM. Being one of the most leading countries with DM as a potential epidemic only few studies were reported in India focusing this fact. The Indian literature also shows contradicting evidences on the relation between the blood sugar level and duration of DM with the pulmonary function. Hence the current study was carried out to add on information's to the existing literature in these aspects. Maximum Phonation Duration (MPD) is a subjective aerodynamic assessment carried out in the daily clinical practice. The study attempts to find the effect of DM in MPD which was not reported yet in the literature.

The aim of the study was to investigate the pulmonary function in individuals with diabetes mellitus. The objectives of the study were:

a) To evaluate the effect of DM in pulmonary functions like FVC, FEV1, FVC/FEV1
b) To evaluate the effect of DM in MPD
c) To analyse the relation between duration of DM and pulmonary function
d) To analyse the relation between the fasting and postprandial glucose levels with pulmonary function

2. MATERIALS AND METHOD:

A total of hundred participants above the age of 30 years were recruited for the study. 50 subjects were diagnosed with diabetic mellitus and were undergoing medication and 50 were healthy matched controls. Participants without any history of any lung disease, and non-smokers were included in the study. Participants with complaint of upper respiratory tract infection and dyspnoea and known cardio respiratory diseases or major illness were excluded from the study. The participants were explained about the study in detail before the data collection.

A detailed history was collected with the importance given to the type of diabetes mellitus, date of diagnosis and details regarding the medication. Fasting and postprandial blood glucose levels of all the participants were checked and recorded. Pulmonary functions including forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and FEV1/FVC ratio were measured by spirometer (RMS Helios 401). For pulmonary function test participants were seated comfortably with feet flat on floor and legs uncrossed. Participants were then instructed to take a deep breath in, as deep as possible, and blows out as hard and fast as possible. Expiration will be instructed to continue until there is no air left. Spirometry was performed three times by each participants and the best of the three was taken into account. Maximum phonation duration (MPD) was also recorded from all the participants.

Statistical Analysis:

Statistical analysis was performed using SPSS version 23.Quantitative data were expressed as mean and standard deviation. The data was analysed by applying independent t test for comparison of two groups of normally distributed variables. Correlation analysis was carried out using Pearson correlation coefficient.

3. RESULT & DISCUSSION:

The current study attempts to find the pulmonary function in individuals with DM. Spirometry and MPD were assessed in all the participants. On spirometry participants with DM showed statistically significant ($p<0.05$) reduction in FVC and FEV1 when compared to healthy age and gender matched control group.

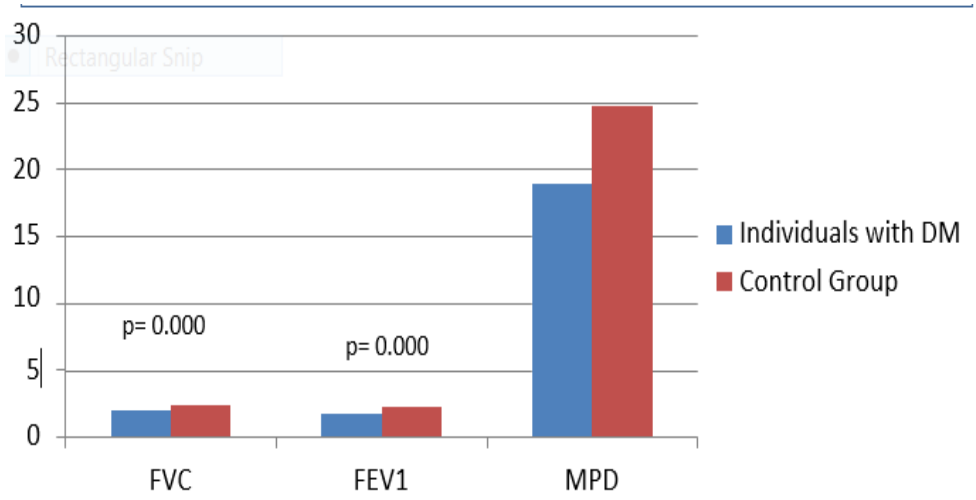

Fig 1.0. Comparison of FVC, FEV1 and MPD between groups

Irfan (2011) reported similar findings in Pakistani population [12]. The study showed significant reduction of FVC, FEV1 and SVC in diabetics and no significant difference in FEV1/FVC. Similar results were reported in the literature [13,14,15]. The possible explanations for this reduced pulmonary functions can be glycosylation of chest wall and bronchial tree proteins [2], thickening of basal lamina [16]. Muscle dysfunction induced due to hyperglycemia, inflammation and diabetes related oxidative stress can also be considered as reasons [17]. Reduced FVC/FEV1 ratio suggests restrictive pattern in individuals with DM. Non enzymatic glycosylation of collagen and elastin fibers of thorax and lungs results in stiffening of thorax and lung parenchyma. This may lead to the restrictive pattern in DM [2]. Studies have even shown diabetic polyneuropathy, which affects respiratory neuromuscular function and thus reducing pulmonary volumes [18]. These changes might be responsible for the limited lung expansion and reduction of ventilator capacity thereby affecting the pulmonary functions.

No significant difference was noted in FEV1/FVC and MPD. However FEV1/FVC and MPD were reduced in participants with DM. Thus it can be inferred from the results that pulmonary function is impaired in individuals with diabetes mellitus. In a study on the prevalence of phonatory symptoms in DM, Hamdan (2011) reported vocal fatigue, strain and aphonia in DM[19]. These symptoms were correlating with the reduced MPD in DM as stated in the current study results.

On correlating FVC and FEV1 with duration of DM, it was found that there exist a strong negative correlation between them. It can be inferred that as individuals with DM since longer duration has FVC and FEV1 reduced to a greater extend. This result is in accordance to Barrett-Conor, Frette(1996) and Davis (2000)[20,21], while some studies reported to significant correlation between duration of DM and pulmonary function [22, 15].

The fasting blood sugar and postprandial sugar levels where not found to be correlated with the pulmonary function as per the current study results. Contradicting to this results Kaur and Agarwal(2016) reported strong positive correlation between fasting blood sugar and FEV1/FVC [14].

The findings of Davis et.al suggested that lung function is an important marker of increased risk of death in patients with diabetes [3]. Monitoring periodic lung function can be advocated in case of DM and this will reduce the premature death from conditions like chronic obstructive pulmonary disease and lung cancer [23].

4. CONCLUSION:

The study results shows that the pulmonary function is impaired in individuals with DM. Impaired pulmonary function can be considered as an indicator for identifying DM. Spirometry being a cost effective and easy to administer procedure thus can be incooporated in the daily clinical évaluation. It is advisable therefore, that diabetic patients must undergo periodic spirometry tests to assess the severity of lung function impairment. These measures will help in preventing lung damage in initial stage and thus contribute to reduction in morbidity and mortality of these patients.This also implies the importance in considering DM as factor affecting the aerodynamic assessment.

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