A COMPARATIVE STUDY ON PULMONARY FUNCTION TEST IN TYPE II DIABETICS AND NON-DIABETICS IN A TERTIARY CARE HOSPITAL IN KOSHI REGION (NORTHERN BIHAR), INDIA

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ABSTRACT

BACKGROUND

Diabetes mellitus is characterised by chronic hyperglycaemia due to defects in insulin secretion, peripheral insulin action or both which leads to alteration in the fat, proteins and carbohydrate metabolism of the individuals. Type 2 diabetes mellitus is associated with long term damage, dysfunction and failure of various organs and its complications are mostly caused by macro vascular and micro vascular damages.

The aim of the study was to assess the effects of chronic hyperglycaemia on lung functions, which focused on mechanical aspects of lung dysfunction, maximal forced spirometric pulmonary function tests like FVC, FEV1, FEV1/FVC to be specific.

MATERIALS AND METHODS

This study is a cross sectional study conducted among 90 people with type 2 diabetes and 90 people with no diabetes without having risk factors that affect the lung functions.

RESULTS

In our study correlation between HbA1c and Pulmonary function is statistically significant (p value is <0.001). Most of the patients with elevated levels of HbA1c had the abnormality in the pulmonary function tests mainly the restrictive pattern of the lung disease. The patients with diabetes have 13% normal, 79% with restrictive lung disease and 8% with obstructive lung disease of pulmonary function tests. In non-diabetics 79% having normal, 11% having restrictive pattern and 10 % having the obstructive pattern of lung disease. In our study both FEV1 and FVC are reduced in diabetics, in which FVC has reduced more than FEV 1 so that FEV1/FVC has increased, and the 'p' value is significant in all the parameters according to independent sample t test.

CONCLUSION

Diabetes mellitus had a significant impact on pulmonary function tests, irrespective of smoking habits in subjects. Diabetes mellitus predominantly causes restrictive changes in the lung function tests. Chronic uncontrolled diabetes is one of the leading causes of lung complications. So, an intensive management will decrease the rate of death by an improved ventilator function.

KEYWORDS

Type 2 Diabetes, Pulmonary Function Test, Non-smokers, Smokers, Spirometry.

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BACKGROUND

Smoking in India has been known since at least 2000 BC when cannabis was smoked and is first mentioned in the Atharvaveda, which dates back a few hundred years BC. Tobacco smoking is menace and contagious problem. Every effort is being made at government level to stop smoking. Even it has been declared as a crime and punishable act. Ordinance about penalty to cigarette smokers has been passed, but in spite of all this, cigarette smokers are still flourishing. Tobacco smoking is an intentionally invited health hazards.[1] The World Health Organisation reported that tobacco smoking killed 100 million people worldwide in the 20th century and warned that it could kill one billion people around the world in the 21st century.[2] Diabetes mellitus is characterized by chronic hyperglycaemia due to defects in insulin secretion, peripheral insulin action or both which leading to alteration in the fat, proteins and carbohydrate metabolism of the individuals. Several distinct types of diabetes mellitus are caused by complex interactions between genetics and environmental factors. Though great attention was centred on the diabetic complications which had cardiovascular nature,

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nephropathy, retinopathy and neuropathy, the pulmonary complications of type 2 diabetes mellitus have been poorly characterized. Type 2 Diabetes mellitus is characterised by persistent hyperglycaemia and abnormal metabolisms of carbohydrates, proteins and lipids. These metabolic disorders result from impaired insulin secretion, an altered tissue sensitivity to insulin or coexistence of both these mechanisms. Type 2 Diabetes mellitus is associated with long term damage, dysfunction and failure of various organs and its complications are mostly caused by macro vascular and micro vascular damages.[3,4]

Major consequences of hyperglycaemia are excessive non-enzymatic glycosylation of various body proteins including albumin.[5,6,7] collagen and elastin. In type 2 diabetics with uncontrolled disease there is decreased pulmonary functions. There may be increased cross linkage between polypeptides of collagen leading on to thickening and restriction of lung volume and alveolar gas transport, reduced membrane diffusion capacity and pulmonary capillary blood volume.[8,9,10] The possible explanations of restrictive type of lung disease are thickening of alveolar epithelium, pulmonary microangiopathy and centrilobular emphysema. The net effect is due to collagen & elastin changes and microangiopathy[11,12] The lung complications of type 2 diabetes mellitus are mainly that affects the mechanical aspects of the organ and among that restrictive pattern of lung disease is the commonest one, these effects are reported by using the spirometry and measuring the forced vital capacity and forced expiratory volume in first second and ratio between these two.

The aim of the present study was to assess the effects of chronic hyperglycaemia on lung functions, which focused on mechanical aspects of lung dysfunction- maximal forced Spiro metric Pulmonary Function Tests like FVC, FEV1, PEFR, FEV1/FVC%, to be specific. Spirometry (which means 'measuring the breath') is the most common of the pulmonary function tests (PFTs) which measures mechanical lung function, specifically the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled. It is the recording of lung volumes and capacities by using spirometer. It is Simple, Measures flow, volumes, volume vs. Time. It is the most readily available most useful pulmonary function test. It takes 10 to 15 minutes and carries no risk. Spirometry is the most commonly used lung function screening study.

MATERIALS AND METHODS

This cross-sectional and retrospective study was conducted in Department of Biochemistry and Department of Physiology and Associated Hospital, Lord Buddha Koshi Medical College, a tertiary care centre in Koshi Region (Northern Bihar), from January 2015 to November 2016.

Inclusion Criteria

1. People with type 2 Diabetes and non-diabetes in age group between 30-65 yrs.
2. Both male and female.

Exclusion Criteria

1. Patient refusal.
2. Subjects with vertebral column or thoracic cavity anatomical abnormality.
3. Acute or chronic respiratory infections.
4. Neuro and muscular disease.
5. Known cancer patients.
6. Cardiac disease.
7. Patient underwent major chest or abdominal surgeries.
8. Smokers of any duration, betel nut chewers, smoking in any form of preparation using.
9. Asthma and COPD.

Data Collection

The following information were collected from patients who were a known case of Diabetes mellitus and a recently noticed type 2 diabetes mellitus among diabetic smokers and non-smokers according to the American diabetes association criteria for diagnosing type 2 diabetes mellitus in Department of Biochemistry in the form of Age, Sex, Height, Weight, BMI, Random blood sugar, HBA1C value from both male and female with type 2 Diabetes mellitus those who were having symptoms of diabetes mellitus in an age between 30 to 65.

The subjects of the study included Persons with any condition which affected the lung functions were excluded from the study, viz. the subjects with gross abnormalities of the vertebral column or thoracic cage, those with a known history of acute or chronic respiratory infections, neuromuscular disease, malignancy and cardiopulmonary disease and those who had undergone major abdominal or chest surgeries. In addition, subjects with current or previous drug or tobacco (smoked or chewed) addictions or who chewed betel nuts were also excluded.

Over a period of one year, from January 2015 to November 2016, about 180 files of type 2 diabetic patients who visited the Lord Buddha Hospital (Central Hospital) and Associated Hospital, were reviewed. After reviewing the files, their detailed histories were taken to determine whether they could be included in the study or not. Individuals were classified as having diabetes if any of the following criteria, which were adapted from 1997. American Diabetes Association criteria were met: a fasting glucose level of at least 7.0 mmol/L (126 mg/ dL); a nonfasting glucose level of at least 11.1 mmol/L (200 mg/dL); current use of anti-diabetic medications; and a positive response to the question "Has a doctor ever told you that you had diabetes (sugar in the blood). The study was approved by the institutional ethical committee.

Statistical Methods

The values were recorded as % of the predicted value. The data was tabulated and was analysed using GraphPad Prism 6 software. Appropriate parametric tests for continuous variables (unpaired Student's t test) and nonparametric for categorical variables (Fisher's exact test) was used for analysis. The results were deemed to be significant for P value ≤0.05 (Significance level 95%). All the subjects and

controls that were enrolled for the study were included in the data analysis.

RESULTS

In Lord Buddha Hospital (Central Hospital) study majority of the population are in between the age group of 41 to 45 years 58 (32%) (Figure 1, Table 1). Males were 100 (56%) and females 80(44%) (Table 2). 90 cases were diabetics and 90 cases were non-diabetics. In our study correlation between HbA1c and Pulmonary function is statistically significant (p value is <0.0001) (Table 3). From this Pearson correlation test we had come to the conclusion that there is a relationship between the HBA1C level and the results of the pulmonary function test. Most of the patients with the elevated levels had the abnormality in the pulmonary function tests mainly the restrictive pattern of the lung disease. In diabetics both FEV1 and FVC are reduced, in which FVC has reduced more than FEV 1 so that FEV1/FVC has increased, and the 'p' value is significant in all the parameters according to independent sample t test. (Table 4). This test depicts that most of the patients with type 2 diabetes mellitus having the restrictive pattern of the lung disease. In our study the patients with diabetes are 13% normal and 79% are with restrictive lung disease and 8% with obstructive lung disease of pulmonary function tests. In non-diabetics 79% having normal and 11% having restrictive pattern and 10% having the obstructive pattern of lung disease (Figure 1). The relation between type 2 diabetes mellitus and restrictive pattern of lung disease is statistically significant. (Pearson's chi square test P<0.001).

Age Group	No. of Patients (Percentage %)
< 35	09 (5%)
36-40	40 (22%)
41-45	58 (32%)
46-50	36(20%)
> 51	37(21%)

Table 1. Age Profile

Male	100(56%)
Female	80 (44%)

Table 2. Gender Distribution

PFT Coefficient Correlation		P value
HbA1c	**0.443**	**<0.0003**

Table 3. Pearson Correlation Test

Parameters	Group A (Type 2 Diabetics) (n=90)		Group B (Non- Diabetics) (n=90)		P value
	Mean	SD	Mean	SD	
FEV1	67.87	10.69	78.97	15.87	0.001
FVC	66.68	12.65	83.32	6.73	0.001
FEV1 / FVC	99.66	14.26	89.28	14.76	0.001

Table 4. Comparison of PFT among Two Groups

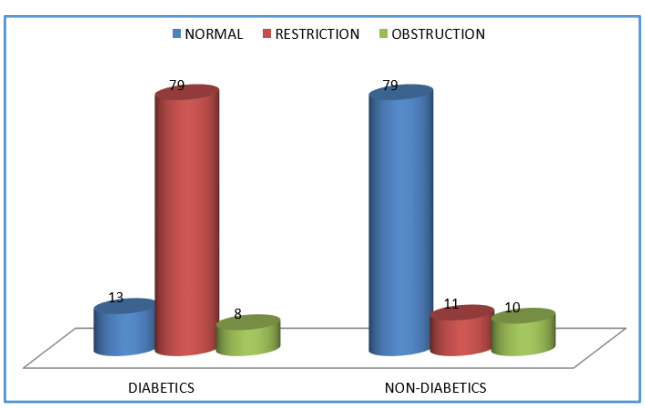

Figure 1. Pattern of Pulmonary Functions between Diabetics and Non-diabetics

DISCUSSION

The present study has clearly showed a statistically significant p value when the lung function tests (FVC, FEV1) were compared between type 2 diabetics and controls (age, sex and BMI matched). In our study done in Lord Buddha Koshi Medical College Hospitals, about 180 participants were studied of which 90 are having type 2 diabetes mellitus are cases and 90 without diabetes mellitus are controls and the males are 56 and females are 44 in number. The age distribution in our study mostly between 41 to 45 years (32%). Pulmonary function test has been conducted in all the persons. There is statistically significant value in correlation between HbA1c and pulmonary function test results were noted, and the p value is <0.0003. The FEV1 and FVC both are reduced in type 2 diabetic patients and the FEV1/FVC is increased. Mean, standard deviation are decreased in type 2 diabetics when comparing to non-diabetics. The p value for FEV1 in type 2 diabetic's is 0.001 and for FVC is 0.001 and for FEV1/FVC is 0.001. The pattern of lung disease is mostly restrictive pattern in patients having type 2 diabetes mellitus. Only 14 persons with diabetes having obstructive type of disease. And the p value is <0.0001 is statistically significant. Recent studies which were conducted by Lange et al[13] indicated that the type 2 diabetic patients are having mild decrease in forced vital capacity maybe because of impaired immunity against environmental challenges such as infections in diabetes and smoking. In a study which was done by Boulbou et al[14] it was found that there was a decrease in mean FVC values in type 2 diabetics. In a study which was done by Robert E. Walter et al., it was found that there was a progressive

decrease in mean forced vital capacity value is 109 ml/year.[15] The FEV1/FVC% was increased in type 2 diabetics as compared to that in the controls and the increase was statistically significant. The increased FEV1/FVC % suggested that the impairment of pulmonary functions in type 2 diabetics was primarily restrictive in nature Davis et al., study detected that almost all the parameters like forced vital capacity, forced expiratory volume at 1st second are decreased so that the ratio is increased almost most of the patient with uncontrolled diabetes mellitus.[16]

The diagnostic difficulties encountered were parallel to those experienced by different authors working on similar projects- Smoking is the major identified risk factor and approximately 15% of smokers developed Chronic obstructive pulmonary disease (COPD).[17] Current cigarette smoking had the higher rate of infection with C. pneumonia. Smoking is a well-known important risk factor for COPD patients through alteration in mechanisms of the host defence system.[18,19] Comparing the burden of tuberculosis and COPD- The aetiological agent in tuberculosis is the bacillus Mycobacterium tuberculosis which represents one of many in the family of mycobacteria. The mode of spread among humans is via aerosol droplet transmission, hence the lungs are often the focus of tuberculosis disease although TB may present with disease in any organ system. In the 1998 survey of TB cases in England and Wales, 62% were noted to exhibit pulmonary involvement.[20] In that survey, 38% had sole extra pulmonary involvement and this figure appeared to be increasing when compared to previous surveys undertaken in the same region.[21,22,23] Lung involvement due to non-typhoid strains of Salmonella was first recognised in patients with underlying conditions such as malignancy, diabetes mellitus, corticosteroid therapy or alcohol abuse.[24] Salmonella has been rarely cited as a significant respiratory pathogen in this population.[25,26,27] Studies on the prevalence of COPD in patients with HCV are also scant. In patients with chronic HCV infection, prevalence of COPD (17.6%) and bronchial asthma (14.7%) is significantly higher compared to that in patients with hepatitis B infection matched in age, gender and smoking status (COPD 5%, bronchial asthma 1.7%).[28,29,30] Bacterial Vaginosis are also including passive cigarette smoking status.[31]

CONCLUSION

Diabetes mellitus has a significant impact on pulmonary function tests, irrespective of smoking habits in subjects. Our study revealed significant reduction in pulmonary functions among diabetics compared with Control group and it also compared changes among the diabetic and non-diabetic smokers and non-smokers, which revealed significant impact of diabetes on pulmonary function use irrespective of smoking. Diabetes mellitus was predominantly associated with a restrictive pattern. Routine spirometry screening in all diabetic patients will help to identify the pulmonary function changes earlier which is often detected late or missed often.

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