

Pulmonary Spirometry in Type 2 Diabetics in Baghdad Teaching Hospital

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Abstract

Background: Diabetes mellitus is a serious progressive condition associated with multisystemic involvement with a number of chronic complications due to macrovascular and microvascular damage. Pulmonary involvement is not studied extensively and is not explained by factors that influence lung function. **Objective:** The aim of this article is to study the effects of type 2 diabetes on lung function and delineate the association between lung function impairment and duration of the disease. **Materials and Methods:** This cross-sectional study was conducted in Baghdad Teaching Hospital. Ninety-one (91) type 2 diabetics with 56 control subjects were included in this study between March 2020 and June 2021. Both groups are matched by age, sex, height, and weight and are met with exclusion criteria. Spirometry was done on an electronic spirometer (videography U.K. 1982) for both groups with the following parameters: forced vital capacity (FVC), force expiratory volume in 1 s (FEV1), FEV1/FVC, and peak expiratory flow rate (PEFR). Statistical methods compared the results. **Results:** Type 2 diabetic patients show a significant reduction in FVC, FEV1, and PEFR relative to their matched controls ($P < 0.05$). However, there was no significant change in the FEV1/FVC ratio between the groups, meaning a restrictive pattern in diabetic patients. **Conclusion:** This study showed that type 2 diabetics had impaired lung function as evidenced by reduced FVC, FEV1, and PEFR as part of chronic complications of diabetes and showed a progressive decline in parameter with increased duration of the disease.

Keywords: Baghdad Teaching Hospital, pulmonary spirometry, type 2 diabetics

INTRODUCTION

Diabetes is a serious, progressive multifactorial disease associated with serious public health problems. It affects more than 120 million people worldwide. It results in several chronic complications that can affect any system in the body. The main underlying pathological change is micro- and macroangiopathy. Diabetes mellitus (DM) is a syndrome of disordered metabolism with hyperglycemia due to an absolute decrease of insulin secretion (type I) or a reduction in the biological effects of insulin (type II).^[1] The WHO criteria for the diagnosis of diabetes are: fasting plasma glucose ≥ 7.0 mmol/L (126 mg/dL) and random plasma glucose ≥ 11.1 mmol/L (200 mg/dL). One abnormal laboratory value is diagnostic in symptomatic individuals, whereas two values are needed in asymptomatic people. The glucose tolerance test is indicated if fasting plasma glucose is 6.1–7.0 mmol/L (110–126 mg/dL) or random plasma glucose is 7.8–11.0 mmol/L (140–199 mg/dL).^[2]

Pulmonary complications of DM: The effects of diabetes on the respiratory system are numerous, but data are mixed concerning the effect of diabetes on pulmonary function. Many authors believe that the lung is not considered a target organ in DM and to be spared from clinically significant diabetic complications.^[3] Many studies documented functional and histopathological abnormality; histopathological examination of lungs of diabetic patients shows thickened alveolar epithelial and pulmonary capillary basal lamina and reduced lung elasticity. Still, lung involvement in diabetes seems always to be subclinical.^[4] *Pathogenesis:* The pathogenesis of diabetic pulmonary problems is thought to be due

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Submission: 26-Aug-2021 **Accepted:** 14-Sept-2021 **Published:** 17-Dec-2021

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How to cite this article: Abbood MH, Sirhan Hassan J, Jassim Mohammed A. Pulmonary spirometry in type 2 diabetics in Baghdad Teaching Hospital. Med J Babylon 2021;18:394-7.

Access this article online

Quick Response Code:



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www.medjbabylon.org

DOI:
10.4103/MJBL.MJBL_62_21

to the following: non-enzymatic glycosylation of tissue proteins inducing an alteration in connective tissue. It has also been demonstrated that both the pulmonary and renal diabetic complications share a similar related microangiopathy.^[5] Diabetic microangiopathy can include capillaries and alveolar tissue leading to lung volume and alveolar gas transfer, as stated by the reduced diffusion capacity for carbon monoxide.^[6] In patients with diabetic neuropathy, there is an abnormal basal airway tone due to a change in vagal pathways: these patients have a reduced bronchial reactivity and dilatation (respiratory autonomic neuropathy).^[7] Diabetic patients have an increased propensity to acquire infections, particularly tuberculosis (TB) and lung fungal disease (coccidiomycosis, aspergillosis, and mucormycosis), which might lead to the increased deterioration in pulmonary function. The mechanism for the increased liability to infection is due to a change in chemotactic, phagocytic, and bactericidal activity of leukocytes.^[7] Pulmonary dysfunction in diabetics is reported to be related to the severity of DM. Although the incidence of asthma and emphysema among diabetics was the same as in the total hospital population, fibrosis incidence was moderately elevated. An altered pulmonary function in asymptomatic diabetics is more than generally recognized, involving >60% of adult cases of diabetes.^[8] The differences in lung function can be measured years before the clinical signs of diabetes become evident and have been suggested to predict the development of diabetes.^[9] The deficit in lung function occurs early in the course of diabetes and is relatively constant after that.^[10] Types of pulmonary function tests: (1) spirometry, (2) lung volumes, (3) diffusing capacity, and (4) pulse oximetry.^[11] The aim of this article is to study the effects of type 2 diabetes on lung function and determine the association between disease duration and lung function.

MATERIALS AND METHODS

Ninety-one (91) adult patients with type 2 DM attending outpatient Baghdad Teaching Hospital were included in the study between March 2020 and June 2021; they were 25 males and 66 females with a mean age of 51 ± 26 years. Fifty-six (56) healthy age-matched persons were also included in the study as their control was 55 ± 29 years, 17 were males, and 39 were females. The patients' disease was either previously or newly diagnosed. The diagnosis of diabetes was established according to the WHO criteria. The patient and the control groups were evaluated clinically regarding the disease duration, significant point

of history, and examination and investigation, including blood sugar, blood urea, serum creatinine, ECG, chest X-ray, and spirometry. Exclusion criteria include subjects with a current or previous history of drugs that are known to affect pulmonary function (e.g., amiodarone, cytotoxic agent, antirheumatic drug, anticonvulsant, etc.). Subjects who use tobacco, those with gross abnormalities of the thoracic cage or vertebral column, limited joint mobility, known cases of severe anemia, pulmonary TB, asthma, chronic bronchitis, bronchiectasis, emphysema, neuromuscular disease, malignancy, and those who had undergone abdominal or chest surgery were excluded from the study. Pulmonary function tests using spirometry were performed on a spirometer (vitalography U.K. 1982) in the pulmonary function unit in Merjan Teaching Hospital. The test was performed with the subject in the sitting position by using a mouthpiece. The parameters forced vital capacity (FVC), force expiratory volume in 1 s (FEV1), FEV1/FVC, and peak expiratory flow rate (PEFR) were reported. Statistical analysis was conducted using a Student's *t*-test for an independent group (two-tailed), on initial analysis, all matched pairs of subjects, and then in three groups divided by their duration of disease. We compare between the three groups using the analysis of variance statistical method. The level of significance was taken as $P < 0.05$.

RESULTS

The patient and the control characteristics are shown in Table 1. The diabetes duration had grouped between 1 and 20 years. Lung function data for the diabetic patients and their matched control are shown in Table 2. Diabetic patients had a statistically significant reduction in all spirometry parameters: FVC, FEV1, and PEFR. There was no statistically significant difference in the FEV1/FVC ratio between the groups. The disease duration had a statistically significant effect on respiratory function. Diabetic patients show a progressive reduction in lung parameters (FVC, FEV1, and PEFR) with the duration of the diseases, as seen in Table 3.

DISCUSSION

Many studies had documented abnormalities in the pulmonary function test in diabetic patients that cannot be explained by the advancement of age and environmental factors; few others have found no significant change.^[12] In this study, FVC, FEV1, and PEFR were reduced in

Table 1: Patients and control characteristics

Group	Males	Females	Total	Age (years)			Height (cm)		Weight (kg)	
				Range	Mean	SD	Mean	SD	Mean	SD
Diabetes	25	66	91	33–70	51.5	26.2	158.0	8.5	73.9	13.60
Non-diabetes	17	39	56	34–76	55.0	29.7	169.0	9.1	75.50	18.90

Table 2: Lung function data for type 2 diabetics and their matched controls

Parameters	Patients			Control			P-value
	No.	Mean	SD	No.	Mean	SD	
FVC (L)	91	2.51	0.9080	56	4.08	0.9059	0.00001
FEV1 (L/s)	91	2.08	0.7553	56	3.37	0.7982	0.00004
PEFR (L/s)	91	4.81	1.4175	56	7.49	1.3756	0.00005
FEV1/FVC (%)	91	83.03	5.5766	56	81.61	8.4551	0.22276

Table 3: The respiratory function in a diabetic patient according to their disease duration

Parameter	Control		< 5 years			5–10 years			> 10 years			P**-value
	No.	Mean±SD	No.	Mean±SD	P*-value	No.	Mean±SD	P*-value	No.	Mean±SD	P*-value	
FVC (L)	56	4.08±0.90	30	3±0.7	0.001	30	2.6±0.07	0.0001	31	1.9±0.8	0.0001	0.001
FEV1 (L/s)	56	3.37±0.79	30	2.4±0.7	0.001	30	2.1±0.6	0.0001	31	1.6±0.6	0.0001	0.004
PEFR (L/s)	56	7.49±1.37	30	5.7±1.1	0.001	30	4.6±1.2	0.0001	31	4±1.3	0.0001	0.006
FEV1/FVC (%)	56	81.61±8.45	30	82.1±4.4	0.755	30	84.2±5.5	0.1312	31	82.7±6.58	0.5194	0.335

P*-value: vs. control, P**-value: vs. diabetic subgroup

type 2 DM but FEV1/FVC was normal, which means a restrictive pattern is seen in diabetic patients. This finding is similar to many other studies.^[13] Still, one study found that diabetes does not appear to have a clinically significant effect on pulmonary function, and routine pulmonary function testing in a patient with diabetes is not warranted.^[3] Studies that had to evaluate total lung capacity, diffusion capacity for carbon monoxide, maximal oxygen uptake, inspiratory muscle strength, pulmonary dispensability, and maximal inspiratory pressure had controversial results.^[14] The Offspring Cohort of the Framingham Cardiac Study found that patients with diabetes had a lower forced vital capacity, with the greatest effect seen in current smokers.^[15] In DM, primarily type 2 diabetes, hyperglycemia and insulin resistance are associated with lower FVC and FEV1.^[16] In this study, the longer the diabetic duration, the more significant the respiratory function reduction.^[14] A restrictive pattern in middle-aged non-diabetic adults is predictive of subsequent type 2 diabetes.^[10] Some found that declining FEV1 and lung volume are directly related to the mortality and glycemic control.^[16]

CONCLUSION

This study showed that type 2 DM adversely affects lung function as a part of chronic complications of diabetes. This impairment shows a restrictive pattern of airways disease and offers a progressive decline in parameters with increased disease duration.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients' verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local Ethics Committee.

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