Section: General Medicine

Research

A STUDY ON PULMONARY FUNCTION TESTS IN TYPE 2 DIABETES MELLITUS PATIENTS- A CASE CONTROL STUDY FROM SOUTH INDIA

Vasantha Kalyani D[1], Suresh Kumar M[1], Natarajan M[2], Deepansuresh V[3], Palanikumaran V[1]

[1]Assistant Professor, Department of General Medicine, Madurai Medical College, Tamilnadu, India
[2]Professor, Department of General Medicine, Madurai Medical College, Tamilnadu, India
[3]Senior Resident, Department of General Medicine, Government Medical College, Kallakurichi, India

Received : 04/09/2022
Received in revised form : 06/10/2022
Accepted : 18/10/2022

Keywords:
Diabetes; glycaemic control; Type-2 diabetes mellitus, pulmonary function.

Corresponding Author:
Dr. Deepansuresh V,
Email: drdeepansuresh@gmail.com
ORCID: 0000-0002-9309-2551

DOI: 10.47009/jamp.2022.4.5.44

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2022; 4 (5); 209-212

Abstract

Background: Diabetes patients are vulnerable to the risk of chronic problems and are at risk of dying prematurely. Microvascular problems, such as background and diabetic nephropathy, proliferative diabetic retinopathy, and autonomic or peripheral diabetic neuropathy, emerge early, within 5 to 10 years. **Materials and Methods:** A randomized case-control study was conducted in cooperation with the Department of Respiratory Medicine from March to July 2021. For this study, 25 Type 2DM patients over 35 years were chosen, with a diabetes duration of more than five years. These patients were outpatients from the department of internal medicine (Govt Rajaji Medical College Hospital, Madurai). **Result:** There were twenty males and ten females in each group designated as case and control. The median ages of both groups were above 35 years old and had a body mass index (BMI) of less than 30. The diabetic group's forced vital capacity (FVC) percent is lower than the controls. The diabetes group's mean was 82.4 ± 12.75, while the control group's was 98.2±10.45. The pulmonary function of 40% of people with diabetes was mildly restricted, and 12% of people with diabetes were moderately restricted. As compared to the remainder of the people with diabetes who took a spirometry test, all patients had a long history of diabetes mellitus (DM). **Conclusion:** Results suggest that diabetes mellitus reduces lung function, which is more frequent in people with long-term DM and uncontrolled glycemia. The current study adds to evidence of lung function restriction among people with diabetes, highlighting the necessity for additional investigation.

INTRODUCTION

According to the International Diabetes Federation (IDF), approximately 463 million people globally will have diabetes in 2020, including 88 million in Southeast Asia. Within the subcontinent, India has 77 million of a total population of 88 million people and as per the latest data from the IDF, the prevalence of diabetes in the population is 8.9%. Recent data suggests that genetic and environmental variables, including inheritance, lifestyle changes, age, smoking habits, increasing alcohol intake, screen time, parental disputes, education, insufficient sleep, and stress, predispose young patients to diabetes.[1] Because the diabetes phenotype of the Asian population appears to be distinct from that of the United States, beginning at a lower BMI, more visceral adiposity, younger age, and impaired insulin secretion capability - the incidence of DM among the Asian population is fast growing. South Asians have the highest diabetes and premature cardiovascular disease (CVD) rates worldwide. As a result, according to the epidemiological survey, the incidence of diabetes mellitus among Asian Indians is expected to be greatest by 2025.[2,3]

Diabetes mellitus is a systemic disorder that affects almost all the organs in our body by causing pathological changes. Diabetes mellitus is a significant source of illness and death in the modern era. Diabetes patients are vulnerable to the risk of chronic problems and are at risk of dying prematurely. Microvascular problems, such as background and diabetic nephropathy, proliferative diabetic retinopathy, and autonomic or peripheral diabetic neuropathy, emerge early, within 5 to 10 years.[4,5] Tight glycemic management can avoid or postpone them. Macrovascular complications, such

ISSN (O): 2687-5365; ISSN (P): 2753-6556

as cerebrovascular accident, peripheral vascular disease, and coronary artery disease, appear later, often within 15 to 20 years following diabetes start, and are substantially related to death. Complications in the skin (diabetic dermopathy, necrobiosis lipoidica diabeticorum, and adipose tissue atrophy) and connective tissue are also possible (tight-waxy skin, joint contractures, and scleroderma).[6] Hyperglycemia can cause end-organ damage. Many theories have been postulated to support this statement. These are the Formation of advanced glycosylation end products, Activation of protein kinase C, Glucose metabolism via sorbitol pathway, and Increased influx via hexosamine pathway.[7,8] Diabetes-related vascular problems continue to be the leading cause of death and morbidity. The vascular complications are classified as macrovascular and microvascular. Generally, the microvascular complications (i.e., retinopathy, neuropathy, and nephropathy) develop early in the disease. Even though respiratory tract diseases such as tuberculosis (TB) are more common in diabetics, the respiratory system receives less attention.[9,10]

AIM

To record pulmonary function test (PFTs) in Type 2 DM and control groups, to compare pulmonary function between groups, and analyse lung functioning in Type 2 DM patients based on diabetes duration and blood sugar levels.

MATERIALS AND METHODS

The current study was a randomized case-control study conducted in cooperation with the Department of Respiratory Medicine from March to July 2021. For this study, 25 Type 2DM patients over 35 years were chosen, who were diagnosed with diabetes for more than five years. These patients were outpatients from the department of internal medicine (Govt Rajaji Medical College Hospital, Madurai). The control group consisted of 25 healthy volunteers who were Madurai Medical College Hospital employees. The patients and the controls gave their signed consent after receiving appropriate information. Then, every patient was given an excellent detailed questionnaire about their personal information and medical history.

The exclusion criteria were smoker's history of hypertension, patients with signs & symptoms of the respiratory infection at the time of test, previous history of lung disease (COPD, PTB, PT SEQULAE), patients having a history of admission for respiratory illness during past six months & patients with cardiovascular illness.

Method

The test can be done multiple times, with the best result memorised so that it can be recalled from the spirometer's memory. The ATS (American Thoracic Society) and ERS (European Respiratory Society) standards identify the optimum test. The study group's HbA1C was determined using the "BIO-RAD" method.

Statistical Analysis

The data were statistically analysed using the SPSS software. In addition, many tests and methodologies were analysed, such as the student's t-test, Pearson's correlation coefficient test, etc. The data was tabulated using Microsoft Excel.

RESULTS

The baseline characteristics of the patient groups are tabulated in table1. Overall, there were 20 males and ten females in each group (Case and Control). They were above 35 years old and had a BMI of less than 30.

Table 1: Gender distribution in Case and Control groups.

Group	Gender	Frequency	Percentage
Case	Male	15	60
	Female	10	40
Control	Male	15	60
	Female	10	40

Table 2: Comparison of two groups' spirometric values.

Parameters	Case			Control			P-Value
	Mean	Range	SD	Mean	Range	SD	
FVC	2.21	1.27-3.37	0.59	3.2	2.3-4.16	0.54	0.001
FEV1	1.96	0.95-3.15	0.56	2.9	2.02-3.39	0.47	0.001
FVC1/FVC	87.8	79-96	4.37	90.52	77.4-94.7	3.42	0.003
PEF	4.29	1.8-7.36	1.64	6.11	3.5-8.35	1.66	0.003
FEF 25-75%	2.6	1.07-4.74	1.007	4.14	2.51-5.37	0.93	0.001

When compared with the control group, the diabetic group showed a 25-75 percent decrease in all spirometric parameters, including FVC, FEV1, FEV1/FVC, PEF, and FEF.

Table 3: Percentage prediction between two groups.

Parameters	Group	Mean	S. D	'P' value
FVC%	Case	82.4	12.75	0.001
	Control	98.2	10.45	
FEV1%	Case	88.68	15.73	0.001

ISSN (O): 2687-5365; ISSN (P): 2753-6556

	Control	106.04	9.63	
FEV1/FVC%	Case	106.52	6.35	0.260
	Control	108.12	5.51	
PEF%	Case	64.6	20.05	0.068
	Control	74.16	17.57	
FEF25-75%	Case	77.24	25.31	0.001
	Control	113.12	17.15	

The diabetic group's FVC percent is lower than the controls. The diabetes group's mean was 82.4±12.75, while the control group was 98.2±10.45.

Table 4: Spirometric pattern distribution in type 2 Diabetes mellitus patients.

Spirometric pattern		Case	Control
Normal	Count	12	25
	% With interpretation	32.40%	67.60%
Mild restriction	Count	10	0
	% With interpretation	100%	0
Moderate restriction	Count	3	0
	% With interpretation	100%	0

The pulmonary function of 40% of people with diabetes was mildly restricted, and 12% of people with diabetes were moderately restricted. However, compared to the remainder of the people with diabetes who took a spirometry test, they all had a long history of DM.

Table 5: Correlation between the duration of diabetes, FBS, PPBS, and HbA1C with PFT values.

Correlation Between		PFT Values with a duration of diabetes	FBS with PFT values	PPBS with PFT values	HbA1C with PFT values
FVC	FVC-R	-0.024	**-0.617****	**-0.559****	**-0.023**
	FVC%	-0.41	**-0.829****	**-0.821****	**-0.185**
FEV1	FVC-R	-0.08	**-0.673****	**-0.688****	**-0.035**
	FEV1%	-0.422**	**-0.853****	**-0.871****	**-0.192**
FEV1/FVC	FEV1/FVC-R	-0.473**	**-0.608****	**-0.655**	**-0.170**
	FEV1/FVC%	-0.329*	**-0.377***	**-0.459****	**-0.150**
PEF	PEF-R	-0.063	**-0.624****	**-0.613****	**-0.012**
	PEF%	-0.248	**-0.555****	**-0.584****	**-0.001**
FEF25-75%	FEF 5-75%-R	-0.153	**-0.78****	**-0.799****	**-0.032**
	FEF 5-75%-(%)	-0.236	**-0.83****	**-0.877****	**-0.089**

FVC & FVC%, and FEV1 & FEV1% have a negligible relationship with HbA1C levels. In addition, FEV1/FVC and FEV1/FVC% have no significant relationship with the HbA1C values. Both PEF & PEF% have no significant relationship with the HbA1C values. Both FEF 25-75% & (FEF 25-75%) % have no significant relationship with HbA1C values.

DISCUSSION

This study summarizes the effects of diabetes on pulmonary function, the major takeaways of this study being that the diabetic group had a mean drop in all spirometric measures, including FVC, FEV1, FEV1/FVC, PEF, and FEF 25-75%, compared to the control group, which a P-value of <0.05 statistically confirmed. In the diabetes group, the percentage prediction of spirometric parameters was also lower than in the control group. When the 25 diabetes patients were examined individually, ten had a mild restrictive spirometric pattern, and three had a moderate spirometric pattern.

Effect of duration of DM-2 on pulmonary functions: The FVC % and FEV1% were shown to have a considerable negative connection with the duration of DM-2 in the study group. i.e., they tend to diminish as the duration of DM-2 increases. The duration of DM-2 demonstrated only a mild negative connection with FEV1/FVC. This outcome supported the concept as reported by Timothy D et al.'s investigation. Spirometric readings were found to be negatively correlated with the duration of diabetes in this study as well.[11]

Agarwal et al. discovered a link between lung function measures and glycemic control (HBA1c). With an increase in HBA1c, FVC percent, FEV1 percent, peak expiratory flow rate (PEFR) percent, FEF25-75 percent, DLCO percent, DL/VA percent, and FEV1/FVC percent decreased.[12]

In the study of Kumari K et al., There were no significant decreases in PFTs in the HbA1C group (7%). There were significant decreases in FVC, FEV1, FEV1/FVC, PEFR, and FEF25-75% in the HbA1C group with p values of 0.00, 0.00, 0.00, 0.00, and 0.00.[13]

Makkar P et al. found that when HbA1C levels were higher than 7%, FVC, FEV1, FEV1/FVC, and PEFR values were lower (P = 0.01).[14]

In another study by Sheikh GP et al., HbA1C values of 7% were not related to any PFT abnormalities, but patients with HbA1C levels of >7% had abnormal PFTs.[15]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

In the current study, no significant association between FVC percent, FEV1 percent, PEF percent, and FEF 25-75 percent and HbA1C level in this research. Seven of the twenty-five diabetic groups demonstrated minor non-proliferative diabetic retinopathy (NPDR) and mild restriction patterns in spirometry. These findings demonstrate that the diabetic population has a restricted pattern of lung function. Furthermore, spirometric characteristics are negatively related to increases in FBS, PPBS, and the duration of diabetic mellitus. Eight of the 13 diabetic patients with restricted lung function had diabetic nephropathy, and six had retinal alterations, indicating microvascular problems. The high prevalence of lung function restriction in diabetics, a sign of microvascular complication, makes us more cautious about maintaining rigorous glycemic control because this limitation pattern will increase morbidity and early mortality in diabetic patients.

CONCLUSION

In conclusion, the pattern of spirometric parameters in the diabetic group revealed the presence of limitation patterns in lung functions, which can be related to non-enzymatic glycosylation of connective tissue. Furthermore, people with diabetic retinopathy typically showed spirometry limitation patterns. All of the data supports the idea that diabetes causes a loss in lung function through restriction, which is more frequent in patients with long-term DM and uncontrolled glycemic status.

REFERENCES

1. Misra P, Upadhyay RP, Misra A, Anand K. A review of the epidemiology of diabetes in rural India. Diabetes Res Clin Pract. 2011;92(3):303-11. doi: 10.1016/j.diabres.2011.02.032.
2. Sadikot SM, Nigam A, Das S, Bajaj S, Zargar AH, Prasannakumar KM, et al. The burden of diabetes and impaired glucose tolerance in India using the WHO 1999 criteria: prevalence of diabetes in India study (PODIS). Diabetes Res Clin Pract. 2004;66(3):301-7. doi: 10.1016/j.diabres.2004.04.008.
3. Marvisi M, Bartolini L, del Borrello P, Brianti M, Marani G, Guariglia A, et al. Pulmonary function in non-insulin-dependent diabetes mellitus. Respiration. 2001;68(3):268-72. doi: 10.1159/000050509.
4. Benbassat Carlos A, Ervin Stern, Mordechai Kramer, Joseph Lebzelter, et al. Pulmonary function in patients with Diabetes Mellitus. The Am J MedSci. 2001; 322(3):127-132.
5. Writing Team for the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Research Group. Sustained effect of intensive treatment of type 1 diabetes mellitus on development and progression of diabetic nephropathy: the Epidemiology of Diabetes Interventions and Complications (EDIC) study. JAMA. 2003;290(16):2159-67. doi: 10.1001/jama.290.16.2159.
6. Gupta R, Joshi P, Mohan V, Reddy KS, Yusuf S. Epidemiology and causation of coronary heart disease and stroke in India. Heart. 2008;94(1):16-26. doi: 10.1136/hrt.2007.132951.
7. Ramachandran A, Mary S, Yamuna A, Murugesan N, Snehalatha C. High prevalence of diabetes and cardiovascular risk factors associated with urbanization in India. Diabetes Care. 2008;31(5):893-8. doi: 10.2337/dc07-1207.
8. Roglic G, Unwin N. Mortality attributable to diabetes: estimates for the year 2010. Diabetes Res Clin Pract. 2010;87(1):15-9. doi: 10.1016/j.diabres.2009.10.006.
9. Tanuseputro P, Manuel DG, Leung M, Nguyen K, Johansen H. Risk factors for cardiovascular disease in Canada. Can J Cardiol. 2003;19(11):1249-59.
10. Bajaj M, Banerji MA. Type 2 diabetes in South Asians: a pathophysiologic focus on the Asian-Indian epidemic. Curr Diab Rep. 2004;4(3):213-8. doi: 10.1007/s11892-004-0026-4.
11. Davis TM, Knuiman M, Kendall P, Vu H, Davis WA. Reduced pulmonary function and its associations in type 2 diabetes: the Fremantle Diabetes Study. Diabetes Res Clin Pract. 2000;50(2):153-9. doi: 10.1016/s0168-8227(00)00166-2.
12. Agarwal AS, Fuladi AB, Mishra G, Tayade BO. Spirometry and diffusion studies in patients with type-2 diabetes mellitus and their association with microvascular complications. Indian J Chest Dis Allied Sci. 2010;52(4):213-6.
13. Kumari K, Nataraj SM, Devaraj HS. Glycemic control and pulmonary function tests in type 2 Diabetes mellitus patients: Do they correlate? Ind J Publ Hlth Res Dev. 2013;4: 124-8.
14. Makkar P, Meenu G, Agarwal, Ventilatory Pulmonary function tests in Type-1 DM. J Assoc Physicians India. 2000; 48 (10): 962-966.
15. Irfan M, Jabbar A, Haque AS, Awan S, Hussain SF. Pulmonary functions in patients with diabetes mellitus. Lung India. 2011;28(2):89-92. doi: 10.4103/0970-2113.80314.

ISSN (O): 2687-5365; ISSN (P): 2753-6556