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RESEARCH ARTICLE

PULMONARY FUNCTION DERANGEMENT IN PATIENTS OF DIABETES MELLITUS

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Abstract

Background: Diabetes mellitus is a metabolic disorder characterized by hyperglycaemia resulting from defects in insulin secretion, action or both. Nonenzymatic glycosylation induced alteration of lung connective tissue is the most likely mechanism underlying the mechanical pulmonary dysfunction in diabetic subjects. The present study evaluates the impact of diabetes mellitus on pulmonary function in this cross sectional study of population.

Aims and objectives: To evaluate the impact of diabetes mellitus on pulmonary functions by comparing with control groups.

Materials And Method: All patients presenting in Department of Medicine, R.N.T. Medical College, Udaipur who were proved cases of type 2 diabetes mellitus were included in this study from September 2017 to September 2018. 50 patients and 50 controls with matched age and sex were included. All patients were interviewed, detailed history was taken with respect to risk factors and detailed physical examination was carried out and appropriate investigations were carried out.

Results: FVC among diabetics was low with a mean of 2.46 as compared to controls with mean of 2.99 with p value of 0.001 which is statistically significant. FEV1 was reduced in cases with mean of 2.0542 compared to controls with mean of 2.4906 with a p value of 0.001 being statistically significant.

FEV1/ FVC was higher in diabetic group with mean value of 0.8304 as compared with controls with mean value of 0.8316.

Conclusion: Diabetic patients show reduced lung function with a restrictive pattern of lung disease on the Spirometry.

Introduction:-

Diabetes mellitus is a metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, action or both. Diabetes is a multisystem disorder that affects many organs of the body[1].

This metabolic disorder is a risk factor precipitating micro vascular pathologies leading to autonomic neuropathy, nephropathy, retinopathy and peripheral neuropathy, and macro vascular pathologies leading to coronary artery disease, cerebrovascular accidents and peripheral vascular disease[2].

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There are histopathological changes seen in lungs of diabetics such as thickened alveolar epithelial and pulmonary capillary basal lamina leading to reduced pulmonary elastic recoil and lung volume. Nonenzymatic glycosylation induced alteration of lung connective tissue is the most likely mechanism underlying the mechanical pulmonary dysfunction in diabetic subjects[3].

This suggests that lung is also a target organ[4]. Spirometry is a widely used pulmonary function test (PFT), ideally suited to describing the effects of obstruction or restriction of lung function. The spirometric parameters have gained more popularity when it has been reported that impaired Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 sec (FEV1) are emerging novel risk factors for diabetes mellitus[5]. In spite of this, spirometry is not used routinely as part of a management system in diabetic patients. Its role is neitherfully explored, nor fully utilized to achieve quality of life when managing diabetesmellitus.

The present study is undertaken to evaluate the impact of diabetes mellitus and pulmonary function in this cross sectional study of population.

Materials And Method:-

Inclusion Criteria:

All patients presenting in Department of Medicine and Endocrinology at attached group of hospitals and R.N.T. Medical College, Udaipur who were proved cases of type 2 diabetes mellitus were included in this study from September 2017 to December 2018.

Selection of participants:

50 cases and 50 controls with matched age and sex were included.

Exclusion Criteria:

1. Previous history of lung disease
2. Signs and symptoms of respiratory infections at the time oftest
3. History of being admitted during past six months with respiratorysymptoms
4. History of cardiovascularillness
5. Alcoholic
6. Obesity
7. Smokers

Data were collected by using performa meeting the objectives of the study. Purpose of the study was carefully explained to patients and consent was taken.

All patients were interviewed, detailed history was taken with respect to risk factors and detailed physical examination was carried out and appropriate investigations done which included complete blood counts, fasting blood sugar, post-prandial blood sugar, $HbA_{1C,}$ X ray chest (PA view), Spirometry (FVC, FEV1, FEV1/FVC values recorded)

Pulmonary function tests(PFT) of diabetic patients and controls were compared by applying student's unpaired t-test while correlations between FVC , FEV1 , HbA1C and duration of illness in diabetic patients were analyzed by applying Pearson's co-efficient.

Results:-

A total of 100 subjects were included in the present study 50(29 males and 21 females) of them were diabetics and the other 50(32 males and 18 females) were non diabetic controls.

50% cases belonged to the age group of 40-49 years, 24% to 50-59 years and 26% to 60 and above age group. Similar distribution was assured in controls with 38%, 34% and 28% respectively in the three age groups. The mean age in both groups being 51.43

The glycemic parameters which included the FBS, PPBS and HbA1c are 204.86mg/dl, 254.30mg/dl and 8.1474% respectively for cases and 96.58, 127.04 and 4.802 respectively for controls.(Table I)

Body mass index (BMI) of cases and controls were comparable with mean among study group being 24.407 and in controls its value was 25.18. The difference was not statistically significant with a p value of 0.209.

The spirometric values in both groups can be seen summarized in Table II. The FVC was 2.4616+0.42553 and 2.9998+0.43302 in cases and controls respectively while value of FEV1 was 2.0542+0.3999 and 2.4906+0.36564 in the same manner. Thus making the ratio of FEV1/FVC almost similar.

The study also tried to correlate the severity of impairment of the lung function test with duration of diabetes mellitus. Two groups were taken- one with disease duration <5 years and other >5 years. The glycemic parameters of the two groups are shown in Table III. It was observed that glycemic control was better in long term diabetics(>5years duration) than the newly diagnosed ones(<5 years)

It was also observed that the values of FEV1 and FVC were better in long term diabetics than newly diagnosed ones(Table IV) being 2.2526 against 1.9523 and 2.72377 against 2.3077 respectively.

Discussion:-

Present study was undertaken to assess ventilatory function of subjects with diabetes mellitus in comparison to subjects without diabetes. Larger population-based studies have been more consistent, demonstrating reduced pulmonary functions in patients with an elevated plasma glucose level and a diagnosis of DM.

The present study is in agreement with the previous study[6-10] (Table V) and the inference drawn from this study is similar to those studies. The study proves the hypothesis of reduced FVC in diabetics compared to their age, sex and BMI matched controls.

The study also shows coherence the study of Walter E Robert et al[11] who studied the relationship between diabetes mellitus and pulmonary function and showed a decrease in FVC by 109 ml and FEV1 by 27ml in diabetes mellitus. Davis M.E. Timothy[12] studied the pulmonary function and its association with Type-2 diabetes mellitus and showed an average decrease of 9.5% in both FVC and FEV1 of diabetics. Different studies[6-10] noting the same results are compared in table VI.

Due to the combined reduction in FEV1 and FVC the FEV1/FVC ratio yielded the value of 0.83 which is suggestive of a restrictive pattern. Studies by Muhammad Irfan et al[8] (0.819), Sultan[7] (0.851) and Sanjeev Verma et al[9](0.90) had similar results. The present study, thus, is in agreement with previous studies which have shown almost same values of FEV_1/FVC in diabetic subjects when compared to age, sex and BMI matched controls.

The key aspect of the present study is the observation that although diabetic subjects had low FVC compared to controls the group of diabetics with diabetes mellitus less than 5 years had lower FVC than in those with duration > 5 years. FVC in diabetics with <5 years duration(22 study subjects) was 2.30, much lower than controls(2.98) but in diabetics >5 years(28 study subjects) it was 2.70 only marginally(but significantly) less than the controls.. These results were contrary to the study done by Sultan[7] where there was no significant reduction in FVC in diabetics of <5 years duration(FVC=3.68) and a linear fall in the values of FVC in diabetics with 5-12years duration(FVC=3.16) and >12 years duration (FVC=3.11) compared to controls(FVC=3.74). (Figure 1)

When the natural history of disease was compared on the time line with regard to FEV1we still observed the same improving pattern with diabetics >5years(comparison shown in table VII and figure II) . While unlike FVC , FEV1 in Sultan's7 study showed similar pattern to that of ours with a decline in diabetics <5years duration and then improving in 5- 12 years duration diabetics. But Sultan's study found that beyond 12 years of duration of diabetes the FEV1 declined again. This result may have not been seen in our study due to not so long (more than 10 years) follow up of thediabetics.

Masmoudi and Zouari13 concluded that pulmonary volumes impairments are slightly more marked with diabetes mellitus duration especially after 10 years. Barret-Connor E et14 also found that pulmonary function in older adults is altered in subjects with diabetes mellitus with duration more than 10 years. The improvement in respiratory function can be hypothesized to a better metabolic control.Our results are similar to those of Lange P[15] who found that the decrease of ventilator capacity is more marked at the beginning of diabetes mellitus. Davis A Wendy et al[16] who studied the glycemic exposure and associated reduced pulmonary function in type 2 diabetes found a decrease in FVC

at an annual rate of 68ml/year and FEV1 at an annual rate of 71 ml/year. This linear decline was not noticed in our study which may be the reflection of very high sugar levels at the diagnosis and eventual better control which is also reflected in asmall scale six years study by Ramiriez L.C. et al[17] (1991) demonstrating that intensive treatment by subcutaneous insulin infusion improved both FVC & FEV1 percentage predictedvalues.

Recently Nakajima et al[18] reported reduced FVC and normal FEV1/FVC and concluded that impaired restrictive pulmonary function but not the obstructive pattern might be associated with metabolic disorders and metabolic syndrome in a severity dependant manner.

Conclusion:-

Lungs also bear the brunt of uncontrolled diabetes mellitus as evident by this study where mean reduction in FVC was 500ml and in FEV1 was 360 ml with the parameters showing a restrictive pattern. Thus lung is also a target organ for diabetes mellitus.

Limitation of the study:

The follow up period of the patient was short and so prolonged follow up is needed to further ascertain the effects of diabetics duration on the lung functions.

Future prospective:

All diabetics can be made to get a baseline pulmonary function test using spirometry with follow up spirometries as warranted**.**

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none Conflict of interest:
none

Table l:- Comparison of glycemic parameters among cases and controls.

Variable	Group	N	Mean	S.D.
FBS	Cases	50	204.86	96.58
	Controls	50	96.58	8.162
PPBS	Cases	50	254.30	46.086
	Controls	50	127.04	5.796
HbA1c	Cases	50	8.1474	0.68136
	Controls	50	4.8082	0.20983

FBS – Fasting Blood Sugar, PPBS – Post Prandial Blood Sugar, HbA1c- Haemoglobin A1c N – sample size S.D.- Standard Deviation

Table II:- Comparison of cases and controls with FVC, FEV_1 and FEV_1/FVC.

Variable	Group	N	Mean	S.D.	P value
FVC	Cases	50	2.4616	0.42553	0.000*
	Controls	50	2.9998	0.43302	
FEV_1	Cases	50	2.0542	0.3999	0.000*
	Controls	50	2.4906	0.36564	
FEV_1/FVC	Cases	50	0.8304	0.10016	0.939
	Controls	50	0.8316	0.04761	

*P<0.05

Table III:- Comparison of duration (< 5 yrs and > 5 yrs) with FBS and PPBS scores in cases by t test.

Variable	Duration	N	Mean	S.D.	P value
FBS	< 5 years	22	214.9615	54.2199	0.2587
	> 5 years	28	198.000	40.9376	
PPBS	< 5 years	22	257.9231	54.7539	0.5697
	> 5 years	28	249.4211	40.1432	

Table IV:- Comparison of duration (< 5 yrs and > 5 yrs) with FVC, FEV1 and FEV1/FVC.

Variable	Duration	N	Mean	S.D.	P value
FVC	< 5 years	22	2.3077	0.4176	0.0010*
	> 5 years	28	2.7237	0.3532	
FEV1	< 5 years	22	1.9523	0.3744	0.0129*
	> 5 years	28	2.2526	0.3964	
FEV1/FVC	< 5 years	22	0.8515	0.0884	0.2842
	> 5 years	28	0.8184	0.1166	

*P < 0.05

Table V:- Comparison of FVC with other studies among Diabetics and Controls.

Study	Diabetics	Controls
Klein[6]	2.79	3.19
Sultan[7]	3.68	3.74
Muhammad Irfan et al.[8]	2.46	2.82
Sanjeev Verma et al.[9]	2.12	2.45
Dharwadkar[10]	1.74	1.88
Present study	**2.46**	**2.99**

Table VI:- Comparison of FEV1 with other Studies among Diabetics and Controls.

Study	Diabetics	Controls
Klein[6]	2.17	2.49
Sultan[7]	3.12	3.13
Muhammad Irfan et al.[8]	2.04	2.29
Sanjeev Verma et al.[9]	1.93	2.20
Dharwadkar[10]	1.16	1.68
Present study	2.05	2.49

Table VII:- The effect of Duration of Diabetes Mellitus on $FEV_{1.}$

	Duration	Diabetics	Controls
Present study	<5 years (n=22)	1.95	2.43
	>5 years (n=28)	2.25	2.43
Sultan[7]	<5 years (n=50)	2.13	3.13
	5-12 years (n=50)	2.74	3.13
	>12 years (n=50)	2.53	3.13

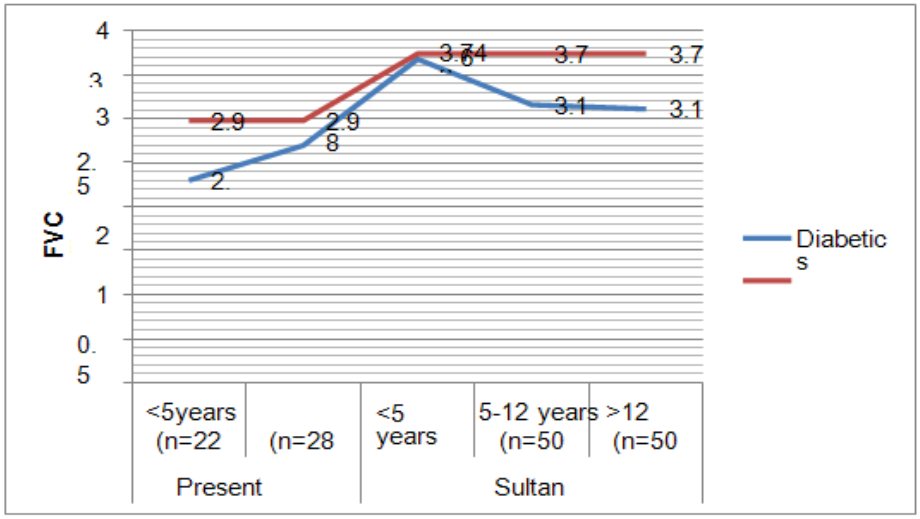

Figure I:- The effect of duration of diabetes mellitus on FVC (litres) showing comparison of our study with Sultan's. n = number of subjects.

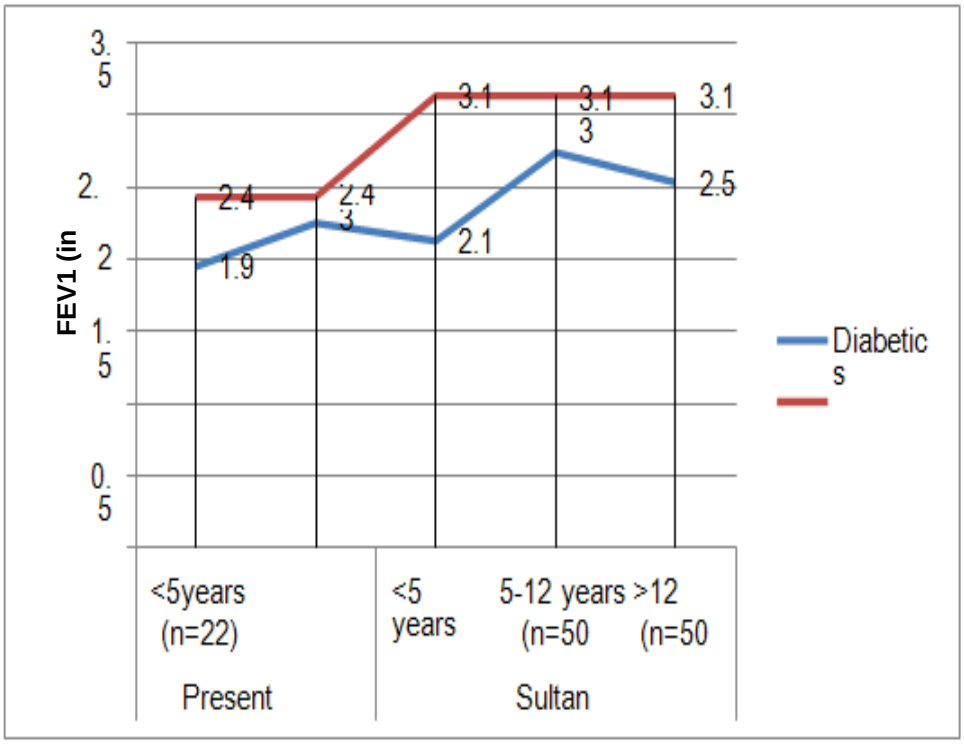

Figure II:- The effect of duration of diabetes mellitus on FEV1(litres) showing comparison of our study with Sultan's. n = number of subjects.

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