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RESEARCH ARTICLE

SPIROMETRIC EVALUATION OF PULMONARY FUNCTION IN PATIENTS WITH TYPE 2 DIABETES MELLITUS (T2DM)

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Abstract

Objective: To study the ventilatory function of individuals with T2DM by performing spirometry and to find its correlation with duration of T2DM and other diabetic microvascular complications.

Methods: 100 T2DM patients attending the OPD and indoor of SGRDIMSR, Amritsar were included in the study. Patients with history of smoking, acute or chronic lung disease, any cardiovascular illness or thoracic cage abnormality were excluded from the study. After evaluating the patients for various anthropometric measurements and diabetic microvascular complications, patients were subjected to spirometry and the results were analysed.

Results: The overall prevalence of restrictive lung disease in the T2DM population was found to be 82% (males 80.9% and females 82.7%). It was observed that diabetic patients had significantly reduced FVC (1.52 ± 0.70 litres) and FEV1 (1.45 ± 0.65 litres) and increased FEV1/FVC ratio (95.4 ± 1.0)

Conclusions: This study observed a significant correlation between T2DM and restrictive pattern of pulmonary function. The decline in pulmonary function also correlated with the duration of diabetes and the severity of other microvascular complications.

Introduction:-

Diabetes Mellitus (DM) refers to a group of a common metabolic disorders that share the phenotype of hyperglycemia.[1] Global prevalence of Type 2 Diabetes Mellitus is expected to double in the period between 2000 and 2025 and may reach a level of almost 500 million patients.[2] The rapid urbanization, change in the lifestyle coupled with ethnic susceptibility has increased the incidence of T2DM.[3] This globally important condition needs to be understood with a proper perspective to deliver effective strategies to the individual and also the population.

The diabetic disease seems to hit the pulmonary microcirculation as any other organ by increasing vessel wall thickness and impairing gas exchange, which leads to a measurable loss of function and respiratory efficiency.[4] However, because of its large reserve, substantial loss of the microvascular bed can be tolerated without developing dyspnoea. As a result, pulmonary diabetic microangiopathy may be under-recognized clinically.[5] In this situation, the application of spirometry must be utilized to rule out pulmonary involvement as a complication of long standing T2DM.

Aims and objectives:-

To study the ventilatory function of individuals with T2DM by performing spirometry and to find its correlation with duration of T2DM and other diabetic microvascular complications

Material and methods:-

The study comprised of 100 patients attending the OPD and indoor of SGRDIMSR, Amritsar. Detailed medical, personal and past history along with a written consent was obtained from each patient. A thorough general physical and systemic examination was performed on all patients.

Inclusion criteria

All patients presenting to OPD and indoor of SGRDIMSR, Sri Amritsar, who were proved cases of T2DM according to American Diabetes Association guidelines.

Exclusion criteria:-

The subjects with a history of smoking, COPD, chronic bronchial asthma, pulmonary tuberculosis, connective tissue disease or musculoskeletal disorder, any acute cardiovascular or respiratory illness or any chest X-ray abnormality were excluded from the study

The blood glucose levels, HbA1C, complete lipid profile (after 8-12 hour fasting), spot urine microalbumin was measured. ECG and Chest X-ray of each patient was done. The patients were then subjected to spirometry by MicroLab 3300 Spirometer, and the results were analysed by unpaired t-test and ANOVA.

Observations:-

It was observed that out of 100 T2DM patients studied, 82 % (n=82) had restrictive lung function while 18% (n=18) had normal pulmonary function. Out of these 82 patients, 26% (n=21) had mild restriction, 32% (n=27) had moderate restriction, and 42% (n=34) patients had severe restriction [Figure 1]. Among the 100 patients studied, 58% (n=58) were females and 42% (n=42) were males. The prevalence of restrictive lung function was observed to be 82.7% (n=48) in females and 80.9% (n=34) in males. [Figure 2]. A mean duration of DM of 3.56 ± 2.32 years was associated with mild restriction, a mean duration of DM of 4.56 ± 4.01 years with a moderate restriction whereas a mean duration of DM of 8.03 ± 5.04 years was associated with severe restriction [Figure 3]. A mean HbA1C of 9.24 ± 2.02 was observed in the study group, with a mean of 9.10 ± 2.33 in patients with mild restriction on pulmonary function, and a mean HbA1C of 9.47 ± 2.33 in patients with severe restriction. A decline in pulmonary function was observed in patients with poor glycemic control, though the association was not statistically significant (P-0.886) [Figure 4]. A mean BMI of 27.8 was observed in patients with abnormal pulmonary function, as compared to a mean BMI of 25.2 in patients of T2DM with normal pulmonary function which was statistically significant ($P<0.05$) [Figure 5]. 16% (n=3) patients with retinopathy had normal spirometry, whereas 84% (n=49) had abnormal spirometry. The frequency of retinopathy correlated with the severity of restrictive lung function with 52% (n=27) patients with retinopathy having severe restriction ($P < 0.001$) [Figure 6]. 10% (n=6) patients with neuropathy had normal spirometry, whereas 90% (n=55) had abnormal spirometry. The frequency of neuropathy correlated with the severity of restrictive lung function with 50% (n=30) patients with neuropathy having severe restriction ($p < 0.001$) [Figure 7]. The degree of proteinuria correlated with the severity of restriction. The majority of patients i.e. 76% (n=76) had microalbuminuria range of proteinuria, out of which 37% (n=28) also had severe restriction on spirometry. 12 patients had macroalbuminuria range of proteinuria, out of which 50% (n=6) had severe restriction on spirometry [Figure 8].

Figure 1: Spirometry results

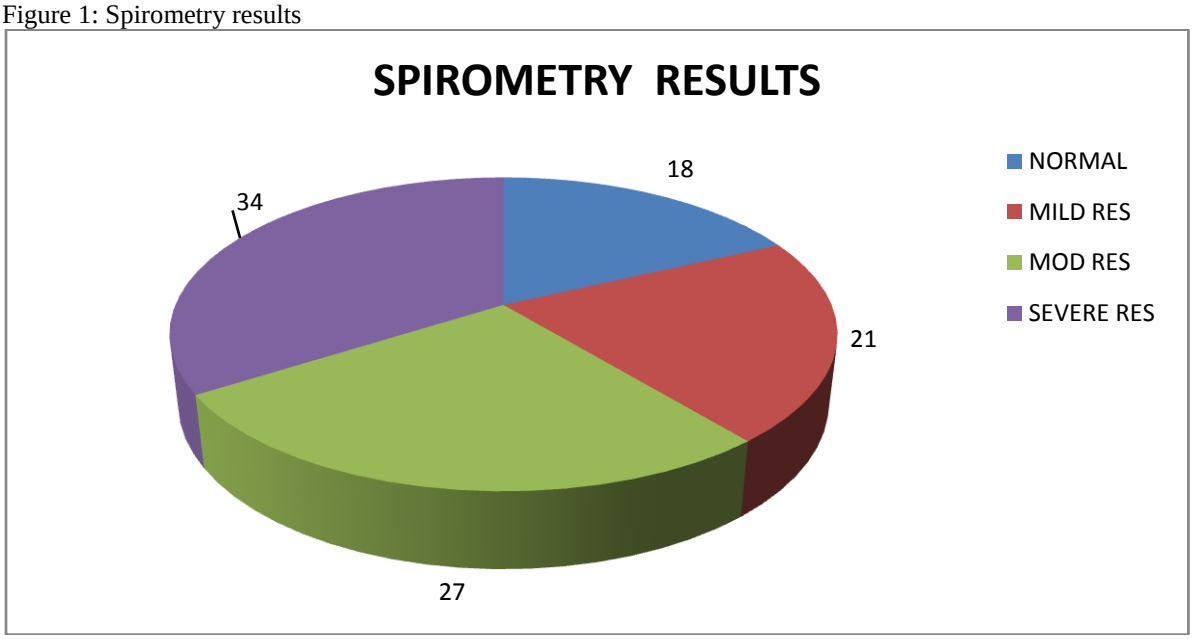


Figure 2: Pie chart showing sex distribution

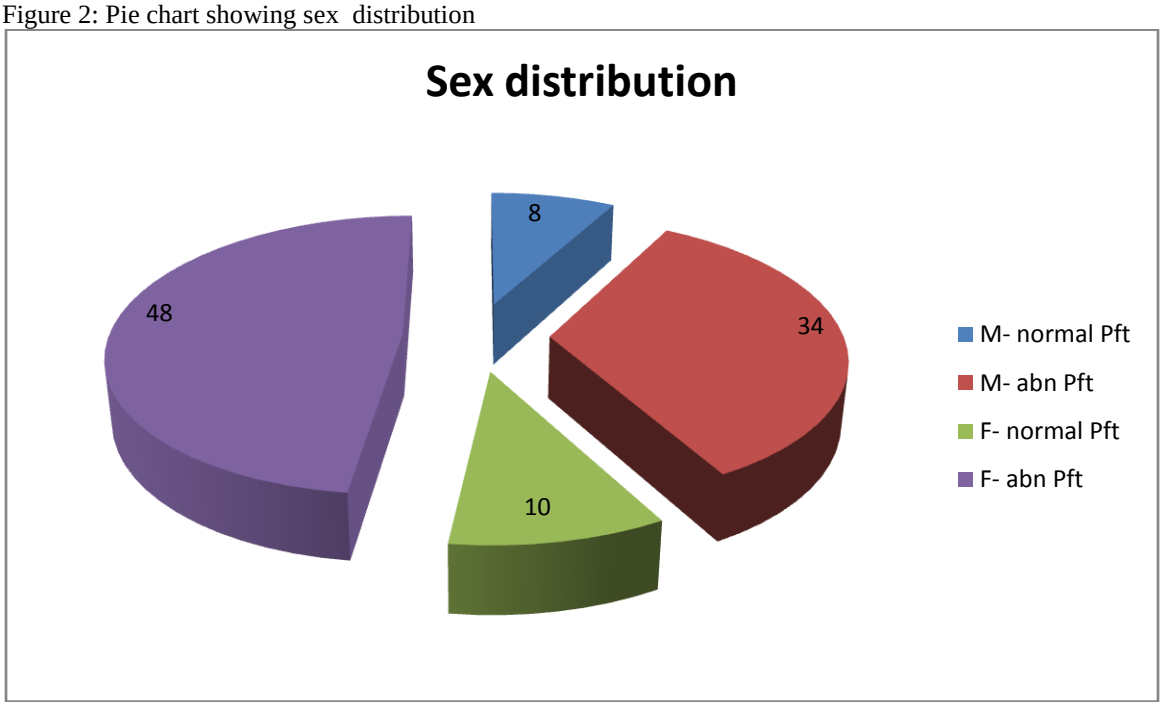


Figure 3: Correlation of PFT results with Duration of Diabetes

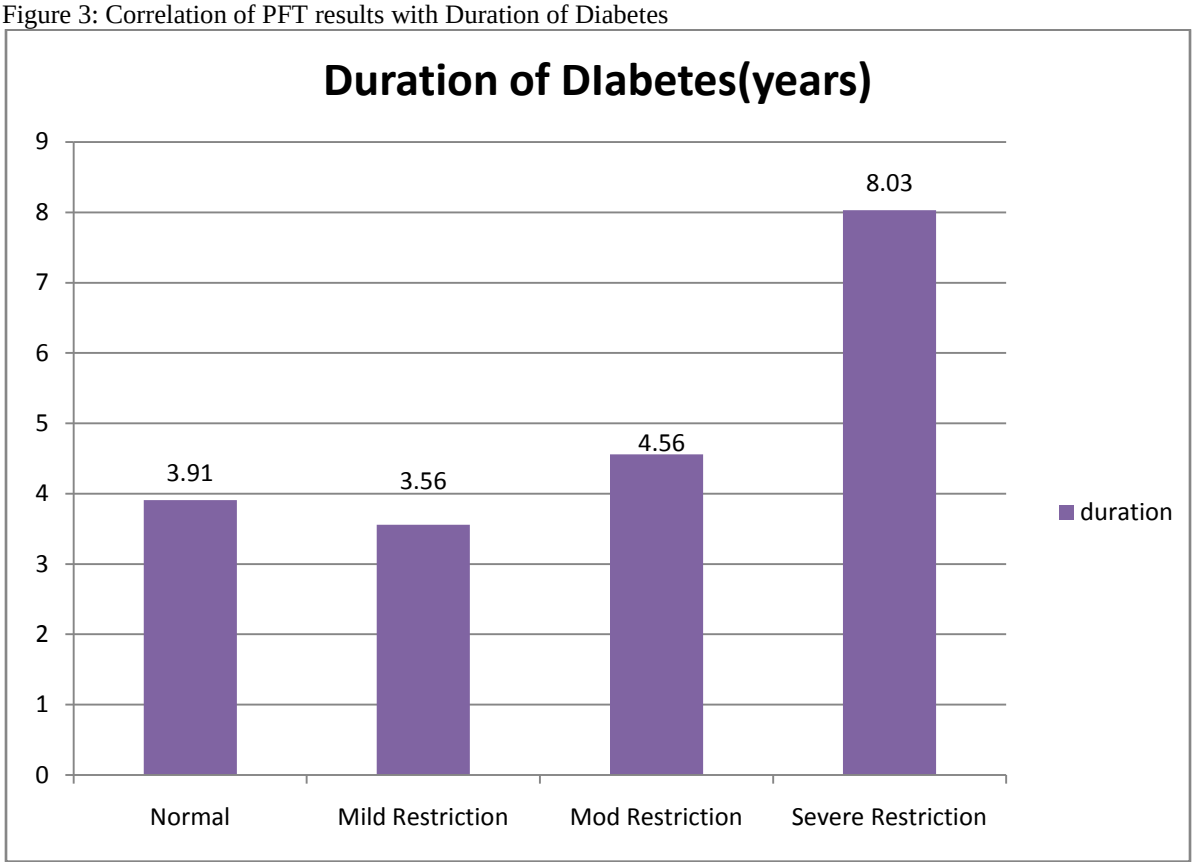


Figure 4: Correlation of spirometry results with HbA1C

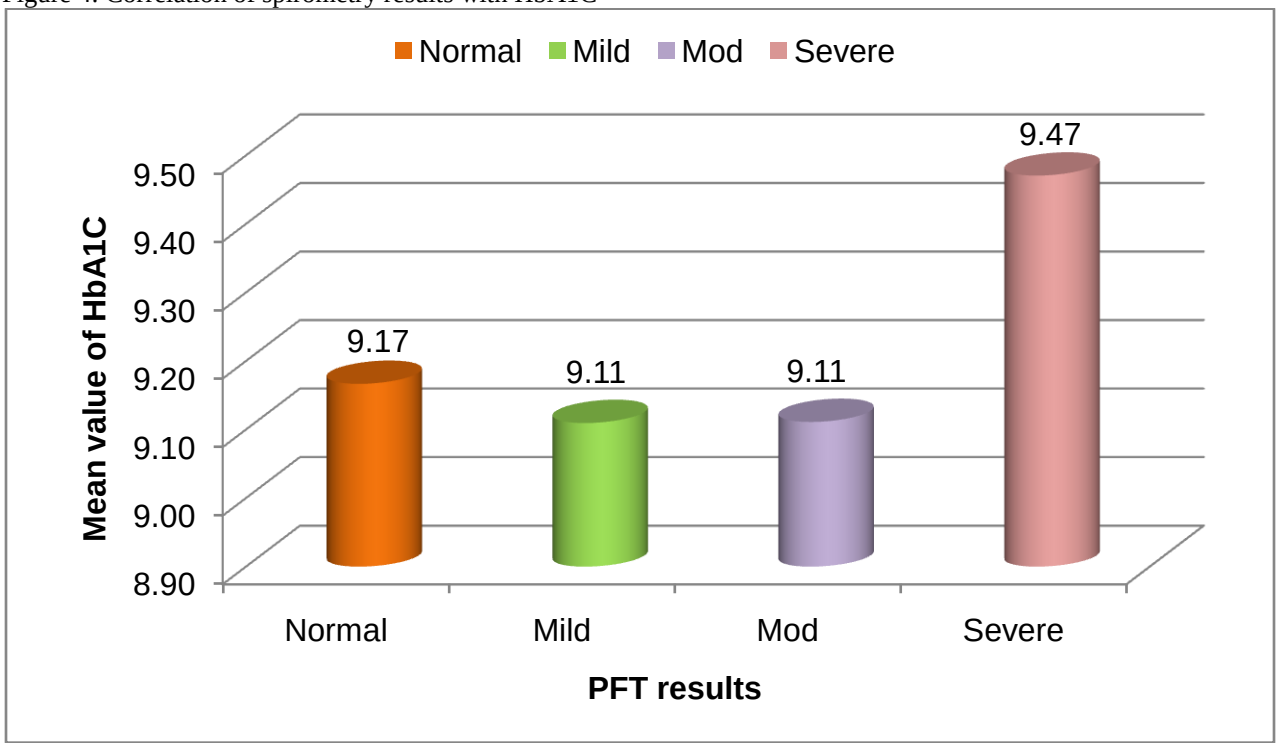


Figure 5: Correlation of spirometry results with BMI

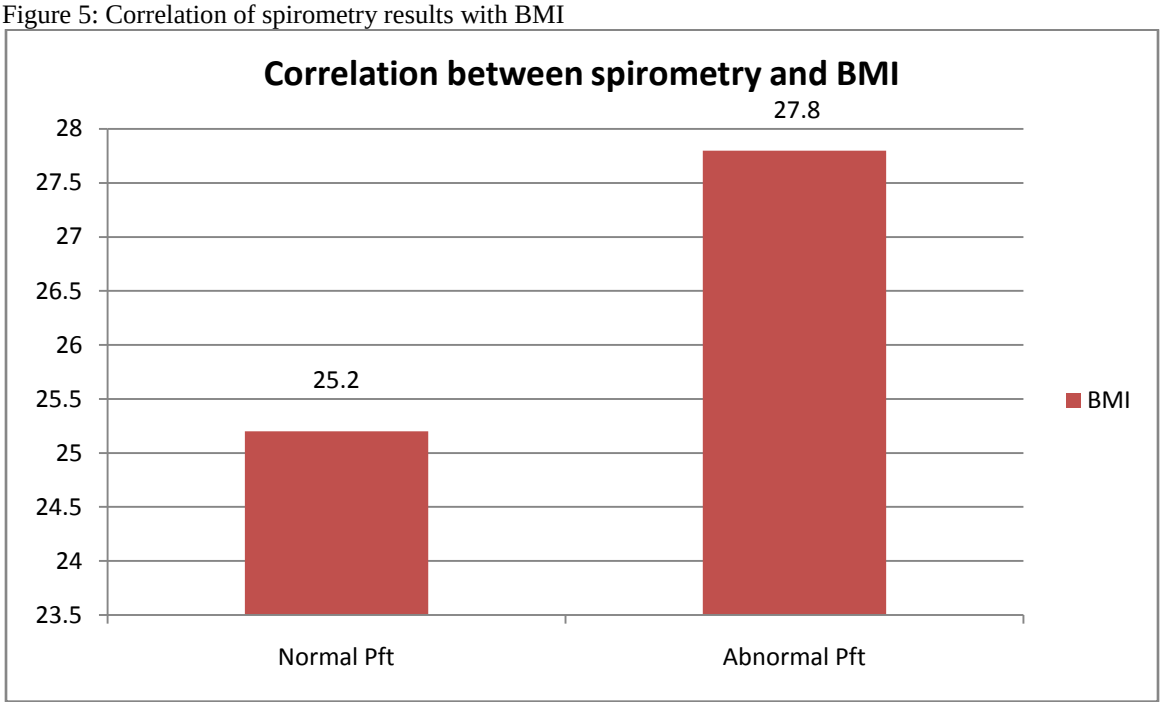


Figure 6: Correlation of spirometry results with retinopathy

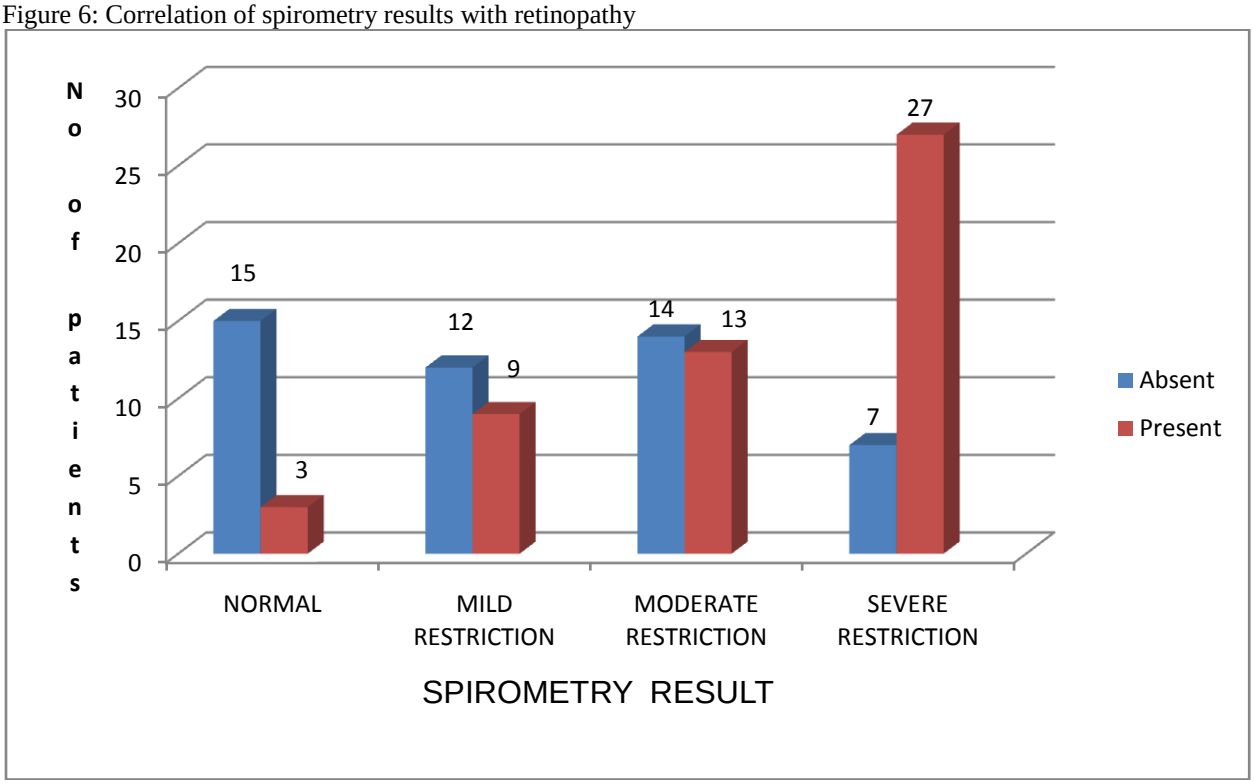


Figure 7: Correlation of spirometry results with neuropathy

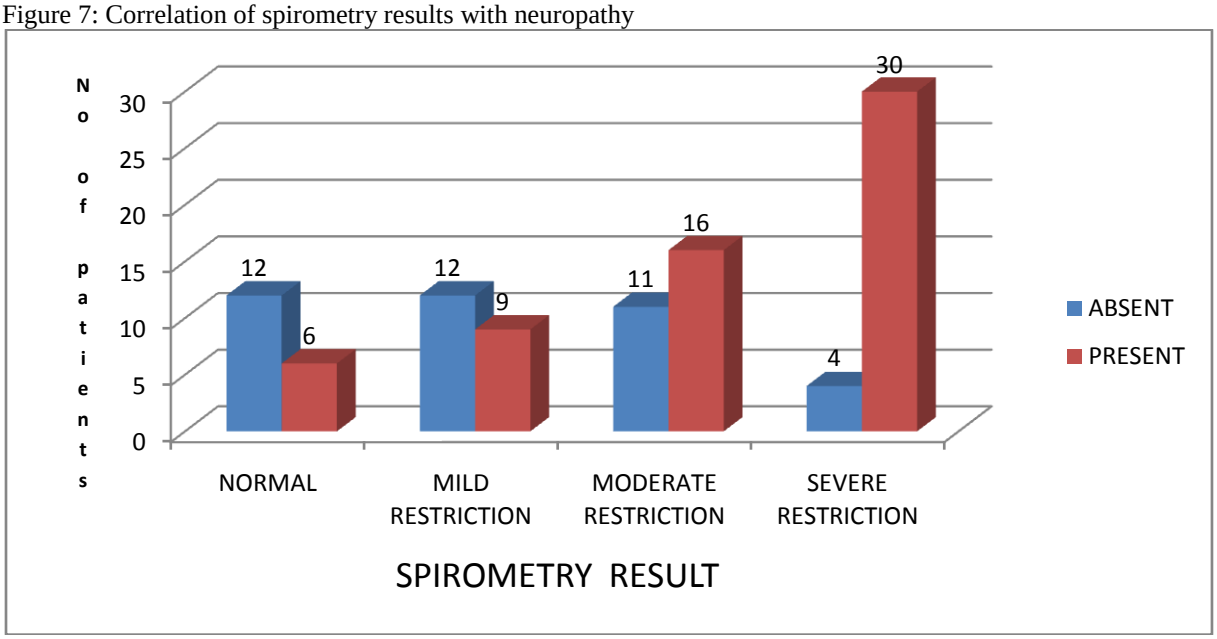
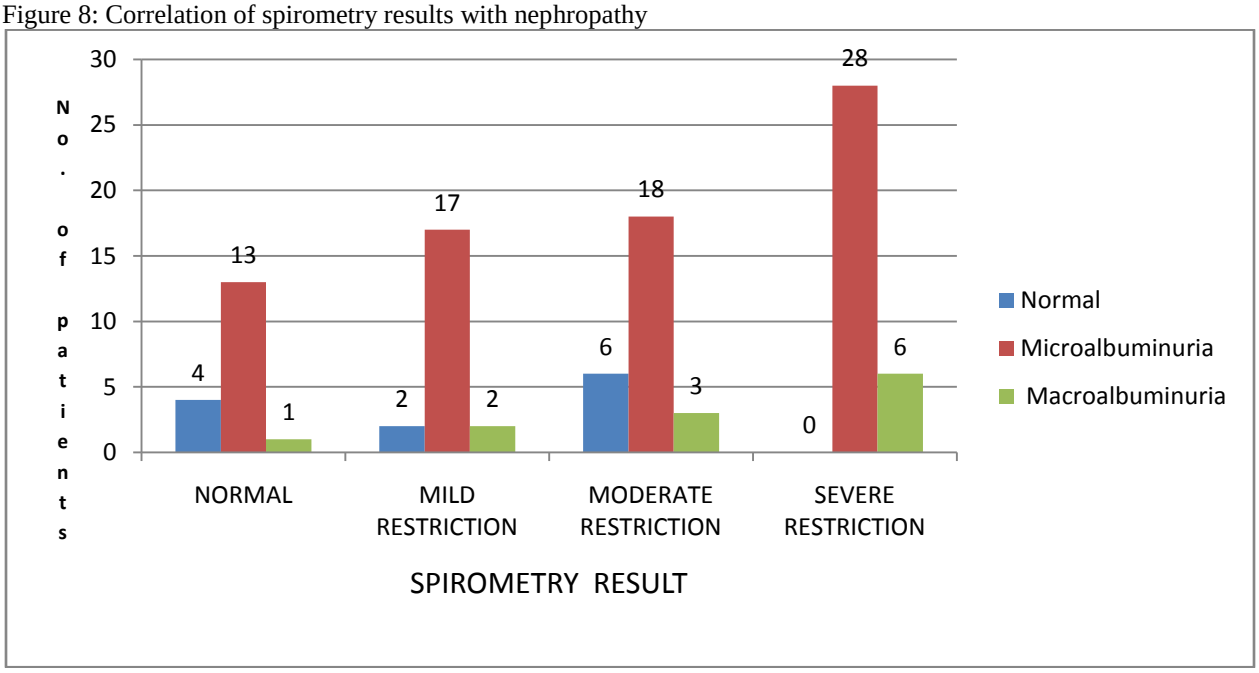


Figure 8: Correlation of spirometry results with nephropathy



Discussion:-

The present study observed an overall prevalence rate of restrictive lung function of 82 % (n=82) in T2DM patients. Restrictive lung function is significantly correlated with variables like age, BMI, duration of DM, poor glycemic control and other diabetic microvascular complications. The prevalence of restrictive lung function reported by different workers in different areas varies considerably with each other. The prevalence of this study is comparable to the study done by Yadav A et al, where it was reported to be 73% (n=22); Adeyeye O et al in Nigeria also observed 38% (n=76) prevalence of restrictive lung defect whereas Dwivedi D et al in Maharashtra observed 10% (n=10) prevalence of restrictive lung defect.[6,7,8,] The higher prevalence noted in present study can be attributed to longer duration of diabetes and its complications.

A slight female preponderance was observed in the present study, with 58% females and 42% males. This was similar to the observation made by Dwivedi D et al, Azeem A et al and Pawar D et al, which may be attributed to various risk factors including anthropometric parameters, dietary, and sedentary lifestyle seen in females.[8,9,10]

A significant correlation between duration of DM and the pulmonary function restriction was observed in the present study. A mean duration of DM of 3.56 ± 2.32 yrs, 4.56 ± 4.01 yrs, 8.03 ± 5.04 yrs was associated with mild, moderate, severe restriction respectively. Similarly, Dwivedi D et al noticed that the patients with recently diagnosed DM had normal pulmonary function but as the duration of DM increased, an increasing number of patients were found to have abnormal pulmonary function.[8] Sinha S. et al also observed that patients with a mean duration of DM of 2.8 years did not have any evidence of microvascular complications whereas patients with longer mean duration of DM (10.2 years) were associated with the presence of other microvascular complications, and an abnormal pulmonary function.[11] Yadav A et al observed a mean FVC, FEV1 of 1.54 ± 0.23 and 1.36 ± 0.31 in <5 yrs duration of DM, which declined to 0.94 ± 0.28 and 0.81 ± 0.20 respectively in patients with duration of DM > 15 yrs.[6]

A mean HbA1C of 9.24 ± 2.02 was observed in the present study. A decline in pulmonary function correlated well with poor glycemic control evident by a rising HbA1C, though this correlation was not statistically significant (P-0.886). This observation was supported by studies conducted by Celik P et al, Sinha S et al, Pawar D et al in which a higher HbA1C level was associated with nonsignificant decline in pulmonary function (P>0.05). This could be explained by the fact that HbA1C is a predictor of short term diabetic control over last 3 months, and may not correlate with the long term complications.[10,11,12]

A significant correlation was also established between BMI and pulmonary function, which may be due to reduced chest wall compliance because of obesity. In the present study, a mean BMI of 27.8 was observed in patients with abnormal pulmonary function, as compared to a mean BMI of 25.2 in patients of T2DM with normal pulmonary function which was statistically significant (P<0.05). As supported by study conducted by Sinha S et al who observed a statistically significant correlation between mean BMI of 25.2 ± 2.9 in patients with diabetic complications as compared to a BMI of 24.7 ± 3.5 in patients of T2DM without any complications(P<0.05).[11] Whereas, Pawar D et al and Dharwadkar A et al noticed an insignificant difference between mean BMI in T2DM patients and controls (P> 0.05).[10,13]

In the present study, the mean FVC (litres) was measured to be 1.52 ± 0.70, which was 56.68 ± 18.95% of the predicted FVC value. The mean FEV1 (litres) was measured to be 1.45 ± 0.65 which was 65.56 ± 23.00% of the predicted FEV1 value. These observations are comparable to study conducted by Yadav A et al who observed in DM patients, a mean FVC of 1.44 ± 0.51, and mean FEV1 of 1.29 ± 0.46, which were significantly lower than predicted (P-0.001).[6] El Azeem A et al observed a mean FVC of 2.00 ± 0.20 and FEV1 of 1.70 ± 0.10 in DM patients, which was significantly lower as compared to controls (P-0.01).[9] Adeyeye O et al also measured the mean FVC of 2.03 ± 0.76, and mean FEV1 of 1.61± 0.62, which were significantly lower than predicted (P-0.001).[7] A mean value of FEV1/FVC of 95.4 ± 1.0 was observed in the present study, which is >70. Similar observations were also made by Pawar D et al, Yadav A et al and Azeem A et al who observed a mean value of FEV1/FVC of 100.05 ± 7.32, 89 ± 1.39 and 85.1 ± 0.1 respectively.[6,9,10]

The present study also observed a highly significant association between the severity of restrictive defect on pulmonary function and retinopathy (P<0.001). 52% (n=27) of patients with retinopathy had severe restrictive defect on pulmonary function, while only 6% (n=3) had normal pulmonary function. Similarly, Cilek P et al observed that patients with retinopathy had a mean FVC and FEV1 of 2.86 ± 0.76 and 2.46 ± 0.78, as compared to 3.18 ± 0.98 and 2.37 ± 0.66 respectively in patients without retinopathy.[12] The present study also observed a highly significant (P<0.001) association between the severity of restrictive defect on pulmonary function, and neuropathy. 50% (n=30) of the patients with neuropathy also had severe restrictive defect on pulmonary function.

In the present study, a significant correlation was established between the decline in pulmonary function and the grade of proteinuria (P<0.05). Shafiee G. et al also noticed a similar result as evident by FVC of 1.64 and FEV1 of 1.62 in patients without nephropathy and FVC of 1.23 and FEV1 of 1.35 in diabetic patients with nephropathy (P<0.05).[14] Singh J et al also observed a significant correlation between pulmonary function and nephropathy (P-0.01). They observed a mean FVC (%predicted) and FEV1 (%predicted) of 71.73 ± 18.79 and 68.67 ± 18.81 in patients with albuminuria, as compared to 81.30 ± 16.53 and 79.00 ± 12.47 respectively in patients without

albuminuria.[14] These studies signify the involvement of pulmonary microvasculature in correlation with renal microvasculature as a consequence of long term diabetes. However, in a study conducted by Pinar Cilek, a nonsignificant correlation between pulmonary function and nephropathy was found ($P>0.05$).[12]

Conclusion:-

Thus, it can be summarized that diabetes leads to a significant involvement of pulmonary microvasculature which is evident in the form of restriction of pulmonary function. This restriction correlated well with longer duration of DM as well as other microvascular complications, thus pointing towards a common pathogenetic mechanism. Thus, pulmonary involvement in the form of restrictive defect can also be considered as another important diabetic microvascular complication. There is a need for periodic assessment of the pulmonary function in DM and spirometry remains a simple, cost effective and non-invasive diagnostic tool. Its judicious application can be useful as a predictor of diabetic microvascular complications and thus timely intervention can be helpful in delaying the disease progression and complications.

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