Correlation of duration of diabetes and pulmonary function tests in type 2 diabetes mellitus patients.

Kanya Kumari DH*, Nataraj S M, Devaraj H S

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ABSTRACT

Objectives and background – Diabetes Mellitus (DM) is a metabolic disorder precipitating micro vascular, macro vascular complications and peripheral vascular diseases. Less has been known about the after effects of diabetes on lungs. So this work was carried out to know the relation between duration of diabetes and pulmonary function tests (PFT) in Type 2 DM patients. Normal lung mechanism and gas exchange are influenced by integrity of pulmonary connective tissues and microvasculature. Abnormality in either of these two structural components of lung leads to development of variations in lung functions. Method– The study group consists of 90 patients with different durations of diabetes (age, sex, height, weight matched). PFT were measured by Medspior. The data was statistically analyzed by using cross tabs procedure (contingency coefficient test), descriptive statistics, Chi square test. Results and conclusion– Among 90 patients 70 had restrictive, 12 had obstructive and remaining 8 had normal spirometric pattern. Even though Type 2 diabetic patients did not have any respiratory symptoms they did have underlying sub clinical restrictive patterns of lung functions. Type 2 Diabetes mellitus is associated with restrictive pattern of respiratory abnormality. As the duration of diabetes increases the restrictive profile is more prominent. Spirometry remains a cost effective, a simple non-invasive diagnostic tool and its judicious use can give warning signal for patients to take early preventive measures.

1. Introduction

Diabetes mellitus is accompanied by widespread biochemical, morphological and functional abnormalities which may precipitate certain complications that may affect neural, cardiovascular, renal systems and also organs and tissues like skin, liver, collagen and elastic fibers. Thus diabetes is a multisystem disorders that affect many organs of the body [1].

Western influence has lead to loss of physical activity and changes in food pattern from traditional unprocessed natural ingredients to highly refined energy dense fatty and sugary fast foods. These two core factors will be responsible for the high incidence of Diabetes in the years to come [2]. The micro vascular complications appear early within 5 to 10 years and macro vascular complications appear within 15 to 20 years from the onset of diabetes [3]. Pulmonary functions are reduced in type 2 DM and duration of diabetes has more influence on pulmonary functions than glycemic control [4].

If diabetes is detected early and adequate steps are taken, it may be possible to significantly delay the occurrence of complications and there after their progression. Although a lot of research work is being carried out on the after effects of Diabetes Mellitus on pulmonary parameters worldwide, the literature pertaining to this is not in abundance in India. Therefore this study was undertaken to find out the correlation between duration of DM and PFTs in patients who attended or admitted to medical OPD or wards of J.S.S Medical College, Mysore.
2. Materials and Methodology

Ninety diabetic patients previously diagnosed, belonging to either sex attending / admitting to OPD/wards of J S S Medical College Hospital, Mysore were studied.

Patients were classified into three groups A, B, C depending on the duration of diabetes.

Group A consists of diabetes with duration of up to 5 years.

Group B consists of diabetes with duration of 6 to 10 years.

Group C consists of diabetes with duration of 11 to 15 years.

Inclusion criteria – Previously diagnosed Diabetic patients, non-smokers, with no previous history of any respiratory and cardiovascular diseases.

Exclusion criteria – Smokers, non-diabetics, patients with previous/present cardio respiratory diseases.

Pulmonary functions were carried out using the instrument Medspiror (a computerized spirometer self calibrating, which fulfills the criteria for standardized lung function tests) available in the Department of Physiology, J S S Medical College Hospital, Mysore.

2.1. Methodology

Diabetic patients of different durations were selected carefully using criteria laid down. Their written consent was taken. The history was elicited. Age, height, weight were recorded.

Thorough clinical examination was carried out. The performance of the pulmonary function tests was demonstrated. Patients were made to undergo pulmonary function tests using Medspiror, for 3 times at every 15 minutes interval and best of 3 readings was taken.

The Forced Vital Capacity (FVC), Forced Expiratory Volume at the end of one second (FEV1), Peak Expiratory Flow Rate (PEFR), FEV1/ FVC ratio, Forced Expiratory Flow (FEF 25–75%) were recorded. Cross tabs procedure, descriptive statistics, Chi square test were applied for the present study.

3. Results

Samples are age, sex, height and weight matched. Among 90 patients 70 had restrictive, 12 had obstructive and remaining 8 had normal spirometric pattern.

Table No. 1 : Comparison between actual value and predicted values of Pulmonary Function Tests (PFT) in group A [Duration of diabetes up to 5 years]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>FVC (ltr)</th>
<th>FEV1</th>
<th>FEV1/FVC</th>
<th>PEFR (ltr/sec)</th>
<th>FEF 25-75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>2.30±0.50</td>
<td>1.94±0.46</td>
<td>1.82±0.11</td>
<td>4.70±1.57</td>
<td>2.33±0.90</td>
</tr>
<tr>
<td>Predicted</td>
<td>2.49±0.45</td>
<td>2.00±0.38</td>
<td>0.79±2.95</td>
<td>6.99±1.29</td>
<td>3.41±1.31</td>
</tr>
<tr>
<td>p value</td>
<td>0.01</td>
<td>0.38NS</td>
<td>0.06NS</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Significance</td>
<td>S</td>
<td></td>
<td>S</td>
<td></td>
<td>S</td>
</tr>
</tbody>
</table>

Pulmonary function tests – FVC, FEV1, FEV1/FVC, PEFR, FEF25-75% were recorded along with predicted values. The mean of both the values were compared, and p value determined.

When the actual and predicted values of FVC, FEV1, FEV1/FVC, PEFR and FEF25-75% were compared, p values obtained were 0.01, 0.38, 0.06, 0.00 and 0.00 respectively.

Table No. 2: Comparison between actual value and predicted values of PFT in group C patients (Duration of diabetes 11 – 15 yrs)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>FVC (ltr)</th>
<th>FEV1</th>
<th>FEV1/FVC</th>
<th>PEFR (ltr/sec)</th>
<th>FEF 25-75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>2.08±0.61</td>
<td>1.71±0.54</td>
<td>0.81±0.11</td>
<td>5.01±2.03</td>
<td>2.16±1.14</td>
</tr>
<tr>
<td>Predicted</td>
<td>2.42±0.53</td>
<td>1.85±0.45</td>
<td>0.74±0.10</td>
<td>6.53±1.28</td>
<td>2.71±0.85</td>
</tr>
<tr>
<td>p value</td>
<td>0.00</td>
<td>0.09</td>
<td>0.01</td>
<td>0.00</td>
<td>0.023</td>
</tr>
<tr>
<td>Significance</td>
<td>S</td>
<td>NS</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>

When actual and predicted values of FVC, FEV1, FEV1/FVC, PEFR and FEF25-75% were compared and values obtained were 0.00, 0.09, 0.01, 0.00, and 0.02 respectively.

Table No. 3: Comparison between actual value and predicted values of PFT in group C patients (Duration of diabetes 11 – 15 yrs)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>FVC (ltr)</th>
<th>FEV1</th>
<th>FEV1/FVC</th>
<th>PEFR (ltr/sec)</th>
<th>FEF 25-75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>2.05±0.57</td>
<td>1.65±0.42</td>
<td>0.82±2.90</td>
<td>4.35±1.63</td>
<td>2.13±0.76</td>
</tr>
<tr>
<td>Predicted</td>
<td>2.45±0.45</td>
<td>1.86±0.37</td>
<td>0.76±2.90</td>
<td>6.48±1.69</td>
<td>2.78±0.36</td>
</tr>
<tr>
<td>p value</td>
<td>0.00</td>
<td>0.01</td>
<td>0.03</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Significance</td>
<td>S</td>
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</tr>
</tbody>
</table>

When the actual and predicted values of FVC, FEV1, FEV1/FVC, PEFR, and FEF25-75% were compared, the p value obtained were 0.00, 0.01, 0.03, 0.00, and 0.00 respectively.

4. Discussion

The complications of diabetes on different organs are well known. Of late even the involvement of respiratory system has also been proved by many researchers, with changes in pulmonary volume, diffusion and elastic properties of lungs as well as the performances of the respiratory muscles leading to restrictive pattern in pulmonary functions. Non enzymatic glycosylation induced alteration of lung connective tissue is the most likely underlying mechanism [5]. The study by David. A Kaminsky in 2004 speculates that abnormal lung function may precede the diagnosis of diabetes, suggesting that lung may contribute to or at least be commonly affected by factors involved in the pathogenesis of diabetes. A total 125 patients were studied. Key finding was that the average rate of decline of FEV1 was 71ml/year compared with an expected decline in healthy, non smokers of 25-30 ml / year. An increase in 1% mean HbA1C was associated with decrease of 4% predicted FVC [6]. Table no: I, II, III show the effect of duration of DM on FVC in group A, B and C respectively.

In group A, FVC showed a significant fall ( p<0.05) from mean values of 2.45± 0.45 to 2.30± 0.05, amounting to 8.26% from predicted value.
In group B, FVC showed a significant fall (\(p<0.01\)) from mean values of 2.42 ± 0.53 to 2.08 ± 0.61, amounting to 16.35% from predicted value.

In group C, FVC showed a significant fall (\(p<0.01\)) from mean values of 2.45 ± 0.45 to 2.05 ± 0.57, amounting to 19.51% from predicted value.

Hence there is a decrease in FVC from 8.26% in group A to 16.35% in group B to 19.51% in group C.

In a study by Davis A. Wendy et al., there was a decrease in mean FVC values as the duration of DM increased. In their study the annual rate of fall in FVC was 68 ml [7]. In a study by Robert E. Walter et al., there was a progressive decrease in mean FVC values by 109 ml/year [8]. A study by Timothy M.E Davis, showed there was an average decrease of 9.5% in mean FVC values in diabetics [4].

In our study also there was a progressive decrease in mean FVC values as the duration of diabetes increased.

4.1. Effect of duration of DM on FEV1

There is a decrease in FEV1 in group A to B to C with mean values of 1.94 L, 1.71 L and 1.65 L with increase in percentage reduction of 3.09 to 8.19 to 6.06. Hence Type 2 DM has minimal effect on FEV1 in group A and B. In a study of Robert E. Walter et al., there was a decrease in FEV1 by 27 ml/year.

In a study by Davis A. Wendy the decrease in FEV1 was at an annual rate of 71 ml/year.

In DM, there is a thickening of alveolar epithelium and pulmonary capillary basal lamina leading to pulmonary microangiopathy, reduced pulmonary elastic recoil due to non-enzymatic glycosylation of connective tissue reducing the FEV1.

4.2. Effect of duration Type 2 DM on FEV1 /FVC

When FEV1 / FVC was reviewed in all the groups, the actual values were higher than the predicted values by 3.75%, 8.6% and 7.3% (\(p<0.05\)) suggestive of restrictive pattern in all the three groups. In a study by Robert E. Walter the ratio was increased by 1.5% in diabetics which was statistically significant.

4.3. Effect of duration of Type 2 DM on PEFR

When PEFR values were reviewed in all the groups, there was an absolute decrease in the mean values compared to predicted values which was statistically significant (\(p<0.01\)). But there was no change as the duration of diabetes increased indicative for restrictive pattern.

In a study by Timothy ME. Davis, there was a average decrease in mean value of PEFR by 9.5%.

As per the study of Sreeja et al., the decrease in PEFR was 267.65L/sec.

Both studies are showing obstructive pattern, whereas our study is showing restrictive pattern.

4.1. Effect of duration of DM on FEV1

When FEF25-75% were reviewed in all the three groups, there was decrease in the mean values as compared to predicted values (\(p<0.01\)) which was statistically significant.

As per the study of Sreeja et al., there was a decrease in FEF25-75% by 2.45 ± 0.55, so our results coincide with the same.

5. Conclusion

1. Even though Type 2 diabetic patients did not have any respiratory symptoms they did have underlying subclinical restrictive patterns of lung functions.
2. Type 2 Diabetes mellitus is associated with restrictive pattern of respiratory abnormality.
3. As the duration of diabetes increases the restrictive profile is more prominent.
4. Spirometry remains a cost effective, a simple non-invasive diagnostic tool and its judicious use can give warning signal for patients to take early preventive measures.

6. References

7. Davis WA, Matthew Kniumann, Peter Kendall et.al., Glycemic exposure is associated with reduced Pulmonary Function in Type2 Diabetes. The Fremantle Diabetes Study Diabetes Care, 2004; (27): 752-757.