Effect Of Diabetes Mellitus On Spirometry

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INTRODUCTION
Diabetes Mellitus is a disease affecting multiple organs. It is defined as having a fasting plasma glucose of ≥126 mg/dl (7.0 mmol/l) confirmed by a 2-h plasma glucose value of ≥200 mg/dl (11.1 mmol/l) in an oral glucose tolerance test (OGTT), or a hemoglobin-A₁C of ≥ 6.5%, or a plasma glucose of ≥200 mg/dl (11.1 mmol/l) in patients with severe hyperglycemia such as those who present with severe classic hyperglycemic symptoms or hyperglycemic crisis. Currently, Indian figures put the numbers at 62 million, with a trend towards epidemic proportions. It has been proven that lifestyle predispositions, like sedentary work situations, high fat diet leading to obesity, along with a higher genetic compredisposition for the disease are few of the factors leading to a rapid increases in the numbers of affected individuals. It is also striking to note that DM is starting to ‘appear’ earlier and in younger populations when compared to other countries.

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ABSTRACT
BACKGROUND: Diabetes mellitus (DM) is a chronic disease whose prevalence is on the rise in the world. In India alone, the prevalence is increasing, reaching up to epidemic proportions. The effect of DM on organs such as the eye, kidney, brain and heart has been extensively studied in the past.
OBJECTIVE: This study aims to find whether or not the functional vital capacity (FVC), forced expiratory volume in the first second (FEV₁), peak expiratory force rate (PEFR) and forced expiratory force 25-75% (FEF₂₅-₇₅%) in diabetics differs from normal adults along with correlating body mass index (BMI) of these patients. RESULTS: 25 patients of DM with a median age of 56 years (range 35-77 years) performed spirometry. Their results were compared with the measurements from 25 normal adults (control group) with a median age of 55 years (range 36-70 years). It was found that the FEV₁ and PEFR values were significantly lower in diabetics (p < 0.05) while the FVC and FEF₂₅-₇₅% were also lower in diabetic patients, although not clinically significant (p > 0.05). CONCLUSION: Diabetes mellitus definitely affects pulmonary functions, having lower results for FEV₁ and PEFR that are clinically significant.

Keywords: diabetes, spirometry, FVC, FEV₁, PEFR

INTRODUCTION
While several studies have been done regarding effects on diabetes mellitus on organs such as the eye (retina and lens), heart, kidneys, etc., a few studies have also shown how diabetes affects the lungs, outlining the need for spirometry in diabetics. To the best of the author’s knowledge, not many studies have been conducted which can compare pulmonary function test measurements in patients of DM with those in normal (control) adults. This study aims to compare pulmonary function test measurements between diabetics and healthy adults.

MATERIALS AND METHODS
The present study was done at Smt. B. K. Shah Medical Institute & Research Centre & Dhiraj General Hospital, Piparia, Vadodara, Gujarat from July 2010 to December 2010. Subjects were chosen from non smoker patients diagnosed with diabetes attending the diabetes clinic at the hospital for the test group and healthy, non-smoker volunteers visiting the hospital without a diagnosis of DM. Subjects with signs of respiratory illness or acute exacerbations of underlying respiratory diseases were excluded from the group. Every effort was made to reduce variables such as time of the day and each subject was asked to perform spirometry under similar conditions. The
subjects were made to forcefully breathe into a sensor and the recordings were used to gather data for FVC, FEV1, PEFR, FEF 25-75%. At least four measurements were taken to ensure acceptability, of which the best value was chose to represent the pulmonary function. The maneuver with the highest sum of FVC and FEV1 was selected and all parameters were selected from that maneuver except PEFR. For PEFR, the highest value was selected. The p-values calculated by comparing the results between measurements from subjects with DM and those without were used to establish a clinical correlation for a 95% CI (mean ± standard deviation (SD)). A p-value < 0.05 was considered significant.

RESULTS
In the present study 50 male non smoker subjects without any past or present history of respiratory diseases were enrolled, of which 25 were patients with an established diagnosis of DM, and 25 were healthy adults without DM. (table 1).

Table 1- Subject characteristics with anthropometric measurements

<table>
<thead>
<tr>
<th>Patients with DM</th>
<th>Control group (healthy adults)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of subjects (n)</td>
<td>25</td>
</tr>
<tr>
<td>Age (in years)</td>
<td>56 (35-77)</td>
</tr>
<tr>
<td>Height (in cm)</td>
<td>162.84 ± 7.49</td>
</tr>
<tr>
<td>Weight (in kg)</td>
<td>66.24 ± 14.35</td>
</tr>
<tr>
<td>BMI (in kg . m(^{-2}))</td>
<td>24.9 ± 4.43</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD, unless otherwise stated. Age is presented as median (range in years)

Out of 25 diabetics, 2 were obese (BMI > 30), 9 were overweight (BMI 25-29.9), 12 had normal BMIs (18.5-24.9) and 2 were underweight (BMI < 18.4). From the control group out of 25 subjects, 2 subjects were obese, 9 were overweight, 12 were in the normal range and 2 were underweight. In the test group (adults with DM), 7 subjects out of 25 showed FVC < 70% of predicted value, 5 showed FEV1 < 70% of the predicted value, 8 subjects showed PEFR < 70% of the predicted value and 7 showed FEF25-75% < 70% of predicted value. On the other hand, in the control group the only measurements < 70 % of predicted value were in PEFR, with 10 subjects giving values < 70%; all the other functions and results were consistently > 70% of predicted values.

It was found that while the mean difference between the two groups was high across all four measurements- FVC, FEV1, PEFR and FEF25-75% with control group having better measurements than patients of DM, significance (p < 0.05) could be shown for only two of the tests. The mean difference for FVC was 6.51 % of predicted value with a p-value of 0.076, which could be interpreted as significant at p < 0.1. FEV1 measurements showed a mean difference of 7.67% of predicted value, with a p-value of 0.042. PEFR measurements had a p-value of 0.024 with a mean difference of 13.45% of predicted value and FEF25-75% had a mean difference of 1.23% and p-value 0.443 (table 2).

Table 2- Data comparison and p-values

<table>
<thead>
<tr>
<th>Patients with DM</th>
<th>Control group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (% of predicted)</td>
<td>84.97 ± 18.73</td>
<td>91.48 ± 11.39</td>
</tr>
<tr>
<td>FEV1 (% of predicted)</td>
<td>85.97 ± 18.9</td>
<td>93.64 ± 9.79</td>
</tr>
<tr>
<td>PEFR (% of predicted)</td>
<td>81.23 ± 29.4</td>
<td>94.6 ± 13.30</td>
</tr>
<tr>
<td>FEF25-75% (% of predicted)</td>
<td>84.05 ± 30.55</td>
<td>85.28 ± 26.74</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD, FVC: functional vital capacity, FEV1: forced expiratory volume in one second, PEFR: peak expiratory flow rate, FEF25-75%: forced expiratory flow at 25-75%

*p-value significant at < 0.05
†p-value significant at < 0.1

DISCUSSION
The principle finding of this study is that diabetes mellitus has the propensity to affect pulmonary function tests. While a lot of studies have focused on pulmonary function tests in patients of diabetes mellitus, not many studies in India have compared the measurements with a normal population. A study done in 2003 uses healthy controls to correlate pulmonary function with microangiopathic complications, but to the best of the author’s knowledge other such studies haven’t been done in India in the last few years. In this study, the subjects were shown a short demonstration about the procedure of spirometry and instructed regarding the same. They were encouraged to report any discomfort and were given adequate rest time if needed. To ensure that variables were kept to a minimum, the tests were performed in the same room at...
similar times of the day and one subject was required to complete his set of tests on the same day. Subjects or volunteers who had ongoing respiratory complains or an exacerbation of any underlying respiratory condition were excluded from the test. It was found that over all, the respiratory functions of diabetics were worse than that of normal (healthy) adults pointing towards diabetes-related damage to the lungs and/or its supporting structures leading to a decrease in their function when compared to healthy adults. But as this is a cross-sectional study, it would be wise to supplement these findings with those of studies who have followed the respiratory functions of diabetics over a long period of time to ensure that their lung function results are an effect of diabetes mellitus, and to monitor any changes in the results.

Over all, out of the four respiratory function tests performed, it is clear that FEV₁ and PEFR were reduced significantly (p-value < 0.05).

CONCLUSION
It is evident that diabetes mellitus has the ability to decrease lung function in patients, thus affecting their overall health and longevity in the long run, which may also predispose them to other lung diseases. However, other studies that have looked at diabetics in a longitudinal manner should also be factored in when determining the prognosis of lung function in patients.

REFERENCES