Association of HbA1C with Microalbuminuria in Type 2 Diabetes

Abstract

Introduction: Microalbuminuria is often the first sign of renal dysfunction (nephropathy) in diabetes mellitus. The current study was aimed at determining the microalbuminuria levels in type 2 diabetes and to correlate changes in microalbuminuria levels with the glycosylated hemoglobin (HbA1c) levels in type 2 diabetic patients.

Materials and Methods: The study was conducted at the Islamabad Diagnostic Centre, Islamabad, Pakistan. Patients with type 2 diabetes aged between 30-60 years were included in the study. Patients with systemic diseases like cardiovascular diseases, cerebrovascular diseases and urinary tract infection was excluded from the study. Fasting blood samples were used to analyze HbA1c levels for the estimation of diabetic control and subsequently random urine specimens to investigate microalbumin level of all the individuals under study. The statistical software SPSS 19.0 was used for the analysis of the data.

Results: The study showed that microalbuminuria levels were linearly correlated to those of HbA1c levels.

Conclusion: Impaired glycemic control is associated with significant elevations in urinary microalbumin levels which suggest that the monitoring of microalbuminuria levels at the early stages of diabetes can avert and reduce the clinical and economic burden of auxiliary complications (nephropathy etc.) in the developing countries like Pakistan.

Key words: HbA1c, Microalbuminuria, Type 2 diabetes mellitus.

Introduction

Diabetes is an important metabolic disorder worldwide and is characterized by variable degree of insulin resistance, impaired insulin secretion, and increased glucose production.¹ The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs. The two main types of the syndrome are Type 1 (usually develops in childhood and adolescence and patients require lifelong insulin injections for survival) and Type 2 which is the commonest type (usually develops in adulthood and is related to obesity, lack of physical activity, and unhealthy diets).² The cause of type 1 diabetes is not known and it is not preventable with current knowledge.

347 million people worldwide have diabetes³ In 2004, an estimated 3.4 million people died from consequences of high fasting blood sugar.⁴ More than 80% of diabetes deaths occur in low- and middle-income countries.⁵ According to an estimate by WHO, diabetes will be the 7th leading cause of death in 2030.⁶ The overall risk of dying among people with diabetes is at least double the risk of their peers without diabetes.⁷ As in other developing countries, the prevalence of diabetes in Pakistan has increased rapidly in recent years and is likely to continue to increase in the future, with important implications for health policy. Diabetes is increasing at an alarming rate in Pakistan as there are approximately 7.1 million diabetic patients and around 120,000 die every year as a result of diabetes related complications and many more are being incapacitated.

Diabetes is among the leading causes of kidney failure⁸ and screening for early signs of diabetes-related kidney disease (nephropathy) is a cost saving intervention and feasible for developing countries. Microvascular complications including nephropathy, retinopathy and...
neuropathy are initiated by chronic hyperglycemia. Many association studies suggested a strong correlation between level of hyperglycemia and the progression of micro vascular complications in diabetic patients. Estimation of microalbumin levels in urine has been the gold standard for monitoring the diabetic nephropathy progression and is also predictive of high HbA1c levels. According to a study by Tobe et al, reduction of HbA1c level by 1% (7.5 to 6.5%) also significantly decreases microalbumin levels, even to normal. The current study was conducted to evaluate the prevalence of microalbuminuria and renal impairment in patients with type 2 diabetes without known proteinuria. In addition, we investigated the association of microalbuminuria with HbA1c levels for indicating risk of diabetic nephropathy in poorly controlled diabetic patients.

Materials and Methods

This cross-sectional study was conducted at the Islamabad Diagnostic Centre (IDC), Islamabad, Pakistan. Ethical approval was granted by the ethical review committee of IDC. 174 type-2 diabetes patients were enrolled in the study. Patients with systemic diseases like cardiovascular diseases, cerebrovascular diseases and urinary tract infection were excluded from the study. A sample of blood was drawn after overnight fasting of 10-12 hours to test for HbA1c levels. The fasting blood sample with EDTA was used to estimate HbA1c levels. The sample was incubated with pretreatment reagent to lyse red blood cells. The pretreated samples were again incubated with magnetic microparticles coated with silica. Hb and HbA1C were bound to the silica surface of the microparticles. After washing, anti-HbA1C acrydinium, labeled conjugate was added to create a reaction mixture. Following another wash cycle, pre-trigger and trigger solution were added to the reaction mixture. The resulting chemiluminescent reaction was measured as relative light units. The result was calculated as a percentage of total hemoglobin concentration (Architect Si 1000 Abbott International).

A morning urine sample was used for estimating the microalbumin levels by Immunoturbidity method. The multigent microalbumin immunoturbidimetric that uses polyclonal antibodies against human albumin was used for the determination of urine microalbumin urea. The specimen was mixed with the reagents. Albumin in the specimen combined with the anti-human albumin antibody, in the reagent to yield an insoluble aggregate that causes increased turbidity in the solution. The degree of turbidity is proportional to the albumin in the specimen, which was measured optically. A <7.0% HbA1c level was considered to be normal while <20mg/L microalbumin was considered as normal. The data were analyzed using SPSS version 19.0. Pearson correlation coefficient was calculated to find the linear relation between HbA1C and microalbuminuria. T test was also used to find out relationship between HbA1c and microalbuminuria. P value was taken as significant at 5 percent confidence level (P<0.05).

Results

Among 174 known diabetic patients, 41.3% (n=72) were females and 58.62% (n=102) were males. The mean age was 51.8 years for both gender groups. The mean results for HbA1c was 8.56% with SD of 2.63 (Table I) and the mean microalbumin results was 66.67mg/L with SD 2.14 (Table I).

<table>
<thead>
<tr>
<th>Table I: Mean HbA1c and microalbuminurea value</th>
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<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>Glycosylated Hb value</td>
</tr>
<tr>
<td>Microalbuminuria value</td>
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</tbody>
</table>

The study revealed that out of 174 diabetic patients 59% (n=99) had HbA1c value of >7.0% and 43% (n=75) had less than 7.0%. Collectively microalbuminuria was seen in 33% (n=57) patients (Figure 1).

The prevalence of microalbuminuria among both genders was same, i.e. 43% in females and 46% in males. A positive correlation was found between the two variables at the level of significance (0.05) and this was evidenced by Pearson correlation coefficient (r=0.190)
and T test. (P<0.05) was considered statistically significant. (Table II).

Table II: Pearson correlation coefficient.

<table>
<thead>
<tr>
<th>Glycosylated HB in %age</th>
<th>Microalbuminuria in mg</th>
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<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.012</td>
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<tr>
<td>N</td>
<td>174</td>
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</tbody>
</table>

Microalbuminuria in mg

| Pearson Correlation | 1.90                  |
| Sig. (2-tailed)     | .012                  |
| N                   | 174                   | 174                    |

* Correlation is significant at the 0.05 level (2-tailed).

Discussion

In the present study, 174 diabetic patients of type 2 were studied. The overall prevalence of microalbuminuria has been established as 33% with a minimal gender difference. A statistically significant correlation was found between the prevalence of microalbuminuria and HbA1c level. The study explicitly indicates that poor diabetic control is the leading cause of diabetic nephropathy as evidenced by elevated microalbuminuria. Many complications arise due to uncontrolled or poorly controlled diabetes mellitus amongst which the most destructive is diabetic nephropathy. The prevalence of microalbuminuria has been reported as 36.3% from India, 16.8% in Saudi Arabia, 22.7% in Hong Kong 14.2% in Iran and 29% in Pakistan. However, Varghese et al. reported a statistically significant correlation between the prevalence of microalbuminuria and the fasting blood HbA1c levels which was similar to findings reported from India and Iran.

In the present study, prevalence of microalbuminuria among males and females was 43% and 46% respectively. Thus the prevalence of microalbuminuria was not statistically different for the two genders which were similar to the findings reported by Mather et al. in European diabetic patients and Sheikh et al. from Pakistan. However, Varghese et al. reported an increased prevalence of microalbuminuria in Indian men compared with Indian women.

In the present study statistically significant correlation was found between the prevalence of microalbuminuria and the fasting blood HbA1c levels which was similar to findings reported from India and Iran.

Conclusion

The prevalence of microalbuminuria in diabetic patients was found to be high, which advocate the need of therapeutic and preventive measures from the Clinicians, Diabetic Associations and overall the Ministry of Health.

Being a developing country, Pakistan needs to formalize an early testing strategy for microalbuminuria and HbA1c estimation in both poorly controlled and uncontrolled type 2 diabetic patients as an early marker for renal risk factor.

Conflict of interest: None

References