Relationship Between HbA1c and Serum Uric Acid Levels in Diabetes

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Abstract

Hemoglobin A1c (HbA1c) is an important marker for long-term assessment of glycemic status, and is currently used for monitoring the effect of therapy in diabetic patients. Diabetes is a metabolic disease associated with serious microvascular (e.g. retinopathy, nephropathy and neuropathy) and macrovascular (e.g. cardiovascular, cerebrovascular and peripheral vascular diseases) complications that are increased by long-term poor glucose control. In the diabetic state, prolonged hyperglycemic conditions have been reported to cause alteration in biochemical organization that in impairment of cell function. The hyper-polarization due to constant oxidative stress in diabetic cells has been reported to be responsible for the complications associated with diabetes [3,4]. There is a strong association of increased HbA1c with the development and progression of diabetic complications. The level of HbA1c in non-diabetic individuals is below 5.7%. Studies have shown that people with diabetes can reduce the risk of complications by keeping HbA1c levels below 7 percent. In this pilot study, we evaluated serum lipids, total protein, albumin, uric acid and glucose levels in non-diabetic and diabetic patients – separated into four groups based on HbA1c levels as follows: control (< 5.7% - non-diabetic), pre-diabetic (5.7 – 6.4%), diabetic-1 (6.5 – 9.2%) and diabetic-2 (9.3 – 11.8%). Our data showed a significant increase in uric acid levels in the diabetic-2 group (≥ 9.3%) compared to the control group. We also noted a normal uric acid level (< 7.0 mg/dL) in the control group compared to pre-diabetic, diabetic-1 and 2 groups which showed high levels of serum uric acid (> 7.0 mg/dL). Similarly, the levels of serum cholesterol and glucose in the diabetic-2 group were significantly elevated compared to the other groups. Serum total protein and albumin levels were not significantly altered among the groups. Overall, an elevated serum uric acid level may be indicative of the severity of diabetes mellitus.

Background

Diabetes mellitus is a group of endocrine or metabolic diseases characterized by impaired glucose utilization leading to chronic hyperglycemia. It is characterized by the disruption of carbohydrate, fat and protein metabolism due to absolute or relative deficiencies in insulin secretion and/or insulin action. Blood glucose levels are commonly used in the diagnosis of diabetes. The use of glycosylated hemoglobin (HbA1c) in the management of diabetes is also well established [1,2]. There is strong association of increased HbA1c with the development and progression of diabetic complications. The level of HbA1c in non-diabetic individuals is below 5.7%. Studies have shown that people with diabetes can reduce the risk of complications by keeping HbA1c and fasting blood glucose levels below 7 percent. However, the relationship between serum uric acid and HbA1c is not clear. Some studies have reported positive associations between serum uric acid and fasting plasma glucose while others suggested an inverse relationship [3–5]. In this pilot study, we evaluated serum uric acid, lipids, total protein, albumin and glucose levels in non-diabetic and diabetic patients based on their HbA1c levels.

Materials and Methods

One hundred and fifty blood samples were obtained from a local hospital in Corpus Christi, Texas. The samples were placed into groups based on their HbA1c levels as follows: group 1 (< 5.7% - non-diabetic group); group 2 (5.7 – 6.4%- pre-diabetic); group 3 (6.5 – 9.2%-Diabetic-1); group 4 (≥9.3%- Diabetic-2). The samples were centrifuged for 10 minutes at 5000 rpm with the supernatant (serum) collected for assays. Biochemical indices in the serum were measured using the Sirrus Stanbio clinical analyzer. Data was analyzed using IBM's SPSS (Statistical Package for the Social Sciences) software and Microsoft Excel to determine mean ± SEM. Analysis of variance (ANOVA) was used to test for differences among the groups. Post hoc analysis was carried out using the Duncan's multiple range test to test for significant difference among the means ($P < 0.05$).
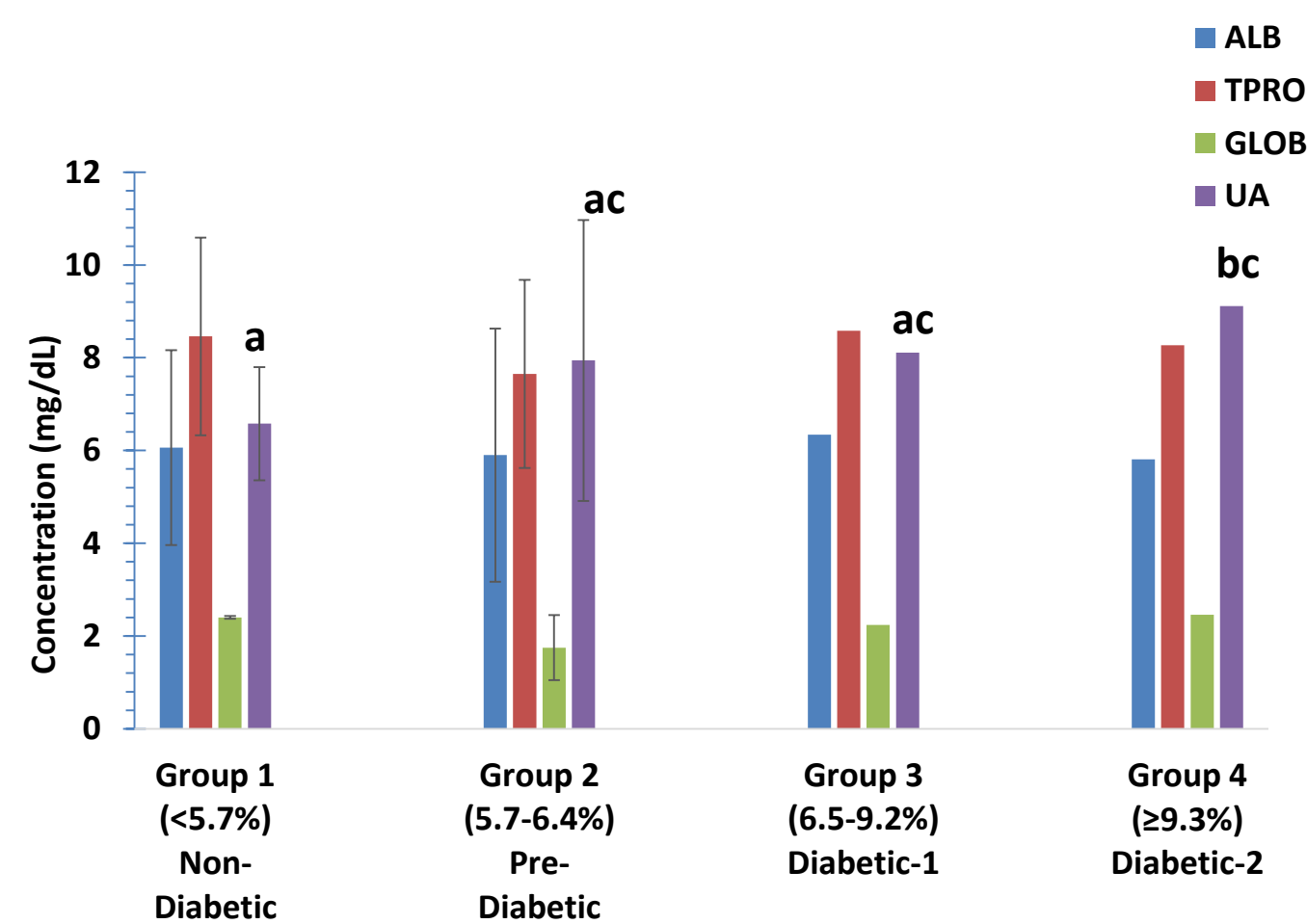

Figure 1: Serum proteins and uric acid levels amongst the various groups. Figures that share different letter superscripts are significantly different ($p < 0.05$)
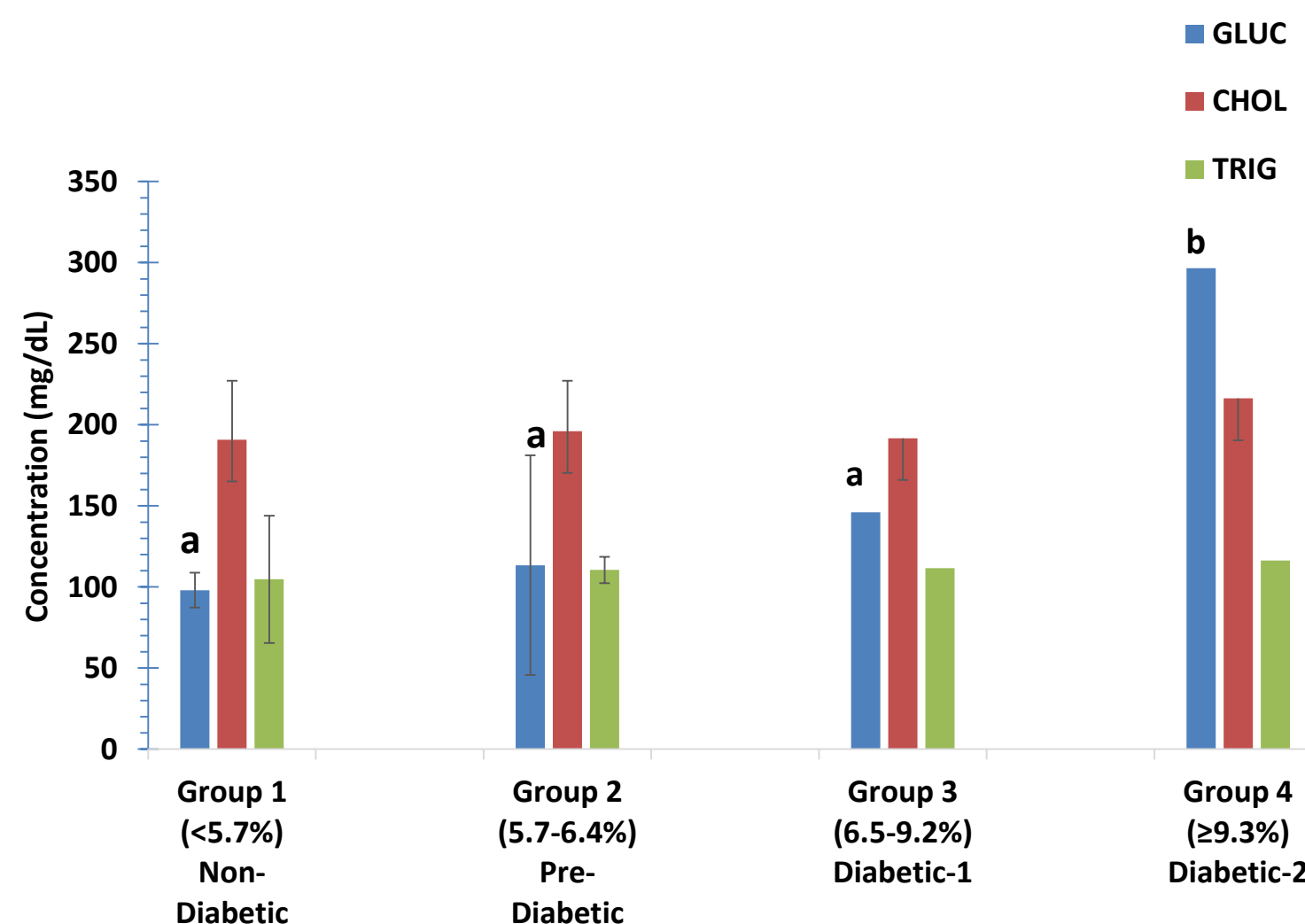

Figure 2: Lipid and glucose levels in the serum amongst the various groups. Figures that share different letter superscripts are significantly different ($p < 0.05$)

Results

- There was a significant increase in uric acid levels in the diabetic-2 group (≥ 9.3%) compared to the control group.
- We also noted a normal uric acid level (< 7.0 mg/dL) in the control group compared to pre-diabetic, diabetic-1 and 2 groups which showed high levels of serum uric acid (> 7.0 mg/dL).
- Similarly, the levels of serum cholesterol and glucose in the diabetic-2 group were significantly elevated compared to the other groups.
- Serum total protein and albumin levels were not significantly altered among the groups.

Conclusion

Overall, an elevated serum uric acid level may be indicative of the severity of diabetes mellitus. The observed changes in uric acid may be helpful in the prevention of diabetic complications in patients whose HbA1c levels may not correlate with their blood glucose levels (patients with hemoglobin variants). Further studies with a larger sample size is needed to evaluate the clinical use of uric acid for patients with hemoglobin variants.

References

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