

DATA REGARDING GLYCOSYLATED HEMOGLOBIN ON DIABETES MELLITUS INDIVIDUALS

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Abstract: The observation by Ranney and colleagues that diabetics have increased levels of A_{1c} hemoglobin, and the subsequent characterization of A_{1c} hemoglobin as resulting from glucose interaction with the β chain of hemoglobin at the N terminal valine residue, suggested that the glucose molecule itself might be directly interacting with proteins. Such a process has been known for decades to food chemists. This is the reaction of aldehyde or keto groups of sugars with amino groups in a non-enzymatic manner, and is called the Maillard reaction. Dixon, demonstrating a slow but significant reaction of glucose with peptide at physiologic concentrations and temperatures, suggested that hemoglobin as well as any other protein with free amino groups is capable of reacting similarly.

INTRODUCTION

The correlation between glucose intolerance or glucose regulation in diabetics and levels of A_{1c} supports the concept that the abnormally high glucose concentration is the primary determinant in the formation of A_{1c} hemoglobin. The level can be used as an index of control over the preceding few weeks.

Glucose is able to bind to a variety of structures, including hemoglobin (especially hemoglobin A₁, in a non-enzymatic irreversible reaction). Initially, free intra-erythrocyte glucose binds to hemoglobin producing a readily reversible Schiff-base intermediate (Amadori product), which then undergoes an irreversible rearrangement to a stable ketoamine derivative. When glucose concentration is elevated in blood as in diabetes mellitus, there is increased binding of glucose to hemoglobin, which increases glycosylated hemoglobin values.

THE PURPOSE OF INVESTIGATIONS

In this paper we want to show the importance of the glycosylated hemoglobin as a laboratory test for those suffering of diabetes mellitus. Research has proven that good control of diabetes is the best way to prevent or delay complications of the disease, complications that include heart disease, blindness, nerve damage and kidney damage. While your daily blood testing tells you how your blood sugar is doing right then, allowing you to make necessary changes in medicine, food and exercise, it doesn't give you a picture of your long-term diabetes management success. To do that, there is glycosylated hemoglobin testing. The glycosylated hemoglobin test or Hemoglobin A_{1c} (HbA_{1c}) is a test used to give you and your doctor the most accurate picture of your overall diabetes control.

MATERIAL AND METHODS

For our research we investigated 55 patients with diabetes mellitus from the population of Neamț County. According to their type of diabetes mellitus, 25 subjects are insulin-dependent (type I of diabetes mellitus) and 30 are insulin-independent (type II of diabetes mellitus). Those patients were from two groups of age: 20-45 years old and 45-70 years old. We took blood samples for laboratory investigations.

In order to determinate the hemoglobin A_{1c} we used the chromatographic- spectrophotometric ion exchange - temperature independent method.

Principle of the method

After preparing the hemolysate, where the labile fraction is eliminated, hemoglobins are retained by a cationic exchange resin. Hemoglobin A_{1c} is specifically eluted after washing away the HbA_{1a+b} fraction and is quantified by direct photometric reading at 415 nm.

RESULTS AND DISCUSSIONS

The HbA_{1c} test measures the amount of sugar that is attached to the hemoglobin in red blood cells, with results given as percentage. Although different laboratories may use different testing methods, the percentage that occurs in people without diabetes is usually about six percent. Because red blood cells live in the bloodstream for about four months, the HbA_{1c} test shows the average blood sugar for the past several months.

Our analysis in male patients (table 1) according to their type of diabetes and the group of age is the following. For the patients with type I of diabetes mellitus from the group of age 20-45 years old the average of HbA_{1c} values is 9,66% and for those with type II of diabetes from the same group of age, the average is 5,5%. For those with diabetes type I from the group of age 45-70 years old the average is 7,8% and for the subjects with type II of diabetes from the same group of age the average is 5,75%.

Comparing these values with the normal values of HbA_{1c} we can appreciate that male patients with type I of diabetes mellitus from both groups of age have higher levels of glycosylated hemoglobin than the patients with type II of diabetes mellitus which values are within normal limits (4-6%).

For female patients with diabetes mellitus (table 2) the situation is the following. The women with type I of diabetes mellitus from the group of age 20-45 years old have the average of HbA_{1c} values 8,66% and those with type II have 6%. For the group of age 45-70 years old, the average for type I patients is 8,4% and for type II patients is 5,83%.

Table 1. The percentage of glycosylated hemoglobin on male patients from the population of Neamt County

The group of age	The type of diabetes mellitus	The number of patients	HbA _{1c} values	
			Normal values	Statistical values
				average ± standard deviation
20-45 years old	I (insulin-dependent)	6	4-6 %	9,66 ± 1,632
	II (insulin-independent)	4		5,5 ± 0,577
45-70 years old	I (insulin-dependent)	5	4-6 %	7,8 ± 1,643
	II (insulin-independent)	8		5,75 ± 1,035

Table 2. The percentage of glycosylated hemoglobin on female patients from the population of Neamț County

The group of age	The type of diabetes mellitus	The number of patients	HbA _{1c} values	
			Normal values	Statistical values
				average ± standard deviation
20-45 years old	I (insulin-dependent)	9	4-6 %	8,66 ± 1,802
	II (insulin-independent)	6		6 ± 1,414
45-70 years old	I (insulin-dependent)	5	4-6 %	8,4 ± 2,073
	II (insulin-independent)	12		5,83 ± 1,114

Just like in the situation of male patients with type I of diabetes, the average of glycosylated hemoglobin values for female subjects with same type of diabetes is beyond normal limits (4-6%).

Analyzing all our subjects with diabetes mellitus we can say that patients with type I of diabetes have higher levels of glycosylated hemoglobin compared to type II suffering patients.

Unlike your regular blood sugar test, the HbA_{1c} test is not affected by short-term changes. So even though you may have had high blood sugar on occasion, a good glycosylated hemoglobin result can show that, overall, you are doing a good job of controlling your diabetes. This provides an additional criterion for assessing glucose control because glycosylated hemoglobin values are free of day-to-day glucose fluctuations and are unaffected by exercise or recent food ingestion.

CONCLUSIONS

The glycosylated hemoglobin test is used to give you and your doctor the most accurate picture of your overall diabetes control.

HbA_{1c} is an indicator of the blood glucose concentration over a longer period of time than either a single blood glucose measurement, which reflects the glucose concentration at the time of blood collection.

Glycosylated hemoglobin concentrations above reference intervals indicate a persistent hyperglycemia and are seen in diabetes mellitus.

Glycosylated hemoglobin should be monitored every 3-4 month.

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