

# HbA<sub>1c</sub> AND THE RISK OF CHRONIC COMPLICATIONS IN 100 DIABETES MELLITUS (DM) PATIENTS

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**Keywords:** HbA<sub>1c</sub>, retinopathy, mellitus, complications  
**Abstract:** Glycated hemoglobin A1c (HbA<sub>1c</sub>) is an approximation of an individual’s average blood glucose levels for the last 2 to 3 months.(1) The HbA<sub>1c</sub> level is a crucial test for use in the assessment of a diabetic patient’s degree of glycemic control.(2) In the current study, we have observed the relation between glycated hemoglobin and chronic complication from our batch of 100 patients diagnosed with Diabetes mellitus. We have analyzed the levels of glycated hemoglobin in relation with the chronic complications on 100 patients.

## INTRODUCTION

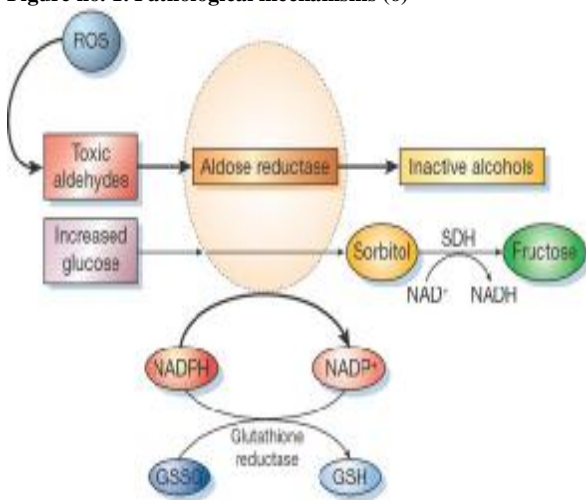
Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.(3,4) An elevated HbA<sub>1c</sub> level (more than 7%) is the most important predictor for the development and progression of microvascular complications. In the most recent studies, there has been proved that for every 1% increase in HbA<sub>1c</sub>, the risk of the progression of complications is 50% higher.(2,5)

The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels.

### Chronic complications in diabetes mellitus

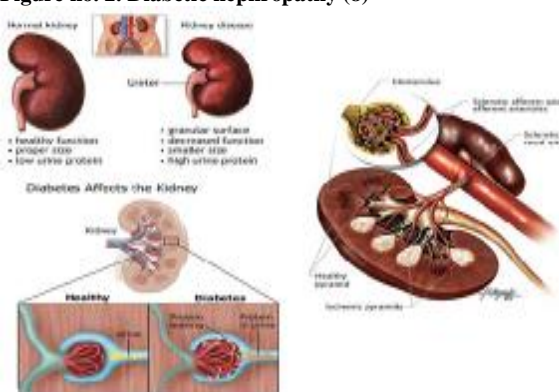
Diabetic retinopathy may be the most common microvascular complication of diabetes.

Figure no. 1. Pathological mechanisms (6)



Diabetic nephropathy is defined by proteinuria > 500 mg in 24 hours in the setting of diabetes, but this is preceded by lower degrees of proteinuria, or “microalbuminuria.” Microalbuminuria is defined as albumin excretion of 30-299 mg/24 hours.(3,7)

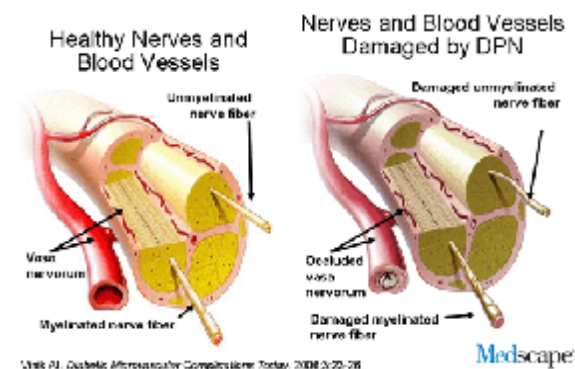
Figure no. 2. Diabetic nephropathy (8)



Diabetic neuropathy is recognized by the American Diabetes Association (ADA) as “the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes”.(9) The precise nature of injury to the peripheral nerves from hyperglycemia is not known, but it is likely related to mechanisms such as polyol accumulation, injury from AGEs, and oxidative stress.(3,6)

Figure no. 3. Diabetic peripheral neuropathy (10)

### Diabetic Peripheral Neuropathy



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## CLINICAL ASPECTS

### *Peripheral obliterative arteriopathy*

It is narrowing of arteries other than those that supply the heart or brain. Most commonly the legs are affected.

The central pathological mechanism in macrovascular disease is the process of atherosclerosis.(1,3)

*Glycated hemoglobin A<sub>1c</sub> (HbA<sub>1c</sub>)*, the result of the nonenzymatic glycation of hemoglobin, is an approximation of an individual's average blood glucose levels for the last 2 to 3 months.(1,7) An elevated HbA<sub>1c</sub> level (more than 7%) is the most important predictor of the development and progression of microvascular complications.(5)

### PURPOSE

The purpose of this paper is to establish the connection between the values of HbA<sub>1c</sub> and the risk of developing chronic complications.

### MATERIALS AND METHODS

A retrospective study was conducted on 100 patients (11 type I diabetes mellitus, 89% type II DM, 61% men, 39% women, age range: 38-69 years old) treated with insulin (61%) and oral diabetes medication (39%), HbA<sub>1c</sub> 7,45 (range 4-14) from the Clinical County Emergency Hospital of Sibiu during the year 2015.

### RESULTS AND DISCUSSIONS

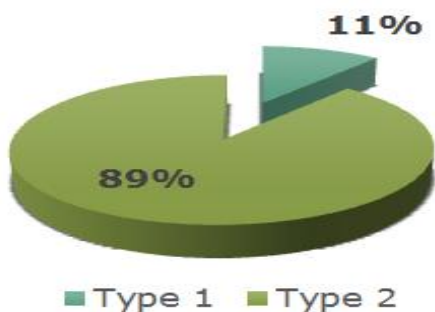
Most of the patients in the study group who came to the Clinical County Emergency Hospital of Sibiu were men (61%) (figure no. 4).

**Figure no. 4. Patients' distribution per gender**



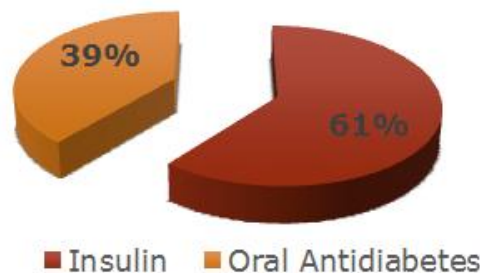
According to the type of DM of the diagnosed patients, 89% of them have DM type 2 (figure no. 5) in accordance with the study literature (11), which highlights that DM type 2 represents 80-90% of all DM cases.

**Figure no. 5. Patients' distribution according to the type of diabetes mellitus**



Of all DM patients taken into study, as one can see in the figure below, 39% are insulin dependent (figure no. 6).

**Figure no. 6. Patients' distribution according to treatment**

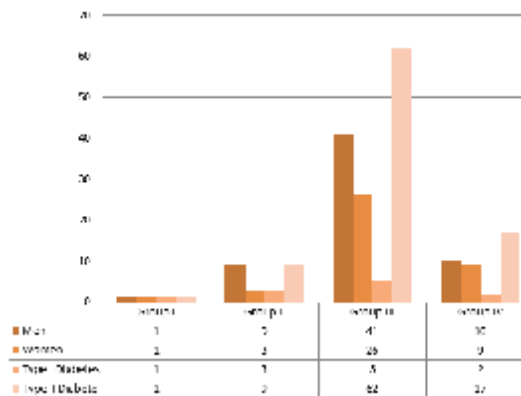


The age of the study patients was between 38 – 69 years old, with a mean age of 55.52 years.

By age, the batch of patients was divided in 4 groups: I (< 40 years old); II (40 – 50 years old); III (50 – 60 years old) – the predominant group; IV (> 60 years old) (figure no. 7).

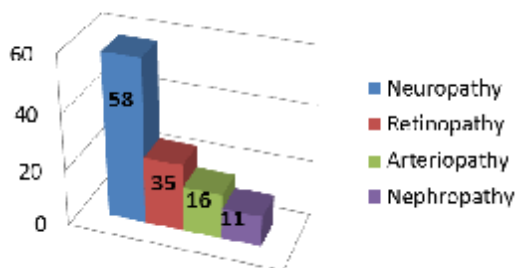
Most patients belonged to the age range between 50-60 years old, were males and were diagnosed with DM type 2. Numerically, the next age group was that of 60 years old, followed by the age group between 40-50 years old (figure no. 7).

**Figure no. 7. Patients' distribution by age groups, gender and type of diabetes**



The most frequent complications given by DM are neuropathy, retinopathy, arteriopathy, nephropathy. Diabetic neuropathy has the highest frequency of all complications being encountered in more than half of the study subjects (figure no. 8).

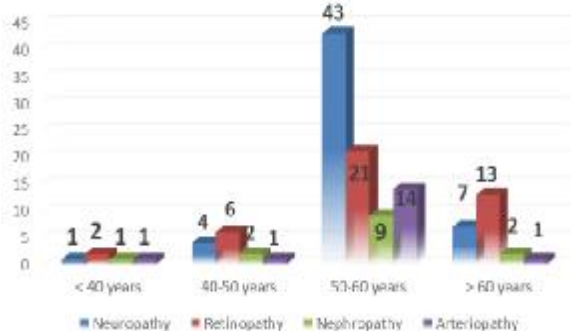
**Figure no. 8. Chronic complications**



The distribution of DM cases with complications per age groups show that the age group between 50-60 years old registers the most frequent complications of all types and of these, nephropathy and neuropathy are present in most subjects (figure no. 9).

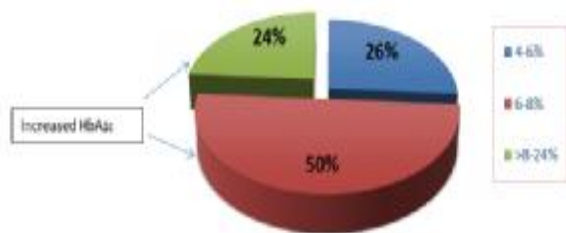
## CLINICAL ASPECTS

**Figure no. 9. Chronic complications of DM divided by ages**



In terms of glycosylated haemoglobin, 74% of the patients had elevated HbA<sub>1c</sub>, as it can be seen from the figure below:

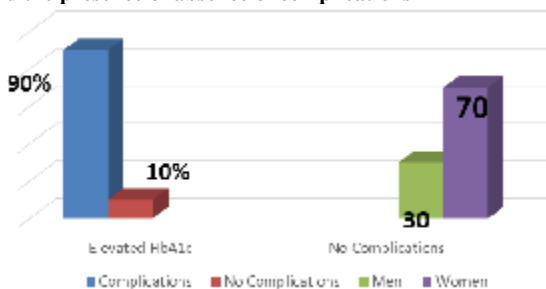
**Figure no. 10. Distribution of glycosylated hemoglobin**



Half of the study subjects show a slight increase of haemoglobin.

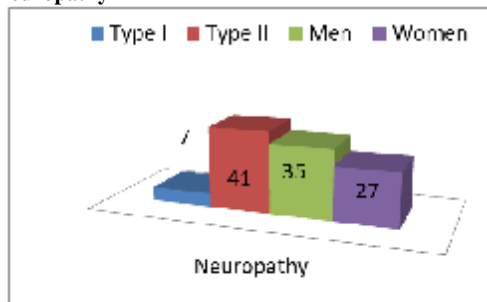
Only 10% from those with increased HbA<sub>1c</sub> (74%) had no complications (70% women, 30% men).

**Figure no. 11. Relation between glycosylated haemoglobin and the presence of absence of complications**



Of the study group, 58 patients had neuropathy and 48 patients from them were with increased HbA<sub>1c</sub>.

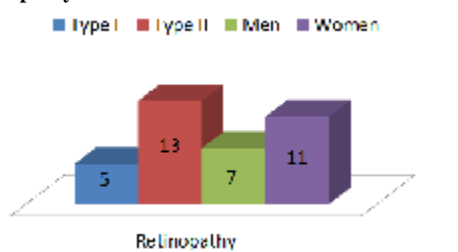
**Figure no. 12. Relation between glycosylated haemoglobin and neuropathy**



Diabetes mellitus is present in 41% of those with increased glycosylated haemoglobin.

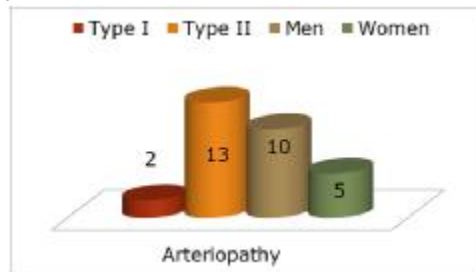
Of the study patients, 35 had retinopathy, and 24 were with increased HbA<sub>1c</sub>.

**Figure no. 13. Relation between glycosylated haemoglobin and retinopathy**



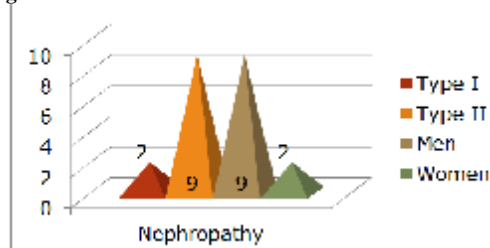
Of the study patients, 13 patients had retinopathy and 15 patients were with increased HbA<sub>1c</sub> levels.

**Figure no. 14. Patients' distribution with arteriopathy and increased haemoglobin according to type of diabetes and gender**



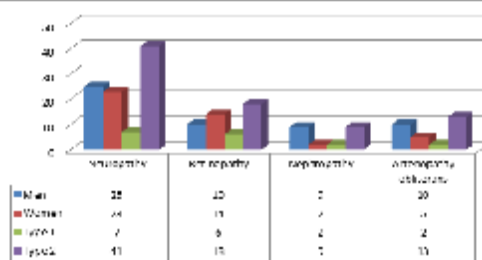
Arteriopathy was found in 13 patients and all of them had elevated HbA<sub>1c</sub>.

**Figure no. 15. Patients' distribution with increased haemoglobin and nephropathy according to type of diabetes and gender**



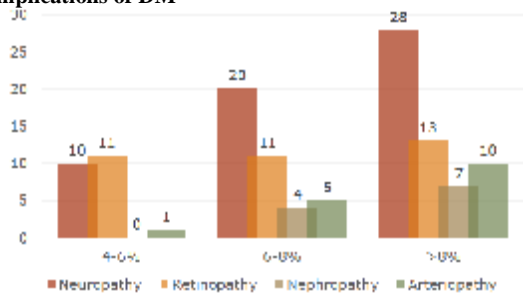
Nephropathy was seen in 11 patients. All of them had elevated HbA<sub>1c</sub>.

**Figure no. 16. Complications divided by gender and type of Diabetes Mellitus in patients with elevated levels of HbA<sub>1c</sub>**



## CLINICAL ASPECTS

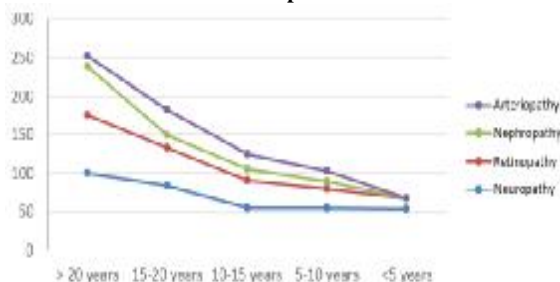
**Figure no. 17. Relation between HbA1c levels and chronic complications of DM**



*The effect in time since diagnosis on chronic complications*

Since diagnosis, the study batch was divided into 5 groups: >20 years old; 15-20 years old; 10-15 years old; 5-10 years old; <5 years old.

**Figure no. 18. Time from the moment of diagnosing DM and the occurrence of chronic complications**



Ocular complications occur earlier in comparison with the other types of complications.

After more than 20 years of disease, all the four studied complications can be found.

### CONCLUSIONS

- High HbA<sub>1c</sub> was associated with increased risk for chronic complications. The higher the level of HbA<sub>1c</sub>, the more the number of patients with chronic complications is.
- Time since diagnosis has an important role in the development of these complications: as the time since diagnosis goes up, the number of each complication goes up.
- Retinopathy appears earlier compared to the others complications.
- In type I DM patients, the chronic complications appear earlier compared to patients with type II DM.
- The most frequent complication is diabetic neuropathy which appears equal in both genders and type of diabetes.
- Retinopathy appears when HbA<sub>1c</sub> >7%, especially in women, but our study proved that retinopathy is not so much influenced by HbA<sub>1c</sub> compared to the other complications.
- Diabetic nephropathy and arteriopathy obliterans are more frequent in men with levels of HbA<sub>1c</sub> > 8% in both types of DM.
- Nephropathy appears only in patients with elevated HbA<sub>1c</sub>.
- Diabetes is more than a health issue and requires concerted policy action across many sectors.

### REFERENCES

1. Merck. Manualul Merck. Ediția XVIII, Ed. All; 2014.
2. Diagnosis and Classification of Diabetes Mellitus

3. Michael J. Microvascular and Macrovascular Complications of Diabetes  
<http://clinical.diabetesjournals.org/content/26/2/77.full>.
4. International Diabetes Federation. IDF Diabetes Atlas update poster, 6th edn. Brussels, Belgium: International Diabetes Federation; 2014.
5. Sakurai M, et al. HbA<sub>1c</sub> and the risks for all-cause and cardiovascular mortality in the general Japanese population. [www.care.diabetesjournals.org](http://care.diabetesjournals.org).
6. [http://eprints.undip.ac.id/43733/3/AULIA\\_AHMAD\\_G2A009130\\_Bab2KTI.pdf](http://eprints.undip.ac.id/43733/3/AULIA_AHMAD_G2A009130_Bab2KTI.pdf).
7. Boitan M. Fiziopatologie, Ed. Universitatea Lucian Blaga din Sibiu; 2005;1.2.
8. [http://intranet.tdmu.edu.ua/data/kafedra/internal/klinpat/classes\\_stud/en/nurse/adn%20\(2%20year%20program\)/full%20time%20study/nutrition%20and%20diet%20therapy/2/15.%20Nutrition%20for%20Diabetes%20Mellitus.files/](http://intranet.tdmu.edu.ua/data/kafedra/internal/klinpat/classes_stud/en/nurse/adn%20(2%20year%20program)/full%20time%20study/nutrition%20and%20diet%20therapy/2/15.%20Nutrition%20for%20Diabetes%20Mellitus.files/).
9. American Diabetes Association - American Diabetes Association Complete Guide to Diabetes: The Ultimate Home Reference from the Diabetes Experts; 2014.
10. Vinik A. Diabetic Microvascular Complications Today; 2006.
11. Ionescu-Tîrgoviște C, Lichiardopol R. Diabetul zaharat tip 2. Ghid terapeutic pentru medicii de familie. Jurnalul Român de Diabet, Nutriție și Boli Metabolice. 2006;13(4):220-221.