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Predictive value of glycated hemoglobin in relation to cardiovascular diseases in non-diabetics

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Abstract

Cardiovascular diseases are a major cause of morbidity and mortality. Current knowledge suggests that there is a relationship between glycated hemoglobin (HbA1c) and cardiovascular diseases, also in non-diabetics. Glycated hemoglobin (HbA1c) is a laboratory indicator that reflects the average blood sugar level over the past two to three months.

Statistical methods. We determined monitored parameter: glycated hemoglobin. We determined the mentioned disease states. We expressed the relationship as a ratio of chances (Odds ratio, OR) (Mikulecký, M. 2003).

The results of our work showed that non-diabetics who have an HbA1c value of 5.45 and higher have an risk of coronary heart disease 2.171 times higher compared to non-diabetics who have an HbA1c lower than 5.45 (OR=2.171) (95 % IS 1.095 – 4.304), the influence of the presence of HbA1c on the occurrence of coronary heart disease is statistically significant in this case ($p \leq 0.05$). In non-diabetics, we demonstrated the effect of HbA1c on the development of the disease even in the case of the risk of myocardial infarction, stroke, peripheral arterial disease of the lower limbs, the results were statistically non-significant.

Further studies are needed to clarify the relationship between HbA1c and cardiovascular diseases in non-diabetics.

INTRODUCTION

Cardiovascular diseases are a major cause of morbidity and mortality. In Slovakia and Europe, they are associated with more than a third of all deaths, with ischemic heart disease and stroke being the most common. It is necessary to prevent the development of cardiovascular diseases. Therefore, it is necessary to look for indicators that would identify people with an increased risk of developing cardiovascular diseases.

Glycated hemoglobin (HbA1c) is a laboratory indicator that reflects the average blood sugar level over the past two to three months. HbA1c is formed by the binding of glucose to hemoglobin in erythrocytes. Current knowledge suggests that there is a relationship between glycated hemoglobin (HbA1c) and cardiovascular diseases.

THE GOAL

The goal of this study was to evaluate the predictive value of the risk value of glycated hemoglobin in relation to macrovascular complications.

MATHERIAL AND METHODS

Selection of probands, monitored parameters and disease states.

Monitored parameter

Glycated hemoglobin (% of Hb) was determined for each patient.

Selection of probands

The basic set included 77 patients without diabetes. These patients were examined at

internal ambulance in a certain period of time, from July 18, 2016 to November 4, 2019.

Determination of risk value for monitored parameter

In the studied group of non-diabetics, we determined a risk value for glycated hemoglobin.

In group non-diabetics, we determined the HbA1c threshold value, which determines the risk, as the arithmetic mean in the group of non-diabetics. In group non-diabetics we determined the number of patients with risk value of the monitored parameter.

Disease states

For each patient, we evaluated qualitatively (yes, no) whether the following medical conditions were present or absent in the anamnesis or diagnoses: coronary artery disease, myocardial infarction, stroke and peripheral arterial disease of the lower extremities.

Statistical methods

We determined monitored parameter: glycated hemoglobin. We determined the mentioned disease states. We expressed the relationship as a ratio of chances (Odds ratio, OR) (Mikulecký, M. 2003).

RESULTS

In the group non-diabetics, we demonstrated the influence of the risk value of the glycated hemoglobin on the onset of the disease in four cases.

In a set of patients without diabetes, we confirmed the effect of the presence of a risk value of glycated hemoglobin on the development of coronary artery disease (OR = 2.171, 95% CI 1.095–4.304), the effect of the presence of a risk factor on the development of the disease state is statistically significant ($p \leq 0.05$).

Furthermore, in the group of patients without diabetes, we confirmed the effect of the presence of risk values of glycated hemoglobin on the development of myocardial infarction (OR = 1.123, 95% CI 0.223–5.662), glycated hemoglobin on the development of stroke (OR = 1.127, 95% CI 0.385–3.301), glycated hemoglobin on the development of peripheral arterial disease of the lower extremities (OR = 1.029, 95% CI 0.438–2.417),

all these effects of the presence of a risk factor on the development of a disease state are

statistically non-significant (p 0.05).

DISCUSSION

In the group of non-diabetics and also in the group of diabetics, we monitored whether the presence of a risk value of the monitored laboratory parameter increases the risk of macrovascular disease.

In a group of non-diabetics, we found a positive relationship between glycated hemoglobin on one side and between coronary heart disease, myocardial infarction, stroke and peripheral arterial disease of the lower extremities on the other.

These our results are comparable with the results of other authors. There are many studies where the authors reached similar results as in our doctoral thesis and confirm the relationship between HbA1c and the above-mentioned diseases.

Santos et al. demonstrated that HbA1c in non-diabetics is an independent predictor of coronary heart disease and its severity, higher HbA1c levels are significantly associated with coronary heart disease, HbA1c can be used as an independent predictor of coronary heart disease, its severity, even in non-diabetics (Santos-Oliveira, R., Purdy, C., et al., 2011). According to our findings, a person with an HbA1c value of 5.45 and above has an average 2.171 times higher risk of developing coronary heart disease than a person with an HbA1c value below 5.45. The effect of the presence of a risk value of HbA1c on the development of a disease state - coronary heart disease is statistically significant ($p \leq 0.05$).

Some studies suggest that HbA1c may be associated with cardiovascular outcomes in an apparently healthy population (Selvin, E., Stefes, MW., et al., 2010). The conclusions of their work indicate that HbA1c values, even within the normal range, can identify individuals at increased risk of coronary heart disease and stroke, even before the diagnosis of diabetes, suggesting that HbA1c is a useful indicator of cardiovascular risk (Selvin, E., Steffes, MW., et al., 2010).

The results of our work are also in accordance with these studies, which show that HbA1c has an impact on the incidence of coronary heart disease and myocardial infarction. Our results show a link between HbA1c on one side and coronary heart disease, myocardial infarction and stroke on the other.

These our results are also consistent with the work of Sinning et al. HbA1c levels were independently associated with cardiovascular disease, the association between HbA1c and cardiovascular disease

was significantly associated with the incidence of cardiovascular disease even in non-diabetic subjects, highlighting the importance of determining HbA1c levels in the general population (Sinning, Ch., Makarova, N., et al., 2021). These conclusions are consistent with the results of our work in which we demonstrated an association between HbA1c and cardiovascular disease in non-diabetics. The results of our work are consistent with the conclusions of Sinning's work and show that there is a relationship between HbA1c and cardiovascular diseases.

According to the results of our work, there is a connection between HbA1c values and the occurrence of myocardial infarction. De Jong et al. conducted a study in which they concluded that HbA1c values are in a linear relationship with the risk of myocardial infarction, in a spectrum of values from values in non-diabetics, pre-diabetics, undiagnosed diabetes to values of already diagnosed diabetes (de Jong, M., Woodward, M., et al., 2020).

Rossello et al. demonstrated in their study that the routine use of HbA1c, in addition to traditional cardiovascular risk factors, can identify asymptomatic individuals at higher risk of subclinical atherosclerosis. Lifestyle interventions and new antidiabetic drugs may be considered to reduce HbA1c levels and subclinical atherosclerosis in these nondiabetic individuals (Rossello, X., Raposeiras-Roubin, S., 2021).

Welsh et al. in their study evaluated the risk of cardiovascular disease depending on HbA1c. According to the authors, the risk of cardiovascular disease was greatest in those with known diabetes, but was also higher in those with undiagnosed diabetes and those with prediabetes (Welsh, C., Welsh, P., et al., 2020). In contrast to the authors' findings, in our work we found a greater association between HbA1c and cardiovascular diseases in non-diabetics than in diabetics.

The HbA1c concentration predicts cardiovascular risk in both people with diabetes and the general population and may help identify individuals at higher risk of cardiovascular disease for targeted interventions, including lowering blood pressure or cholesterol. Understanding the nature of this relationship can be the source of new preventive and therapeutic interventions (Khaw, KT., Wareham, N., 2004).

The conclusions of our work are in line with those of Ewid et al., who state that glycated hemoglobin can be used as a predictive biomarker for CAD in non-diabetic low-risk patients. Glycated hemoglobin can be used as a predictive biomarker for CAD in non-diabetic low-risk patients (Ewid,M., Sherif, H., 2019).

The prediction that the obesity epidemic will continue to accelerate the incidence of type 2 diabetes and its fatal consequence, atherosclerotic vascular disease, in the coming decades emphasizes the importance of further medical work in this critical area of biomedical research (Bornfeldt, KE., Tabas, I., 2011).

CONCLUSION

The goal of this study was to evaluate the predictive value of glycated hemoglobin in relation to macrovascular complications.

In our work, we came to the following conclusions:

in non-diabetics, we found a statistically significant relationship between the risk value of HbA1c and the occurrence of coronary heart disease.

Furthermore, in non-diabetics, we found relationships between HbA1c on the one side and between myocardial infarction, stroke, peripheral arterial disease of the lower limbs on the other; all of these relationships were statistically insignificant.

The conclusions of our work are in accordance with the vast majority of data known from the literature.

Based on current scientific knowledge, we can say that HbA1c is an independent predictor of coronary heart disease, even in non-diabetics.

We recommend determining HbA1c also in non-diabetics who have other cardiovascular disease risk factors, such as obesity, dyslipidemia, and hypertension, in order to identify high-risk individuals for future cardiovascular disease.

ABBREVATIONS

CAD ... coronary artery disease

CI ... confidence interval ... interval spoľahlivosti

Hb ... hemoglobin

HbA1c ... glycated hemoglobin

HDL cholesterol ... high density lipoprotein - cholesterol

IS ... interval spoľahlivosti

Odds ratio ... OR ... ratio of chances

OR ... Odds ratio ... ratio of chances

p ... the p-value in statistics indicates the probability that the results obtained occurred by

chance, assuming the null hypothesis is valid.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethical committee at the Hospital Nemocnicna, in the city of Malacky on June 24, 2016. All experiments were performed in accordance with relevant guidelines and regulations (such as the Declaration of Helsinki). Informed consent to participate was obtained from all of the participants in the study.

Consent for publication

Consent for publication was obtained from all of the participants in the study.

Availability of data and materials

I declare that all data and materials are available.

Competing Interests

The authors certify that there is no conflict of interest regarding the manuscript.

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Authors' contributions

Authors have read and approved the final version of the manuscript.

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