UDC 616.379-008.64:616-079 + 615.017
SRSTI 76.29.37, 76.31.29

CLINICAL AND PHARMACOLOGICAL EVALUATION OF THE INFLUENCE OF DIFFERENT CLINICAL FACTORS ON THE DETERMINED LEVEL OF GLYCATED HEMOGLOBIN IN PATIENTS WITH DIABETES MELLITUS TYPE 2

DOI: 10.31618/ESU.2413-9335.2020.3.73.664

Moroz V.A.
Doctor of Med.Sci., Professor
Tymchenko Yu.V.
Candidate of Med.Sci., Associate Professor
Semenov A.M.
Candidate of Med.Sci., Associate Professor
National University of Pharmacy, Ukraine

ABSTRACT

With the purpose to determine the prevalence and significance of the influence of various clinical factors on the glycemic control of patients with diabetes mellitus type II, 118 case histories of a therapeutic hospital were analyzed. Analysis of the documentation included the identification of concomitant diseases and conditions, as well as the use of medicines that could directly or indirectly affect the level of HbA1c detected in the patient's blood. In the first case, the presence of such a pathology or condition was revealed in 35 patients (29.7% of the contingent). Moreover, in the 22s they influenced the direction of false understatement, and in 13, on the contrary, its false overestimation. Acceptance of medicines that had significant potential for falsification of the determined level of HbA1c was observed in 39 patients (33.1% of the examined). The quantitative values of the possible analysis error as a result of such influences are discussed. The need for a more thorough analysis of the upcoming course of medicinal therapy for patients with diabetes mellitus type II, including with the participation of a clinical pharmacist (pharmacologist), is indicated.

АННОТАЦИЯ

С целью определения распространенности и значимости влияния различных клинических факторов на гликемический контроль пациентов с сахарным диабетом типа 2 было проанализировано 118 историй болезни терапевтического стационара. Анализ документации включал выявление сопутствующих заболеваний и состояний, а также использование лекарственных препаратов, которые могли прямо или опосредовано влиять на уровень определяемого HbA1c в крови пациента. В первом случае было выявлено наличие такой патологии или состояния у 35 пациентов (29,7% контингента). При этом у 22-х они влияли в сторону ложного занижения, а у 13, наоборот, ложного его завышения. Прием препаратов, которые имели значимый потенциал для фальсификации определяемого уровня HbA1c отмечен у 39 пациентов (33,1% обследованных). Обсуждаются количественные значения возможной погрешности анализа, как результата таких влияний. Указывается на необходимость более тщательного анализа предстоящего курса лекарственной терапии пациентов с сахарным диабетом типа 2, в том числе и с участием клинического фармацевта (фармаколога).

Keywords: diabetes mellitus, glycated hemoglobin, glycemic control, iron deficiency anemia, chronic blood loss, hypercholesterolemia, hemoglobinopathies.

Ключевые слова: сахарный диабет, гликированный гемоглобин, гликемический контроль, железодефицитная анемия, хроническая кровопотеря, гиперхолестеринемия, гемоглобинопатии.

Background. Diabetes mellitus has become an epidemic in the modern world, determining a high level of morbidity and mortality in almost all countries. According to various sources, the number of patients with this disease in the world is estimated from 380 to 415 million, and it is expected that by 2025 it will reach 770 million. The numbers vary due to differences in the estimates of the number of undiagnosed patients with diabetes, which reaches in different regions of the planet 30-40% of the number of registered patients. In particular, data from a 2006 National Health and Nutrition Examination Survey in the United States based on fasting plasma glucose (FGG) and a 2-hour glucose tolerance test (OGTT), indicate the prevalence of diabetes among US adults in 12.9% (about 40 million people). And about 16 million of them (40% of patients with diabetes mellitus) were not diagnosed at that time. The prevalence of diagnosed diabetes mellitus type 2 (DM II) was 8.6% of the US population in 2016, which is 21.0 million adults. Added to this is another 1.3 million adults with diabetes mellitus type 1 (0.55% of the population). There is reason to expect that the true number of patients with diabetes, as well as the percentage of undiagnosed patients, is actually much larger [1, 2].

Given the direct correlations with age, level of education and income, access to medical care and some other factors, the International Diabetes Federation in 2015 estimated the number of undiagnosed patients with DM II in the world at 193 million. Moreover, in developing countries, their share is, according to various researchers, 50-63% or more. Currently, one out of 15 adults on the planet has impaired glucose tolerance, and every seventh newborn is born to a mother who suffered from gestational diabetes during pregnancy. It is worth remembering that this particular

contingent of patients has the highest risk of developing complications of this disease. Including severe and fatal [3 - 5].

The development of vascular complications of DM II, such as retinopathy, nephropathy, and aggravation of the course of cardiovascular diseases, is closely related to the level of glycemic control achieved by a person with diabetes. However, monitoring the course of DM II as a whole is complex and requires solving many issues besides glycemic control. In this regard, it is important to have an index of long-term glycemic control, which, in turn, can be used to prescribe adequate therapy and predict the likelihood of complications. About ten years ago, the use of blood HbA1c as a diagnostic test became the basis for basic therapeutic decisions. At the same time, the FPG and / or OGTT tests previously used for this purpose have not lost their significance [6]. At the same time, the assessment of the determined level of HbA1c has a number of nuances associated with the individual characteristics of the patient, existing concomitant diseases, medications, and some other factors. Simply put, by such influences or conditions that can significantly change the biochemical processes of formation, destruction, and elimination of glycated hemoglobin. At the same time, the final result can, to a certain extent, be both false positive and false negative. Some publications on this issue evaluate the possible error in determining the level of HbA1c in the blood to 10-13% or even more. But universally recognized and clinically important change in this indicator is estimated at 0.5%, which is slightly more than 8%. All this puts the patient at serious risk of decompensation of the course of diabetes and the development of complications of the disease [1, 6, 7].

To date, efforts have worldwide been made to standardize analysis, however, for example, the use of high-performance liquid chromatography is far not in all places is possible. Thus, a possible error in the determination method and, more importantly, the uncertainty of its scale constitutes a serious threat to the completeness of compensation for DM II. In a broad sense, this problem was first noticed almost for the first time on the basis of the results of a special joint international study in 2009 [4, 8].

The purpose of our study was to determine the prevalence and significance of the influence of various clinical factors on the glycemic control of DM II in a therapeutic hospital. We deliberately narrowed our attention to possible false indicators of HbA1c concentration in the blood, leaving purely technical problems and errors in the methods for its determination outside the brackets.

Materials and methods

Retrospectively analyzed medical records of 118 patients with DM II – 73 women and 45 men aged 42 to 72 years (average 53 ± 2.14 years) who were treated in one of the medical centers of the city of Tripoli (Libya) in the second half 2016 year. All of them had a diagnosis of DM II for at least 3 years. When analyzing the documentation, special attention was paid to the presence of concomitant diseases and conditions that could directly or indirectly affect the level of detectable HbA1c. Medical history with a focused assessment of the medicines taken, as well as the timing of their use and doses, was carefully analyzed. This was important in terms of the possible effect on the detected level of HbA1c in the blood. All this was compared with the nature of the course and the degree of compensation of DM II in accordance with the goals and objectives of our work.

Blood HbA1c level was determined by high-performance liquid chromatography on an automatic analyzer D-10 (Bio-Rad Laboratories Inc., USA). All examined patients carefully adhered to the doctor's dietary guidelines (predominant intake of carbohydrates of slow absorption, dosing of fats and proteins, dosed physical activity, etc.). Patients with uncompensated forms of DM II, with significant concomitant systemic diseases in the acute stage, as well as those receiving insulin and having a low level of compliance (according to medical records) were carefully discarded from the study.

Results and discussion

Among the examined contingent of elderly patients (over 65), there were 17 people (14.4% of patients). As well as patients aged 70 years and older, respectively, 4 and 3.4%.

Concomitant diseases and conditions that created the prerequisites for a false determination of the level of HbA1c in the blood were noted in 35 patients (29.7% of the study population). In particular, 22 of them had factors for false underestimation in the definition of this indicator, and 13, on the contrary, to its false overestimation.

So, in six patients with signs of chronic blood loss due to diverticula and peptic ulcers of the gastrointestinal tract, colon polyps, and hemorrhoids, the detected lowered level of blood HbA1c was due to a reduction in the time of functioning of red blood cells. Serum iron deficiency was not determined in all cases. It is known that the HbA1c test is determined by the hemoglobin glycation process throughout the life of the red blood cell, which is estimated at 120 days on average. However, for red blood cells in conditions of chronic blood loss, it is shortened. And, for example, for a period of 90 days, a similar degree of glycation according to the existing method will not show 7%, but only 5.3%. Those. the error can be up to 25% of the real level of HbA1c. Similar physiological mechanisms of influence on this indicator are present in hemolytic anemia, pregnancy, and severe chronic renal failure. A number of researchers recommend that such patients consider using alternative forms of laboratory diagnostics, such as determining the level of glycated whey protein or glycated albumin [1, 9, 10].

Another expected specific source of a significant error in determining the level of glycemia is hemoglobinopathies, in particular thalassemia and sickle cell anemia, which are endemic to the countries of North Africa. In our observations, we did not meet patients with this disease or its asymptomatic carriage. However, in general, in Libya, its incidence is estimated at about 0.37%. And although representative studies of the population on the prevalence of hemoglobinopathies among the local population have

been conducted for a long time, they showed a very low incidence of abnormal hemoglobins in the indigenous population of Libya. Which is indirectly confirmed by our results. At the same time, this pathology is characteristic of Azerbaijan (up to 10-12% of the population) and Dagestan (5-7%), as well as a number of other regions. The life span of red blood cells in such patients is 20-35% below average, which makes it possible to underestimate the determined level of blood HbA1c. At the same time, it is not possible to assess the degree of possible error in determining glycated hemoglobin in general for this type of pathology due to the significant individual variability of the manifestations of individual hemoglobinopathies [11, 12].

Patients with chronic liver diseases (chronic hepatitis and cirrhosis) were also conditionally included in the group of possible false underestimation of the test of the level of HbA1c in the blood. It is traditionally believed that in most of these patients the erythrocyte lifetime is reduced, and the process of erythropoiesis is excessively activated. It is also assumed that a certain contribution to the determination error is made by the existing violation of the process of glucose accumulation in the liver. And this, in turn, reduces the activity of the hepatic segment of hemoglobin glycation. However, there is no certain clarity in this matter, since the fact of the presence of a normal level of HbA1c in patients with severe hepatic pathology has no logical explanation. But most authors believe that the best glucose control option for these patients is an oral glucose tolerance test (OGTT) [7, 13].

Separate studies show that in liver failure there is an independent "toxic" effect on the islets of the pancreas, which leads to secondary β-cell dysfunction. That gives reason to their authors to introduce the special concept of "hepatogenic diabetes" in individuals with its actual absence. At the same time, in our study, two patients had an initial form of cirrhosis (according to the Child-Pugh scale, did not go beyond A), and we did not notice signs of liver failure in the examined patients [8, 14].

Five people had nephropathies with a slight or moderate decrease in glomerular filtration rate, in which there is every possibility of overestimating the determined level of HbA1c due to microvascular renal changes. At the same time, in the literature, opinions regarding the nature of this error and its dimension are quite contradictory. Many authors attribute the possibility of such an error in the determination of glycemic control not by altered renal function, but with renal anemia often present in this pathology, consumption of erythropoietin, the influence of dialysis and some other factors. Most authors conclude that renal failure with a significant change in the filtration function of the kidneys leads, on the contrary, to a false overestimation of the determined level of glycated hemoglobin. It is believed that glycated albumin for this pathology is a more reliable indicator of glycemic control. However, more research is needed to clarify the role of HbA1c in DM II patients with chronic renal failure [7, 10].

Four more of our patients had hypercholesterolemia (increase in cholesterol over 4.0 mmol/l or 155 mg/dl). In general, there are 5 ranges for increasing low-density lipoprotein concentrations, which, depending on the risk category (very high, high, moderate and low), determine the strategy of treatment measures. But the mechanism of reducing the level of HbA1c in the blood with this syndrome is not fully understood, although it is widely described in the literature. There are suggestions that this is due to a decrease in serum lipase activity, which directly affects the concentration of lipoproteins, and also depends on the degree of insulin resistance. Which in itself is the hallmark of DM II. At the same time, it should be remembered that higher levels of blood triglycerides (> 1000 mg / dL) falsely increase the level of HbA1c [5, 15, 16].

We also identified prerequisites for overstating the determined level of HbA1C in the blood in one patient who underwent blood transfusion a little less than 2 months ago. The effect of the presence of normal red blood cells in the bloodstream lasts the entire period of their life - up to 3 months [7, 16].

Among patients with false overestimation of the level of HbA1c level in the blood, the majority were patients with iron deficiency anemia (without signs of chronic blood loss), where the period of functioning of red blood cells was significantly increased (see Table 1). Previous studies with this pathology show an approximately 15% increase in the life expectancy of red blood cells. And although in some cases this increase is less, however individually this indicator is quite stable with this type of anemia. There is an opinion in the literature that the contribution to false overestimation of the HbA1c level is negligible. However, calculations show that an increase in red blood cell life of 10 days gives an increase in its detectable concentration from 6.0% to 6.5%. What can be essential for the glycemic control of the patient. In addition, with iron deficiency anemia, the level of malondialdehyde increases, which directly increases the rate of hemoglobin glycation. And this is without the likely effect of iron preparations. And the direct effect of taking iron salts on the level of HbA1c detected in the blood is well known. Currently, most authors are inclined to conclude that it is necessary to compensate for iron deficiency before measuring HbA1c in individuals with severe iron deficiency anemia [17, 18]. In our observations, 10 patients showed only moderate and mild anemia. And no patient at the time of determining the level of HbA1c in the blood did not take iron preparations.

Two patients with a history of chronic alcoholism also had all the prerequisites for a false overestimation of blood HbA1c levels. In the literature at the turn of the beginning of this century, it was believed that this phenomenon is not associated with a change in any specific function of the body, but with the direct influence of alcohol. In this case, tissue sensitivity to insulin also increases, which makes fat metabolism slow. These phenomena are stored in the body of a person who regularly consumes alcohol for 1-2 years. At the same time, modern publications on moderate and

chronic alcohol use in DM II give conflicting conclusions. So, as shown by a representative study in 38,564 patients with DM II, alcohol reduces the level of HbA1c in the blood. In particular, among consumers 2-2.9 drinks per day, it decreased in absolute terms by almost 0.5%. One drink corresponds to the alcohol content of 45 ml of vodka or 400 ml of beer. And since a 1% reduction in HbA1c is associated with a 21% reduction in the risk of any diabetes-related endpoint and a 37% reduction in the risk of microvascular complications, the authors conclude that these mechanisms deserve further study [19, 20].

We also identified one patient who had persistent hyperbilirubinemia at 4-6 mg / dL (possibly Gilbert's syndrome). In this case, the level of error of HbA1C, as is traditionally believed, is due to the effect of bilirubin on the chemical reaction of determining its level (technical analysis errors). At the same time, Farasat T. et al. [21] found a significant correlation of the levels of HbA1C and bilirubin in the blood (r = 0.7) already at moderate concentrations of the latter in the blood. However, it is now generally accepted that a false increase in the determined level of HbA1C is really significant only at a blood bilirubin concentration of 20 mg / dL or more [10, 16].

The resulting clinical data are presented in table 1.

Table 1.

Concomitant diseases and conditions that affected on determined blood HbA1c levels

Disease / Condition	Number of patients	%
Chronic blood loss	6	5,1
Chronic liver disease	6	5,1
Nephropathy	5	4,2
Hypercholesterolemia	4	3,4
Blood transfusion	1	0,8
Total falsely understated	22	18,6
Iron-deficiency anemia	10	8,5
Alcoholism	2	1,7
Hyperbilirubinemia	1	0,8
Total falsely overestimated	13	11,0
Total	35	29,7

When analyzing medicinal therapy in 39 patients (33.1% of the study group), preparations were identified that also had a certain potential for influencing the determined level of HbA1c in the blood. And only in one case, there was a tendency to a false increase in the level of HbA1c against the background of long-term administration of celecoxib in high doses (about 800 mg/day) due to polyposis of the colon. All other medicines had the potential to falsely lower this indicator (aspirin, cotrimoxazole, iron preparations, etc.). Their list and frequency of use in the examined patients are presented in table 2.

Table 2.

Medicines that had the potential to underestimate the detectable level of HbA1c

Preparation	Number of patients	%
Cotrimoxazole	16	13,5
Aspirin	15	12,7
Vitamin C	3	2.5
Dapsone	2	1,7
Erythropoietin	2	1,7
Sulfapyridine	1	0.8
Total	39	33,1

According to the literature, the effect of medicines on the determined level of HbA1c in the blood can be realized in a variety of ways. Both through a change in the life span of red blood cells and the mechanisms of formation of HbA1c, and through falsification of the process of such a determination. In the vast majority of cases, as noted by most authors, these effects are dose-dependent.

In particular, long-term administration of 16 patients of the studied group of co-trimoxazole in connection with a chronic infection of the lower urinary tract definitely stimulates the destruction of red blood cells, which gives a false decrease in the determined level of HbA1c in the blood due to the rejuvenation of their population. At the same time, according to literary sources, the severity of this effect largely depends on the innate activity of glucose-6-phosphate dehydrogenase and is difficult to quantify. And this asymptomatic enzymopathy is not rare in the countries of the southern Mediterranean. In addition, in the study group of patients, the used doses of cotrimoxazole fluctuated vary significantly - from 200 to 1100 mg/week [22, 23].

Taking low doses of aspirin (<150 mg/day) is a frequent prescription for patients with coronary heart disease and, of course, affects the process of glycation of hemoglobin through a direct effect on the accumulation of glucose in the liver (the hepatic segment of hemoglobin glycation). In a study by Finamore F. et al. [24] it was convincingly shown that

in the presence of aspirin, the concentration of one of the HbA1c subunits decreases by 30%, which can significantly affect its detectable level in the blood. A similar, but most likely much less pronounced effect is provided by sulfapyridine, which is approximately 30% metabolized by the intestinal flora to salicylate. It was used by one patient in connection with ulcerative colitis. A total of 15 patients took aspirin (12.7% of the examined).

Three examined patients took vitamin C in large doses (more than 500 mg per day) due to chronic venous insufficiency of the lower extremities. In this case, an excess of this vitamin inhibits the hemoglobin glycation process, which is a well-known phenomenon. Two patients took dapsone for prophylactic anti-leprosy treatment. It should be noted that endemic foci of leprosy have been preserved in Libya to date and up to 10 cases of this disease are detected annually. Dapsone potentiates the destruction of red blood cells, reducing their lifespan. In addition, two patients with a history of (up to 3 months) took erythropoietin due to anemia. In all these cases, erythropoiesis was stimulated, which definitely reduced the detectable level of HbA1c in the blood [6, 8, 25].

Thus, as our study has shown, the prerequisites for erroneously determining the level of HbA1c in the blood of patients with DM II in medical practice are quite common. And in some cases, the result can significantly affect glycemic control (for example, with chronic blood loss). Individual preparations were taken by patients also contribute. Methods for determining the level of HbA1c in the blood, excluding high-performance liquid chromatography, are also subjected to specific effects and are also able to significantly distort the result. In our opinion, it is very important that doctors are aware of these effects and medicine interactions, and should exercise caution in interpreting the obtained levels of HbA1c in the blood of such patients. In doubtful cases, the recommendation to conduct FGG and OGTT analyzes remains valid, and for a qualified correction of the plan for the necessary medical treatment of a patient with type II diabetes, the participation of a clinical pharmacist (clinical pharmacologist) needed.

Conclusions

1. In 35 patients with DM II (29.7% of the study group), concomitant diseases and conditions were identified that had the potential to falsify the determined level of HbA1c in the blood. In 22 of them, they affected the false understatement of this indicator (chronic blood loss, liver disease, nephropathy, hypercholesterolemia, etc.), and in 13, on the contrary, they contributed to overstatement (iron deficiency anemia, hyperbilirubinemia, etc.).

2. In 39 patients (33.1% of the study group), preparations intake was detected that could also falsify the determined level of HbA1c in the blood. In most cases (38 out of 39), there was a tendency for the false understatement of this indicator.

3. Given the high incidence of various clinical factors that potentially affect the glycemic control of patients with type II diabetes, it is necessary to more carefully plan the upcoming course of their medicinal treatment.

References

1. Identifying Trends in Undiagnosed Diabetes in U.S. Adults by Using a Confirmatory Definition A Cross-Sectional Study / E. Selvin, D. Wang, A.K. Lee [et al.] // Ann Intern Med. 2017; 167(11): 769-776. doi:10.7326/M17-1272

2. Undiagnosed Diabetes Mellitus and Related Factors in East Gojjam (NW Ethiopia) in 2016: A Community-Based Study / A.T. Wondemagegn, H.M. Bizuayehu, D.D. Abie [et al.] // J Public Health Res. 2017; 6(1): 834. doi: 10.4081/jphr.2017.834.

3. Prevalence of Diagnosed Diabetes in Adults by Diabetes Type – United States, 2016 / K.M. Bullard, C.C. Cowie, S.E. Lessem [et al.] // MMWR Morb Mortal Wkly Rep. 2018; 67(12): 359-361. doi: 10.15585/mmwr.mm6712a2.

4. IDF Diabetes Atlas. 7th ed. - Brussels: IDF, 2015.- 144 p.

5. Moroz V.A. Clinical and pharmaceutical analysis features of oral hypoglycemic medications usage at patients with diabetes mellitus type 2 / V.A. Moroz, E.F. Grintsov // Eksperymentalna i klinichna medytsyna. 2016; 1(70): 52-58.

6. American Diabetes Association Diagnosis and classification of diabetes mellitus // Diabetes Care. 2012; 35(Suppl 1): S64-S71. doi: 10.2337/dc12-s064.

7. Li R. Cost-effectiveness of interventions to prevent and control diabetes mellitus: a systematic review / R. Li, P. Zhang, L.E. Barker, F.M. Chowdhury, X. Zhang // Diabetes Care 2010; 33: 1872-1894. doi: 10.2337/dc10-0843.

8. International Expert Committee International Expert Committee report on the role of the A1C assay in the diagnosis of diabetes // Diabetes Care 2009; 32: 1327-1334. doi: 10.2337/dc09-9033.

9. George J.A. Haemoglobin A1c or Glycated Albumin for Diagnosis and Monitoring Diabetes: An African Perspective / J.A. George, R.T. Erasmus // Indian J Clin Biochem. 2018; 33(3): 255-261. doi: 10.1007/s12291-018-0755-9.

10. Ciaccio M. Introduction of glycated albumin in clinical practice / M. Ciaccio // J Lab Precis Med 2019; 4: 28. doi: 10.21037/jlpm.2019.08.02.

11. Jain R.C. Sickle cell and thalassaemic genes in Libya / R.C. Jain // Trans R Soc Trop Med Hyg. 1985; 79(1): 132-3. doi: 10.1016/0035-9203(85)90257-3.

12. Klonoff D.C. Hemoglobinopathies and Hemoglobin A1c in Diabetes Mellitus / D.C. Klonoff // J Diabetes Sci Technol. 2020; 14(1): 3-7. doi: 10.1177/1932296819841698.

13. Schiavon L.L. HbA1c Levels as a Parameter of Glycemic Control in Patients with Liver Diseases / L.L. Schiavon, J.L. Narciso-Schiavon // Annals of Hepatology, 2017; 16 (3): 469-470. doi: 10.5604/16652681.1235495

14. Hepatogenous diabetes: Is it time to separate it from type 2 diabetes? / E. Orsi, V. Grancini, S. Menini [et al.] // Liver Int. 2017; 37(7): 950-962. doi: 10.1111/liv.13337.

15. Association between glycated hemoglobin (HbA1c) and the lipid profile in patients with type 2 diabetes mellitus at a tertiary care hospital: a retrospective study / S.H. Alzahrani, M. Baig, M.M. Aashi [et al.] // Diabetes Metab Syndr Obes. 2019; 12: 1639-1644. doi: 10.2147/DMSO.S222271.

16. Radin M.S. Pitfalls in Hemoglobin A1c Measurement: When Results may be Misleading / M.S. Radin // J Gen Intern Med. 2014; 29(2): 388-394. doi: 10.1007/s11606-013-2595-x.

17. Increased plasma malondialdehyde and fructosamine in iron deficiency anemia: effect of treatment / R.C. Sundaram, N. Selvaraj, G. Vijayan [et al.] // Biomed Pharmacother 2007; 61: 682-5. doi: 10.1016/j.biopha.2007.06.013/

18. Welsh K.J. Role of glycated proteins in the diagnosis and management of diabetes: research gaps and future directions / K.J. Welsh, M.S. Kirkman, D.B. Sacks // Diabetes Care 2016; 39: 1299-306. doi: 10.2337/dc15-2727.

19. The Relationship Between Alcohol Consumption and Glycemic Control Among Patients with Diabetes: The Kaiser Permanente Northern California Diabetes Registry / A.T. Ahmed, A.J. Karter, E.M. Warton [et al.] // J Gen Intern Med. 2008; 23(3): 275-282. doi: 10.1007/s11606-007-0502-z.

20. Hong J.W. Association between Alcohol Intake and Hemoglobin A1c in the Korean Adults: The 2011-2013 Korea National Health and Nutrition Examination Survey / J.W. Hong, J.H. Noh, D.J. Kim // Plos one 2016; 11(11): e0167210. doi.org/10.1371/journal.pone.0167210.

21. Serum bilirubin is significantly associated with Hba1c in type 2 diabetic subjects / T. Farasat, S. Sharif, F. Manzoor et al. // Endocrinol Metab Int J. 2017; 5(6): 338-341. doi: 10.15406/emij.2017.05.00142.

22. Differential Effects of Azithromycin, Doxycycline, and Cotrimoxazole in Ingested Blood on the Vectorial Capacity of Malaria Mosquitoes / M. Gendrin, R.S. Yerbanga, J.B. Ouedraogo [et al.] // Open Forum Infectious Diseases 2016; 3(2): ofw074. doi.org/10.1093/ofid/ofw074.

23. Cappellini M.D. Glucose-6-phosphate dehydrogenase deficiency / M.D. Cappellini, G. Fiorelli // Lancet. 2008; 371(9606): 64-74. doi: 10.1016/S0140-6736(08)60073-2.

24. Aspirin-mediated acetylation of haemoglobin increases in presence of high glucose concentration and decreases protein glycation / F. Finamore, F. Priego-Capote, S. Nolli [et al.] // EuPA Open Proteomics 2015; 8: 116-127. doi.org/10.1016/j.euprot.2015.04.003.

25. Kotb A. Effect of Vitamin C on Blood Glucose and Glycosylated Hemoglobin in Type II Diabetes Mellitus / A. Kotb, K.M. Al Azzam // World Journal of Analytical Chemistry 2015; 3(1A): 6-8. doi: 10.12691/wjac-3-1A-2.

THE FREQGUENCY OF CRITICAL INCIDENTS AT PERIOPERATIVE PERIOD IN SMOKING PATIENTS

DOI: 10.31618/ESU.2413-9335.2020.3.73.668

V.D. Slepushkin,* M.C. Musaeva,
G.G. Bestaev, P. V. Musaeva
North-Ossetian State Medical Academ,
Vladikavkaz 362025, Russia

ABSTRACT

A prospective, randomized, open research was performed, including 114 patients who had laparoscopic cholecystectomy: 1 group - non-smokers (57 people), 2 group - smokers (57 people).

Among smokers, both during the operation and within the near postoperative period (up to 120 minutes), the number of critical incidents increases, connected with the following systems: respiratory system, blood circulation system, and, especially, nervous system: motor excitation, fever, muscular tremors, the feeling of air lack.

Research Results allow to recommend to the anesthetist to pay attention to the smoking experience, the quantity of smoked cigarettes per day and to be wary concerning the occurrence of possible critical incidents.

Keywords: smoking, critical incidents, perioperative period

1.Введение

В мире ежегодно регистрируется 5,4 миллиона смертей, связанных с курением [1]. Курение увеличивает риск неблагоприятных послеоперационных исходов, особенно – сердечных и легочных осложнений [2, 3]. У курильщиков преобладают легочные проблемы, учитывая, что курение ухудшает транспорт слизи, провоцирует гиперплазию бокаловидных клеток, гиперсекрецию слизи [4], ухудшает функцию легочных макрофагов [5], увеличивает реактивность бронхов путем стимуляции воспаления дыхательных путей [6]. Достаточно хорошо установлено, что курение способствует развитию сердечно-сосудистых заболеваний, однако взаимосвязь между курением и периоперационными сердечно-сосудистыми осложнениями остается спорной [7]. В большинстве исследований не четко идентифицирован предоперационный статус курения в качестве независимого фактора сердечных событий после выполнения некардиальных хирургических вмешательств [2, 8, 9]. Одним из способов выявления влияния курения на возникновение сердечно- сосудистых и легочных осложнений в интраоперационном периоде является регистрация критических инцидентов [10, 11]. Под критическим инцидентом понимается событие при проведении анестезиологического пособия, которое при