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RESEARCH ARTICLE

Prevalence of Diabetes Melitus, Glicemic Status in Periopeative Period and the Incidence of Complications in the Early Postoperative Period in Patients Operated for Heart Disease

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Abstract

Introduction: Patients with diabetes who require surgical intervention are at increased risk of numerous complications. Complications arise due to already developed vasculopathy and neuropathy, but surgery in itself represents stress for the body and causes reactive hyperglycemia, which can affect the development of complications just as in patients with diagnosed diabetes mellitus.

Methods: Retrospective analysis of prospectively recorded electronic records of 130 patients who had myocardial revascularization and/or replacement of heart valves with the use of extracorporeal circulation at the Department of Cardiac and Transplant Surgery of the University Hospital Dubrava.

Results: The prevalence of diabetes in the population of patients who underwent heart surgery was 31%. Out of a total of 130 patients 34% of them developed some complications in the postoperative period. These were delirium (3% of patients), cerebrovascular stroke (0.7% of patients), urinary tract infections (8.4% of patients), superficial and deep sternum infections (4% of patients), atrial fibrillation (12% of patients), pneumonia (1.5% of patients), prolonged mechanical ventilation (0.7% of patients) and death within 30 days of surgery (3% of patients). Complications occurred equally in diabetics as in patients who were not diagnosed with diabetes.

The obvious difference in the occurrence of complications between the diabetic and non-diabetic groups was the number of patients that developed delirium, which occurred in a total of 3% of patients, in the diabetic group in 7% of patients and in the non-diabetic group in 1% of patients. In diabetics, delirium occurred 6.94 times more often than in patients who had not been diagnosed with diabetes.

Conclusion: There is no strong evidence that diabetes has an impact on the occurrence of complications after heart surgery, except for the occurrence of delirium which is much more common in the diabetic group.

Keywords: Diabetes Mellitus, Complications, Glicemic Control, Cardiac Surgery.

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1. Introduction

Patients with diabetes who require surgical intervention are at increased risk of numerous complications. The most common complications are hyperglycemia, hypoglycemia, difficulty in healing the surgical incision site, surgical wound infections, pneumonia, urinary tract infections, sepsis, hyperosmolar hyperglycemic nonketotic syndrome, diabetic ketoacidosis, and electrolyte imbalance in the blood (Whitlock et al, 2011).

Complications arise, on the one hand, due to already developed vasculopathy and neuropathy, which are inevitable in long-term disorders of blood sugar metabolism and, in connection with this, disturbed organ supply, and on the other hand, due to inevitable hyperglycemia that occurs as a result of the stress of surgical intervention.

Hyperglycemia in the perioperative period occurs as a result of stress. Stress causes hyperglycemia through several mechanisms, including metabolic and hormonal changes and an increased pro-inflammatory response of the body to stress, which together slows carbohydrate metabolism but increases glucose production and decreases insulin secretion. Complications after surgical interventions in patients with diabetes, but also in the healthy population in states of hyperglycemia, are also attributed to endothelial dysfunction that occurs with pathological blood sugar values. The function of the endothelium is to control vascular tone, inhibit platelet aggregation and control the permeability of blood vessel walls. Due to the dysfunction of the endothelium, the tone of the blood vessels is reduced and hypertension occurs, the aggregation of platelets is increased, and thrombosis of the blood vessels can occur.

When the organism is under stress, a typical defense reaction is a systemic inflammatory response and the secretion of protective hormones. As part of the systemic inflammatory response, there is the secretion of superoxide and kinases, which are increased in high blood sugar levels and cause dysfunction of the endothelium, increasing its permeability and resulting in the appearance of edema in various organs. Protective hormones that are secreted more during stress protect the body, but they have the opposite effect of insulin on carbohydrate metabolism. These are growth hormone, catecholamines adrenaline and noradrenaline, cortisol and glucagon, without which the body cannot function, but when they are present in excessive amounts, they cause hyperglycemia.

Due to developed vasculopathies and neuropathies that affect the entire organism, complications occur after surgical interventions, most often from the heart, kidneys and central nervous system.

Chronic complications affecting the heart are the most common cause of death in people with diabetes. According to Galway et all more than 50% of patients have an unrecognized myocardial infarction, and an increased prevalence of heart failure (Galway, 2021). Since long-term hyperglycemia causes pathological processes in the heart and blood vessels, due to neuropathy of the autonomic nervous system, patients do not feel the symptoms of reduced oxygenation of the heart muscle, so heart attacks remain unrecognized, and arrhythmias, postural hypotension, decreased functional status, and decreased blood pressure regulation potential are also possible. pressure. All of these are the reasons for complications from the heart in the postoperative period after surgical interventions.

As for the kidneys, complications after surgical intervention can arise due to the presence of vasculopathy that prevents sufficient supply of oxygen and nutrients to the kidneys, but also due to uncorrected dehydration due to ketoacidosis or non-ketotic syndrome and water and electrolyte imbalances that occur in connection with these severe reactions to hyperglycemia.

Complications on the central nervous system occur due to vasculopathy, neuropathy, but also imbalance of water and electrolytes. Vasculopathies on the blood vessels as well as neuropathies of the brain reduce the autoregulation potential, so brain tissue ischemia is possible in patients with diabetes with arterial pressure values higher than in the healthy population. In addition, developed atherosclerosis can lead to embolization and the path of the stream through the blood vessels of the brain. An imbalance of water and electrolytes can lead to edema or dehydration of brain cells. All these complications can result in temporary and mild forms of brain deficits (delirium) or permanent deficits, such as various motor deficits or coma.

Decreased flow through blood vessels can also be the cause of infections in the postoperative period. Tissues and organs have a weaker supply of oxygen, leukocytes, but also antibiotics because the delivery to the target organs is questionable due to vaculopathy. In addition, hyperglycemia reduces defense mechanisms by reducing the function of granulocytes and reducing cellular immunity (Queiroz Santos, 2016.).

2. Aim

Epidemiological analysis of the preoperative profile and the incidence of complications in the early postoperative period in patients with diabetes operated for heart disease.The specific objectives of the research are to analyze the incidence of certain complications within 30 days after surgery, including mortality, new-onset atrial fibrillation, myocardial infarction, infection of incision site or other infection within 30 days of surgery, prolonged mechanical ventilation and prolonged hospital stay, and a comparison with the appearance of complications in patients who do not have diabetes.

3. Methods

3.1 Design

3.1.1. A Descriptive Cross-Sectional Study

3.1.1.1. Sample

The analysis included all patients who went on an elective aortocoronary bypass procedure and/or a heart valve procedure performed with extracorporeal circulation in 2020. The patients were divided into two groups. The first group (DM group) included patients who had been diagnosed with diabetes in the preoperative period, while the second group (NDM group) consisted of patients in whom no diabetes was detected in the preoperative period.

3.1.1.2. Data Collection

A retrospective analysis of data taken from the database of electronic patient records of the Department for Cardiac and Transplantation Surgery, UH Dubrava, CardioBase® was performed.

3.1.1.3. Data analysis

The t-test for independent samples was used to compare two groups with a normal distribution of variables. If the data were irregularly distributed, the Mann-Whitney U test was used. Differences between groups of patients in categorical variables were tested using the $\chi 2$ test. Correlations between continuous variables were analyzed using the Pearson correlation coefficient (r). The $\chi 2$ test was used to compare the occurrence of complications between groups of patients, and the results are presented as odds ratios (OR) and 95% confidence intervals (CI). All the mentioned statistical tests were performed with a statistical significance level of $p<0.05$.For data processing Microsoft Excel 2010 (Microsoft Corp., Redmont, WA, 2010), and statistical program Statistical Package for the Social Sciences, Windows version 21.0, (SPSS Inc., Chicago, IL, USA) were used.

The consent of the Ethics Committee of UH Dubrava was obtained, approval number 2021/1006-05.

4. Results

The analyzed group consisted of 130 patients, 41 patients (DM group) with diabetes and 89 patients (NDM group) in whom diabetes was not recorded in the preoperative period.

Table 1. *Preoperative demographic characteristics of the analyzed patients*

Age (years)[1]	64,61 ±11,47	DM group	NDM group	p
		68.63 ±7.64	62.76 ±12.47	0.006
Gender[2]	male	84 (64)		
	female	46 (36)		
Diabetes mellitus[2]	41 (31)	male	female	p
		28(68)	13 (32)	0,55
Hypertension[2]	78 (60)	DM group	NDM group	0,88
		34 (82)	61(68)	
Hyperlipidemia[2]	67 (51)	22 (53)	45 (51)	0,49
Smoking[2]	12 (9)			
BMI (kg/m^2)[1]	34.53±22.48	DM group	NDM group	p
		37.70±22.32	32.67±22.13	0.10

mean value (± SD)[1]; number (%) of patients[2]

In the analysis of conditions related to the presence of diabetes, the variables NYHA status, left ventricular ejection fraction, presence of congestive heart disease and cardiac arrhythmias, presence of disease of carotid arteries and peripheral vascular disease were analyzed.

Table 2. *Preoperative morbidity as a potential consequence of diabetes*

Preoperative morbidity		All patients	DM group	NDM group	p
NIHA status[1]		2 (1-4)			
	1[2]	29 (22)	5 (12)	24 (27)	0,06
	2[2]	79 (60)	31(76)	48 (54)	0,01
	3[2]	21 (16)	8 (19)	13(15)	0,48
	4[2]	1	1	0	-
LVEF (%)[1]		59.5 (30-76)			
	<30% [2]	0	-	-	-
	30%–49%[2]	35 (27)	10 (24)	25 (28)	0,65
	>49%[2]	95 (73)	31 (76)	64 (72)	0,01
Congestive heart failure[2]		11 (8)	2 (4)	9 (10)	0,12
Arrhytmias[2]		30 (23)	9 (22)	21 (23)	0,83
Peripheral vascular disease[2]		8 (6)	5 (12)	3 (3)	0,04
Carotid arteries disease[2]		9 (7)	4 (10)	5 (4)	0,35

median[1], number (%) of patients[2]

Table 3 shows the results of cardiopulmonary bypass time, time of myocardial ischemia, the duration of the surgical procedure and blood sugar values in intraoperative period

Table 3. *Distribution of results of intraoperative variables*

All analyzed patients (N=130)				
Variables	All patients	DM group	NDM group	p
Duration of ardiopulmonary bypass [1]	83 (29-437)	85 (29-437)	83 (40-196)	0,85
Myocardial ischemia time[1]	53,5 (12-253)	52 (12-253)	55 (25-135)	0,58
Operation time[2]	187,16± 66,17	195,83± 98,50	186,21± 45,6)	0,44
Blood sugar values (mmol/L)[1]	All patients	DM group	NDM group	p
After induction in anesthesia	6 (4-18)	7 (4-18)	5 (4-17)	<0,00001
During cardiopulmonary bypass	7(4-14)	7 (5-14)	6 (4-12)	0,0075
After surgery	8 (4-16)	9 (5-16)	8 (4-15)	0,015

median[1], mean ± SD[2]

Table 4 shows the results of the distribution of patients, with regard to glycemic values and the need for value correction.

Table 4. *Distribution of patients who needed glycemic correction*

Blood sugar values (mmol/L)[1]		All patients	DM group	NDM group	p
	Before surgery				
	<10	115 (88)	31(76)	84(94)	0,001
	>10	15 (12)	10 (24)	5 (6)	
	During cardiopulmonary bypass				
	<10	106 (82)	28 (68)	77 (88)	0,02
	>10	24 (18)	12 (32)	12 (13)	
	After surgery				
	<10	93 (72)	23 (56)	70 (79)	0,008
	>10	37 (28)	18 (44)	19 (21)	

number (%) of patients[1]

In the analysis of the clinical outcome after heart surgery, the variables total duration of treatment, i.e. the number of days of hospital stay, the number of patients with complications, the number of patients with new disorders of the central nervous system, the number of patients with new infections and arrhythmias, the patients who needed prolonged mechanical ventilation after surgery and the number of patients who had a fatal outcome within 30 days of surgery.

Table 5. *Distribution of clinical outcome scores*

Variables	All patients	DM group	NDM group	p
Number of patients with complications[1]	44 (34)	13 (32)	31 (35)	0,72
Days of hospitalisation[2]	9 (5-47)	10 (5-47)	9 (5-28)	0,71
Delirium[1]	4 (3)	3 (7)	1(1)	0,05
CVI[1]	1 (0,7)	-	1	-
UTI[1]	11 (8,4)	2 (5)	9 (10)	0, 31
Superficial infection of the sternum[1]	4 (3)	2 (5)	2 (2)	0,41
Deep sternal infection[1]	1 (0,7)	1	-	-
Atrial fibrilation[1]	16 (12)	4 (10)	11 (12)	0, 66
Pneumonia[1]	2 (1,5)	-	2	-
Prolonged mechanical ventilation[1]	1 (0,7)	1	-	-
Death[1]	4 (3)	1 (2)	3(3)	0,77

number (%) of patients[1], median[2]; CVI-cerebrovascular insult; UTI-Urinary tract infections

5. Discussion

In order to analyze the influence of diabetes on the clinical outcome of patients operated because of heart disease, a retrospective analysis of the preoperative profile of patients with regard to the occurrence of conditions associated and the clinical outcome in the postoperative period within 30 days of the operation was made.

According to the results of the analysis, the prevalence of diabetes in the population of patients who underwent heart surgery is 31%, which is significantly higher than in the general population. According to the "European Health Survey in Croatia, 2019", which was published in 2021, 11.5% of women and 12.9% of men have diabetes (EHIS, 2019.). The proportion of diabetics in the population operated on for heart disease in UH Dubrava coincides with the number in other studies, with the proven fact that the number of diabetics in the population of cardiac surgery patients grows year by year (Bax et al, 2007.; WHO, 2016.; Grundy et al, 1999.; Raza et al, 2015.). It is to be expected such a large proportion of patients with diabetes in the operated population due to changes in the endothelium that are inevitable with long-term elevated blood sugar values, which leads to the occurrence of cardiovascular diseases.

Out of 130 patients, 68% were male. The analysis of hospital morbidity in Croatia in 2011 by gender shows that for cardiovascular diseases the overall hospitalization rate is higher in men than in women, 2,165.1 : 1,766.8/100,000 (HZJZ, 2011.). Whenever epidemiologic analyzes of those operated on for heart disease are performed, a much higher proportion of men is always found because men have an increased risk of heart disease compared to premenopausal women. Female sex hormones have a protective effect on blood vessels and slow down the development of atherosclerosis until menopause. However, once they enter menopause, women's risk is similar to men's. Another reason why men are more represented in the population of cardiac surgery patients may be due to possible gender differences in the symptoms of cardiovascular diseases. Myocardial infarction in men is more often manifested by a typical clinical picture, i.e. stronger pain behind the sternum that lasts twenty or more minutes and is the dominant symptom. In women, heart attack is more often manifested by less typical symptoms such as general weakness, cold sweat, shortness of breath, and due to less pronounced symptoms, women more often overlook the existence of cardiovascular disease (Wakabayashi, 2017.).

The average age of the analyzed patients was 64 ± 11.47 years. The operated patients who had diabetes were significantly older when compared to the patients who did not have diabetes. The results of this analysis are not unique, the literature often states that the diabetic population is older than the non-diabetic population in cardiac surgery (Moorthy et al, 2019.). Diabetes causes changes in heart structures and contributes to the development of heart failure due to the potential of continuous hyperglycemia to accelerate the development of atherosclerosis, but on the other hand, neuropathy as a result of diabetes can contribute to the later manifestation of heart dysfunction symptoms.

The long duration of diabetes causes changes in the endothelium of the arteries, which results in narrowing and impaired blood flow through the blood vessels and is manifested as hypertension. According to Svirčić-Duvnjak the frequency of hypertension

in diabetes patients is significantly higher, about 2x higher than in the non-diabetic population, and is present in about 70% of diabetes patients (Svirčić-Duvnjak, 2009.).

In patients with diabetes, hyperlipidemia occurs as a result of increased production of lipoproteins in the liver due to reduced levels of insulin in the blood, and due to insulin resistance as a consequence of increased fat tissue mass. In this analysis, hyperlipidemia was not found to be more common in patients with diabetes, probably because all patients used some antidiabetic drugs, and it was proven that blood lipids decrease with proper glycemic regulation, especially in diabetics on insulin therapy (Abbate et al, 1990.).

Increased body weight and obesity are risk factors for the onset of diabetes. Fat cells are less susceptible to the action of insulin than muscle cells, so with an increase in fat tissue mass, insulin resistance increases (Honor Health, 2021.). According to the criteria of the World Health Organization, the ideal body mass is 18.5 to 24.9 kg/m^2. If the body mass index is higher than previously mentioned, the risk of cardiovascular diseases as well as diabetes increases (Grundy et al, 1999.). The average value of the body mass index in the analyzed patients was 34.53 ± 22.48 kg/m^2, which classifies the patients to the population with an increased or greatly increased risk for the development of cardiovascular diseases. In the diabetic group, the average value of the body mass index was higher compared to the group of patients who did not have diabetes, which may indicate a possible greater need for corrective actions from the aspect of glycemic control in the stressful perioperative period, because excessive body mass makes it difficult to regulate blood glucose levels due to greater resistance of fat cells to the action of insulin.

5.1 Analysis of the Patient's Preoperative Profile, Considering the Incidence of Conditions Associated with Diabetes

In the analysis of the conditions associated with diabetes preoperative morbidity and functional status of the patient were analyzed.

The mean value of the degree of heart failure (NYHA status) was 2 (1-4) and indicates that the majority of patients came to the surgical intervention in a relatively good functional state, with milder symptoms. Only one patient from the diabetic group had the most severe grade, NYHA 4. But when comparing the values of the NYHA status between the group of patients with diabetes in relation to the rest of the analyzed, diabetics had a worse functional status, which can be attributed to diabetes-related neuropathy, which is why diabetics develop heart weakness faster, but the symptoms begin to be felt at a more advanced stage of the disease and patients later seek medical help.

The values of the ejection fraction of the left ventricle were also analyzed, the mean value of which was 59.5%. The largest number of patients had an ejection fraction greater than 49%, and this was significantly more common in the diabetic group. This finding does not coincide with the results of other studies that present solid evidence that the ejection fraction is lower in diabetics (who, 2016.). The different result of this analysis can perhaps be attributed to the fact that valvular patients were also included in the analysis. Coronary patients develop ischemic heart disease and consequently the ventricle has less power to eject blood, the ejection fraction is lower. If we have a mixed population that also includes valvular patients, we can expect to find higher ejection fraction values, because heart failure with preserved left ventricular function (HFpEF, engl. heart failure with preserved ejection fraction) is also possible. In this syndrome, the ejection fraction of the left ventricle is usually greater than 50%. The left ventricle has enough power to eject blood and the ejection fraction is high, but due to structural changes (which are more intense in diabetics), the ventricle cannot relax enough and fill with blood, so the blood lags behind in the left atrium and in the lungs. Congestive heart disease develops, which 8% of analyzed patients had, but there is no difference between diabetics and other patients.

Cardiac arrhythmias are a common occurrence in patients with diabetes. The appearance of arrhythmias is explained as a consequence of the action of several factors including autonomic dysfunction, molecular changes, remodeling of the atria and ventricles that affect the electrical conduction system in the heart, and is usually manifested by atrial fibrillation and various forms of ventricular arrhythmias (Eh let al, 2011.). Some forms of arrhythmias were present in 23% of analyzed patients, but they were not more common in patients with diabetes.

As for the narrowing of the carotid arteries, which occurs as part of general atherosclerosis in cardiovascular patients in a population of 130 patients, it was present in 7% of those analyzed, although the higher prevalence was in diabetics, the higher number found was not statistically significant.

What definitely makes the difference between diabetics

and the rest of the patients is the higher prevalence of patients with peripheral vascular disease, which was present in 12% of diabetics compared to 3% of patients from the NDM group. Diabetics had peripheral vascular disease 3.83 times more often.

5.2 Analysis of the Surgical Procedure

Although theoretically diabetes leads to numerous structural changes in the body, none of these had an impact on the duration of extracorporeal circulation, myocardial ischemia time, or the total duration of the operation. No patient was connected to mechanical circulatory support, which would require cannulation of the femoral arteries. This could be a problem for diabetics who have developed peripheral vascular disease. It could be difficult to cannulate, but also compromised peripheral circulation for the duration of the support.

5.3 Glycemic Values in the Perioperative Period

Stress hyperglycemia is inevitable in all patients in the perioperative period of cardiac surgery. According to Galindo (2018), it is to be expected that hyperglycemia occurs in 60-90% of diabetics and 60% of patients who do not have diabetes (Grisanti, 2018). In the analyzed patients operated on in UH Dubrava regardless of blood sugar measurement and glycemia correction before arriving in the operating room, values up to 18 mmol/L were found in the first value measured after induction of anesthesia in some patients. Even in that first measurement, the values in diabetics were higher than in patients who had not been diagnosed with diabetes. At each measurement, glycemia was corrected by administering short-acting insulin, however, as the operation progressed, the blood sugar values increased in all patients with a positive correlation with the body mass index, the duration of extracorporeal circulation and the total duration of the operation. Mean blood sugar values were significantly higher in diabetics at all measurement points.

What is the ideal value of blood sugar at the European level, there are no unified guidelines. Blood sugar values lower than 6 mmol/L were recommended 10-20 years ago which often resulted in hypoglycemia (Galindo et al, 2018.). Greco et al analyzed the influence of hyperglycemia on the clinical outcome of cardiac surgery patients in a population of 4316 patients operated on in several American centers. The conclusion of the study is that in patients who do not have diabetes, an increase in blood sugar above 10 mmol/L is closely related to an increase in the number of complications (Greco et al, 2016.) . The frequency of infections and respiratory complications is increasing. However, their conclusion is that in diabetics on insulin therapy, the protective values of glycemia are slightly higher and amount to 10-15 mmol/l.

At the American level, the recommendations for glycemic control of the Association of Thoracic Surgeons, published in 2009, are generally accepted and are still valid (Lazar et al, 2009.). According to these recommendations, hyperglycemia should be corrected in surgical patients in the perioperative period when blood sugar values rise to more than 10 mmol/L. In accordance with these guidelines, in the analyzed patients operated on in UH Dubrava, after measurement of glycemia immediately after induction of anesthesia, correction was necessary in 12% of patients, in 6% of patients who did not have diabetes and in 24% of diabetics. At the end of extracorporeal circulation 18% of patients needed glycemic correction. The number of patients in the NDM group increased to 13%, and in the DM group up to 32%. After the surgery, the number increased even more, 28% of patients out of a total of 130 needed an intervention to lower blood sugar, 21% from the NDM group and 44% diabetics. So, as the perioperative course lasted longer, the number of patients who needed glycemic correction increased. All these data show that perioperative hyperglycemia is common in cardiac surgery patients, and with intermittent administration of insulin it is impossible to maintain the desired glycemic values.

5.4 Clinical Outcome in the Postoperative Period and Analysis of Complications

Cardiac surgery is one of the more invasive branches of surgery, on the one hand, due to extensive surgical interventions on an organ that is expected to function normally after the intervention (all other organs are spared or rest for a while after surgery), and on the other hand, due to the use of extracorporeal circulation, which is inevitable, but it represents only a rough imitation of circulation and can cause numerous pathological processes in the body. After the application of extracorporeal circulation in contact of blood with synthetic surfaces, a systemic inflammatory response very often occurs. This can lead to disturbances in the microcirculation of the heart, brain and other organs, and ultimately result in the dysfunction of these organs . If the difficulties and complications caused by diabetes are added to this, the perioperative course becomes even more demanding, and the number of complications may increase.

According to the results of the study published by Bucerius et al. which included 16,184 cardiac surgery patients, diabetes was identified as a significant prognostic factor for the occurrence of seven severe complications in the postoperative period, including prolonged stay in the intensive care unit, instability of sternal sutures, infection of sternum, respiratory insufficiency, postoperative delirium, cerebrovascular insult and kidney function disorder (Bucerius et al, 2003.). After analyzing 2831 patients, Moorthy et al. conclude that diabetes is a significant risk factor for renal dysfunction, hyperglycemia and infection in cardiac surgery patients (Morty et al, 2019.).

In the analysis of the clinical outcome of 130 patients operated on in UH Dubrava, 34% of patients experienced some of the complications in the postoperative period. These were delirium (in 3% of patients), cerebrovascular insult (0.7% of patients), urinary infections (in 8.4% of patients), superficial and deep infections of the sternum (4% of patients), atrial fibrillation (12% of patients), pneumonia (1.5% of patients), prolonged mechanical ventilation (0.7% of patients) and death within 30 days of surgery (3% of patients).

When comparing the incidence of complications between the groups, they occurred equally in diabetics as well as in patients without diabetes. The reason for this may be that in the NDM group there were also a lot of patients who had developed diabetes but it was not recognized. Another important fact to consider is that recognizing diabetes as a risk factor interferes with the presence of other factors such as hypertension, hyperlipidemia, and smoking, which also increase the risk of complications and often accompany diabetes. This fact is confirmed by the results of a study of 2,688 coronary patients conducted by Alcantra et al., whose results show a higher prevalence of infections and renal failure in the diabetic population, however, when they did a detailed propensity score analysis, diabetes did not appear as independent risk factor of worse clinical outcome (Alcantra et al, 2016.).

The number of days of hospitalization in the analyzed patients was 9 days (5-47), without any significant difference between diabetics and non-diabetics.

An evident difference in the occurrence of complications between the diabetic and non-diabetic groups was the number of patients with delirium, which occurred in a total of 3% of patients. It occurred in 7% of patients in the diabetic group, and in 1% of patients in the non-diabetic group. In diabetics, delirium occurred 6.94 times more often than in patients who had not been diagnosed with diabetes.

Delirium has also been observed in other studies as a frequent phenomenon that occurs after heart surgery, with a significant increase in the number in diabetics (Morty, 2019.). It is explained by the atherosclerotic potential of diabetes and a higher risk for cerebral embolization with atherosclerotic plaque. In addition to this, a compromised autoregulation of blood pressure in the vasculature of the brain is also a risk factor, which is possible due to changes in blood vessels and nerves, which are not inevitable in diabetic patients. Delirium is also possible as a result of an imbalance of water and electrolytes in the body due to hyperglycemia.

6. Conclusion

Based on the results, the following conclusions can be drawn:

1. Diabetes is present in more than 30% of patients who need cardiosurgical intervention due to coronary disease or valve dysfunction
2. It represents a significant risk factor for the development of peripheral vascular disease
3. Patients who have diabetes at the time of cardiac surgery are significantly older than patients who do not have diabetes
4. Diabetes has no influence on the duration of cardiac surgery
5. In the perioperative period, a large number of patients, including patients without recorded diabetes, experience an increase in blood sugar values that require correction, and an increase in glycemia is significantly more common in patients with diabetes.
6. The duration of the surgical intervention affects the increase in the number of patients with blood sugar values higher than 10 mml/L, which requires the use of insulin
7. The increase in glycemia is related to the duration of extracorporeal circulation
8. Postoperative complications occur equally in diabetics as in operated patients who have not been diagnosed with diabetes, with the exception of delirium, which occurs much more often in diabetics.
9. Intermittent administration of short-acting insulin in the perioperative period does not prove to be an efficient method of maintaining the desired blood sugar values.

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