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## **A person with diabetes as a patient - basic rules of conduct**

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### **Abstract:**

**BACKGROUND:** Diabetes is very widespread disease. More and more patients suffer from hyperglycaemia and low levels of insulin because of obesity, aging and wrong diet. The most important in treatment based on health condition is to normalize glucose level. It is recommended to treat patients to avoid many complications of hyperglycaemia, e.g. cardiovascular diseases, stroke episodes, neuropathy or nephropathy. The most common cause of death are cardiovascular problems and renal failure.

**MATERIAL AND METHODS:** A proper review of published literature provide to define laboratory indexes, risk factors, complications to precise methods of treatment among patients with diabetes.

**RESULTS:** The problem of growing number of people suffering from diabetes is an important issue to find solutions to conduct their treatment. Basic method is a change of diet and body loss. The most important medicament in treatment is metformin. To achieve the best results of conducting therapy should be extended by pioglitazone or liraglutide. Also addition of aspirin lower dyslipidemia problems. Such a combination provides to minimise side effects of sickness.

**CONCLUSIONS:** Number of people suffering from DM is still and will be growing over the next years. It is significant to diagnose these people because untreated diabetes provides to many complications e.g. stroke or acute coronary syndrome. It is important to examine patients correctly what allows to turn on correct treatment. Basic standards in treatment should contain lower glucose levels, avoid complications to enhance life quality. . Expanded therapy is also concentrated on hypertension, acidosis and ketoacidosis coma to obtain beneficial effects.

**KEYWORDS:** diabetes, stroke, cardiovascular, hyperglycaemia, neuropathy, nephropathy, treatment, metformin

## **Introduction**

Diabetes is the term for metabolic disorders. Its main feature is permanent hyperglycemia. It is caused by reduced insulin secretion or its reduced activity. We distinguish three main types of diabetes. The first type is characterized by  $\beta$ -cell destruction (This results in a deficiency of insulin). In type 2 It can range from insulin resistance with lowering insulin levels to defective secretion with insulin resistance. In addition, it involves other problems of the so-called metabolic syndrome. The following criteria are used to diagnose diabetes mellitus: HbA1c  $\geq 6.5\%$  ( $\geq 48\text{mmol/mol}$ ), random plasma glucose  $\geq 200\text{mg/dl}$  ( $\geq 11.1\text{mmol/l}$ ), fasting plasma glucose  $\geq 126\text{mg/dl}$  ( $\geq 7.0\text{mmol/dl}$ ), OGTT 2-hour glucose in venous plasma  $\geq 200\text{mg/dl}$  ( $\geq 11.1\text{mmol/l}$ ) [1]. These data come from the recommendations of the Austrian Diabetes Association for the clinical practice of treating diabetes. [2]. Due to an aging population, the number of older people with various types of diabetes also increases. This leads to the development of many recommendations in the management of diabetes in geriatric patients. It is necessary to consider the assessment of medical, psychological, functional and social factors of geriatrics in the elderly. The purpose of this is to create a framework for determining the goals and therapeutic methods in the treatment of diabetes. Screening tests for geriatric teams may be indicated in people who have limitations in the basic and instrumental activities of everyday life. They can affect the independent treatment of diabetes and be related to the quality of life associated with health. [3]. Diabetes is often driven by an epidemic of obesity. The number of patients is likely to double in the next 20 years and fourfold by 2050 large losses for patients and families. Diabetes and its complications lead to higher mortality and practices in a nursing home for the elderly.[4]

## **Results**

### **1. Epidemiology of diabetes.**

Diabetes belongs to the group of metabolic diseases. A characteristic feature is the presence of hyperglycaemia, which arises as a result of impaired insulin secretion or action. Diabetes can be divided into four types:

- type 1 diabetes, it accounts for 5-10% of all cases of diabetes,
- type 2 diabetes, accounts for 90-95% of all cases of diabetes,
- gestational diabetes, incidence is estimated at 3-20%,
- other specific types of diabetes [5].

According to the World Health Organization (WHO), around 422 million people with diabetes lived in the world in 2014, of whom nearly 60 million were in Europe. The incidence of diabetes is constantly increasing, this is evident in recent years. From the available data, we learn that in 1980, about 108 million were ill. It follows that the incidence since that time has increased 3.5 times. This trend is still growing. WHO predicts that by 2030, diabetes will be seven of the most common causes of death. The problem of diabetes incidence also affects

the population of Poland. According to the statistics 1 out of 4 people aged > 60 years has diagnosed diabetes. In 2013, the number of diabetics in Poland was about 2,730,000, this number is constantly increasing [6, 7, 8].

Untreated diabetes leads to serious health consequences. The most common complications include: damage to the heart and blood vessels, damage to the kidneys, nerves (diabetic neuropathy) and eyes (diabetic retinopathy). The most common cause of death, because among 50% of diabetics are cardiovascular diseases. Renal failure is the cause of death in 10-20% of cases. Among the complications of diabetes, we also distinguish those that are not the cause of death, but significantly impair the quality of life of patients. They include neuropathies and diabetic retinopathy. Diabetic neuropathy is related to nerve damage. It is estimated that this problem affects 50% of patients. This is a serious problem, because in combination with damage to the blood vessels leads to the formation of "diabetic foot" which can cause amputation. Diabetic retinopathy refers to damage to the blood vessels in the eye. As a result, about 2% of patients become blind, and nearly 10% suffer from severe vision problems [6, 7, 8].

## **2. Sudden conditions in patients with diabetes.**

This concept includes: acidosis and ketoacidosis coma, stroke, hyperglycemic-hyperosmolar syndrome, hypoglycemic coma.

One of the most dangerous complication of diabetes is stroke, the risk of this disease is four times higher in DM. Therefore, chronic hyperglycemia can lead to acceleration of atherosclerosis through chronic endothelial damage. Apparently the influence of free radicals on DNA strand cracking is noticeable, which directly contributes to endothelial dysfunction [9]. An important strategy in the prevention of cardiovascular events in the course of diabetes is to exclude the effect of 'metabolic memory'. This term refers to the beneficial effects of immediate treatment of hyperglycemia over the years [10]. It has been proven that even short-lived insulin spikes can have a disastrous effect on endothelial function despite long-term normal blood sugar control. Undoubtedly, an important role in the development of atherosclerosis has necrotic disintegration of atherosclerotic plaques. Insulin resistance leads to this. In obese people, with excess body fat, lipolysis is not actively suppressed by insulin. In this way the amount of free fatty acids increases. This consequently causes an increase of the amount of free oxygen radicals. As a result it gives the progression of atherosclerosis [11]. Blood pressure control is very important because it is another important risk factor in people with DM.

Lowering blood glucose below 2,8 mmol/l leads to brain dysfunction, loss of consciousness and consequently to coma. Data indicate that up to 14% of diabetic patients using hypoglycemic agents have hypoglycemia. That's why it is so important to control level of glycated hemoglobin. Not infrequently patients overly controlling the level of glycaemia cause it excessive fall. The fact should be explained to patients regardless of their education, in particular to the elderly. Too low blood sugar increases the risk of premature death [12]. Too low blood sugar levels can lead to macrovascular damage. This also applies to microvascular lesions like kidney damage. Patients with type 2 diabetes are more at risk.

Acidosis and ketoacidosis coma are caused by a significant, sudden shortage of insulin. In the serum and urine, ketone bodies appear, which is characteristic of this condition. Insulin deficiency leads to an increase in gluconeogenesis and thus to an increase of glucose. Then we observe the loss of glucose in urine, hyperglycemia, metabolic acidosis. In a patient this condition is manifested by excessive thirst, polyuria, weakness and impaired consciousness. Ketoacid coma should be differentiated from ketosis hunger, lactic acidosis.

Hyperglycemic-hyperosmolar syndrome is said to be the most severe form of acute hyperglycemia in patients with diabetes. Urinary glucose levels in patients with HHS are over

600 mg/dl in the absence of ketoacidosis. It appears in <1% of patients with diabetes who are hospitalized. Mortality is up to 20%. HHS syndrome has three components: severe hyperglycemia, hyperosmolarity, dehydration (in the absence of acidosis) [13]. There is deficiency of insulin and an increase in the level of hormones acting antagonistically – glucagon, cortisol [13]. Increasing level of gluconeogenesis leads to higher level of glucose. The osmolality gradient and causes water to be removed from the tissues. Initially, glomerular filtration grows, but later hypovolemia causes a decrease in GFR and hyperglycaemia. A higher circulatory index of insulin/glucagon causes that ketoacidosis does not develop.

### **3. Proceedings at the beginning of hospitalization of a person with diabetes.**

After admission to the hospital, people with diabetes are undoubtedly one of the most important elements is to normalize the level of glucose in the blood. Patients with diabetes may be in the hospital for several reasons whose occurrence is coordinated with diabetes. As one study shows - the glycemic variability observed during hospitalization is independently related to the length of hospitalization and hypoglycaemia in non-critically ill, elderly patients. The mean patient-day blood glucose is associated with growth of mortality. [14]

One such condition that is more likely to occur in people with diabetes is stroke. Hyperglycemia, which is found during stroke (or close to this time), is unfavorable. Hyperglycemia often correlates with a greater extent of stroke or the possibility of undergoing ischemic change in hemorrhage. This, of course, is associated with a worse clinical course and greater mortality. [15] That is why glycemic control is so important in patients with suspected stroke.

As it turns out, a high level of glucose may also have an adverse effect on the patient's results after thrombolysis. The admission glucose level (AGL) and history of diabetes mellitus were associated with patients with poor clinical outcome after thrombolysis. The AGL may be an indicator of the severity of a stroke, but not necessarily a causative factor. [16]

It should also be remembered that patients with diabetes also have an increased risk of developing acute coronary syndrome. In all patients with acute coronary syndrome with concomitant carbohydrate disorders, intravenous insulin therapy should be used during this cardiovascular event. Subcutaneous use of insulin usually does not allow to achieve glycemic normalization, which is a basic condition for improving the prognosis in this group of patients. Treatment of ischemic heart disease in people with carbohydrate metabolism disorders should be done in cooperation with a specialist diabetologist. One should strive to obtain and maintain blood glucose within 100-180 mg / dl (5.6-10 mmol /l). [17]

As it turns out, the impact of the condition of patients has not only the level of glucose but also, among other things, their nutritional status. This applies to patients with both the appropriate glucose level and patients with diabetes. But this is a very interesting discovery, which can also affect the final results in patients with diabetes. A recent study in the US shows differences regarding better end results in patients adequately nourished compared to malnourished patients after arthroplasty. As it turns out, patients with adequate nutrition experienced significant postoperative improvement, while the undernourished patient showed no significant improvement. This study showed how important the impact of patients' nutritional status on the final outcome of the disease or surgery is, which should also be taken into account when examining patients with diabetes while admitted to the hospital. [18]

#### **4. Principles of hospitalization of a patient with diabetes.**

Diabetes mellitus is such a common disease that it is impossible not to have contact with it in the hospital. It is very important to ask about it in detail during an interview with a patient at every ward. Basic goals when it comes to diabetic patients should be control over glycemia level, blood pressure and dyslipidemia. Hypertension, lipid-lowering and aspirin treatment is able to reduce cardiovascular risk. Older adults can be treated using relaxed, individual criteria according to their health condition but attention has to be paid to complications leading to functional disorders [19].

The approach in treatment should be patient-centered. It should be chosen considering its efficacy, the risk of hypoglycemia, patient's weight, atherosclerosis or cardiovascular history, side effects, renal problems, delivery method, cost and individual factors [20].

Patients with diabetes are treated based on their health condition. From always recommended diet and exercise to multiple oral agents and injectable therapy with glucagon-like peptide 1 (GLP-1) receptor agonists, insulin, or a combination of both. Controlling HbA<sub>1c</sub> reduces the risk of complications, with the lowest risk HbA<sub>1c</sub> being in the normal range (<6.0%) [21].

The first-line in pharmacological therapy for those patients should be intensive glucose control with metformin. It is proven to decrease the risk of diabetic endpoints and is associated with fewer hypoglycaemic attacks and better weight control than are insulin and sulphonylureas [22]. Liraglutide, semaglutide, pioglitazone, and empagliflozin reduce the plasma glucose concentration. They also lower CVD risk, so if they are used in combination it can lead to cardiovascular benefit [23].

Another valid thing is bedside point-of-care blood glucose monitoring. It is used to assess treatment and guide dosing of insulin for the patients who need it. The timing of this procedure should match carbohydrate exposure when the patient receives nutrition. If not, then glucose monitoring is performed every 4–6 h. Patients on intravenous insulin infusions require more frequent blood glucose testing [19].

The screening of all patients with diabetes to identify those at risk for foot ulceration is a must in hospital. Prevention including intensive podiatric care along with evaluation for surgical intervention can save patient from unpleasant effects such as infection or even amputation [24].

Diabetic patient is excessively exposed to certain health problems that unfortunately lead to many complications. Diabetes can itself contribute to necessity to stay in hospital and may affect many different diseases that patient suffer from.

#### **5. Complications of diabetes.**

Diabetes is chronic and important disease, because of increasing the number of ill people. It increased from 108 million (in 1980) to 422 million (in 2014). Moreover there are some reports that in 2015, 1,6 deaths due to diabetes were registered. International Diabetes Federation (IDF) assesses that more or less 425 million people had DM in 2017, and this is anticipated 629 million by 2045. It is related to increasing the number of overweight and obese people and population aging. It is observed more incidence of hyperglycemia and deaths related to this disease. What is more, diabetes mellitus is a main cause of blindness, renal failure, myocardial infarction, stroke, lower limb amputation and other complications that significantly affect quality of life. [25] Moreover there are some reports that there is a relationship between DM-II (type 2 DM) and the risk of hypothyroidism. [26]

One of the main reasons of motor, sensory and autonomic neuropathy is diabetes mellitus type 2. One of the symptoms of neuropathy which is associated with diabetes is weakness of lower limb skeletal muscles. This disorder damages lower limb function and

prevents locomotion. There are some studies that use magnetic resonance imaging (MRI) and show relationship between acceleration of muscle atrophy in people who also have type 2 diabetes mellitus. [27]

One of the most dangerous complication of diabetes is nephropathy. It demonstrated high morbidity and mortality. No treatment has been found for the time being. Diabetes nephropathy still leads to end-staged renal failure. There are some studies which proves that patients with DN (diabetic nephropathy) have higher blood cell filtration index, viscosity of blood and volume of cells compared to healthy people. [28] Moreover there are some reports that in general population patients with diabetes have worse results after kidney transplantation than non-diabetic people. The mortality among them is higher because of more frequent complications due to diabetes mellitus such as cardiovascular disease and infection. What is more in the last study fund that diabetes increased probability of cellular rejection after kidney transplantation. But renal replacement is still more preferred for these patients than dialysis. [29]

Moreover diabetic patients has worse results in acute coronary syndromes (ACS). Hyperglycemia in patients with myocardial infarction with STEMI has been qualified for adverse prognostic factors regardless of the implementation of therapeutic thrombolysis and percutaneous coronary intervention. What is more there are some studies that frequency of hypertension, dyslipidemia and anemia is higher in patients with hyperglycemia. [30]

One of the most common microvascular complication of diabetes mellitus is diabetic retinopathy (DR) . Moreover it is the one of the leading causes of blindness in population of adults at age 20-74 years old. DR can pass individual stages, including non-proliferative diabetic retinopathy (NPDR), moderate NPDR, severe NPDR and proliferative DR (PDR). NPDR is characterized by microaneurysms, hemorrhage, cotton wool spots and hard lipid deposits. On the other hand to PDR are included: higher vascular permeability, tissue ischemia, neovascularization, what can cause fibrovascular transformations, retinal detachment or blindness. [31]

## Discussion

Diabetes is one of the most diagnosed disease in the world. However, each ethnic or age group has different incidence rate. This is primarily due to the quality of lifestyle, genetic conditions but also comorbidities.

Many researches show the relationship between the place of residence and the number of people suffering from diabetes. It is connected, among others, with the type of diet, physical activity. In the countries of Europe or North America the association of diabetes with obesity or hypertension is observed [32].

Studies published in 2013 by International Diabetes Federation said that 382 million people were suffered from diabetes, including 14 million more men than women. Many cases are still undiagnosed, but it is estimated that by 2035 the number of patients will increase to 592 million. the highest prevalence of diabetes is in The Middle East and North Africa, what's more Western Pacific Region has the highest number of adults diagnosed with diabetes and has also countries with the highest prevalence [33].

According to results of The Turkish Diabetes Epidemiology Study from 2002, crude prevalence of diabetes was more frequent in women than men and in those who live in urban than rural area [34]. Prevalence of diabetes increased with rising BMI, waist-to-hip ratio and waist girth.

Diabetes often occurs in the elderly and it is difficult to treat because of other complicating diseases. In order to avoid complications related to diabetes, appropriate treatment should be implement as soon as possible. It is important that treatment does not interfere with other medications that patients are taking. Unfortunately as other

pharmaceuticals, anti-diabetes medications have side effects. According to studies from “Sage Journals” which was published in 2010, diabetes medications are related to increase risk of falls and fall-related morbidity in the elderly patients with 2 type diabetes. These studies cannot be ignored but take into consideration [35].

## Conclusions

Age and genetics are not the only predisposing factors for diabetes. Apart from them, a significant role is played by diet and incorrect vitamin supplementation, or the lack thereof. After diagnosing diabetes, the patient should start treatment as soon as possible, if left untreated, it can lead to serious health effects. It is extremely important to exclude the effect of metabolic memory in the prevention of cardiovascular complications, therefore correct and systematic control of blood pressure is one of the basic actions in the case of diabetes. Attention should also be paid to controlling the level of glycated hemoglobin when hypoglycemic drugs are used and to a proper diet.

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