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### ASSESSMENT OF EXECUTIVE FUNCTIONS IN THE FRONTAL LOBE OF THE BRAIN AND THE PRESENCE OF DEMENTIA PATIENTS WITH TYPE 2 DIABETES MELLITUS ON A CONTINUOUS SUBCUTANEOUS INSULIN INFUSION

*Background: Cognitive impairment becomes a problem in the 21st century, due to increasing background diseases leading to this problem. It should be noted that the average age of mankind increases, respectively, the executive functions of the brain among the population of the Earth is also getting older. Dementia and cognitive functions of the brain are undoubtedly relevant topics today. Diabetes mellitus is a background factor that leads to dementia and memory impairment [1].*

*Aim: to study the presence of impaired executive function of the frontal lobes of the brain and dementia among patients with type 2 diabetes mellitus on a continuous subcutaneous insulin infusion and multiple daily insulin injection therapy from 45 to 65 years, according to the experience of diabetes from 5 years and above.*

*Materials and methods: 210 patients with type 2 diabetes were studied. The main group consisted of patients with type 2 diabetes using the method of treatment as a permanent subcutaneous insulin infusion (n = 105), in the control group there were patients with type 2 diabetes on multiple insulin injection therapy (n = 105). Patients were selected from two study groups according to age: from 45 to 65 years, according to the experience of diabetes were selected from 5 years and above.*

*The presence of impaired executive functions of the frontal lobes of the brain and presence of dementia were determined using the clock drawing test.*

*Results: In our research work, the cognitive functions (executive work) of the frontal lobe of the brain and the presence of dementia in patients with type 2 diabetes (n = 210) were studied for two methods of CSII (n = 105) and MII (n = 105) from 45 up to 65 years old and with a disease duration of > 5 years and above. In the present study, a clock drawing test (CDT) was used to identify dementia and cognitive impairment of the brain (executive works of the frontal lobe of the brain). The results of the comparative analysis showed that only in patients with type 2 diabetes from 45 to 50 years (n = 40) there were significant differences between the compared groups on the effectiveness of treatment ( $\chi^2 = 11.87$ , at a significance level of  $p < 0.003$ ) as compared with MII, which means among patients with type 2 diabetes with the method of treatment with CSII, there are less pronounced executive disorders of the frontal lobe of the brain and dementia, compared with patients with the method of treatment of MII. According to the results of the study, patients with type 2 diabetes of the first subgroup with the experience of the disease from 5 to 10 years (n = 114) had significant differences: the number of patients in whom dementia was not detected and cognitive impairments of the frontal lobe according to the PPII treatment were more, (1%), compared with the control group at MII (31.3%). Their difference was -24.8%. That is, manifestations of executive dysfunction of the frontal lobes of the brain and the presence of dementia were less susceptible to patients with the method of CSII.*

*Conclusion: it is possible to consider CSII as one of the effective methods of preventing dementia and executive brain dysfunction among patients with type 2 diabetes from 45-50 years old, with an experience of the disease from 5 to 10 years. The remaining subgroups (by the duration of the disease from 11 years and above, as well as by age groups: from 51-55 years; 56-65 years) did not reveal the effect of CSII or MII. The earlier treatment is started with the CSII method, the less the manifestations of executive dysfunction in patients with type 2 diabetes and the development of dementia.*

**Keywords:** dementia, diabetes mellitus type 2, clock drawing test, cognitive function, continuous subcutaneous insulin infusion.

#### Introduction.

Scientists from the Kaiser Permanente Research Center (California) studied patients diagnosed with type 2 diabetes. Of the 22,852 patients studied, it turned out that dementia was more frequently detected in patients with poor blood glucose control. Also, researchers found that poor blood sugar control increased the risk of dementia to 78% [6]. Researchers from another center found out in their research about the connection between diabetes and Alzheimer's disease. It turned out that among patients who participated in the study during 9 years of observation, even in the pre-diabetes state, the risk of Alzheimer's disease was 77% higher, and the risk of dementia was almost 67% [7].

**The aim of the study:** to study the presence of impaired executive function of the frontal lobes of the brain among patients with type 2 diabetes mellitus on a continuous subcutaneous insulin infusion (CSII) and multiple injection insulin therapy (MII) from 45 to 65 years, according to the experience of diabetes from 5 years and above.

#### Materials and methods.

In our research work, patients with type 2 diabetes mellitus (type 2 DM) on a CSII in the amount of 105 people were involved, the control group consisted of 105 people with type 2 diabetes on traditional multiple injection insulin therapy. The subject being studied was dementia and the executive functions of the brain (gnostic and executive functions, constructive praxis). To study these data, a clock drawing test was used (Clock Drawing Test, abbr. CDT, was developed in 1920 by the English neuropathologist G. Head to identify dementia in patients) [2]. Features of the selected test is that the test is highly specific in identifying dementia, right-hemispheric lesions and impaired executive function (praxis) in the frontal regions of the brain and has sufficient sensitivity.

Interpretation of the clock drawing test results:

10 points - the norm, a circle is drawn, numbers in the right places, the arrows show the set time;

9 points - minor inaccuracies in the location of the arrows;

8 points - errors in the location of the arrows are more noticeable (one of the arrows deviates by more than an hour);

7 points - both arrows show the wrong time;

6 points - arrows do not show time (time is circled);

5 points - wrong arrangement of numbers on the dial (numbers follow in the reverse order, that is, counterclockwise, or the distance between them is not the same);

4 points - the integrity of the clock is lost, some of the numbers are missing or located outside the circle;

3 points - the dial and the numbers are no longer related to each other;

2 points - the patient attempts to complete the task, but without success;

1 point - the patient does not attempt to follow the instructions of the doctor.

The patient is given a pencil and a blank sheet of paper and is asked to self-depict a round clock, put the numbers in the desired positions of the dial and draw arrows indicating the set time. The test result of less than 10 points indicates the presence of cognitive disorders. The performance of this test is impaired in both dementia of the frontal type, and in Alzheimer's dementia and dementia with a primary lesion of the subcortical structures. For a differential diagnosis of these conditions, with the wrong self-drawing, the patient is asked to draw the arrows on the dial already drawn (by the doctor) with numbers. In dementia of the frontal type and dementia with a primary lesion of subcortical structures of mild and moderate severity, only independent drawing suffers, while the ability to locate the arrows on an already painted dial

remains. With Alzheimer's type of dementia, both independent drawing and the ability to position the hands on the ready-made dial are violated.

Patients with diabetes were approximately comparable to the control group by age, sex, and number. By age, all patients from the main and control groups were divided into 3 subgroups: 1-subgroup: from 45 to 50 years(n=40); Subgroup 2: from 51 to 55 years(n=55); 3-subgroup: from 56 to 65 years(n=115). The age group was chosen taking into account the fact that according to specialists, the risk of developing diabetes increases after 45 years. At the same time, according to the objectives of the study, the choice of patients took into account the risk of dementias and cognitive disorders associated with age-related changes, which increases after 55-65 years. Therefore, the optimal age for our study was 45-65 years.

It has been proven that the duration of diabetes mellitus directly affects metabolic processes [3][4]. Considering this important factor, all patients of the two studied groups were divided into 3 subgroups according to the duration of the disease: 1-subgroup: the experience of the disease is from 5-10 years(n=114); 2-subgroup: the experience of the disease from 11-15 years(n=53); 3-subgroup: the experience of the disease from 16 years and above(n=42).

Criteria for inclusion in research.

1. Age - from 45 to 65 years;
2. Diagnosis: diabetes mellitus type 2 on the insulin period;
3. Disease experience: at least 5 years;
4. Persons residing in the city of Almaty and the Almaty region who are citizens of the Republic of Kazakhstan.

Criteria for exclusion from the study.

1. Age is younger than 45 years, and also is more senior than 66 years;
2. The presence of dementia;
3. Refusal or inability to participate in the study;
4. The experience of the disease is less than 5 years;
5. The presence of the following comorbidities: acute infectious and inflammatory diseases, chronic infectious and inflammatory diseases in the acute stage, allergic, oncological diseases, alcoholic and viral etiology hepatitis, hypothalamic obesity, chronic heart failure according to NYHA IV Art. or cerebral stroke, conditions after severe head injuries and surgeries, taking sedatives, severe dysfunction of the kidneys and liver of any etiology, elaya form of hypertension, mental illness, epilepsy, blood system diseases, feverish conditions.

An open, comparative, prospective study was conducted with an assessment of the presence of dementia in previously undetected patients and the executive functions of the brain between the two groups differing by treatment method.

All patients were informed about testing, their consents for testing and signatures on informed consent were obtained.

Data from 210 patients with diabetes were collected, recorded and evaluated using the SPSS 22 statistical program.

The study was conducted in a research clinic - the Center for Diabetes at the KazNMU named after SD Asfendiyarov, Kazakhstan, Almaty from 2015 to December 2017. All patients had type 2 diabetes.

This research work was carried out by the ethics committee at KazNMU named after S.D.Asfendiyarov and permission was received to conduct a scientific research in 2015.

#### Results.

Evaluation of the executive functions of the brain in those who were on a permanent subcutaneous insulin infusion determined that among the age group of 45 to 50 years, there was no violation of the executive functions of the frontal lobe of 3/4 of the subjects (76.0%) compared with multiple injection insulin therapy (20.0%).

As can be seen from Table 1 and Figure 1, the quantitative relationship between the variable — the Clock Drawing test and the type of therapy used by patients in the 45-50 age group is reliable, since the critical value of  $\chi^2$  at a significance level of  $p < 0.003$  is 11.87. With a score of 0, patients showed a significant difference between the levels of 76.0% and 20.0% of the two types of therapies by 56.0% ( $p < 0.001$ ). In addition, Kramer's calculated criterion V showed a relatively strong relationship between the nominal variables under study at a level of 0.54.

However, in the age groups of 51-55 years and 56-65 years in patients (Table 2-3, Figure 2-3), no reliable statistical relationship was found between the presented nominal variables ( $\chi^2 = 1.57-2.15$ ,  $p > 0$ , 34-0.45; Kramer's V, 0.14-0.16; That is, the comparative characteristic of the executive functions of the frontal lobe of the brain in patients of the main and control groups did not differ in the effectiveness of treatment methods in the other subgroups (51-55 years and 56-65 years).

Table 1 - Characterization of test results with drawing hours among the 1st age group (45-50 years old) depending on the type of treatment

			Clock drawing test(CDT), points			Total
			0	1	2	
Type of therapy	CSII	Quantity, abs. number	19	2	4	25
		% of therapy	76,0%	8,0%	16,0%	100,0%
		% of CDT	86,4%	33,3%	33,3%	62,5%
		% total	47,5%	5,0%	10,0%	62,5%
	MII	Quantity, abs. number	3	4	8	15
		% of therapy	20,0%	26,7%	53,3%	100,0%
		% of CDT	13,6%	66,7%	66,7%	37,5%
		% total	7,5%	10,0%	20,0%	37,5%
Total		Quantity, abs. number	22	6	12	40
		% of therapy	55,0%	15,0%	30,0%	100,0%
		% of CDT	100,0%	100,0%	100,0%	100,0%

	% total	55,0%	15,0%	30,0%	100,0%
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X<sup>2</sup>- 11.87, p <0.003; Cramer's V - 0.54, p <0.003.

The "0" value means that the patient has no cognitive impairment in the frontal part of the brain and there is no violation of executive praxis (corresponding to 10 points in the clock drawing test).

"1" means that the patient has minor cognitive impairment and the beginning of the violation of executive praxis (corresponds to 9 points in the watch drawing test).

"2" patients whose scores were below 8 points on the clock drawing test.

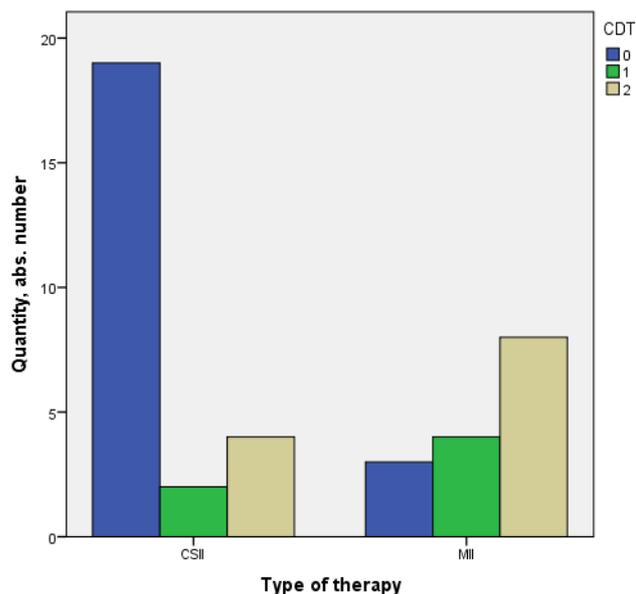


Figure 1 - Memory level among patients in the 1st age group (45-50 years old) depending on the type of treatment

Note: 0-no violation of executive memory; 1 - there are moderate violations of the executive memory; 2-there are violations of the executive memory.

Table 2 - Characterization of test results with drawing hours among the 2nd age group (51-55 years) depending on the type of treatment

			Clock drawing test(CDT), points			Total
			0	1	2	
Type of therapy	CSII	Quantity, abs. number	10	8	9	27
		% of therapy	37,0%	29,6%	33,3%	100,0%
		% of CDT	55,6%	57,1%	39,1%	49,1%
		% total	18,2%	14,5%	16,4%	49,1%
	MII	Quantity, abs. number	8	6	14	28
		% of therapy	28,6%	21,4%	50,0%	100,0%
		% of CDT	44,4%	42,9%	60,9%	50,9%
		% total	14,5%	10,9%	25,5%	50,9%
Total	Quantity, abs. number	18	14	23	55	
	% of therapy	32,7%	25,5%	41,8%	100,0%	
	% of CDT	100,0%	100,0%	100,0%	100,0%	
	% total	32,7%	25,5%	41,8%	100,0%	

X<sup>2</sup> - 1,57, p >0,45; Cramer's V - 0,16, p >0,45.

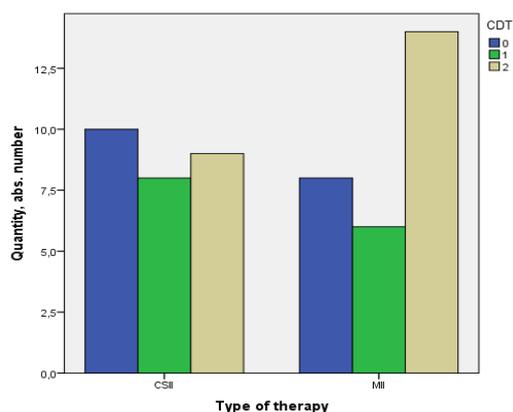


Figure 2 - The memory level among patients in the 2nd age group (51-55 years old) depending on the type of treatment

Table 3 - Characterization of test results with drawing hours among the 3rd age group (56-65 years old) depending on the type of treatment

			Clock drawing test(CDT), points			Total
			0	1	2	
Type of therapy	CSII	Quantity, abs. number	22	8	23	53
		% of therapy	41,5%	15,1%	43,4%	100,0%
		% of CDT	53,7%	34,8%	45,1%	46,1%
		% total	19,1%	7,0%	20,0%	46,1%
	MII	Quantity, abs. number	19	15	28	62
		% of therapy	30,6%	24,2%	45,2%	100,0%
		% of CDT	46,3%	65,2%	54,9%	53,9%
		% total	16,5%	13,0%	24,3%	53,9%
Total	Quantity, abs. number	41	23	51	115	
	% of therapy	35,7%	20,0%	44,3%	100,0%	
	% of CDT	100,0%	100,0%	100,0%	100,0%	
	% total	35,7%	20,0%	44,3%	100,0%	

$\chi^2 = 2,15$ ,  $p > 0,34$ ; Cramer's V = 0,14,  $p > 0,34$ .

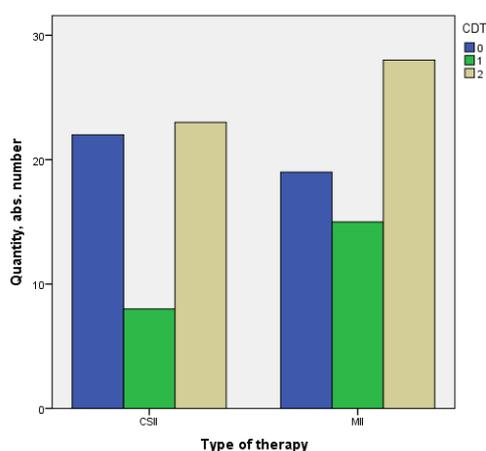


Figure 3—Level of executive memory among patients in the 3rd age group (56-65 years old) depending on the type of treatment

As can be seen from Table 4 and Figure 4, the quantitative relationship between the variable — the Clock Drawing test and the type of therapy used by patients in the group for the duration of the disease — 5-10 years is reliable, since the critical value of  $\chi^2$  at a significance level of  $p < 0.02$  is 7.37. With a score of 0, patients showed a significant difference between the levels of 56.1% and 31.3% of the two types of therapies by 24.8% ( $p < 0.009$ ). In addition, the calculated Kramer's criterion V showed an average relationship between the nominal variables under study at a level of 0.25. That is, manifestations of executive dysfunction of the frontal lobes of the brain are less susceptible to patients with the method of PPII treatment.

However, in groups by disease duration of 11–15 years and 16 years and above, patients (Table 5–6, Figure 5–6) did not find a reliable statistical relationship between the presented nominal variables ( $\chi^2 = 0.88-1.79$ ,  $p > 0.40-0.64$ ; Cramer's V - 0.14-0.18).

Table 4 - Characteristics of the test results with drawing hours among patients for the duration of the disease from 5-10 years

			Clock drawing test(CDT), points			Total
			0	1	2	
Type of therapy	CSII	Quantity, abs. number	37	9	20	66
		% of therapy	56,1%	13,6%	30,3%	100,0%
		% of CDT	71,2%	40,9%	50,0%	57,9%
		Quantity, abs. number	32,5%	7,9%	17,5%	57,9%
	MII	Quantity, abs. number	15	13	20	48
		% of therapy	31,3%	27,1%	41,7%	100,0%
		% of CDT	28,8%	59,1%	50,0%	42,1%
		Quantity, abs. number	13,2%	11,4%	17,5%	42,1%
Total		Quantity, abs. number	52	22	40	114
		% of therapy	45,6%	19,3%	35,1%	100,0%
		% of CDT	100,0%	100,0%	100,0%	100,0%
		% total	45,6%	19,3%	35,1%	100,0%

$\chi^2 - 7,37$ ,  $p < 0,02$ ; Cramer's V - 0,25,  $p < 0,02$ .

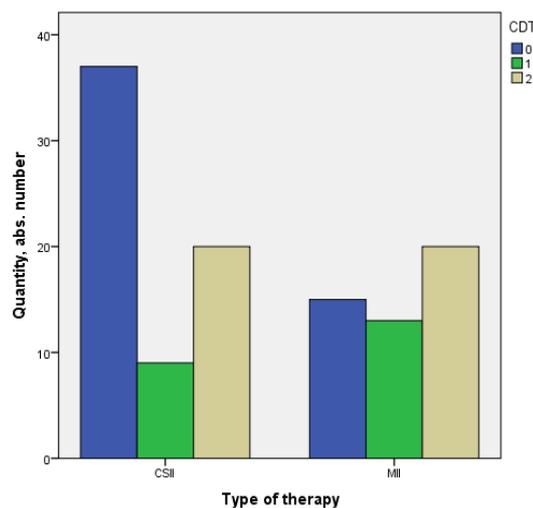


Figure 4 —The memory level among patients in the group according to the duration of the disease from 5-10 years, depending on the type of treatment

Table 5 – Characteristics of the test results with drawing hours for the duration of the disease from 11-15 years depending on the type of treatment

			Clock drawing test(CDT), points			Total
			0	1	2	
Type of therapy	CSII	Quantity, abs.	8	7	7	22

apy		number				
		% of therapy	36,4%	31,8%	31,8%	100,0%
		% of CDT	47,1%	50,0%	30,4%	40,7%
		% total	14,8%	13,0%	13,0%	40,7%
	MII	Quantity, abs. number	9	7	16	32
		% of therapy	28,1%	21,9%	50,0%	100,0%
		% of CDT	52,9%	50,0%	69,6%	59,3%
		% total	16,7%	13,0%	29,6%	59,3%
Total	Quantity, abs. number	17	14	23	54	
	% of therapy	31,5%	25,9%	42,6%	100,0%	
	% of CDT	100,0%	100,0%	100,0%	100,0%	
	% total	31,5%	25,9%	42,6%	100,0%	

$X^2 - 1,79, p > 0,40$ ; Cramer's V - 0,18,  $p > 0,40$ .

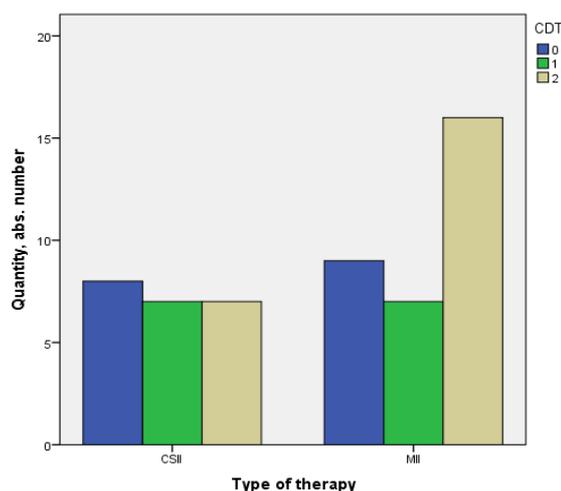


Figure 5 - The level of memory in patients depending on the duration of the disease (51-55 years) in two groups by type of treatment

Table 6 - Characteristics of the test results with drawing hours for the duration of the disease from 16 years and above, depending on the type of treatment

			Clock drawing test (CDT), points			Total
			0	1	2	
Type of therapy	CSII	Quantity, abs. number	6	2	9	17
		% of therapy	35,3%	11,8%	52,9%	100,0%
		% of CDT	50,0%	28,6%	39,1%	40,5%
		% total	14,3%	4,8%	21,4%	40,5%
	MII	Quantity, abs. number	6	5	14	25
		% of therapy	24,0%	20,0%	56,0%	100,0%
		% of CDT	50,0%	71,4%	60,9%	59,5%
		% total	14,3%	11,9%	33,3%	59,5%
Total		Quantity, abs. number	12	7	23	42

	% of therapy	28,6%	16,7%	54,8%	100,0%
	% of CDT	100,0%	100,0%	100,0%	100,0%
	% total	28,6%	16,7%	54,8%	100,0%

$\chi^2 = 0,88, p > 0,64$ ; Cramer's V = 0,14,  $p > 0,64$ .

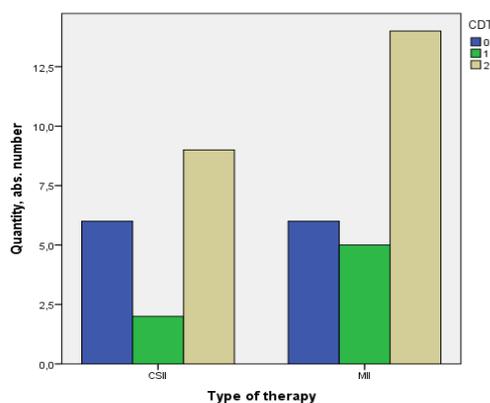


Figure 6 - Memory level according to the test with drawing hours in patients with type 2 diabetes depending on the duration of the disease in two groups by type of treatment

In the present study, the average level of glycemia—glycated hemoglobin over the past 6 months—was evaluated in patients in both groups differing by treatment method. When evaluating the mean value of glycated hemoglobin in the main group with insulin pump therapy was 7.45%, in the control group it was 9.84%. Glycolized hemoglobin (HbA1c) was analyzed by age and duration of the disease. The average HbA1c in the age group of 45–50 years was lower at the CSII ( $M \pm m - 7.07\% \pm 0.21\%$ ), compared to patients with MII ( $M \pm m 10.20\% \pm 0.28\%$ ) [sixteen]. However, glycated hemoglobin indices in this age subgroup were higher than in patients from 51-55, 56-65 years old. Evaluation of carbohydrate metabolism showed that patients with a disease duration of 5 to 10 years and from 16 years and above from the control group have higher glycemia rates ( $M \pm m - 10.23\% \pm 0.26\%$  and  $M \pm m - 9, 45\% \pm 0.40\%$ ) compared with the main group, where the mean value of glycated hemoglobin was subcompensated ( $M \pm m - 7.31\% \pm 0.14\%$ ) in patients with a disease duration of 5-10 years. We also performed a linear regression analysis between HbA1c (glycolized hemoglobin) and the average value of the clock drawing test, however, no Pearson correlation coefficient was found for constant subcutaneous insulin infusion ( $r = 0.05$ ;  $p > 0.61$ ); similarly, it was not detected correlation with multiple injection insulin therapy. That is, the disorders obtained from the clock drawing test among patients with type 2 diabetes were not associated with the glycemic level. In connection with this data, we cannot assume that the correction of glycemia was the best indicator of the clock drawing test.

#### Discussion.

In our research work, the cognitive functions (executive work) of the frontal lobe of the brain and the presence of dementia in patients with type 2 diabetes ( $n = 210$ ) were studied for two methods of CSII ( $n = 105$ ) and MII ( $n = 105$ ) from 45 up to 65 years old and with a disease duration of  $> 5$  years and above. In the present study, a clock drawing test (CDT) was used to identify dementia and cognitive impairment of the brain (executive works of the frontal lobe of the brain). The results of the comparative analysis showed that only in patients with type 2 diabetes from 45 to 50 years ( $n = 40$ ) there were significant differences between the compared groups on the effectiveness of treatment ( $\chi^2 = 11.87$ , at a significance level of  $p < 0.003$ ) as compared with MII (Table 1, Figure 1), which means among patients with type 2 diabetes with the method of treatment with CSII, there are less pronounced executive disorders of the frontal lobe of the brain and dementia, compared with patients with the method of treatment of MII. According to the results of other research works, it turned out that poor cognitive work of the brain and the presence of dementia is associated with poor self-control of blood glucose [18] [19]. However, according to the results, ACCORD MIND did not show predominant differences in cognitive function after intensive glycemic control in patients with type 2 diabetes. In our research work, glycated hemoglobin—HbA1c was also studied; the average value from both groups was taken in the last 3 months (CSII was 7.45%, in the control group with MII it was 9.84%). Such comparative research was carried out in the randomized multicenter research work Opt2mise [22], where the correction of glycemia was better demonstrated on the CSII in patients with type 2 diabetes, which is confirmed in our research work. A linear regression analysis was performed between HbA1c (glycolized hemoglobin) and the average value of the clock drawing test, however, we could not reveal a linear correlation between cognitive impairment, dementia and the average HbA1c ( $r = 0.05$ ;  $p > 0.61$ ) in patients with Type 2 DM at CSII and MII. That is, violations of the clock drawing drawing test among patients with type 2 diabetes were not related to the level of blood sugar in patients with type 2 diabetes in both study groups. In connection with these data, we cannot assume that the correction of glycemia was the best indicator of the clock drawing test in patients aged 45 to 50 years. According to the results of the study, patients with type 2 diabetes of the first subgroup with the experience of the disease from 5 to 10 years ( $n = 114$ ) had significant differences: the number of patients in whom dementia was not detected and cognitive impairments of the frontal lobe according to the PPII treatment were more (1%), compared with the control group at MII (31.3%). Their difference was 24.8% (Table 4, Figure 4). Further, in patients with a longer duration of the disease (Table 5-6, Figure 5-6) did not differ significantly among themselves (from 11-15 years ( $n = 53$ ) and 16 years and above ( $n = 42$ )), no significant statistical relationship between the presented methods of treatment ( $\chi^2 = 0.88-1.79$ ,  $p > 0.40-0.64$ ; V Cramer's — 0.14-0.18), which means the effectiveness of the CSII for patients with a disease duration from 11 years and above. These results in the subgroups have not been thoroughly investigated, requiring convincing, thorough research including other factors influencing cognitive function and the presence of dementia in patients with type 2 diabetes. According to some researchers, the influence of age, as well as the duration of the disease are important background risks for the development of dementia and cognitive impairment [8], as well as the diagnosis of diabetes mellitus according to scientists (Roberts et al., 2008) with a long period of disease are more closely related with dementia [9]. In other studies, a link was found to have good metabolic control among patients with diabetes and better cognitive performance [11]; [12] and the amount of memory (Lenore et al., 2011). The results of our study showed the opposite, that is, glycemic control did not affect the level of cognitive work and dementia in patients with type 2 diabetes. In turn, the lack of dementia and cognitive impairment can lead to better control of glycemia in general and other late complications of diabetes, as the patient better understands and accepts external information about his illness. The results of our study confirm that the best indicators of the test results in patients at a relatively young age (45-50 years old) with CSII are associated with several factors: a relatively young age, as well as the least development of cognitive impairment, due to the small history of

the disease. According to the results of our research work, we can distinguish the duration of diabetes and age as factors affecting the executive memory of the frontal lobes of the brain and manifestations of dementia. It can be assumed that the introduction of CSII at the earlier stages of the treatment of diabetes in the insulin-dependent period has a positive effect on the state of cognitive functions and the prevention of the development of dementia. Early insulin therapy and good sugar control prevents cognitive dysfunction [15].

**In conclusion**, it is possible to consider CSII as one of the effective methods of preventing dementia and executive brain dysfunction among patients with type 2 diabetes from 45-50 years old, with an experience of the disease from 5 to 10 years. The remaining subgroups (by the duration of the disease from 11 years and above, as well as by age groups: from 51-55 years; 56-65 years) did not reveal the effect of CSII or MII. The earlier treatment is started with the CSII method, the less the manifestations of executive dysfunction in patients with type 2 diabetes and the development of dementia.

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## ҮЗДІКСІЗ ТЕРІАСТЫ ИНСУЛИН ИНФУЗИЯСЫН ҚОЛДАНАТЫН 2 ТИП ҚАНТ ДИАБЕТИ БАР НАУҚАСТАРДА БАС МИИНЫҢ МАНДАЙ БӨЛІМІНДЕГІ АТҚАРУШЫ ФУНКЦИЯЛАРДЫ ЖӘНЕ ДЕМЕНЦИЯНЫҢ БОЛУЫН БАҒАЛАУ

**Түйін:** Мидың деменция және когнитивті функциялары бүгінгі күннің өзекті тақырыптары болып табылады. Қант диабеті - бұл деменция мен есте сақтаудың бұзылуына әкелетін фондық фактор [1]. Зерттеудің мақсаты үздіксіз теріасты инсулин инфузиясы қолданатын 2 тип қант диабеті бар науқастар арасында мидың маңдай бөлігіндегі атқару қызметін және деменцияны анықтау болды. Біздің ғылыми зерттеу жұмысымызда 2 типті қант диабеті бар 210 науқас зерттелді. Негізгі топ үздіксіз теріасты инсулин инфузиясын қолданатын 2 типті қант диабетімен ауыратын науқастарды құрады (n = 105), бақылау тобында бірнеше инъекциялық инсулин терапиясын қолданатын (n = 105) 2 типті қант диабеті бар науқастар болды. Қант диабеті ұзақтығы 5 жыл және одан жоғары адамдар іріктелді. Мидың маңдай бөлігіндегі атқарушы функцияларының бұзылуы және деменция сағат салу тесті көмегімен анықталды.

Зерттеудің салыстырмалы нәтижелері көрсеткендей, үздіксіз теріасты инсулиндік инфузия қолданатын науқастарда когнитивтік функциялары бақылау тобымен салыстырғанда 45-50 жас аралығындағы 2 типті қант диабеті бар науқастарда және ауру ұзақтығы 5-10 жыл болған науқастарда ғана жақсы көрсеткіштер көрсеткен.

**Түйінді сөздер:** деменция, 2 типті қант диабеті, сағат салу тесті, когнитивтік функция, үздіксіз теріасты инсулин инфузиясы

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## ОЦЕНКА ИСПОЛНИТЕЛЬНЫХ ФУНКЦИЙ В ЛОБНОЙ ДОЛЕ ГОЛОВНОГО МОЗГА И НАЛИЧИИ ДЕМЕНЦИИ У ПАЦИЕНТОВ С САХАРНЫМ ДИАБЕТОМ 2 ТИПА НА ПОСТОЯННОЙ ПОДКОЖНОЙ ИНСУЛИНОВОЙ ИНФУЗИИ

**Резюме:** Деменция и когнитивные функции головного мозга несомненно актуальные темы на сегодняшний день. Сахарный диабет — это фоновый фактор, который приводит к деменции и ухудшению памяти[1]. Целью исследования являлось изучение наличия нарушения исполнительных функций лобных долей головного мозга и деменции среди пациентов с сахарным диабетом 2 типа на постоянной подкожной инсулиновой инфузии. Были изучены 210 пациентов с сахарным диабетом 2 типа. Основную группу составили пациенты с СД 2 типа использующие подкожную инсулиновую инфузию (n=105), в контрольной группе были пациенты с СД 2 типа на множественной инъекционной инсулинотерапией (n=105). Пациенты были выбраны от 45 до 65 лет, по стажу диабета были выбраны от 5 лет и выше. Наличие нарушения исполнительных функций лобных долей головного мозга и деменция определялись с помощью теста рисования часов.

Результаты нашего сравнительного исследования показали, что когнитивные функции на постоянной подкожной инсулиновой инфузии лучше по сравнению с контрольной группой на множественной инъекционной инсулинотерапии только у пациентов с СД 2 типа от 45-50 лет, со стажем заболевания от 5-10 лет.

**Ключевые слова:** деменция, сахарный диабет 2 типа, тест рисования часов, когнитивные функции, постоянная подкожная инсулиновая инфузия.