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CHARACTERISTICS OF THE CONDITION OF CENTRAL RETINA IN PATIENTS WITH TYPE 2 DIABETES MELLITUS AND PROLIFERATIVE DIABETIC RETINOPATHY

Abstract. Objective. To Investigate the characteristics of the condition of central retina in patients with type 2 diabetes mellitus (DM2) and proliferative diabetic retinopathy (PDR). The study involved 62 patients with DM2. All patients were diagnosed with non-proliferative (31 patients, 31 eyes) and proliferative diabetic retinopathy (31 patients, 31 eyes) on the basis of results of clinical and instrumental examination and according to the ETDRS classification. The ophthalmological examination included measurements of visual acuity with optimal optical correction, tonometry, biomicroscopy, ophthalmoscopy, optical coherence tomography. The thickness and volume of the central retina in patients with proliferative DR were 309.0 ± 130.0 μm and 7.6 ± 2.7 mm^3, respectively, in subcompensated DM, whereas these indicators were 287.0 ± 40.0 μm and 7.80 ± 0.57 mm^3 ($p > 0.05$), respectively, in decompensated DM. A statistically significant decrease in corrected visual acuity ($p = 0.012$) and an increase in the volume of the central retina (by 6.9%; $p = 0.034$) were detected under the conditions of diabetic retinopathy (DR) progression. More expressed demonstrative changes in the retina ($p < 0.05$) were found in patients with proliferative DR complicated by macular edema. Patients with PDR had no differences in eye condition in subcompensation and decompensation of DM2. As a result of progression of DR from non-proliferative to proliferative stage, the corrected visual acuity decreased and the thickness and volume of central macular retina increased. This may be associated with the development of edema due to the progression of the pathological process.

Key words: proliferative diabetic retinopathy; type 2 diabetes mellitus; central retina , macula edema, retinal volume.

INTRODUCTION. So far, there is an increase in the number of patients with diabetes mellitus (DM) in the world. Mainly, these are patients suffering from type 2 DM [1]. The disease is an important medical, social and economic problem as it leads to early disability and premature mortality due to vascular complications. In particular, diabetic retinal lesion (proliferative retinopathy and diffuse macular edema) is a leading cause of blindness in persons of working age [2]. It is believed that the most significant factor predicting the development of diabetic retinopathy (DR) is the duration of DM. It is established that if the period of diabetes is in the range of 5 to 10 years, the risk of DR is 27%. If it is from 10 to 20 years, that the risk increases to 71-90%, and from 20 to 30 years – to 95% [3]. Glycemic level may be a significant risk factor affecting the development of DR [4]. A number of studies had confirmed the dependence of progression rates of microvascular complications on the compensation of DM [5]. In this regard, the achievement of compensation for carbohydrate metabolism disorders is considered an important link in the set of measures aimed at preventing the development and progression of late complications of DM [6]. However, one point is still unclear: Does the condition of the central retina differ in patients with DR at different stages?

Traditional ophthalmological examination for DR include assessment of visual acuity, measurement of intraocular pressure, biomicroscopy, ophthalmoscopy, photographic recording of the fundus, fluorescein angiography, etc. [7]. Optical coherence tomography (OCT) is considered to be one of the most informative non-invasive methods for visualization of the retina nd diffuse macular edema. This method allows to accurately assess the thickness and structure of the retinal layers [8]. Despite a rather intensive study of DR, there is little information on morphometric retinal gradations with the progression of DR in literature. Thus, the characteristics of the structural and functional condition of the retina in the process of development of DR from zero stage (without changes in the fundus) to proliferative stage, i.e. absolute values and factors dynamics, remain ambiguous and incomplete. It is therefore relevant to clarify the influence of DM2 on the progression of DR and quantitative parameters of visual functions.

The objective of the study was to determine the dependence of the condition of the central retina in patients with proliferative diabetic retinopathy on the duration of DM2 and the glycemic level.

MATERIALS AND METHODS. The study involved 62 patients with type 2 DM. All patients were diagnosed with non-proliferative (31 patients, 31 eyes) and proliferative DM (31 patients, 31 eyes) on the basis of results of clinical and instrumental examination and according to the ETDRS classification. All patients involved in the study were examined by endocrinologist and nephrologist. The ophthalmological examination included visiometry with a computerized phoropter (Refractor RT-5100, Nidek, Japan) and chart projector (CP-770, Nidek, Japan), pneumotonometry (NT-530, Nidek, Japan), kerato-refractometry (ARK-1000 OPD-Scan II, Nidek, Japan), anterior segment biomicroscopy (HaagStreit BQ 900 slit lamp, Switzerland), Super Pupil XL wide-angle biomicroscopy (Volk Optical, USA), optical coherence tomography (Optovue RTVue, Optovue, USA).

The analysis was performed using statistical package Medcalc. A point estimation of the values to be analyzed was performed by calculating the arithmetic mean (M) and the corresponding standard error (m). The analysis of intergroup differences in the case of two groups was performed using the Student's t-test (in case of normal law of distribution and quantitative characteristics), the Wilcoxon rank sum test (in case of non-normal law of distribution and quantitative characteristics). In all cases, the difference was considered statistically significant at a significance level of $p < 0.05$.

RESULTS. The average age of patients with proliferative DR (main group) was 61.2 ± 2.4 years; the largest number of patients, 10 (32.2%), were in the age range of 60-65 years. The main group included 8 (25.8%) men with an average age of 61.0 ± 2.6 years (95% confidence interval (CI) 54.8–67.2 years) and 23 (74.2%) women 60.9 ± 1.7 years old in average (95% CI 57.3–64.4 years); the gender differences in age was not statistically significant ($p = 0.968$).

The age categories of 50–55, 60–65 and 65–70 years included the same number of men, while the highest number of women, 8 (88.8%), was in the category of 60-65 years. The glycemic level in patients with proliferative DR reached 9.15 ± 0.51 mmol/L and the level of glycated hemoglobin (HbA1c) was 7.55 ± 0.15%. Macular edema was detected in 19 (61.3%) patients of the main group, where 5 (26.3%) patients were male and 14 (73.7%) patients were female.

This poses the question: Does the condition of the eye differ in patients with proliferative DR depending on the duration of type 2 DM? The results of the study were divided and analyzed in 3 groups depending on the duration of DM: from 1 to 10 years – 11 (35.5%) patients, from 11 to 15 years – 12 (38.7%), from 15 to 20 years – 8 (25.8%) patients.

Analysis of clinical laboratory data (Table 1) showed that the maximum glycemic level was observed in patients with 11-15 years duration of DM. This indicator exceeded the value in patients with disease duration of 1–10 years by 46.7

Table 1

Results of clinical and laboratory study of patients with proliferative diabetic retinopathy depending on the duration of type 2 DM

Indicators	Duration of DM 1–10 years (n = 11)	Duration of DM 11–15 years (n = 12)	Duration of DM 15–20 years (n = 8)
Fasting blood glucose level, mmol/L	7.50 ± 0.69 (CI 6.1-8.3)	11.0 ± 1.1 (CI 9.1–13.0) $p_{1–10} = 0.001$ p15–20 = 0.001	7.55 ± 0.97 (CI 6.7–10.7)
Best corrected visual acuity	0.20 ± 0.13 (CI 0.1–0.5)	0.10 ± 0.08 (CI 0.05–0.5)	0.30 ± 0.15 (CI 0.15–0.8)
Intraocular pressure, mm Hg	16.0 ± 0.9 (CI 15.0–19.0)	18.0 ± 1.5 (CI 14.0–22.0)	18.0 ± 2.2 (CI 15.0–20.0)
Central retinal thickness, μm	363.0 ± 79.7 (CI 272–480)	397.0 ± 72.1 (CI 252–461)	245.5 ± 23.8 (CI 212–309) $p_{1–10} = 0.030$ p11–15 = 0.027
Macular retinal volume, mm^3	8.29 ± 1.64 (CI 7.63–9.87)	7.95 ± 1.03 (CI 6.83–10.77)	7.03 ± 0.53 (CI 6.40–7.48) $p_{1–10} = 0.005$

% ($p = 0.001$).

This fact is due to the different number of patients with decompensated DM: there were 8 (72.7%) such patients in the age group 1–10 years and 12 (100%) in the age group 11–15 years. The paradoxical results of the OCT eye examination in patients with a DM duration of 15–20 years are attributed to the absence of macular edema in the majority of the examined patients – 7 (87.5%) patients. If to compare the results of examination of patients with macular edema with patients with a DM duration of 1–10 and 11–15 years (there were 9 such patients in each group), no statistically significant difference in the central retinal thickness and central retinal volume are detected (Fig. 1).

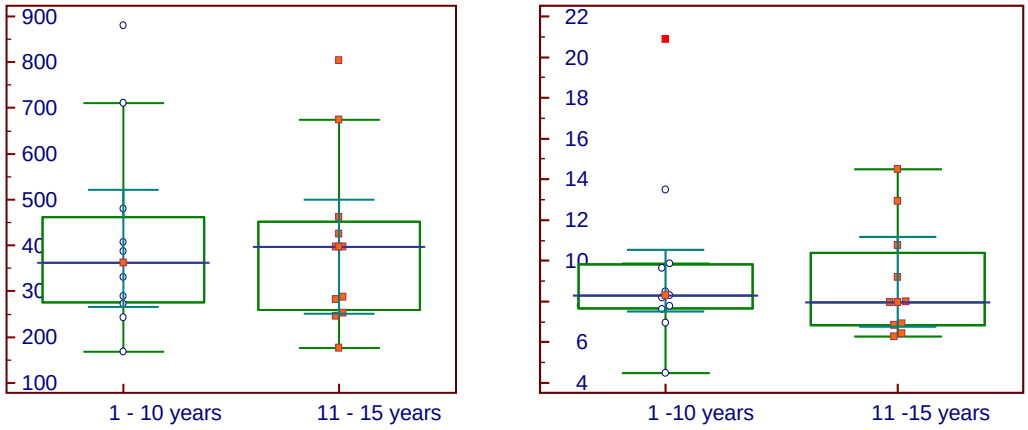

Figure 1. Characteristics of the condition of the retina in patients with proliferative DR under conditions of type 2 DM of different duration. X-axis – patient groups; y-axis: a – retinal thickness (μm); b – macular retinal volume (mm^3)

The next question is: Does the condition of the eye differ in patients with proliferative DR in different compensation stages of type 2 DM?

Our sample included 7 (22.6%) patients with subcompensated and 24 (77.4%) patients with decompensated DM. Correctness of the above distribution of patients in the main group was confirmed by the glycemic level. The glycemic level in patients with subcompensated DM was 6.1 ± 0.36 mmol/L (95% CI 5.0–6.8 mmol/L), in patients with decompensated DM – 10.0 ± 0.6 mmol/L (95% CI 8.0–11.0 mmol/L), i.e. 63.9% (p <0.001) higher. The average duration of DM at stage of subcompensation and decompensation was not statistically significantly different (p = 0.506) and was 19.0 ± 3.2 years (95% CI 5–20 years) and 13.0 ± 2.0 (95% CI 10–15 years), respectively. The analysis did not reveal any statistically significant difference in the main indicators (Table 2).

Table 2

Results of clinical and laboratory study of patients with proliferative diabetic retinopathy under conditions of subcompensation and decompensation of type 2 DM

Indicator	Median value	I quartile	III quartile	Median error	Left eye (95% CI)	Right eye (95% CI)
DM subcompensation state (n = 7)						
Best corrected visual acuity	0.15	0.05	0.3	0.08	0.04	0.5
Intraocular pressure, mm Hg	18	15	20	2.4	15	29
Central retinal thickness, μm	309	212	710	130	149	880
Macular retinal volume, mm^3	7.6	6.4	13.5	2.73	3.96	20.88
DM decompensation state (n = 24)						
Best corrected visual acuity	0.3	0.1	0.5	0.08	0.1	0.5
Intraocular pressure, mm Hg	17	14	19	0.8	15	19
Central retinal thickness, μm	287	246	407	40	252	397
Macular retinal volume, mm^3	7.8	6.91	9.2	0.57	6.94	8.48

If to compare the subgroups of patients with macular edema, the results of the OCT eye examination do not change significantly (Fig. 2).

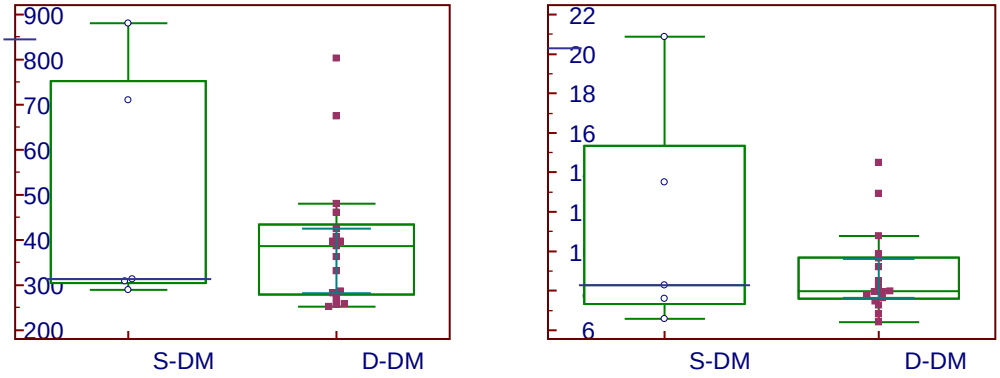

Figure 2. Characteristics of the condition of the retina in patients with proliferative diabetic retinopathy in various compensation conditions of type 2 DM . X-axis – groups of patients with subcompensated (S-DM) and decompensated (D-DM) conditions of DM; y-axis: a –retinal thickness (μm); b – macular retinal volume (mm^3)

The subgroup with subcompensated DM included 5 (71.4%) patients with macular edema and 2 (28.6%) patients without it. The subgroup with decompensated DM consisted of 17 (70.8%) patients with macular edema and 7 (29.2%) patients without it. In particular, the macular retinal thickness and volume in subcompensated DM were 313.0 ± 154.6 μm and 7.94 ± 3.13 mm3, respectively, whereas these indicators in decompensated DM were 387.0 ± 45.6 μm and 7.98 ± 0.65 mm3 (p> 0.05), respectively. According to the severity classification of diffuse macular edema [9], the majority of the examined patients had pronounced macular edema.

Therefore, patients with proliferative DR did not show a statistically significant difference in the morphofunctional condition of the eye in subcompensated and decompensated conditions of type 2 DM. Given the limited number of studies, further investigation of this problem is needed.

Another interesting question is: Does the glycemic level influence the condition of the retina during the progression of DR from the non-proliferative to the proliferative stage?

In this context, we compared the data of 24 patients with proliferative and 22 patients with non-proliferative DR in conditions of decompensation of type 2 DM. The glycemic level in patients in both groups did not differ and was 10.0 ± 0.65 mmol/L and 9.0 ± 0.5 mmol/L, respectively. The average duration of DM in proliferative DR was longer than in non-proliferative DR and was 13.0 ± 2.0 years and 8.0 ± 1.5 years (p = 0.021), respectively. The analysis showed a statistically significant decrease in the corrected visual acuity (p = 0.012) and an increase in the macular retinal volume (by 6.9%; p = 0.034) under the conditions of DR progression (Table 3).

Table 3

Results of clinical and laboratory study of patients with proliferative and non-proliferative diabetic retinopathy under conditions of DM decompensation

Indicator	Median value	I quartile	III quartile	Median error	Left eye (95% CI)	Right eye (95% CI)
Proliferative stage of diabetic retinopathy (n = 24)						
Best corrected visual acuity	0.3 P_{NPDR} = 0.012	0.1	0.5	0.08	0.1	0.5
Intraocular pressure, mm Hg	17	14	19	0.8	15	19
Central retinal thickness, μm	298	249	402	38	257	397
Macular retinal volume, mm^3	7.7 P_{NPDR} = 0.034	6.87	8.84	0.55	6.94	8.2
Non-proliferative stage of diabetic retinopathy (n = 22)						
Best corrected visual acuity	0.7	0.4	0.9	0.08573	0.4	0.9
Intraocular pressure, mm Hg	16.5	14	18	0.8	14	18
Central retinal thickness, μm	283	243	357	18	250	352
Macular retinal volume, mm^3	7.2	6.5	7.47	0.55	6.94	8.2

More expressed demonstrative changes in the retina were found in patients with macular edema. There were 17 (70.8%) such patients with proliferative DR and 15 (68.2%) patients with non-proliferative DR.

The results of the study showed (Fig. 3) that, under the conditions of DR progression, macular edema was characterized by an increase in thickness (by 35.9%; p = 0.026) and a volume of central macular retina (by 12.3%; p = 0.005).

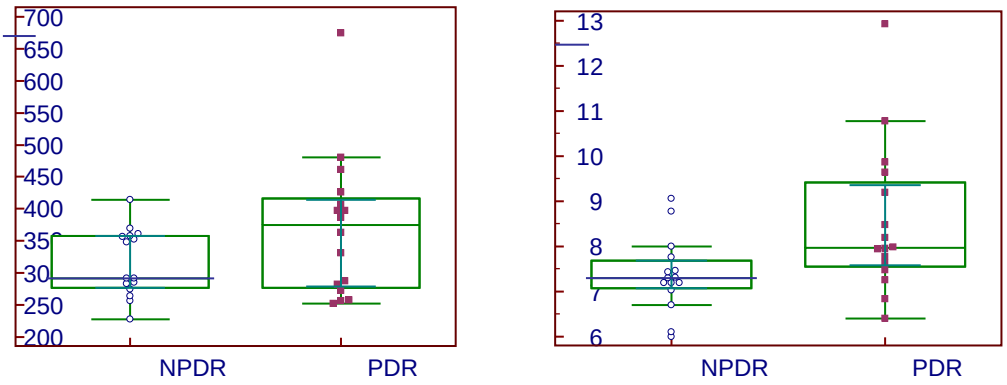

Figure 3. Characteristics of the retina in patients with non-proliferative (NPDR) and proliferative diabetic retinopathy (PDR) in the presence of macular edema. X-axis – patient groups; y-axis: a – retinal thickness (μm); b - central retinal volume (mm^3)

DISCUSSION. Macular edema was revealed in the majority (61.3%) of patients in the main group. The provided frequency of macular edema is slightly lower than that presented in the literature. A particular focus in the literature is put on 70% of cases of this pathology in the proliferative stage of DR [10]. Therefore, diagnostics of DR should be aimed at the early detection of vascular complications of DM, including macular edema.

We have not found any evidence of dependence of central retinal thickness and volume in proliferative DR on the type 2 DM duration of 20 years. According to the existing paradigm in the literature, retinal deterioration before initiating insulin therapy is more common among patients with severe DR and less common in the absence of changes in the fundus or with minimal signs of retinopathy [11]. Thus, the detected inconsistency in the obtained results may be explained by the condition of the retina prior to the initiation of antipyretic therapy, the duration of treatment of the detected DM and / or the ineffectiveness of such therapy. The initial condition of the retina is considered to be the most significant risk factor for the progression of DR after the start of insulin therapy [12].

The significance of the increase in retinal thickness in macular edema is of interest in the context of decreased optical density of macular pigment, which causes visual discomfort, eliminates photostress and adaptation to glares from bright light. In this regard, a correlation was found between the quantitative indices of the optical density of macular pigment and the retinal edema area, as well as the decreased light sensitivity in the central retinal area in diabetic macular edema [13]. A similar point of view is expressed by other authors [14] who have found a decrease in the retinal sensitivity threshold in diffuse macular edema areas. Consequently, a high intensity of light stimulus is required to reach the threshold.

As relating to the critical analysis of the DR progression, it should be noted that retinal deterioration after initiation of insulin therapy is more common among patients with severe DR and less common in the absence of changes in the fundus or with minimal signs of retinopathy [15]. This is probably associated with the better condition of the retina at the time of starting insulin therapy and decreased risk of frequent hypoglycaemia in subcompensated DM.

CONCLUSIONS. Patients with proliferative DR had no differences in eye condition in subcompensated and decompensated DM2. However, taking into account the systemic factors that may influence the results obtained, we consider it necessary to continue the studies.

As a result of progression of DR from non-proliferative to proliferative stage, the best corrected visual acuity decreases and the thickness and volume of central macular retina increases. This may be associated with the development of edema and progression of the pathological process.

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CLINICAL EXPERIENCE USING THE POLYPROPYLENE MESH FOR THE PREVENTION OF HIP ARTHROPLASTY DISLOCATION

Abstract. Formulation of the problem Dislocation of the femoral component of the endoprosthesis is one of the most frequent complication of total hip replacement. One of the method preventing this complication is a proper restoration of soft tissue and capsule structures. In this paper, we propose a method for restoring and strengthening the posterior structures of the capsule of the hip joint using polypropylene mesh. The purpose of this study is to improve patient outcomes by strengthening the hip joint capsule and closing it with the polypropylene mesh and to study the expectation of THA dislocation in such cases.

Results The results showed that HHS total points were better in the study group than control one after 12 months as well as after 24 months post-OP. The static-dynamic function of the operated limb in patients whose capsule defect was closed with PM was higher than the corresponding parameters of the control group, which corresponded to 42.86±3.01 points after one year after surgery. According to the findings, the risk of hip arthroplasty dislocation in patients undergoing posterior strengthening of the capsule joint with the PM was significantly less than in the control group. The proportion of patients in whom this complication may not develop in the main group was 82.4%, which is better than in the control group - 64.9% by 17.5%.

Conclusions Strengthening of the hip joint soft tissue structures using PM leads to better prognostic results of primary and revision surgery and reduces the risk of dislocation after arthroplasty

Keywords: endoprosthesis, hip joint, dislocation, polypropylene, total hip arthroplasty

Background

Among all complications of total hip arthroplasty (THA), dislocations is on the second place, by frequency of causes the revision surgery, after aseptic loosening of components. Therefore, the treatment of patients with this complication is an urgent and