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CLINICAL RESEARCH

Proliferative Diabetic Retinopathy Surgery against the Background of Prior Retinal Laser Coagulation

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Abstract

The study has been performed to compare the immediate and long-term outcomes of Vitreoretinal Surgery (VS) on patients with Proliferative Diabetic Retinopathy (PDR) in relation to Prior Retinal Laser Coagulation (PLC). The study included 56 patients (71 eyes) with diabetes mellitus (type 2 - 52/93%, men – 39/75%) complicated with proliferative diabetic retinopathy (PDR), requiring VS. Of these, 33 eyes (no PLC) underwent primary vitrectomy, while the remaining 38 eyes (PLC) had undergone panretinal laser coagulation over the past five years. In our study, PLC significantly contributed to the preservation of improved functional retinal status, despite the development of complications, which is an indication for VS. The PLC patients exhibited early recovery and a higher visual acuity throughout the observation period. Thus, the study revealed that in the case of prior VS, laser photocoagulation of the retina helps preserve the visual acuity, both at the time of and during the first year after surgery, reduces surgery duration and decreases the need to tamponade the vitreous cavity with silicone oil. Besides, PLC of the retina is accompanied by a significantly lower incidence of intra- and post-operational hemorrhage and reduces the need for repeated vitreoretinal procedures. The present study presents further arguments in favor of early retinal laser photocoagulation on patients with diabetes mellitus complicated by PDR.

Key words: *Proliferative Diabetic Retinopathy, Prior Retinal Laser Coagulation.*

Introduction

Proliferative Diabetic Retinopathy (PDR) is a variation of diabetic microangiopathy, a natural consequence of vascular wall changes, leading to hypoxia of the retina, development of growth factors and neovascularization. At the PDR stage, retinal laser coagulation proves to be an effective treatment method, as it helps arrest the neovascularization nidus. Timely laser coagulation helps reduce the risk of irreversible vision loss by 50%. However, even after retinal laser coagulation, the proliferation process may progress, resulting in complications in the form of intravitreal hemorrhage and tractional retinal detachment when laser coagulation becomes impossible and a special surgical intervention, viz., vitrectomy, is required.

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The aim of this retrospective study was to compare the immediate and long-term outcomes of Vitreoretinal Surgery (VS) on patients with PDR in relation to Prior Retinal Laser Coagulation (PLC).

Material and methods

The study included 56 patients (71 eyes) with diabetes mellitus (type 2 - 52/93%, men – 39/75%) complicated with PDR, requiring VS. Of these, 33 eyes (no PLC) underwent primary vitrectomy, while the remaining 38 eyes (PLC) had undergone panretinal laser coagulation over the past five years. All patients in the study had received prior correction of metabolic, somatic and hemodynamic status. Surgeries had been performed not earlier than two weeks after the sub-compensation of carbohydrate metabolism and target blood pressure were secured, and the inflammatory processes in the kidneys relieved. Contraindications to surgery included active inflammatory processes, expressed organ failure and acute cardiovascular disorders during the preceding two months. The study excluded

patients whose diabetic nephropathy was complicated by end-stage renal failure. The basic therapy included hypoglycemic and antihypertensive therapy (angiotensin converting enzyme inhibitors, beta-blockers and calcium channel blockers), aspirin, and statins.

VS included segmentation, delamination and removal of the epiretinal membranes, removal of vitreous, endolaser coagulation, liquid/gas exchange and, when indicated, removal of a cloudy lens and implantation of intraocular lens, and tamponade of the vitreous cavity with silicone oil.

During the study, the following aspects were assessed: initial visual acuity and visual acuity at one week, six months and one year after surgery, duration of surgery and the need to tamponade the vitreous cavity with silicone oil, the frequency of intra-and postoperative intravitreal hemorrhage, the need for further surgeries and their structure, and the need for repeated retinal laser coagulation.

All data were processed using the BIOSTAT software. Intergroup differences in frequency distribution were calculated using $\chi 2$ rate. Differences were considered significant at $p<0.05$.

Results

Clinical characteristics of the comparison groups and the outcome of surgery are shown in the Table 1. As evident from the data, the groups were randomized by diabetes type, frequency of insulin therapy, renal function (glomerular filtration rate). Moreover, the indications for VS on patients with no PLC, significantly more frequently, included nonabsorbable intravitreal hemorrhage, flat macular detachment and premacular fibrosis ($p<0.05$ between groups). No combined retinal detachment in patients with PLC was detected, while it served as an indication for surgery in three patients (9.09%) in the group of patients with prior VS. Besides, PLC helped maintain high visual acuity (VA) at the time of VS (there was a significantly larger number of patients with VA above 0.1 and fewer with VA lower than 0.01 compared with the primary surgery group).During the surgery, the primary intervention group revealed a significantly higher incidence of intraoperational hemorrhage ($p<0.001$); they also required significantly more tamponade of the vitreous cavity with silicone oil ($p<0.001$), which is associated not only with intra-operative bleeding, but also with a more frequent presence of combined retinal detachment and flat macular detachment. Due to the more stable pre- and intra-operational status of the posterior segment of the eye, the duration of surgery in the group with PLC was shorter than in the primary intervention group ($p<0.001$).

The analysis of the dynamics of visual acuity during the first year after VS was based on the frequency distribution of the patients with VA below 0.01, 0.01-0.1, and above 0.1. In the group with primary intervention, a gradual decrease in the number of patients with VA below 0.01(from 17 to 10 people, $p<0.05$) was recorded in favor of the subgroup with VA of 0.01-0.1. The number of patients with VA above 0.1 was stable during the year. In the group of PLC, one week after the surgery, the number of patients with VA below 0.01 was significantly lower than in the primary intervention group (11% *vs* 52%, $p<0.05$), and remained stable throughout the observation period, while the number of patients with VA at 0.01-0.1 dropped in favor of the subgroup with VA of 0.1. Thus, by the end of the observation period, among those patients with VA below 0.01 and 0.01-0.1 significantly fewer patients with primary retinal laser correction were seen than in the primary intervention group ($p<0.05$ for both sub-groups of VA), and significantly more patients with vision above 0.1 ($p<0.001$).

Table 1.
Comparative clinical and ophthalmological characteristics of the patients and the results of VS on the eyes with PDR, in relation to PLC

Parameters	No PLC (n=33)	PLC (n=38)	$\chi 2$
Diabetes, type 2	30 (90.9%)	33 (86.8%)	NS
Insulin therapy	16 (48.5%)	18 (47.4%)	NS
Glomerular filtration rate, ml/min	65.47±21.86	64.93±25.64	NS
Indications to vitrectomy			
Nonabsorbable intravitreal hemorrhage	17 (51.5%)	11 (28.9%)	P<0.05
Progressive neovascularization	10 (30.3%)	8 (21.0%)	NS
Dense premacular hemorrhage	10 (30.3%)	8 (21.0%)	NS
Flat macular detachment, premacular fibrosis	10 (30.3%)	4 (10.5%)	P<0.05
Tractional retinal detachment	7 (21.2%)	8 (21.0%)	NS
Combined retinal detachment	3 (9.1%)	0 (0%)	P<0.05
Initial VA with maximum correction			
Below 0,01	17 (51.5%)	8 (21.0%)	P<0.01
0,01-0,1	13 (39.4%)	19 (50.0%)	NS
Over 0,1	3 (9.1%)	11 (28.9%)	P<0.05
Vitreoretinal intervention			
Duration, minutes, *	96.85±14.65	68.72±10.94	P<0.001
Tamponade with silicon oil	25 (75.8%)	10 (26.3%)	P<0.001
IOL implantation	17 (51.5%)	18 (47.4%)	NS
Intraoperational hemorrhage	23 (69.7%)	4 (10.5%)	P<0.001
Vision acuity in 1 week			
Below 0,01	17 (51.5%)	4 (10.5%)	P<0.05
0,01-0,1	10 (30.3%)	19 (50.0%)	NS
Over 0,1	7 (21.2%)	15 (39.5%)	NS
Vision acuity in 1 month			
Below 0,01	12 (36.4%)	4 (10.5%)	P<0.01
0,01-0,1	13 (39.4%)	15 (39.5%)	NS
Over 0,1	8 (24.2%)	19 (50.0%)	P<0.05
Vision acuity in 6 months			
Below 0,01	12 (36.4%)	4 (10.5%)	P<0.01
0,01-0,1	13 (39.4%)	11 (28.9%)	NS
Over 0,1	8 (24.2%)	23 (60.5%)	P<0.01
Vision acuity in 1 year			
Below 0,01	10 (30.3%)	4 (10.5%)	P<0.05
0,01-0,1	17 (51.5%)	11 (28.9%)	P<0.05
Over 0,1	7 (21.2%)	23 (60.5%)	P<0.001
Intraocular hypertension			
IO pressure over 20 mm of mercury in 1 m	12 (36.4%)	4 (10.5%)	P<0.01
IO pressure over 20 mm of mercury in 6 m	2 (6.1%)	2 (5.3%)	NS
IO pressure over 20 mm of mercury in 1 yr	2 (6.1%)	2 (5.3%)	NS
During observation period			
Decompensation of carbohydrate metabolism	22 (66.7%)	27 (71.0%)	NS
Hypertensive crises	31 (93.9%)	36 (94.7%)	NS
Post-operational hemorrhages	10 (30.3%)	4 (10.5%)	P<0.05
Repeated surgery			
Removal of silicon oil	25 (75.8%)	10 (26.3%)	P<0.001
Vitreous cavity lavage	10 (30.3%)	4 (10.5%)	P<0.05
Repeated vitrectomy	7 (21.2%)	2 (5.3%)	P<0.05
Other (Phaco + IOL)	13 (39.4%)	10 (26.3%)	NS

Note: *NS = Not Significant*

The incidence of ocular hypertension in one month after surgery in the primary intervention group was significantly higher than in the PLC group (36% *vs* 11% of patients, $p<0.01$). Postoperative hemorrhage within one year after surgery was more common in patients with primary intervention when compared with the PLC group (30% *vs* 11% of patients, $p<0.05$), despite the comparable rates of hypertensive crises and episodes of decompensation of carbohydrate metabolism.

The structure of repeated interventions also differed between the comparison groups: in all the cases where vitreous cavity tamponade with silicone oil had been performed, during the observation period, removal of silicone oil was done (76% in the primary intervention group and 26% in the prior retinal laser coagulation group, $p<0.001$). Besides, vitreous cavity lavage had to be performed more frequently on patients with primary VS (30% *vs* 11%, $p<0.05$) and repeated vitrectomy (21% *vs*. 5%, $p<0.05$). The incidence of cataract surgery between the groups, however, did not differ.

Conclusion

Despite the advances being made in diagnostic and surgical technologies, deterioration of vision after vitrectomy in patients with PDR was observed in 5.4-25% of cases [1,2]. Predictors of negative functional prognosis include iris neovascularization, active proliferation in the fundus [3], impaired macular perfusion and tractional retinal detachment in the macular region (50% functional success at 100% anatomical [4,5]), low preoperative visual acuity [6]. Preliminary panretinal laser coagulation helps stabilize the proliferation process, prevent the development of vitreomacular traction, and retain the available visual acuity. However, it still remains uncertain whether the PLP is able to improve the forecast of VS on patients with PDR.

In our study, PLC significantly contributed to the preservation of improved functional retinal status, despite the development of complications, which is an indication for VS. The PLC patients exhibited early recovery and a higher visual acuity throughout the observation period.

Thus, the study revealed that in the case of prior VS, laser photocoagulation of the retina helps preserve the visual acuity, both at the time of and during the first year after surgery, reduces surgery duration and decreases the need to tamponade the vitreous cavity with silicone oil. Besides, PLC of the retina is accompanied by a significantly lower incidence of intra- and post-operational hemorrhage and reduces the need for repeated vitreoretinal procedures. The present study presents further arguments in favor of early retinal laser photocoagulation on patients with diabetes mellitus complicated by PDR.

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