INFLUENCE FACTORS OF PUPIL CHANGE AFTER PHACOEMULSIFICATION AND INTRAOCULAR LENS IMPLANTATION IN DIABETIC RETINOPATHY PATIENTS WITH CATARACT

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ABSTRACT

Introduction: *To investigate the influence factors of pupil changes after phacoemulsification and intraocular lens (ICL) implantation in patients with diabetic retinopathy (DR) and cataract, and provide more reference for clinical diagnosis and treatment.*

Materials and methods: *A total of 120 DR patients with cataract who underwent phacoemulsification combined with ICL implantation in our hospital from January 2019 to January 2022 were included retrospectively. Univariate and multi-variate analyses were employed to evaluate independent influence factors of postoperative pupil changes, and the correla-tion between related clinical indicators and postoperative pupil changes of patients was analyzed.*

Results: *Univariate analysis showed that the course and DR stage of type 2 diabetes mellitus (T2DM) were correlated with postoperative mydriasis time and diameter (P<0.05). Pearson test indicated that postoperative mydriasis time was positively correlated with the course and DR stage of T2DM (P<0.05), while postoperative mydriasis diameter was nega-tively correlated with the course and DR stage of T2DM (P<0.05). Multivariate analysis showed that the course of T2DM>10 years and proliferative DR were independent risk factors for postoperative pupil changes (P<0.05).*

Conclusions: *DR patients with cataracts are more likely to have contracted pupil and longer mydriasis after phacoemulsification combined with ICL implantation if the course of T2DM is longer than 10 years or DR is in prolifera-tion stage.*

Keywords: *Cataract, diabetic retinopathy, phacoemulsification, ICL implantation.*

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Introduction

Pupil diabetic retinopathy (DR) and cataract are common long-term eye complications of diabetes and have become a significant because affecting patients' qual-ity of life[(1)]. At present, it is considered that transparent refractive media and rational pupil diameter are the basis for diagnosis and treatment of fundus diseases[(2)]. The mainstream view about the treatment of DR with cataract is still surgery, but it is found in clinical practice that with the preoperative pupil diameter being sound, some DR patients have difficulty in postoperative mydriasis. The limited visual field of patients is also likely to exert an adverse effect on the diagnosis and treatment of fundus diseases[(3,4)]. How to effectively prevent difficulty in post-operative mydriasis in DR patients with cataract has been increasingly held in great honor by the medical communi-ty. Based on the above evidence, a total of 120 DR patients with cataract who underwent phacoemulsification combined with intraocular lens (ICL) implantation in our hospital from January 2019 to January 2022 were includ-ed in this study retrospectively, which provides further reference for clinical diagnosis and treatment.

Materials and methods

General data

A total of 120 DR patients with cataract who underwent phacoemulsification combined with ICL implantation in our hospital from January 2019 to January 2022 were included retrospectively.

Inclusion criteria:

• Those who met the diagnostic criteria of Chinese DR Guide-lines[5];

• Whose right eye was taken as the tested eye; successfully completed phacoemulsification combined with ICL implantation;

• We're able to communicate normally;

• The pupil diameter was >6mm before surgery and after mydriasis; the fasting blood glucose was maintained below 8.0mmol/L.

Exclusion criteria:

• Ametropy;

• Took medications that affected pupil functionn;

• Stage IV DR;

• Other diseases affecting pupil function;

• Complicated by other factors that affected pupil dilation;

• The clinical data were incomplete.

The research design conformed to the requirements of the Declaration of Helsinki of the World Medical Association.

Methods

The author logged into the electronic medical record system to collect the age, gender, course of type 2 diabetes mellitus (T2DM), DR stage and HbA1c level, etc. of the patients. All surgeries were performed by the same group of surgeons and anesthesia ICLogists, and mydriasis operation and pupillometry were conducted by the same professionally trained nurse.

One week after surgery, compound tropicamide eye drops were applied for mydriasis, which was dripped into the eyes every 5min for 3-5 times, until the pupillary light reflex disappeared. The mydriasis time referred to the duration from the first administration to the disappearance of pupillary light reflex.

The detection method of pupil diameter: a specially-assigned person measured the pupil diameter for 3 times with a straightedge after the disappearance of pupillary light reflex at the same point-in-time, with adequate indoor lighting and calculated the average.

Statistical processing

SPSS20.0 software was adopted to analyze and process data. Kolmogorov-Smirnov test was used to evaluate normality. Among them, measurement data conforming to normal distribution were compared using an independent sample t-test and expressed by ($\bar{x}\pm s$), and enumeration data were compared using a χ^2 test, and expressed by %. Pearson test was adopted for correlation analysis, multivariate analysis was done with a binary Logistic regression model, with $P<0.05$ indicating that the difference was statistically significant.

Results

Univariate analysis of influence factors of postoperative pupil changes of patients

Univariate analysis showed that the course and DR stage of T2DM were correlated with the postoperative mydriasis time and diameter ($P<0.05$). See Table 1.

Indicator	Case	Postoperative Mydriasis Time (min)	*P*	Postoperative Pupil Diameter (mm)	*P*
Age			0.12		0.23
≥60	54	28.64±8.27		5.54±0.84	
<60	66	29.20±8.71		5.69±0.88	
Gender			0.37		0.17
Male	70	27.60±7.92		5.68±1.04	
Female	50	26.32±8.39		5.57±0.96	
Course of T2DM			0.01		0.00
≤5 years	32	22.04±6.34		5.96±1.52	
~10 years	31	26.18±8.54		5.72±1.37	
~15 years	26	29.59±10.26		5.06±1.40	
>15 years	31	30.75±10.52		4.68±1.12	
DR Stage			0.00		0.00
Non-proliferative	52	18.98±6.50		6.08±0.86	
Proliferative	68	30.09±10.60		4.53±0.57	
HbA1c Level			0.89		0.73
<8.4%	36	27.80±5.67		5.29±1.70	
8.4%~13.4%	54	27.28±5.38		5.33±1.77	
>13.4%	31	28.74±5.36		5.54±1.82	

Table 1: Univariate analysis of influence factors of postoperative pupil changes of patients.

Correlation analysis between relevant clinical indicators and postoperative pupil changes of patients

Pearson test indicated that postoperative mydriasis time was positively correlated with the course and DR stage of T2DM ($P<0.05$), while

postoperative mydriasis diameter was negatively correlated with the course and DR stage of T2DM (P<0.05). See Table 2.

Indicator	Postoperative Mydriasis Time		Postoperative Pupil Diameter	
	r	*P*	*r*	*P*
Age	0.09	0.37	-0.09	0.41
Gender	0.06	0.45	-0.05	0.66
Course of T2DM	0.41	0.01	-0.49	0.00
DR Stage	0.34	0.02	-0.44	0.01
HbA1c Level	0.01	0.81	-0.13	0.26

Table 2: Correlation analysis between relevant clinical indicators and postoperative pupil changes of patients.

Multivariate analysis of independent influence factors of postoperative pupil changes

Factors with statistically significant differences in the univariate analysis in Table 1 were included in the multivariate Logistic regression model as independent variables, while changes in postoperative mydriasis time and pupil diameter were taken as dependent variables. Multivariate analysis showed that the course of T2DM >10 years and proliferative DR were independent risk factors for postoperative pupil changes (P<0.05). See Table 3.

Indicator	*B*	*SE*	*Wald*	*OR*	95%CI	*P*
Postoperative mydriasis time						
Course of T2DM	0.53	0.03	7.47	4.07	1.12~9.37	0.03
DR stage	0.41	0.23	9.56	3.72	1.39~6.31	0.01
Postoperative pupil diameter						
Course of T2DM	-0.47	1.44	16.83	2.43	1.21~5.90	0.00
DR stage	-0.32	0.36	11.49	1.90	1.07~3.90	0.00

Table 3: Multivariate analysis of independent influence factors of postoperative pupil changes.

Discussion

There are many reports on the pupil changes in DR patients during cataract surgery and their effect on surgical results at home and abroad[6]. Some scholars have confirmed that 10% norepinephrine eye drops before surgery can help maintain a rational pupil diameter. For T2DM patients with cataract, intraoperative injection of 1% lidocaine can ensure adequate size of pupils[7]. With the aggravation of aging worldwide, the number of diabetic patients has grown rapidly, followed by an increasing trend of DR and cataract year by year[8]. Previous studies have documented that DR can progress rapidly within 6 months after cataract surgery, among which proliferative DR should be controlled by photocoagulation surgery within 1 month after cataract surgery[9]. In clinical practice, however, some DR patients don't have mydriasis after cataract surgery and their pupil diameter is significantly smaller than before surgery, and a small pupil usually affects the observable range of fundus, posing a great challenge to subsequent DR treatment[10].

Some studies reveal that the postoperative pupil contraction in DR patients is related to the occurrence or aggravation of postoperative anterior chamber inflammation. The blood-aqueous humor barrier function of diabetic patients is damaged, and the iatrogenic injury during cataract surgery further aggravates the symptoms[11]. As manifested by other reports, after cataract surgery, the aqueous flare of anterior chamber of diabetic patients increases dramatically and the degree of aqueous flare is higher in patients with proliferative DR. It is speculated that the anterior chamber inflammation level of patients is associated with the severity of DR[12]. The results of this study also support this viewpoint, that is, postoperative mydriasis diameter is negatively correlated with DR stage, and proliferative DR is an independent risk factor for postoperative pupil changes, implying that the degree of postoperative pupil contraction increases with the aggravation of DR. As manifested in foreign studies, pupil abnormality tends to occur prior to DR and worsens with the progression of DR[13], which coincides with the results of this study.

What's more, surgical procedures can also impair the physical barrier of human eyes, and stimulate the synthesis and secretion of a variety of inflammatory cytokines. Intraoperative intraocular pressure fluctuation can affect eye perfusion, aggravate physICLogical barrier dam-age and anterior chamber inflammation, induce such problems as caligo pupillae and rubeosis iridis and finally make it impossible for pupils to dilate to a satisfactory level[14]. Previous studies have reported that the postoperative mydriasis effect of DR patients has a close tie with the course of diabetes, and the longer course of disease, the higher risk of postoperative pupil contraction[15], which is also supported by the results of this study. The change of pupil diameter is immediately dominated by sympathetic and parasympathetic nerves. If the sympathetic nerve is excited, the pupil will expand. On the contrary, if the parasympathetic nerve is excited, the pupil will shrink. However, with the prolongation of the

course of diabetes, the blood glucose level will continue to rise. With high glucose, the end products of glycation will be formed in the body in large quantities. The end products of glycation have been proved to cause the decrease of iris tissue elasticity in diabetic patients and make it impossible for pupils to effectively dilate[16, 17]. In addition, ultrasonic energy stimulation and surgical procedures during cataract surgery can also aggravate the injury of iris peripheral nerve, and increase the difficulty of postoperative mydriasis[18]. Our findings showed that the course of T2DM >10 years was an independent risk factor for postoperative pupil changes, which also supported the above viewpoint.

HbA1c level can affect both DR and cataract. It has been reported that people with high HbA1c level tend to have a higher risk of postoperative complications of cataract, such as corneal redness, macular edema and strong anterior chamber reaction[19]. However, our study doesn't support the direct influence of HbA1c level on postoperative pupil changes in DR patients with cataract. The author considers that this may be attributed to the small sample size and selection bias in the study, so the conclusion is yet to be confirmed in future studies. Based on the above evidence, the author holds that the cooperation with cataract and fundus specialists should be reinforced in clinical work, and attention should be paid to pupil management of DR patients after cataract surgery. For patients with a long course of T2DM or proliferative DR or both, while strengthening preoperative blood glucose management, as well as gentle operation and hormone application during operation, the follow-up observation of postoperative pupil changes should also be valued, to avoid the delay in subsequent treatment and maximize the clinical outcomes.

In conclusion, DR patients with cataracts are more likely to have contracted pupil and longer mydriasis after phacoemulsification combined with ICL implantation if the course of T2DM is longer than 10 years or DR is in proliferation stage.

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