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Prognosis of cataract with diabetic retinopathy by vitrectomy combined with phacoemulsification and its influence on serum related factors.

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Abstract

Objective: To evaluate the clinical efficacy of vitrectomy combined with phacoemulsification in the treatment of cataract with diabetic retinopathy (CDR) and to explore its effect on serum inflammatory cytokines, including tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6) and hypersensitive C-reactive protein (hs-CRP) and oxidative stress, including Superoxide dismutase (SOD) and Malondialdehyde (MDA) levels.

Methods: One hundred patients (104 eyes) with CDR were randomly divided into control group and study group (n=50) (52 eyes). The patients in control group were treated by vitrectomy combined with lensectomy, while the patients in study group were treated by Vitrectomy and phacoemulsification. The curative effects of the two groups were observed and the levels of serum inflammatory cytokines (TNF-α, IL-6 and hs-CRP) and oxidative stress (SOD and MDA) levels were compared before and after operation at the same time.

Results: The average visual acuity of the control group and the study group were both significantly improved (P<0.05), and the number of postoperative visual acuity improved eyes and visual acuity overall average in study group patients was significantly greater than the control group (P<0.05). There was no significant difference in serum inflammatory cytokines (TNF-α, IL-6 and hs-CRP) and oxidative stress (SOD and MDA) level between the two groups before operation (P>0.05). The levels of TNF-α, IL-6, hs-CRP and MDA in the study group were significantly lower than those in the control group one month after operation (P<0.05), while the SOD level in the study group was significantly higher than that in the control group (P<0.05). The incidence of iris neovascularization (INV) in the study group was 1.9%, significantly lower than that in the control group (9.6%, P<0.05). The incidence of capsular opacification was 7.7% in the study group, which was significantly lower than that in the control group (28.8%) (P<0.05). Other complications in both groups were recovered after symptomatic treatment.

Conclusion: Compared with vitrectomy and lensectomy, vitrectomy combined with phacoemulsification in the treatment of CDR is more effective in improving postoperative visual acuity, while postoperative complications and incidence of INV is lower, which is worth to be popularized clinically.

Keywords: Vitreous surgery, Phacoemulsification, Cataracts, Diabetic retinopathy.

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Introduction

With the rapid development of economy and society, people's living standards are constantly being improved. At the same time, people's lifestyle changes accordingly. The incidence of diabetes, especially type 2 diabetes, also continuously increases and seriously affects people's quality of life; therefore, diabetic retinopathy also become one of the common eye diseases [1]. Cataracts are also one of the more common diseases with many related factors, such as age, injury, poisoning, etc, which can cause damage to the lens capsule of the human eye and cause lesions, resulting in decreased vision [2]. The incidence of cataract with diabetic retinopathy (CDR) is also more common in clinical, and its incidence is earlier and faster than ordinary cataract, seriously affecting the quality of life of patients and their health. Re-cataract surgery will have a series of unstable factors, resulting in a lot of complications of the probability of occurrence when patients have undergone vitreous surgery [3-5]. With the continuous improvement of surgical technique, vitrectomy combined with cataract surgery has become a necessary conventional scheme. The combined surgery has the advantages of good surgical field, less trauma, lower cost and significant curative effect. However, at present, there are more controversies about the clinical efficacy of different types of joint surgery reported at home and abroad [6]. This paper retrospectively analysed the clinical efficacy of vitrectomy combined with different cataract surgery in 100 patients (104 eyes) with CDR treated in our hospital from 2013 to 2015, and investigate the effect on serum inflammatory cytokines, including tumour necrosis factor-α (TNF-α), interleukin-6 (IL-6) and hypersensitive C-reactive protein (hs-

CRP) and oxidative stress, including superoxide dismutase (SOD) and malondialdehyde (MDA) levels.

Information and Methods

General information

100 cases (104 eyes) of patients with CDR treated in our hospital from 2013 to 2016 were enrolled in the study. Preoperative diabetic retinopathy stage ranged from IV grade to IV grade, and no grade V was found. 19 cases (21 eyes) has a history of retina laser photocoagulation. According to the principle of voluntary, the patients were divided into two groups: control group (vitrectomy+lensectomy group), 50 cases (52 eyes), including 26 males and 24 females; mean age (57.5 ± 2.8), course of disease (11.5 ± 1.6) years, 9 cases of type 1 diabetes, 41 cases of type 2 diabetes, and study group (Vitrectomy+phacoemulsification group), 50 cases (52 eyes), including 25 males and 25 females, mean age (57.3 ± 2.6) years, mean duration of diabetes (11.7 ± 1.9) years, 10 cases of type 1 diabetes, 40 cases of type 2 diabetes. There was no significant difference in the gender, age, disease course between the two groups (P>0.05) (Table 1).

Table 1. Comparison of general information in 2 groups.

Group	n	Eyes	Gender		Age(y)	Course of disease(y)	Types of diabetes	
			Male	Female	type 1		type 2	
Control group	50	52	26	24	57.5 ± 2.8	11.5 ± 1.6	9	41
Study group	50	52	25	25	57.3 ± 2.6	11.7 ± 1.9	10	40
t			6.362		5.374	4.898	5.456	
p			>0.05		>0.05	>0.05	>0.05	

Surgical methods

Patients in the control group were treated with vitrectomy and lensectomy [7], and all operations were performed by the same surgeon. After local anaesthesia, scleral incision was performed at about 4.0 mm from the limbal margin. A standard three-way approach was established for standard closed type vitrectomy. First, two scleral puncture knifes was inserted into the crystal nucleus through scleral incision, and slowly crushed crystalline nuclei. The crystal nucleus and cortex were removed and sucked out by vitrectomy knife. And then cleaned the anterior capsule base vitreous and posterior capsule, retained the integrity of the anterior capsule, and closed the microscope light source. Optical fiber head was used to suck and scrape the anterior subepithelial cell layer, especially the peripheral part until the bag became clear and transparent. Finally, vitrectomy before and after the line, fibrinolytic membrane stripping, and intraocular coagulation of neovascular membrane and active bleeding point were performed by three-channels. For some of the neovascular membrane resection of thicker proliferative membrane, the retina extensive photocoagulation was performed by filling with heavy water. Whether to implant the intraocular lens was based on intraoperative fundus when vitreoretinal surgery was completed.

Patients in the study group were treated with vitrectomy and phacoemulsification [8]; all operations were performed by the same skilled surgeon. Surgery was performed under local anaesthesia. Firstinlet needle fixation was performed at infratemporal gland margin 3.5-4.0 mm to establish intraocular perfusion. Make a tunnel incision in corneoscleral limbal, then sucking crystal nuclei and cortex by conventional phacoemulsification. After polishing the posterior capsule and capsular bag, viscoelastic agent was injected in to anterior chamber and capsular bag. corneoscleral limbal incision was stitched with 10-0 nylon thread in order to maintain a good pressure balance between anterior and posterior chambers. Then vitreous and retinal surgery was performed, and surgical methods were the same as the control group. Silicone oil was filled at the end of the operation without intraocular lens implanted at the first stage.

Observational index

The average follow-up time was 12 months after operation. The main observation indexes included intraocular pressure, visual acuity, the incidence of neovascularization of iris (INV), iris adhesion, retina and lens implantation. According to the vitreous and retina, retinal laser photocoagulation was added; and appropriate drug or surgical treatment was carried out for the complications.

Fasting peripheral venous blood samples were taken before and one month after surgery to detect inflammatory cytokines and oxidative stress. Inflammatory markers included TNF-α, IL-6 and hs-CRP. Oxidative stress indicators included SOD and MDA. Among them, TNF-α, IL-6 and hs-CRP were detected by double antibody sandwich enzyme-linked immunosorbent assay (ELISA). The kit was provided by Shanghai Harling Biotechnology Co., Ltd. SOD was detected by radioimmunoassay, the kit will be provided by the future Industrial Co., Ltd. Shanghai. MDA was detected by thiobarbituric acid assay, and the kit was provided by Shanghai Bang Yi Biotechnology Co, Ltd. The operation strictly followed the instructions.

Statistical analysis

SPSS 21.0 (IBM) was used to analyse the data. Measurement data was expressed with means ± SD and analysed by t test, while count data was analysed by χ^2 test. P <0.05 was considered statistically significant.

Results

Comparison of vision acuity before and after operation

The number of eyes with visual acuity and the overall average of vision in the study group were better than those in the control group after operation (P<0.05), while there was a significant difference in the average visual acuity before and after surgery in the control group (P<0.05). 4 eyes with visual acuity <0.1 in 10 had macular edema of the retina and posterior pole hard exudate, while 5 eyes with INV, and 1 eye of intraocular lens (IOL) with pupil occlusion. 4 eyes of IOL with visual acuity ranged from 0.1 to 0.5 had pupil occlusion after operation. The postoperative visual acuity of the study group was significantly higher than that before operation (P<0.05). Among the 3 eyes with visual acuity <0.1, 2 had macular edema and hard exudation of the posterior pole, while 1 had INV (Table 2).

Table 2. *Comparison of vision acuity before and after operation.*

Group	n	Vision acuity before operation				Vision acuity after operation				Improved	Not improved
		<0.1	0.1-0.5	0.6-1.0	average	<0.1	0.1-0.5	0.6-1.0	average		
Control group	52	40 (76.9)	12 (23.1)	0 (0.0)	0.29 ± 0.06	10 (19.2)	33 (63.5)	7 (13.5)	0.56 ± 0.15[a]	40 (76.9)	12 (23.1)
Study group	52	39 (75.0)	13 (25.0)	0 (0.0)	0.28 ± 0.08	3 (5.8)	29 (55.8)	20 (38.5)	0.79 ± 0.27[ab]	47 (90.4)[c]	5 (9.6)

[a]The overall average of vision before and after operationP<0.05; [b]the overall average of vision between study group and control group after operation, P<0.05; [c]the number of eyes with vision improved between study group and control group after operation, P<0.05.

Comparison of serum cytokines between two groups

The level of serum TNF-α, IL-6 and hs-CRP in the two groups were not significantly different before operation (all P>0.05). Serum TNF-α, IL-6 and hs-CRP were significantly lower in the study group than those in the control group (P<0.05) (Table 3).

Table 3. *Comparison of serum cytokines between two groups.*

Group	n	TNF-α/(ng/L)		IL-6/(pg/L)		hs-CRP/(mg/L)	
		Before operation	after operation	Before operation	after operation	Before operation	after operation
Control group	52	168.7 ± 12.4	90.3 ± 7.8	17.6 ± 2.3	13.4 ± 1.7	8.2 ± 1.5	4.8 ± 0.4
Study group	52	169.1 ± 13.5	67.4 ± 3.5	17.8 ± 2.1	10.6 ± 1.9	8.1 ± 1.2	3.1 ± 0.2
t		0.427	7.128	0.409	6.062	0.246	5.133
p		>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

Comparison of oxidative stress level between two groups

Before operation, there was no significant difference in SOD and MDA between the two groups (P>0.05). One month after operation, the level of SOD in the study group was significantly higher than that in the control group (P<0.05), while the level of MDA in the study group was significantly lower than the control group (P<0.05) (Table 4).

Table 4. *Comparison of oxidative stress level between two groups.*

Group	n	SOD/ (U/mL)		MDA/ (nmol/mL)	
		Before operation	after operation	Before operation	after operation
Control group	52	65.2 ± 3.2	82.6 ± 8.5	7.2 ± 0.8	6.1 ± 0.3
Study group	52	65.4 ± 3.5	93.5 ± 8.3	7.1 ± 0.6	4.3 ± 0.4
t		0.196	5.148	0.322	6.027
p		>0.05	<0.05	>0.05	<0.05

Comparison of INV and the incidence of capsular opacity

In the control group, 15 eyes in 52 received postoperative laser photocoagulation and 5 eyes had INV (9.6%) 2-15 months after operation. In the study group, the posterior capsule was preserved in 52 eyes and 9 eyes were supplemented with postoperative laser photocoagulation, while 1 eye had INV 3

months after operation. There was significant difference in the incidence of INV between the two groups (χ^2=8.125, P<0.05). 15 eyes (28.8%) in the control group developed capsular opacification at 4-16 months 4-16 months after operation, and visual acuity was improved by yttrium aluminium garnet (YAG) treatment. 4 eyes (7.7%) in the study group developed capsular opacity 4-16 months after operation, and visual acuity improved by YAG treatment. The difference of incidence of capsular opacification between two groups was statistically significant (χ^2=6.734, P<0.05).

Other complications

In the control group, there were 5 cases of secondary vitreous haemorrhage within 14 days after operation, which was related to the increase of blood glucose. After controlled by blood sugar, intraocular pressure and haemostatic drug treatment, 5 eyes were self-regression, and supplemented with photocoagulation treatment 2 times. A repeated vitreous haemorrhage in 1 eye was cured by the vitreous replacement cleaning and intraocular photocoagulation treatment. 4 eyes in the study group developed corneal edema, and was returned to normal by acetazolamide and timolol treatment.

Brief summary: The average visual acuity of the control group and the study group were significantly improved (P<0.05), and the number of postoperative visual acuity improved eyes and visual acuity overall average in study group patients was significantly greater than the control group (P<0.05). There was no significant difference in serum inflammatory cytokines (TNF-α, IL-6 and hs-CRP) and oxidative stress (SOD and MDA) level between the two groups before operation (P>0.05) The levels of TNF-α, IL-6, hs-CRP and MDA in the study group were significantly lower than those in the control group one month after operation (P<0.05), while the SOD level in the study group was significantly higher than that in the control group (P<0.05). The incidence of INV in the study group was 1.9%, significantly lower than that in the control group (9.6%, P<0.05). The incidence of capsular opacification was 7.7% in the study group, which was significantly lower than that in the control group (28.8%) (P<0.05). Other complications in both groups were recovered after symptomatic treatment. Compared with vitrectomy and lensectomy, vitrectomy combined with phacoemulsification in the treatment of cataract combined with CDR is more effective in improving postoperative visual acuity, while postoperative complications and incidence of INV is lower, which is worth to be popularized clinically.

Discussion

With the improvement of vitreous surgical instruments and surgical techniques, CDR is a common indication of vitrectomy surgery. Its purpose is to remove the cloudy or haemorrhagic vitreous, relieve the pulling of proliferation membrane, restore refractive media transparency, and complete the whole retina light coagulation, thus improving vision and quality of life [9]. Due to the influence of diabetes or patient's age, the most common complication after vitrectomy is cataract, especially in elderly patients with characteristics of early occurred, rapid progress and easily matured after vitrectomy [10]. Vitrectomy can lead to cataract complications or exacerbations of existing cataracts, it has been reported that [11] the incidence rate of cataract after vitrectomy by CDR was 88%, and due to the lack of vitreous support, the second surgery increased the difficulty and risk of cataract surgery, so the treatment faced the problem of joint surgery. With the phacoemulsification, phacoemulsification, IOL implantation and vitrectomy surgery continues to improve, making the joint surgery become possible. Although the technical requirements of joint operation for surgeons are high with long operation time and more postoperative complications, the second surgery can be avoided to reduce trauma and reduce costs; more importantly, the joint surgery without cataracts, intraoperative fundus images clearer, stripping more accurate, so that the removal of peripheral vitreous more convenient and complete. In addition, joint operation can facilitate postoperative fundus examination and retinal photocoagulation treatment, and is conducive to the maintenance of long-term effects [12,13]. At present, vitreous combined with cataract surgery can better restore the patient's vision, and has been widely supported by literatures [14,15]. However, it is still rarely reported that whether vitrectomy combined with phacoemulsification or phacoemulsification for CDR with cataract eyes is more reasonable.

This study compared the clinical efficacy of vitrectomy combined with different cataract surgery in the treatment of proliferative diabetic retinopathy and found that combined surgery can indeed improve the visual acuity in proliferative diabetic retinopathy patients with cataract complications. The difference of preoperative and postoperative visual acuity between control group and study group were statistically significant (P<0.05), and the number of postoperative visual acuity improvement in the study group was significantly better than that in the control group (P<0.05). The poor visual acuity after operation in both groups was associated with macular edema, exudative lesions of the posterior pole and neovascular haemorrhage, which also showed that although cataract patients had fundus lesions, cataract surgery can still improve visual acuity in varying degrees. By observing the complications, we found that the incidence of postoperative INV and capsular opacity in the study group were significantly lower than the control group (P<0.05), which may be due to retinal ischemia was the main cause of INV formation, and the lens inhibited angiogenesis [16]. Cystectomy patients lost the lens barrier and accelerated the formation of INV, so the lens surgery can induce the formation of INV to a certain extent. Intraoperative pupil cannot be fully dispersed; resulting in residual lens epithelial cell hyperplasia and opacification capsule, so vitrectomy combined lens resection should remove the peripheral vitreous as much as possible during surgery, but sometimes miscut the posterior capsule [17].

TNF-α, IL-6 and hs-CRP are important inflammatory factors in the body. IL-6 is the key factor in inflammatory cascade. High concentration of IL-6 can reduce insulin secretion by impairing the function of pancreatic β-cells, so that the body is in the

state of insulin resistance. TNF-α is a trigger factor of IL-6, which can induce the production of IL-6, and it also influences the insulin signal chain. hs-CRP is a typical acute phase reaction protein, which is obviously stimulated by IL-6, and affect the insulin signal chain, resulting in insulin resistance. The results of this study showed that there was no significant difference in the levels of TNF - α, IL - 6 and hs - CRP between the two groups before operation (all $P>0.05$) and these indicators were significantly lower in the study group than in the control group 6 months after operation ($P<0.05$). The result indicated that vitrectomy combined with phacoemulsification can effectively reduce the patient's inflammatory response, thereby alleviating the patient's condition.

Oxidative stress injury is an important pathological process of diabetic retinopathy. Hyperglycemia increases oxidative stress, and the content of oxygen free radicals, while peroxidation leads to antioxidant enzymes such as MDA and SOD to consume continuously, and eventually causes retinal tissue damage. The results of this study showed that there was no significant difference in serum SOD and MDA before and after operation between two groups ($P>0.05$), but the level of SOD in the study group was significantly higher than that in the control group 1 month after operation ($P<0.05$), while MDA level in study group was significantly lower than that in control group 1 month after operation ($P<0.05$). The result suggested that vitrectomy combined with phacoemulsification can reduce oxidative stress injury, thus relieving the symptoms of cataract with diabetic retinopathy.

In summary, the long-term effect of combination of vitrectomy and phacoemulsification as well as combination of vitrectomy and lensectomy needs further observation, but the advantage of combination of vitrectomy and phacoemulsification in improving visual acuity, reducing INV and capsule opacity and other complications, reducing the inflammatory response and oxidative stress injury was significantly better than combination of vitrectomy and lensectomy. Therefore, vitrectomy combined with phacoemulsification was safer and more effective than vitrectomy combined with lensectomy in the treatment of CDR with cataract, but both surgeries have their own advantages and disadvantages, and the surgeons need comprehensive consideration and further research.

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