ORIGINAL ARTICLE

Effect of Phacoemulsification Combined with Intraocular Lens Implantation on Inflammatory Factors, Oxidative Stress Response and Hemorheology in Diabetic Cataract Patients

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Abstract

Objective: To investigate the change on phacoemulsification combined with intraocular lens implantation on inflammatory factors IL-2, IL-6, hs-CRP,TNF-α; oxidative stress response indexes MDA, CAT, SOD, GSH-Px; peripheral blood hemorheologic index WHV, WMV,PV, PCV, FIB in diabetic cataract patients.

Study Design: An observational study.

Place and Duration of Study: Department of Ophthalmology, the Second Hospital of Shandong University, Jinan, China, from January 2015 to July 2017.

Methodology: One hundred anf fifty-two diabetic cataract patients (160 eyes) were randomly divided into observation group and control group, each with 76 cases (80 eyes). The control group was treated with conventional therapy, while the observation group was treated with phacoemulsification combined with intraocular lens implantation on the basis of conventional treatment. After one month of treatment, the patients were tested for IL-2, IL-6, hs-CRP, TNF-α, MDA, CAT, SOD, GSH-Px, WHV, WMV, PV, PCV, FIB.

Results: After one month of treatment, the levels of IL-2, IL-6, hs-CRP and TNF-α were lower in the observation group ($p < 0.001$); the levels of SOD, GSH-Px and CAT were higher in the observation group ($p < 0.001$), while MDA level was higher in the control group ($p < 0.001$); the levels of WHV, WMV, PV were lower in the observation group ($p < 0.001$), and there was no significant difference in the levels of PCV and FIB between the two groups ($p = 0.794$ and 0.838, respectively).

Conclusion: Phacoemulsification combined with intraocular lens implantation can improve the level of aqueous inflammatory factors and oxidative stress response indexes in diabetic cataract patients and improve their level of hemorheological indexest.

Key Words: *Phacoemulsification, Intraocular lens implantation, Diabetic cataract, Inflammatory factor, Oxidative stress.*

INTRODUCTION

Diabetic cataract is a disease in which blood glucose levels increase due to lack of insulin *in vivo* or decreased galactokinase activity *in vivo*, so that intraocular aqueous osmotic pressure increases, lens fiber swells, fractures or disintegrates, resulting in complete lenticular turbidity.[1] Diabetic cataract is a major complication of diabetes. Compared to non-diabetic patients, diabetic patients are more susceptible to cataract in early stage.[2] Phacoemulsification is currently one conventional surgical treatment for cataract, which has such advantages as no incision or suture, less postoperative astigmatism and rapid visual recovery.[3] However, it may cause varying degrees of damage to corneal endothelial cells and corneal incision, which then leads to corneal edema, turbidity, and in severe cases, corneal endothelial function decompensation, resulting in bullous keratopathy. With the rapid development of modern medical technology, phacoemulsification combined with intraocular lens implantation has become a safe and effective new treatment. It can significantly deepen the central and peripheral chamber depth, relieve pupillary block state, not only effectively reducing intraocular pressure, but also significantly lowering the incidence of complications.[4,5] However, there are a few reports on the effect of phacoemulsification combined with intraocular lens implantation on aqueous inflammatory factor, hemorheologic indexes in diabetic cataract patients.

The purpose of this study was to investigate the effect of phacoemulsification combined with intraocular lens implantation on aqueous inflammatory factor, oxidative stress response and peripheral blood hemorheologic indexes in diabetic cataract patients, so as to provide reference for clinical treatment of diabetic cataract.

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METHODOLOGY

This was an observational study done in the Department of Ophthalmology at The Second Hospital of Shandong University, from January 2015 to July 2017. Approval was taken from the Hospital's Institutional Review Board. Diabetic cataract patients (160 eyes) were enrolled in this study, without any surgical contraindications or active eye inflammation. The binocular lacrimal ducts were routinely irrigated to exclude infectious diseases. Exclusion any other diseases in heart, liver, blood, inflammation, endocrine, did not receive any treatment in the recent three months, and could actively cooperate with the relevant treatment with detailed clinical data provided before treatment.

One hundred fifty-two patients (160 eyes) were divided into observation group, and control group according to the random number table method, 76 cases in each group (80 eyes). Control group patients received conventional treatment of blood sugar reduction, intraocular pressure control and anti-inflammation. The observation group patients were treated with phacoemulsification combined with intraocular lens implantation, based on routine treatment. The phaco-emulsification combined with intraocular lens implantation was performed by physicians with skilled surgical experience. Compound tropicamide eye drops were dripped three times half an hour before the operation, retrobulbar nerve blocking anesthesia was performed, transparent corneal incision was made, the anterior chamber was maintained with viscoelastic substance, continuous annular capsulorhexis was performed, lens nucleus and cortex were separated by water, crystalline lens were emulsified by phacoemulsification, residual cortex was extracted, posterior chamber intraocular lens were implanted, and the incision was stitched until watertight. All patients' operative eyes were treated with tobramycin dexamethasone eye drops, pranoprofen eye drops, in gradually reduced amount until withdrawal, sustained medication for 1-3 months.

After one month of treatment, 5 mL peripheral blood was drawn from the two groups of patients with empty stomach for hemorheology examination. Anterior chamber puncture was performed through corneal margin by 1mm, and 0.2 mL aqueous humor was collected for detection of inflammatory reaction and oxidative stress response. Inflammatory factors like IL-2, IL-6, high hs-CRP, TNF-α, and oxidative stress response indexes like MDA, CAT, SOD, GSH-Px were detected by enzyme-linked immunosorbent assay (ELISA). Hemorheologic indexes of the two groups, such as PV, WHV, WMV, FIB, PCV, were tested by automatic hemorrheology tester.

Data was entered and analysed by using SPSS 21.0. P-value of less than 0.05 was considered significant. Measurement data like inflammatory factors, oxidative stress response indexes, and hemorheologic indexes were indicated in $\bar{\chi} \pm s$. The t-test was used to compare the outcome between two groups. X^2 test was used to compare count data like gender.

RESULTS

The study included 152 patients; out of which 86 (56.58%) were males with 90 (56.25%) eyes and 66 (43.42%) females, 70 (43.75%) eyes. Seventy-two patients (47.37%) were of 41-54 years of age, and 80 (52.63%) 54~67 years of age. With 4~17 years of diabetes history, they had an average diabetes history of 12.5 ±1.6 years. With 1~6 years of cataract history, they had an average cataract history of 2.9 ±1.5 years. There were 50 (31.25%) eyes with a vision of 0.02~0.04, 60 (37.50%) eyes with a vision of 0.05~0.08, and 50 (31.25%) eyes with a vision of 0.10 ~ 0.30.

After one month of treatment, the levels of IL-2, IL-6, hs-CRP and TNF-α in the observation group were lower than control group (p <0.001, Table I); the levels of SOD, GSH-Px and CAT in the observation group were higher than control group (p <0.001, Table II), while MDA level in the observation group was higher in the control group

Table I: Comparison of aqueous inflammatory factors between the two groups after one month of treatment.

Groups	n	IL-2 (pg/mL)		IL-6 (pg/mL)		hs-CRP (mg/L)		TNF-α (ng/mL)	
		Mean ±SD	p-value	Mean ±SD	p-value	Mean ±SD	p-value	Mean ±SD	p-value
Control group	80	96.78 ±0.69	<0.0001	45.55 ±1.37	<0.0001	12.05 ±1.22	<0.0001	1.17 ±0.09	<0.0001
Observation group	80	91.41 ±0.76		40.78 ±1.26		9.94 ±0.78		0.98 ±0.06	

Table II: Comparison of aqueous oxidative stress response indexes between the two groups after one month of treatment.

Groups	n	SOD (U/mL)		GSH-Px (mol/L)		MDA (mmol/mL)		CAT (U/mL)	
		Mean ±SD	p-value	Mean ±SD	p-value	Mean ±SD	p-value	Mean ±SD	p-value
Control group	80	44.37 ±1.30	<0.0001	101.45 ±2.85	<0.0001	3.52 ±0.53	<0.0001	9.39 ±1.42	<0.0001
Observation group	80	52.64 ±0.74		128.64 ±2.49		2.19 ±0.21		13.55 ±1.74	

Table III: Comparison of peripheral blood hemorheologic indexes between the two groups after one month of treatment.

Groups	n	WHV (mPa·s)		WMV (mPa·s)		PV (mPa·s)		PCV (%)		FIB (pg/L)	
		Mean ±SD	p-value	Mean ±SD	p-value	Mean ±SD	p-value	Mean ±SD	p-value	Mean ±SD	p-value
Control group	80	5.21 ±0.71	<0.0001	13.56 ±1.43	<0.0001	1.69 ±0.21	<0.0001	42.83 ±7.12	0.794	3.44 ±0.85	0.838
Observation group	80	4.63 ±0.80		11.94 ±1.72		1.33 ±0.11		42.57 ±5.34		3.41 ±0.93	

($p < 0.001$, Table II); the levels of WHV, WMV, PV in the observation group were lower than control group ($p < 0.001$, Table III), and there was no significant difference in the levels of PCV and FIB between the two groups ($p = 0.794$ and 0.838, respectively, Table III).

DISCUSSION

The main cause of diabetic cataract is weakened galactokinase activity in patients or lack of insulin which leads to elevated blood sugar levels, increased intraocular aqueous osmotic pressure, resulting in severe expansion of lens fibers and even rupture and collapse, and finally complete lenticular turbidity.[6,7] Diabetic cataract, as a common complication of diabetes, has an incidence rate as high as 63% in diabetic patients. Its incidence is positively correlated to course of diabetes.[8] As more people have diabetes, the number of diabetic cataract cases is also on the rise. The attack of diabetic cataract will seriously impact patients' physical and mental health, and also bring heavy financial burden to the patients, their families and society.[9,10] The treatment of diabetic cataract has become the top priority for medical workers.

There are many influencing factors in diabetic cataract. With the rapid development of science and technology, the related research on pathogenic mechanism of diabetic cataract is more thorough, and the treatment methods are more effective and targeted.[11,12] Phacoemulsification, a more commonly used method to treat cataract, has been widely used in the treatment of cataract. It has the advantages of less postoperative complications, faster visual recovery, and lower incidence of astigmatism.[13] Intraocular lens implantation has replaced the former lens in anatomy and optics.[14] Conducive to rapid visual recovery, it establishes stereoscopic vision and binocular single vision, featuring the advantages of small corneal tissue destruction, no surgical suture and predictability of refractive correction.[15,16]

The effect of phacoemulsification combined with intraocular lens implantation on aqueous inflammatory factors IL-2, IL-6, hs-CRP,TNF-α; oxidative stress response indexes MDA, CAT, SOD, GSH-Px and peripheral blood hemorheologic index WHV, WMV,PV, PCV, FIB level of diabetic cataract patients remains unknown. This study tested and analysed above-mentioned aqueous inflammatory factors, oxidative stress response indexes and peripheral blood hemorheologic index level of the diabetic cataract patients before and after treatment. The results showed that phacoemulsification combined with intraocular lens implantation can significantly improve diabetic cataract patients' above-mentioned aqueous inflammatory factors, oxidative stress response indexes and peripheral blood hemorheologic index level, which is conducive to rehabilitation. Protein degeneration in the crystalline lens of diabetic cataract patients causes turbidity, leading to oxidative stress and inflammatory reactions, thereby further damaging the lens.[17] Treatment of diabetic cataract patients with phacoemulsification combined with intraocular lens implantation slows down the production of aqueous inflammatory factors IL-2, IL-6, hs-CRP, TNF-α and oxidative stress response indicators MDA, CAT, SOD, GSH-Px, thereby reducing the damage to the eye, which helps cataract treatment. Eye blood regulation and blood perfusion of the optic nerve are important factors affecting the ocular nerve.[18,19] Related studies have shown that eye blood viscosity of cataract patients was high.[20] The results of this study show that phacoemulsification combined with intraocular lens implantation improves the hemorheology of diabetic cataract patients, and helps lower osmotic pressure of aqueous humor in the patients' eyes and supply optic nerve and retinal nutrition, which guarantees eye restoration after the surgery.

CONCLUSION

Based on routine treatment of blood sugar reduction, intraocular pressure control and anti-inflammation, phacoemulsification combined with intraocular lens implantation can significantly improve the level of aqueous inflammatory factors and oxidative stress response indexes in diabetic cataract patients and improve their level of hemorheological indexes, which is the first choice for treatment of diabetic cataract.

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