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Measurement of macular thickness after uncomplicated cataract phacoemulsification surgery with intracameral cefuroxime

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白内障超声乳化术中前房注入头孢呋辛钠后黄斑厚度的测量

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摘要

目的:了解白内障超声乳化术中前房注入头孢呋辛钠后黄斑厚度的变化。

方法:前瞻性临床对照研究。药物组前房内注入头孢呋辛钠,对照组是前房内注入灌注液。入选患者分为4组:<60岁药物组,<60岁对照组,≥60岁药物组和≥60岁对照组。分别于术前,术后1,6mo光学相干断层扫描测量黄斑厚度。

结果:术后1mo,≥60岁药物组在中心凹、内下区、颞内区和外下区区域的厚度大于其他三组。术后6mo,只有≥60岁药物组的内下区的厚度大于其他三组。术后1mo,与各自术前的黄斑厚度相比,≥60岁药物组在中心凹、内下区、颞内区和外下区区域的增加的厚度大于其他三组。术后6mo,≥60岁药物组的中心凹和内下区的增加的厚度大于其他三组。

结论:白内障术后黄斑厚度增加在术后6mo尚不能恢复到术前状态。相对于较年轻患者,超过60岁的白内障患者在术中使用头孢呋辛钠会在术后1mo黄斑厚度增加更多。

关键词:黄斑厚度; 光学相干断层扫描; 白内障手术

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Abstract

• AIM: To investigate the change of macular thickness after uncomplicated cataract phacoemulsification surgery with intracameral cefuroxime.

• METHODS: Prospective, controlled and parallel compared clinical study. Enrolled patients were divided into 4 groups based on age under or over 60 years old (<60 group and ≥60 group) and with intracameral cefuroxime (experiment group) before ending operation or with irrigating solution (control group). Macular thicknesses were measured at baseline and 1 month and 6 months postoperatively.

• RESULTS: At 1 month, ≥60 experiment group has thicker fovea, inferior inner area and temporal inner area than other 3 groups. At 6 months, only inferior inner area was thicker in ≥60 experiment groups than other 3 groups. With response to preoperative value, at 1 month, 4 sectors of macular thickness were thicker in ≥60 experiment group than other 3 groups, which were forvea, inferior inner area, temporal inner area and inferior outer area. At 6 months, only 2 areas were thicker in ≥60 experiment group than other 3 groups, which were fovea and inferior inner area.

• CONCLUSION: Macula becomes thicker after cataract surgery which cannot restore preoperative level at 6 months. Patients elder than 60 will have thicker macula after cataract surgery with intracameral cefuroxime at 1 month postoperatively.

• KEYWORDS: macular thickness; optical coherence tomography; cataract surgery
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INTRODUCTION

Postoperative endophthalmitis is a very severe complication and one of the main causes of low vision after surgery. Statistical data showed that, there are about 0.06% postoperative endophthalmitis in China in the past 9 years[1]. From 2005 to 2009, over 3 millions cataract surgeries have been performed in China[2]. How to prevent this is the main task for cataract doctors.

Doctors have applied many methods to avoid this complication, including dripping antibiotic eyedrops before surgery, disinfecting skin and conjunctival sac, adding antibiotics in perfusion solution, subconjunctival injection of antibiotics and dripping antibiotic eyedrops after operation.

European Society of Cataract & Refractive Surgeons (ESCRS) multicenter clinical trials have indicated that intracameral cefuroxime can reduce postoperative endophthalmitis 5 times[3,4]. Recent follow-up data have showed this method will reduce postoperative endophthalmitis 10 times at 3 to 6 years after surgery[5].

Cefuroxime is a second generation of cephalosporin antibiotic. The selection of cefuroxime has been based on the etiological spectrum of isolated bacterial strains in post-cataract surgery endophthalmitis patients and approved by our hospital's Infectious Committee [6]. The adoption of intracameral cefuroxime has been encouraged to be considered as part of standard cataract phacoemulsification surgery[7]. The aim of this paper is to test the influence of intracameral cefuroxime to the macular thickness of uneventful cataract surgery in healthy populations.

MATERIALS AND METHODS

This study was approved by the local Ethics Committee and conducted in accordance with the Declaration of Helsinki. All patients received detailed information about the objectives and methods of the proposed OCT study. All patients gave written informed consent for the operation and inclusion in the study.

Materials Cataract patients were consecutively selected in Department of Ophthalmology, First Affiliated Hospital of Zhengzhou University from December 2009 to December 2010. Inclusion criteria include 1) senile cataract patients without other systemic diseases or ocular abnormality; 2) cataract nuclear graded level one to three[8]; 3) ultrasonic energy during operation less than 30%; 4) total operative duration was less than one hour. Exclusion criteria include 1) systemic diseases; 2) ocular problems or surgical history; 3) patients with complications like corneal edema, anterior chamber flare, leaking wound, flat anterior chamber, hyphema, eccentric intraocular lens, intraocular pressure higher than 21mmHg even with antiglaucoma medication, macular edema, retinal detachment, *et al.*; 4) changing of surgical model; 5) patients with any drug allergic history.

Enrolled patients were divided into two groups based on age under or over 60 years old (<60 group and ≥60 group). In each group, enrolled patients were then divided into two groups based on random numbers calculated by computer, one of which was treated with intracameral cefuroxime (experiment group) before ending operation, the other with irrigating solution (control group). So there are four groups in our study: <60 control group; <60 experiment group; ≥60 control group; ≥60 experiment group. The follow up were at 1 month and 6 months postoperatively.

Methods

Surgical Procedure All the surgeries were performed by the same experienced cataract doctor (F. Y. Z). All patients received tropicamide 0.5% and tobramycin 5mL: 15mg drops administered 4 times at 10-min intervals before surgery. After topical anaesthesia, a tunnel incision wide 3.2mm temporally was performed and on the left side an assistant incision was made. Viscoelastic agent was injected into the anterior chamber and continuous curvilinear capsulorhexis of anterior capsular membrane was performed. After hydrodissection, the lens nucleus was emulsified by phaco(INFINITI VISION (Alcon, USA)). Then the nuclear piecese and cortex were irrigated and aspirated. A posterior chamber artificial intraocular lens was implanted into the capsular bag. In the experiment group, intracameral cefuroxime was injected into anterior chamber before ending the operation. The cefuroxime injection was prepared by diluting cefuroxime in normal saline with final concentration 1mg in 0.1mL. This dose surpasses the minimum inhibitory concentration for microorganisms susceptible to cefuroxime, even those usually considered not susceptible (gram positive or gram negative). This dose also leads to a concentration high enough to benefit from the postantibiotic effect, which depends on the concentration of the antibiotic agent and the time of exposure[5].

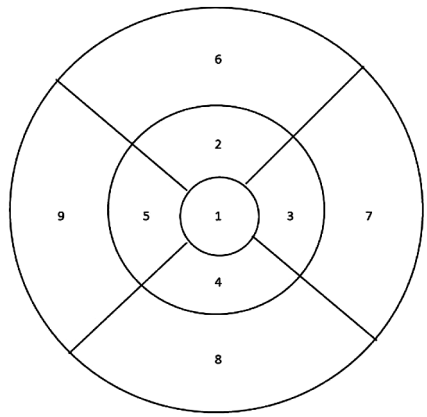

Figure 1 Early treatment diabetic retinopathy study (ETDRS) macular layout The diameters of the three concentric circles are 1, 3 and 6mm. 1 fovea; 2 superior inner area; 3 temporal inner area; 4 inferior inner area; 5 nasal inner area; 6 superior outer area; 7 temporal outer area; 8 inferior outer area; 9 nasal outer area.

Routine ocular examination All cases were examined at 1 month and 6 months after surgery. Visual acuity was tested by LogMAR visual chart. Intraocular pressure was tested by Goldmann applanation tonometer. Eyes were examined by slit lamp microscopy and direct ophthalmoscope.

Optical coherence tomography (OCT) Retina scanning was tested with the Stratus OCT (software version 4.0, Model 3000, Carl Zeiss Meditec, Inc. Dublin, CA) by one independent experienced OCT technician who was unaware of treatment assignments. The best quality map of three acquisitions from the fast macular thickness protocol (6 consecutive 6-mm redial scans centered on the macular) was chosen to study retinal thickness. Mean sectoral thicknesses were displayed in the 9 macular sectors determined by the early treatment diabetic retinopathy study (ETDRS) (Figure 1) [9].

Statistics Analysis Data were analyzed by SPSS package version 17.0 (SPSS, Chicago, USA). Analysis of variance was used to compare macular thicknesses among different groups 1 month and 6 months after surgery. The increases of macular thickness between baseline and follow up were studied using the repeated measures analysis of variance. Significance was assessed at the 5% level.

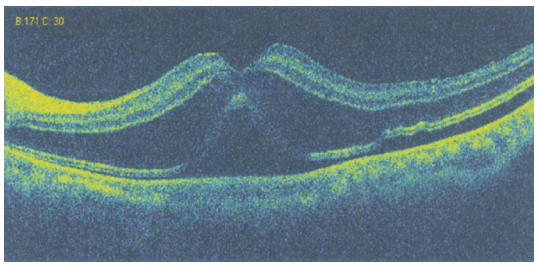

Figure 2 OCT macular scanning result of one patient with clinically manifested cystoid macular edema.

Table 1 The corrected visual acuities at 1 month and 6 months after operation ($\bar{x}\pm s$)

Group	1 month	6 months
<60 Control group	0.62±0.18	0.69±0.08
<60 Experiment group	0.64±0.05	0.71±0.03
≥60 Control group	0.67±0.03	0.68±0.04
≥60 Experiment group	0.68±0.04	0.69±0.02

SD=Standard deviation.

Table 2 Macular thicknesses at 1 month postoperatively ($\bar{x}\pm s$, μm)

Group	<60 Control group	<60 Experiment group	≥60 Control group	≥60 Experiment group
Fovea thickness	195.32±22.57	195.28±21.28	196.57±23.28	210.78±21.35 *
Superior inner thickness	279.58±24.38	280.34±22.25	281.19±29.52	281.23±25.47
Nasal innerthickness	276.31±27.56	275.86±21.72	276.23±12.56	273.54±23.63
Inferior inner thickness	279.28±24.27	276.72±23.24	281.64±25.72	287.92±31.06 *
Temporal inner thickness	269.23±28.26	270.82±31.75	272.49±23.37	286.52±29.73 *
Superior outer thickness	249.82±22.58	251.84±31.39	252.65±22.48	252.42±22.95
Nasal outer thickness	271.38±25.27	270.59±26.23	272.17±28.27	273.65±27.83
Inferior outer thickness	241.28±28.25	242.32±25.37	243.48±26.34	250.21±23.42 *
Temporal outer thickness	232.45±28.33	231.94±25.29	233.44±25.30	234.26±25.35

* $P<0.05$ *vs* other groups. SD= Standard deviation.

Table 3 Macular thicknesses at 6 months postoperatively ($\bar{x}\pm s$, μm)

Group	<60 Control group	<60 Experiment group	≥60 Control group	≥60 Experiment group
Fovea thickness	195.72±21.42	196.23±22.93	196.23±22.13	196.34±24.63
Superior inner thickness	281.24±25.03	282.31±24.32	280.84±23.42	283.38±32.63
Nasal inner thickness	277.53±23.65	276.43±25.74	278.21±26.54	279.43±30.63
Inferior inner thickness	280.23±22.87	279.43±27.65	281.53±24.64	293.21±25.63 *
Temporal inner thickness	370.43±25.53	372.31±22.42	371.02±28.37	372.48±28.43
Superior outer thickness	248.98±29.20	247.43±21.50	248.48±26.73	250.52±24.75
Nasal outer thickness	269.34±28.49	268.77±26.32	268.53±25.65	270.24±26.63
Inferior outer thickness	238.42±21.43	237.53±24.63	239.49±26.84	240.63±25.92
Temporal outer thickness	230.53±28.94	231.32±23.74	229.53±27.38	228.53±25.67

* $P<0.05$ *vs* other groups. SD= Standard deviation.

RESULTS

This study enrolled 97 patients who underwent cataract surgery in one eye. During follow up, one eye (patient age 82 with intracameral cefuroxime) manifested clinically significant cystoid macular edema (Figure 2) at 1 month was excluded from the study. So there were 96 patients involved in the study. There are 34 patients under 60 with 16 male and 18 female. Mean age was 56.32±2.82 (range: 52-59). 62 patients were over 60 years old with 29 male and 33 female. Mean age was 79.23±7.65 (range: 60-91).

Postoperative corrected visual acuity was analyzed and showed in Table 1. There were no significant differences among these 4 groups at 1 month and6 months after operation.

Nine sectors of macular thicknesses at 1 month and 6 months were shown in Table 2 and Table 3. At 1 month, ≥60 experiment group has thicker fovea, inferior inner area and temporal inner area than other 3 groups. At 6 months, only inferior inner area was thicker in ≥60 experiment groups than other 3 groups.

Figure 3 and Figure 4 showed the change of macular thickness with response to preoperative value at 1 month and 6 months, respectively. At 1 month, 4 sectors of macular thickness were thicker in ≥60 experiment group than other 3 groups, which were forvea, inferior inner area, temporal inner area and inferior outer area. At 6 months, only 2 areas were thicker in ≥60 experiment group than other 3 groups, which were fovea and inferior inner area.

Curve line (Figure 5) indicated that all groups have thicker macular thickness than baseline values at 1 month and 6 months. The average increase of macular thickness were 5.03±0.24μm in <60 control group, 5.03±0.18μm in <60 experiment group, 5.06±0.27μm in ≥60 control group and 5.66±0.33μm in ≥60 experiment group at 1 month. The increase of macular thickness in ≥60 experiment group was higher than other 3

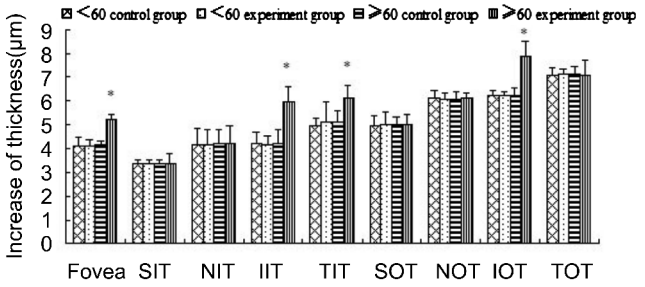

Figure 3 The increase of macular thicknesses at 1 month postoperatively with respect to baseline levels (fovea: fovea area, SIT: superior inner thickness, NIT: nasal inferior thickness; IIT: inferior inner thickness; TIT: temporal inferior thickness; SOT: superior outer thickness; NOT: nasal outer thickness; IOT: inferior outer thickness; TOT: temporal outer thickness) ($*P<0.05$ *vs* preoperation).

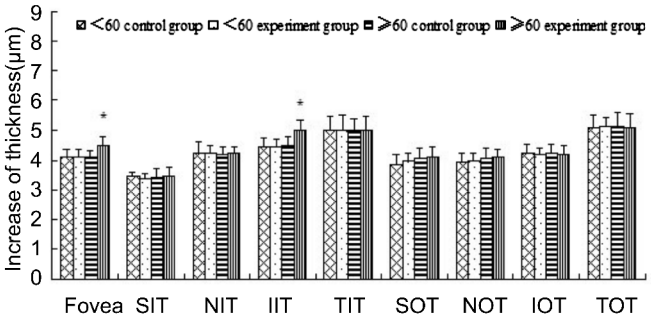

Figure 4 The increase of macular thicknesses at 6 months postoperatively with respect to baseline levels (fovea: fovea area, SIT: superior inner thickness, NIT: nasal inferior thickness; IIT: inferior inner thickness; TIT: temporal inferior thickness; SOT: superior outer thickness; NOT: nasal outer thickness; IOT: inferior outer thickness; TOT: temporal outer thickness) ($*P<0.05$ *vs* preoperation).

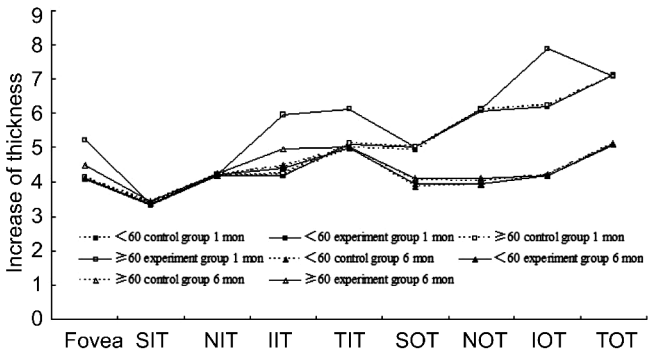

Figure 5 Curve line shows the increase of average macular thickness in 4 different groups at 1 month and 6 months postoperatively.

groups. P value was smaller than 0.05 and the difference was statistically significant. The average increases of macular thickness were 4.25±0.16μm in <60 control group, 4.23±0.28μm in <60 experiment group, 4.29±0.26μm in ≥60 control group and 4.40±0.52μm in ≥60 experiment group at 6 months. There were no significant differences among these 4 groups.

DISCUSSION

Although fluorescein fundus angiography has been the gold standard to test macular edema, OCT test has already shown advantages for postoperative examination as a useful, non-invasive diagnostic tool. Many cataract doctors have applied OCT to measure macular changes[10,11]. Retinal 9 sectors has been initialized by ETDRS, many cataract researches have used this method to describe retinal change. We also describe our data by this method.

Our data (Figure 3, 4) show that after cataract surgery macular thicknesses were higher than that before operation. Even at 6 months after the surgery, macular thicknesses have not recovered to the preoperative levels. All of 9 sectors of macular thicknesses (Figure 5) have become thicker than the preoperative values in different degrees. The results have been in accordance with the Carlo Cagini research work[12]. And the greatest change was noted at 1 month (Figure 5). This result was in accordance with yazici AT findings[13]. However, other researches have different results with us. Vukivcevic study has showed that central foveal thickness can return to pre-operative levels at 6 months[10]. Maybe a longer observation period will be needed to provide more useful data.

There are two theories to explain thicker macula after cataract surgery, one of which is mechanical traction mechanism, and another is blood-retinal barrier breaking-down. The mechanism theory states that thicker macular is caused by anterior capsular rupture and posterior vitreous traction on macula[14]. Gass think that is not the only reason because half of the patients with macular edema have intact anterior limited membrane[15]. Based on this, some scientists have reported another blood-retinal barrier breaking-down theory. Literatures have shown prostaglandin inflammation agents increase in aqueous humor and vitreous body to support this theory. Actually, there are more than 20 items related to the postoperative edema clinically[16]. So the reasons for cataract postoperative macular edema were complicated.

Our data showed that increase of thickness of macula was higher in ≥60 experiment group than other 3 groups at 1 month. There is no difference among these groups at 6 months postoperatively. We doubt that patients beyond 60 aremore sensitivity to intracameral cefuroxime than younger patients at initial stage of postoperative recovery. Maybe this is because the medication can be metabolized as time goes on, or self-compensation helps patients absorb subretinal exudates. The specific mechanism has not been known.

Our results also showed that the main increase points are fovea, inferior inner area, temporal inner area and inferior outer area at 1 month. At 6 months, the increase points are only fovea and inferior inner area. The mechanism has remained unknown. Similar reports have not been found.

For clinical doctors, we should pay more attention for cataract

patients over 60 years old with prophylactic application of intracameral cefuroxime. More and earlier fundus examination should be done to make sure macular edema discovered in early stage postoperatively.

In our case, we only consider a population without any ocular or systemic problems. Consequently, our results cannot refer to other people existing with eye problems or systemic diseases, like age related macular degeneration, diabetic retinopathy or hypertensive retinopathy.

In summary, our study has two conclusions: 1) Macula become thicker after cataract surgery which cannot restore preoperative level at 6 months; 2) Patients elder than 60 will have thicker macula after cataract surgery with intracameral cefuroxime at 1 month postoperatively.

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