Early retinal changes after uncomplicated mild and hard cataract surgery

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ABSTRACT
To evaluate and compare the possible effects of hard and soft nuclear cataract surgeries in the development of early postoperative retinal complications.
In a retrospective study design 1388 uncomplicated phacoemulsification surgery were enrolled in the study. Data for 688 Grade 5-6 and 700 Grade 2-3 nuclear cataracts according to Lens Opacities Classification System III (LOCS III) were used for comparison. All patients were evaluated for visual acuity (VA), intraocular pressure (IOP), central macular pathologies and angiographic fluid leakage pattern at 1 week and 1 month. Biomicroscopic evaluation, optical coherence tomography (OCT), fluorescein angiography (FA) and indocyanine green angiography (ICG) were used for examination.
Follow up time was 1 month. Mean CMT of patients were higher at hard cataracts but not statistically significant (p>0.24). Clinically significant cystoid macular edema after hard nuclear cataract surgery was 1.59 % (11) and 1.28 % (9) for soft cataracts (p>0.05). After 20/20 visual acuity at 1 week, 5 (0.72 %) patients from hard nuclear group had visual loss and hemorrhagic pigment epithelial detachment (PED) at 1 month control. Angiographic evaluations revealed them 4 as insignificant polyoid choroidal vasculopathy (PCV). One of them is still controversial. IOP and VA results were similar at both controls (p> 0.05).
Subretinal hemorrhage after cataract surgery may be the first sign of some PCV patients. Patients who were diagnosed with PCV should be carefully evaluated for cataract surgery. Hard nuclear cataract may be a predisposing factor for early hemorrhagic PED in patients with PCV. Any retinal pathology should be carefully evaluated before cataract surgeries.

Key Words: Cataract, polypoidal choroidal vasculopathy, hemorrhagic pigment epithelial detachment

Introduction
It could be safely assumed that as the society gets older the number of cataract patients increase (1). According to 2010 National Eye Institute (NEI) records number of cataract patients in the U.S is expected to be doubled from 24.4 million to about 50 million by 2050. Such an increase will bring a higher demand for cataract surgery. Today it is widely accepted that the most frequent surgical method which is used for cataract surgery is phacoemulsification (2). Cataract surgery complications are mainly posterior capsular rupture and vitreous loss, vitreous prolapse, expulsive haemorrhage, Descemet's membrane detachment, intraocular haemorrhage, wound malposition, shallow anterior chamber, iris prolapse, infectious endophthalmitis, corneal oedema, dropped nucleus or retained nuclear fragments, cystoid macular oedema, retinal detachment, posterior capsule opacification (3,4).
The nature of cataract itself also effects the results of surgery. In eyes with hard nuclear cataract, the total ultrasound time and cumulative dissipated energy (mean percentage of ultrasound power) during phacoemulsification surgery increases as well as complications (5).
In this study we aimed to evaluate and compare the early retinal complications of phacoemulsification surgery after low-density and high-density nuclear cataracts.

Material and Method
Medical records of 1388 patients who had phacoemulsification surgery at Namik Kemal University Department of Ophthalmology between November 2010 and March 2016 were reviewed. All surgeries were made at the same hospital without any intraoperative complications. Informed consent was taken from all patients. The study protocol was approved by the local ethics committee of the same university and performed according to the Declaration of Helsinki.
All patients were routinely classified in accordance with Lens Opacities Classification System III (LOCS III). A total of 688 hard nuclear cataracts (Grade 5-6) and 700 soft nuclear cataracts (Grade 2-3) were enrolled in the study. Inclusion criteria
were; cataract formation, visual acuity (VA) lower than 5/10 Snellen, Endothelial Cell Density (ECD) higher than 1500 cells/mm². Exclusion criteria were uncontrolled glaucoma, blood glucose level over 200 mg/dl (DM), active uveitis, senile macular degeneration, high myopia, hypermetropia, retina detachment and any active corneal pathology.

All patients had complete ophthalmic examination including slit-lamp microscopic evaluation, intraocular pressure measurement (Goldmann Applanation Tonometry), central corneal thickness (CCT) measurement (Pascan 300P, Sonomed, Inc.), VA (with Snellen chart) before operations and postoperative 1 day, 1 week and 1 month. Those patients with early retinal complications were evaluated with Fluorescein angiography (FA), indocyanine green angiography (ICGA) and Optical Coherence Tomography (OCT) (Cirrus HD-OCT, Carl Zeiss Ophthalmic System Inc, Zeiss-Humphrey, Dublin, California, USA).

Before operations 3 times at 5 minutes intervals propacaine hydrochloride was dropped for local anesthesia. 2.8 mm clear corneal incisions were made superotemporally and 2 20-G MVR incision on 10 and 4 o’clock. Continuous capsulorrhesis at least 6 mm was achieved and after hydrodissection the standard surgery used for groups was torsional quick chop method (Ozil IP, Alcon Laboratories, Inc.). Cortex and viscoelastics were cleaned by irrigation/aspiration cannula (Alcon Lab.). Corneal endothelial protection was achieved by Ophthalmic Viscoelastis Device (OVD) (sodium hyaluronate [Mircovise 1.4%]. All incision places were closed with stromal hydration and moxifloxacin was administered to anterior chamber. Topical moxifloxacin and prednisolone acetone were reciped for at least 2 weeks 4 times a day.

Statistical Analysis: The data were analyzed with SPSS for Windows, version 18.0; IBM-SPSS, Chicago, Illinois, USA. Distribution analysis were made with Kolmogrov-Smirnov tests. Mann-Whitney U tests were used to compare the groups.

Results

No complications occurred during surgeries. Follow up time was 1 month. (Table 1) shows all patient characteristics.

Postoperative 1 week and first month mean visual acuity of groups were 0.82± 0.7 and 0.93 ± 0.88 for soft cataract group and 0.76 ± 0.17 and 0.91± 1.1 Snellen for hard nuclear cataract group, respectively. There was no statistically significant difference in the mean VA between hard nuclear and soft nuclear cataract groups at 1 week and 1 month postoperative controls (P=0.22). Postoperative 1 week and first month mean central macular thickness (CMT) of groups were 243 ± 19.1 μm and 245 ± 15.8 μm for soft cataract group and 278 ± 22.2 μm and 270± 17.9 μm for hard nuclear cataract group, respectively. Mean postoperative 1 month CMT of patients were higher at high density nuclear cataract group however it was not statistically significant (p=0.24).

Three patients (0.21%) had rhegmatogenous retinal detachment (RD) at postoperative 1 week control. Two of these subjects were from the soft nuclear group with high myopia (>6D) and 1 was from the hard nuclear group without any myopia or a significant history.

| Parameters | Hard Cataracts | Soft Cataracts | P values |
|------------|----------------|----------------|----------|
| Sex, n     |                |                |          |
| Male       | 258 (37.5%)    | 190 (27%)      | P=0.35   |
| Female     | 430 (62.5%)    | 510 (73%)      | P=0.51   |
| IOP, mmHg  | 17.6± 3.3      | 14.4±2.9       | P=0.64   |
| CCT        | 535±13.2       | 549±18.1       | P=0.81   |
| Age        |                |                |          |
| Mean ± SD  | 69.4 ± 11.5    | 71.7 ± 8.2     | P=0.9    |
| Range      | 50, 85         | 54, 84         | P=0.48   |
| VA ± SD, Snellen | 0.142±0.11 | 0.19±0.23     | P=0.24   |
| Hypertension, n | 132 (19.1%) | 105 (15%)     | P=0.26   |
| Diabetes Mellitus,n | 58 (8.4%) | 79 (11.2%)    | P=0.37   |
| Systemic Steroid Use, n | 9 (1.3%) | 24 (3.4)      | P=0.19   |

VA, visual acuity IOP, intraocular pressure SD, standat deviation D, diyopter, p>0.05 is insignificant
Number of clinically significant pseudophakic cystoid macular edema (PCME) after hard and soft nuclear cataract surgeries were 11 (1.59%) and 9 (1.28%), respectively (p= 0.52). Eight out of 20 patients with PCME were diabetic and 12 (60%) of them were male.

After near 20/20 visual acuity at 1 week, 5 (0.72%) patients from hard nuclear group had visual loss and hemorrhagic pigmen epithelial detachment (PED) until 1 month control. VA of the patients with PED varied between hand motions to 1 meter finger counting. Figure 1 shows fundus photographs of a patient with hemorrhagic PED. Patients underwent OCT, FA and ICGA. Evaluations revealed them 4 as polypoidal choroidal vasculopathy (PCV). One of them is still controversial because of massive subretinal hemorrhage and low vision patient didn't follow the visits. Two patients had systemic hypertension, 1 patient had asthma and one was an obese woman. Almost all patients were smoking cigarette. Table 2 shows all clinical characteristics of patients with hemorrhagic PED.

### Table 2. Clinical Characteristics of Patients Who Developed Postoperative Hemorrhagic Pigment Epithelial Detachment

| Patients, n | Age | Sex | VA (Before Hemorrhage) | VA (After Hemorrhage) | PCV Location | Duration Until Postoperative Hemorrhage | Systemic Diseases | Drugs | Preoperative Eye Disorders | Cigarette Smoking, n/day |
|-------------|-----|-----|------------------------|-----------------------|--------------|----------------------------------------|-------------------|-------|-----------------------------|-------------------------|
| 1           | 68  | Male | 20/20                  | 10 cm                 | Juxtafoveal  | 10 days                                | Hypertension      | B-Blocker | None                        | 20/day                  |
| 2           | 57  | Male | 18/20                  | 1 m                   | Juxtafoveal+ Subfoveal | 14 days                              | Hypertension      | B-Blocker+ACE inhibitor | Myopia 5 D                | 30/day                  |
| 3           | 55  | Female | 18/20                 | 1 m                   | Juxtafoveal | 11 days                                | None              | None | None                        | 5/day                   |
| 4           | 69  | Male | 20/20                  | 50 cm                 | Subfoveal   | 18 days                                | Asthma            | Ventolin inhaler | none                        | 10/day                  |
| 5           | 74  | Male | 16/20                  | HM                    | ?           | 8 days                                 | Obesity           | None | Myopia 4 D                  | none                    |

VA, visual acuity; PCV, polypoidal vascular chorioretinopathy; HM, Hand Motions; D, dioptere

### Table 3. Postoperative early retinal complications

|                      | Hard Cataracts | Soft Cataracts | P value |
|----------------------|----------------|----------------|---------|
| Retina Detachment    | 1 (0.14%)      | 2 (0.28%)      | p>0.05  |
| Endophthalmitis      | None           | None           |         |
| CME, n               | 11 (1.59%)     | 9 (1.28%)      | p=0.52  |
| Hemorrhagic PED, n   | 5 (0.72%)      | None           | p=0.18  |

CME, cystoid macular edema; PED, pigment epithelial detachment.

### Discussion

Cataract is the foremost cause of preventable blindness and phacoemulsification. Surgery is the most common operation performed worldwide (6). To our knowledge PCME is the most frequent early postoperative retinal complication which result in impaired VA (7). Incidence of PCME in previous studies varies between 0.1% to 2.35% (8). In the studies intraoperative complications (vitreous loss etc.), male sex and diabetes mellitus are implicated as risk factors for PCME (9). In accordance with the studies mentioned above, the mean PCME in our patients was 1.44% and 60% were male, 40% were diabetic. There was no significant difference between high density and low density nuclear cataract groups (p=0.52).

RD is one of the leading sight-threatening complication of phacoemulsification surgery and complicates almost 1% of all operations performed in the developed countries (10). Mainly...
three risk factors are implicated, 1-Patient factors (long axial length etc.), 2-Surgical factors (vitreous loss, and posterior capsule rupture etc.) and 3-Postoperative factors (Nd:YAG laser posterior capsulotomy). In a mult centered study median time to RD after cataract surgery was defined as 11 months (range, 0-8.4 years) (11). In our study the RD rate was 0.21% (3 of 1688) by the 1st month. High myopia in two of our RD patients were implicated as patient dependent risk factor since there was no intraoperative complications.

Endophthalmitis is a very rare but devastating complication of cataract surgery, with a reported incidence of 0.04% to 0.41% (12). Diabetes, vitreous loss, extracapsular cataract extraction and older age are implicated for endophthalmitis after cataract surgery (13). All our patients had conventional phacoemulsification method without any complication. Surgeries of patients who had uncontrolled blood sugar levels were postponed until blood sugar regulation. Thus none of our patients in neither group experienced endophthalmitis.

The term PCV is used to distinguish a specific subtype of neovascular macular degeneration. The disease is characterized with polypoidal choroidal grape-like vascular lesions (14). The prevalence of PCV is as high as up to 55% in newly diagnosed wAMD in Asian society (15). However the data on epidemiology of PCV and confidential prevalence from population based studies are been difficult because of difficulty of diagnosing the condition without ICGA. Turkey is a bridge between Asia and Europe and there is still no population based study on PCV. The risk factors for PCV formation mainly comprises; male gender, genetical factors, cigarette smoking and DM (16,17). Cackett et al. (18) reported that patients who smoked were four fold more likely to have PCV than normal subjects. Sometimes these polyps progress to hemorrhagic complications in the subretinal pigment epithelial space and results in hemorrhagic PED. In a retrospective study reported by Cho et al. (19) 5 (8.6%) of 56 eyes who had received intravitreal ranibizumab 0.5 mg for PCV developed postoperative subretinal hemorrhage (19). In this study the mean time to postoperative hemorrhagic PED was 2.8±0.4 days (range, 2 to 6 days) and the most possible mechanism blamed for postoperative hemorrhagic complications of PCV is retina pigment epithelial tear.

This study is the first study to show and compare the hemorrhagic PED after soft and hard nuclear cataract surgeries. Five (0.72%) patients from high density nuclear cataract group had postoperative hemorrhagic PED while none of the patients from soft nuclear cataract group experienced hemorrhagic PED. One patient had massive subretinal hemorrhage and did not come to the visits. Four of the patients had juxtafoveal (3) and subfoveal (1) PCV. But we did not know preoperative PCV numbers in the patient population and this produces bias in our study.

Unlike the studies mentioned above mean duration to PED formation was 10.4±1.8 (8-18) day in our study. This might lead us to think that the process is not only related with mechanical stress but also with local inflammation. In terms of local inflammation, longer ultrasonic phaco power used in hard nuclear cataracts might be a reason of greater local inflammation. This local inflammation might increase the choroidal blood flow in the fragile vessels and cause a subretinal hemorrhage. Four of the patients with hemorrhagic PED were smoking cigarette, which is thought to be one of the major risk factors in PCV formation by means of systemic inflammation (17). Two of the patients had systolic hypertension (HT) and one patient had asthma. However the previous studies couldn’t find a relation between HT and PCV formation they might increase intravascular pressure and cause hemorrhage in weak vessels.

In conclusion, patients who were diagnosed with PCV should be carefully evaluated for cataract surgery. Cataract surgery increases intraocular inflammation and many studies revealed that phacoemulsification surgery is one of the causes of age related macular degeneration. It is logical that increased surgery time and inflammation increases these effects. We focused on hemorrhagic PED in patients after cataract surgery and results were as expected. Hard nuclear cataract surgery with coexisting systemic diseases might augment early hemorrhagic PED in patients with PCV.

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