• Letter to the Editor •

Differences in intraocular lens power calculation in patients with sub-foveal choroidal neovascularization

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Dear Editor,

I am Dr Xing-Chao Shentu, from the Eye Center of the Second Affiliated Hospital, Medical College of Zhejiang University, Hangzhou, China. I write to present case series of differences in intraocular lens (IOL) power calculation by partial coherence interferometry (PCI) and ultrasound A-scan biometry with sub-foveal choroidal neovascularization (CNV). Cataract and age-related macular degeneration (AMD) commonly affect the aging population, and frequently co-contribute to visual impairment, often occurring jointly. The prevalence of both diseases would likely rise over the next decade, reflecting the demographics change of aging society. Majority of severe visual loss cases in AMD is caused by its neovascular form, arised from CNV and its consequences[1]. Recent studies have demonstrated that cataract surgery is safe for neovascular AMD, and leads to visual improvement, especially in the era of anti-vascular endothelial growth factor (VEGF) therapy[2-5]. In addition to neovascular AMD, CNV also accounts for vision loss of pathological myopia and other macular diseases[6]. It was our clinical observation that CNV beneath the macular might affect the accuracy of the IOL power calculation. Commonly, an incorrect lens power calculation has been the main cause for dissatisfaction and lens exchanges in modern cataract surgery[7-8]. Here, we describe 4 cases showing the differences in the IOL power calculation with PCI or ultrasound A-scan biometry in patients with sub-foveal neovascularization which, to our knowledge, has not yet been described in the literature.

An 81-year-old female presented with bilateral gradual deterioration of visual acuity over the past 2y. Her medical history was positive for systemic hypertension, without any past history of ocular disease. Ophthalmological examination revealed a decimal best corrected visual acuity (BCVA) of 20/100 in the right eye and 20/60 in the left eye. The views of both fundi were occluded by cataracts. Age-related cataract was diagnosed and both IOLMaster and ultrasound A-scan biometry were performed. The axial length of the right eye was 22.57 mm with the PCI (IOLMaster, V5.5; Carl Zeiss Meditec Inc., Jena, Germany) and 24.61 mm with the ultrasound A-scan biometry (Quantel Medical Inc., France). Different results were found in the IOL power calculations: +21.50 diopters (D) with PCI and +15.38 D with ultrasound A-scan (SRK II formula, A constant was set as 118.5 in both devices). No differences between the two devices were found in the left eye. Phacoemulsification (1.8 mm incision) surgery was performed to the right eye, and a piece of IOL (+21.5 D, AMO Tecnis ZCB00, A constant: 119.4) was implanted into the posterior chamber. One week after the surgery, BCVA was improved to 20/60 corrected with -1.75 D spherical equivalent refraction. Detailed examinations were performed, including optical coherence tomography (OCT; Carl Zeiss Cirrus HD-OCT4000, California, USA) and fluorescein fundus angiography (FFA). OCT demonstrated an elevated hyper-reflective subretinal lesion beneath the fovea (Figure 1A). FFA revealed focal hyperfluorescence of CNV with leakage of the dye (Figure 1B). Unfortunately, the patient refused further treatment with anti-VEGF agents. After reviewing the clinical findings of this patient, we hypothesized that the sub-foveal neovascularization might account for the approximate 5 D refractive error of the IOL power calculation between the PCI and the ultrasound A-scan. Further efforts were made to observe the effects of the sub-foveal neovascularization on the axial length measurement and IOL power calculation.

Second case was a 63-year-old male was referred to our clinic with a diagnosis of wet-AMD in his left eye. The patient reported no history of systemic or ocular disease, and ophthalmological examination revealed a BCVA of 20/40. The OCT images (Figure 1C) revealed thickening of

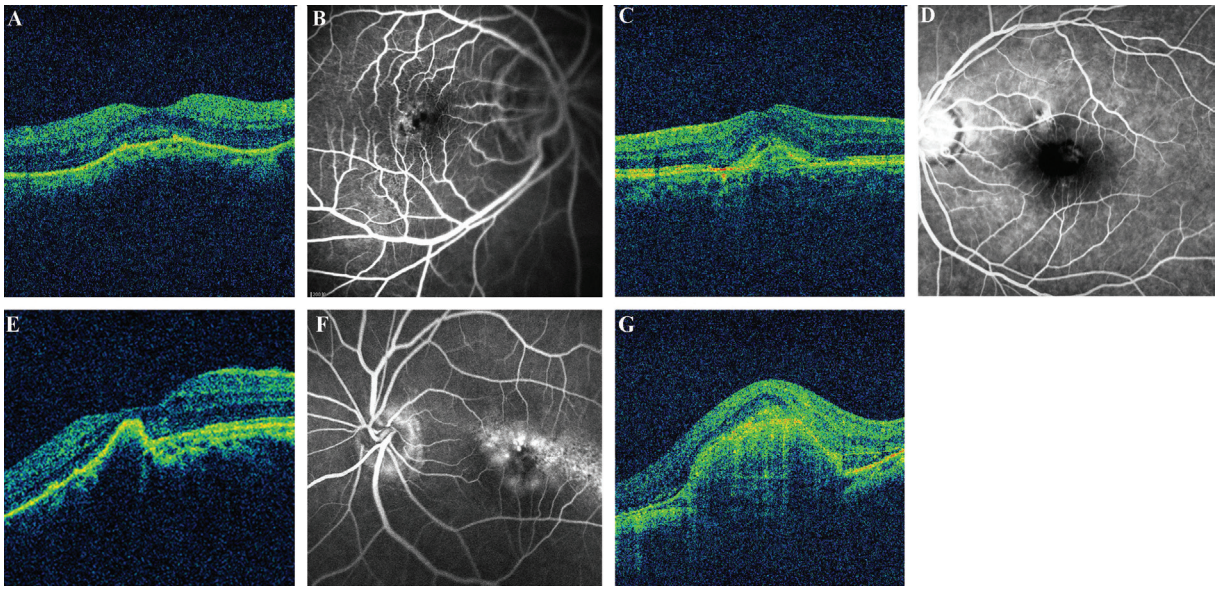

Figure 1 Spectral domain OCT and FFA A, B: Case 1; C, D: Case 2; E, F: Case 3; G: Spectral domain OCT view of case 4.

the macular neuroepithelium, with laminal separation and cystic low-reflecting areas in the inner layer. FFA showed hyperfluorescence of CNV with leakage of the dye (Figure 1D). IOLMaster showed an axial length of 23.73 mm and IOL power (SRK II formula) was calculated as +20.02 D. Axial length was 24.24 mm, with IOL power calculation of +18.96 D with A-scan ultrasound (SRK II formula) detection. The patient then received 3 doses of ranibizumab (anti-VEGF agent, Genentech, Inc.) for the treatment for CNV.

Third case was a 44-year-old male complaining of blurred vision in his left eye for 2mo. The patient had past history of myopia. Ophthalmological examination revealed a BCVA of 20/100. OCT scanning showed an elevated hyper-reflective subretinal lesion (Figure 1E). FFA found hyperfluorescence leaking around macular area (Figure 1F). The axial length was 24.87 mm by PCI and 26.36 mm by ultrasound A-scan. IOL power was calculated as +16.50 D and +13.50 D based on the PCI (SRK II formula) and ultrasound A-scan (SRK/T formula) respectively. CNV secondary to pathological myopia was then diagnosed. However, the patient refused further treatment with anti-VEGF agents.

The last case was a 54-year-old female complaining of decreased visual acuity in her left eye over the previous 1mo. Ophthalmological examination revealed a BCVA of 20/200, and an elevated hyper-reflective subretinal lesion was found *via* OCT (Figure 1G). FFA examination was not performed to this patient due to positive result of allergy skin test to fluorescein. Then CNV secondary to pathological myopia was diagnosed. Further measurements of axial length were 25.70 mm by PCI and 26.78 mm by ultrasound A-scan. IOL power was calculated as +12.73 D and +10.15 D based on the PCI and ultrasound A-scan (SRK/T formula in both devices), respectively. This patient then received treatment with ranibizumab.

Contact ultrasound A-scan biometry and non-contact PCI are both well-established methods for measuring the axial length. PCI measures the interferometry between the surface of tear film and retinal pigment epithelium (RPE), without contact, and ultrasound biometry measures the distance from the cornea to the internal limiting membrane. In healthy eyes, two methods of axial-length measurement are highly correlated[9]. The calculation of IOL power based on the axial length by the PCI provided no clinical advantage over the conventional ultrasound, as measured by postoperative refractive outcome[10]. IOLMaster has the clinical advantage of being a non-contact technique, without the need for topical anesthesia, and reduces measurement errors by the examiner[11]. However, measurement might differ since the two methods have a different target. Previous studies reported that the axial length measurements using the applanation A-scan ultrasound and IOLMaster in eyes with macular edema significantly differ both statistically and clinically[12-13]. More studies described the changes in the axial length of the eyes after macular hole or epiretinal membrane surgery by the A-scan ultrasound or IOLMaster; however, we found few reports about patients with variations of retinal thickness from sub-foveal CNV with IOLMaster and A-scan ultrasound[14].

Differences in the PCI with respect to the US measurement, we postulated, these differences might be based on two reasons: 1) the RPE layer was elevated by the sub-foveal CNV in these cases. The abnormal position of the RPE layer in the macular region could affect the detection based on the optical reflection of the RPE by IOLMaster; 2) another contributing reason for the difference may be the alignment of the measurement axis. In normal eyes, IOLMaster relies on optical alignment methods in which the patient fixates on a light spot, which ensures better alignment of the measurement axis with the visual axis,

compared with ultrasound[15]. Ultrasound generally detects an area of 0.3 mm^2 in the macular region, which is larger than the area in the PCI measurement (0.05 mm^2)[2]. Thus, the off-optical axis detection and measurement of a different position, shift of fixation from foveola to a parafoveal area, might occur. The differences in the IOL power calculation in these cases are not directly related to the height of elevated macular, which suggested that more factors (such as elevated area of macular, cornea applanation by ultrasound probe, *etc.*) might affect the results. Caution should be taken with macular disorders when differences occur between IOLMaster and traditional ultrasound A-san during cataract surgery. Further prospective studies regarding the IOL power calculation based on PCI or ultrasound in patients with sub-foveal neovascularization are necessary to optimize the refractive outcomes of cataract surgery.

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