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Comparison of the anterior chamber parameters in the pseudoexfoliation syndrome, pseudoexfoliation glaucoma and primary open angle glaucoma patients

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Abstract

Purpose: To evaluate the anterior chamber parameters in the pseudoexfoliation syndrome (PEXS) and pseudoexfoliation glaucoma (PEXG) patients with Pentacam Scheimpflug camera and comparison of the results with the primary open angle glaucoma (POAG) patients.

Methods: Three groups were formed in our study. Sixteen eyes in PEXS (group 1), 20 eyes in PEXG (group 2) and 41 eyes in POAG (group 3) were included. Anterior chamber volume (ACV), anterior chamber depth (ACD) and anterior chamber angle (ACA) values were recorded by Pentacam Scheimpflug camera.

Results: In our study, ACD and ACV values were statistically significant lower in the pseudoexfoliation groups than the POAG group ($p<0.05$), no significant differences in the ACA values ($p>0.05$).

Conclusion: Glaucoma and/or cataract are seen often in pseudoexfoliation, the surgery is difficult and potentially challenging. Therefore, before planning a surgery for the patients with pseudoexfoliation, it is important to be informed about the anterior chamber parameters.

Introduction

Pseudoexfoliation syndrome (PEXS) was first described in 1917 by Lindberg [1].PEXS is an age-related systemic disease with primarily ocular manifestations characterized by deposition of whitish-gray pseudoexfoliation fibrillogranular amyloid like material on the anterior lens capsule, zonules, ciliary body, pupillary margin of the iris, corneal endothelium, anterior vitreous and trabecular meshwork [2,3]. The awareness of the significance of pseudoexfoliation has increased considerably in the latest decade. Pseudoexfoliation is a risk factor not only for open-angle glaucoma but also for angle-closure glaucoma, lens subluxation, blood aqueous barrier impairment serious intraoperative and postoperative complication and has been correlated with an increased incidence of cataract formation. Exfoliation of fibrillogranular amyloid-like material has been found in many organs such as skin, heart, lungs, liver, kidney, gall bladder, blood vessels, extraocular muscle, connective tissue in the orbit, optic nerves and meninges suggesting that PEXS is not only an ocular disease but also a general disorder that involves the abnormal production of extracellular matrix material [4,5]. PEXS is recognized as an important risk factor for glaucoma. Pseudoexfoliation glaucoma (PEXG) is most often classified as a secondary glaucoma. It occurs in eyes with PEXS and usually with an open anterior chamber angle [6,7]. PEXG tends to be more severe than primary open-angle glaucoma and not only responds poorly to medical therapy but also needs surgery for glaucoma more frequently [8]. Many resent studies have shown that patients with PEXS have higher rates of complications during and after cataract surgery compared to patients without this disorder. The alternations of tissues of the anterior eye segment make cataract and glaucoma surgery potentially challenging and thus surgeons must be aware of numerous intraoperative and postoperative problems in managing the patient with PEXS and PEXG [9]. Anterior segment parameters can give valuable information to the surgeon to be more careful before both cataract and glaucoma surgery in patients with pseudoexfoliation. Thus the assessment of anterior segment parameters, such as anterior chamber depth (ACD), anterior chamber volume (ACV) and anterior chamber angle (ACA) is an important part of ophthalmic examination in patients with pseudoexfoliation and POAG [10]. A small anterior chamber depth may indicate zonular instability in eyes with PEXS and should alert the cataract surgeon to the possibility of intraoperative complications [11]. In recent years, different devices for anterior segment evaluation have been used, such as slit lamp optic coherence tomography, ultrasonic biomicroscopy, orbscan scanning slit topography, scanning peripheral ACD analyzer and Pentacam Scheimpflug imaging. All of these devices provide quantitative information and qualitative imaging of the anterior segment structure [12]. Images of the anterior eye segment

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were captured by Pentacam (Oculus, Optikgeräte GmbH, Wetzlar, Germany). With Pentacam, a rotating Scheimpflug camera supplies pictures in three dimensions, and the geometry of the anterior eye chamber is calculated. Pentacam Scheimpflug is a fast, non-invasive, easy-to-use, reproducible, user independent method with high patient comfort. The Pentacam system may be used for the measurement of the corneal thickness (CT), anterior and posterior corneal curvature and elevation, ACD and ACA.In this study we aim to evaluate the anterior chamber parameters in PEXS and PEXG patients with Pentacam Scheimpflug camera and comparison of the results with POAG patients.

Methods

This study consists of 77 eyes of 64 patients, 16 eyes of 13 patients with PEXS (Group 1), 20 eyes of 16 patients with PEXG (Group 2), 41eyes of 35 patients with POAG (Group3). Patients were informed about the disease and tests. The patients consent forms were included. Study was organized according to the Declaration of Helsinki. All cases were asked for their consent and an independent ethics committee approved the investigation.Pentacam Scheimpflug imaging system system (rotating Scheimpflug camera; Oculus, Wetzlar, Germany) measurements were performed in all cases and the best images were evaluated. ACV, ACD and ACA values were recorded and results were compared statistically. Group 1 included PEXS patients who have normal IOP (under 21 mmHg), visible pseudoexfoliation material on the anterior segment structures, normal optic nerve head and normal visual field examination (Humphrey 30-2,SITA-FAST). Group 2 included PEXG patients who have high IOP (over 21 mmHg), visible pseudoexfoliation material on the anterior segment structures, glaucomatous optic nerve head changes and visual field defects. Group 3 included POAG patients who have high IOP (under 21 mmHg), absence of pseudoexfoliation material on the anterior segment structures, glaucomatous optic nerve head and visual field defects. The exclusion criterias were previous ocular surgery, ocular trauma, corneal pathology, posterior segmentpathology, uveitis that might influence anterior segment parameters, over one dioptre of cylindrical and/or three dioptres of spherical refractive errors and evident cataract. The Pentacam Scheimpflug imaging system is based on a 180-degree rotating Scheimpflug camera, which can take 12 to 50 single captures to reconstruct the anterior chamber. The Pentacam Scheimpflug imaging system software constructs a three-dimensional image of the anterior segment and calculates the anterior chamber parameters. This imaging provides measures of ACD, ACV, ACA, CCT, CV and pupil size. Statistical analysis was performed with SPSS for Windows version 13.0 (SPSS Inc, Chicago, IL, USA). Student t test was used to compare data. The statistical significance was accepted as $p< 0.05$.

Results

The avarege ages of the three groups were 63.6±11.8, 62.6 ± 6.5, 54.2 ± 7.7 years respectively. There was no statistically significant difference with respect to gender and age between groups ($p>0.05$). ACD measured values are approximately 2.5 mm in group 1, 2.4 mm in group 2 and 2.8 mm in group 3. ACV avarage values are respectively 110.2 mm^3, 127.6 mm^3 and 145 mm^3, while ACA measurements are 30.1° in group 1, 31.9° in group 2 and 33.2 in group 3 (Table 1). The statistical comparisons of PEX groups (group 1 and group 2) and group 3, significant difference was detected in ACD and ACV measurements between the groups ($p<0.05$), no significant differences in the ACA values ($P>0.05$).

Table 1. Group 1, group 2 and group 3 anterior segment parameters.

Groups	ACD (mm)	ACV (mm^3)	ACA (°)
Group 1	2.5±0.3	110.2±23.1	30.1±5.8
Group 2	2.4±0.4	127.6±33.3	31.9±6.6
Group 3	2.8±0.4	145±43.9	33.2±7.9
P values	P< 0.05	P< 0.05	P > 0.05

ACD: Anterior chamber depth, ACV: Anterior chamber volume ACA: Anterior chamber angle. Group 1: Pseudoexfoliation syndrome, Group 2: Pseudoexfoliative glaucoma, Group 3: Primary open angle glaucoma

Discussion

PEXS is an age-related disorder characterized by the production and accumulation of an abnormal pseudoexfoliation fibrillar material in various ocular tissues. This syndrome affects about 0.2–30% of people older than 60 years worldwide. Ocular manifestations of pseudoexfoliation have been well defined, such as PEXG, cataract formation, zonular instability, etc. Pseudoexfoliation fibers also have been identified in many extra-ocular tissues, such as the heart, lung, gall bladder, kidney, and cerebral meninges, so the search for systemic implications of this syndrome has attracted a great deal of attention [11].PEXS is the most common cause of secondary glaucoma worldwide, and the most frequent cause of unilateral glaucoma. PEXG responds poorly to medical therapy compared with other types of glaucoma and can lead to rapid progression of optic nerve damage [12]. Owing to PEXG prevalence and severity, ophthalmologists should examine the eye for signs of PEXS, as it is a major risk factor for glaucoma development. PEXG commonly presents unilaterally with IOP that tends to escalate faster than among patients with POAG. The higher IOP observed in PEXG can lead to more rapid optic nerve damage and visual field loss. When symptoms are present in one eye, the contralateral eye must be examined carefully and monitored, since PEXG will develop in the other eye of more than 40 percent of these patients. Poor pupillary response to dilation is a subtle finding that is observed frequently in patients with PEXS and resultant glaucoma. This is believed to be related to iris dilator muscle atrophy and can complicate cataract surgery. Such eyes have weak zonular attachments as well, also complicating cataract surgery. Many resent studies have shown that patients with PEXS have higher rates of complications during and after cataract surgery compared to patients without this disorder [13]. Two pathological manifestations of pseudoexfoliation, zonular weakness and poor pupillary dilation have been identified as the most significant risk factors for surgical complications. Zonular weakness can be attributed to the deposition of pseudoexfoliation material on the zonular fibers and ciliary processes resulting in a proteolytic disintegration of the zonules that can lead to spontaneous devastation. Thus, a significant zonular instability can cause phacodonesis, spontaneous subluxation of the lens and angle-closure glaucoma due to pupillary and ciliary block [14,15,16]. The incidence of phacodonesis and/or subluxation of the lens in eyes with PEXS have been reported to be between 8.4% and 10.6% [17,18]. Anterior chamber depth is a useful predictor of intraoperative complications in eyes with PEXS. An anterior chamber depth of less than 2.5 mm centrally—probably an indication of zonular instability—poses a significantly higher risk for intraoperative complications [19]. A prospective clinical study of the ACA was performed in 263 eyes (152 patients) with PEXS. No significant difference was found in width and depth of the anterior chamber in comparison with the normal population [20]. Lanzl, Merté and Grahaminvestigated the changes in ACD and whether the increased mobility of the lens influences ACD in patients with pseudoexfoliation. That study showed that in patients with clinically apparent unilateral pseudoexfoliation, the lens seems to be more mobile

in the affected eye. In addition, results suggest that a shallower anterior chamber occurs when the head is placed in a prone position [21]. In another study, Bartholomew reported that no significant difference was found in ACD in eyes with or without pseudoexfoliation in 34 eyes of patients with PEXS and in 334 normal controls [22]. Layden and Shafferreported a 23 per cent incidence of occludable angles in PEXS cases compared with a five percent incidence in the normal population. Although the mechanism is unknown, investigators postulate a variety of mechanisms, such as posterior synechiae, zonular weakness and enlargement of the lens due to cataract formation, a thick or a rigid iris with predisposition to relative pupillary block.Doganay, Tasar and Cankaya showed that the ACD of PEXG patients were lower than those of healthy individuals. Although the difference in ACD between PEXG patients and normal patients was statistically significant, this finding is unlikely to be of clinical significance. There were no significant differences in the means of ACV, ACA width, CCT, pupil diameter and corneal volume values [9]. To our knowledge, there is no prospective clinical study that quantitatively evaluates ACD, ACV and ACA in the PEXS and PEXG patients with Pentacam Scheimpflug camera and comparison of the results with the POAG patients. In our study, the mean ACD and ACV values were lower in the pseudoexfoliation groups than the POAG group. Glaucoma and/or cataract is seen often in pseudoexfoliation, the surgery is difficult and potentially challenging. Therefore, before planning a surgery for the patients with pseudoexfoliation, it is important to be informed about the anterior chamber parameters. Further large clinical trials with different devices are necessary to more clearly understand these findings.

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