Brief Communication

Prevalence of ocular pseudoexfoliation syndrome and associated complications in Riyadh, Saudi Arabia

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ABSTRACT

Objectives: To assess the prevalence of pseudoexfoliation syndrome (PEX), and associated ophthalmic complications among Saudi patients.

Methods: The prevalence of PEX and associated ocular co-morbidities were determined among the Saudi patients visiting the Primary Care Clinic of Prince Sultan Military Medical City, Riyadh, Kingdom of Saudi Arabia, between January 2009 and January 2010. A total of 1967 patients were examined biomicoscopically by ophthalmologists to determine the presence of PEX and associated ocular complications.

Results: Sixty-nine of the 1967 examined patients (3.5%) showed the presence of PEX with no significant gender difference. There was an age dependent increase in the prevalence of PEX after the age of 50 years. Pseudoexfoliation syndrome was associated with higher intraocular pressure, cataract, and poor vision. There was no significant difference in the prevalence of PEX in male and female Saudi patients.

Conclusion: Pseudoexfoliation syndrome is an age-related disorder, and its prevalence increases with age. Further larger population based studies are warranted to assess the prevalence of PEX and associated risk factors.

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The pseudoexfoliation syndrome (PEX) is an age related systemic disease primarily manifesting in the eyes. It is characterized by the accumulation of dandruff like fluffy deposits of fibrillar granular material.[1,2] The basic etiologic concept of PEX is a pathological process of the extracellular matrix characterized by the excessive production of an abnormal extracellular material, which aggregates and accumulates and is not degraded in vivo. The unique fibrillar PEX material is composed of a microfibrillar core surrounded by an amorphous matrix. In the eye, PEX material is produced primarily by the nonpigmented epithelium of the ciliary body, the posterior iris pigment epithelium, and the preequatorial lens epithelium, while the corneal endothelium, trabecular cells, vascular endothelia, and smooth muscle cells of the iris have also been implicated. Besides its age related manifestations in ocular tissue, the PEX material has been observed in extraocular tissues including skin, heart, lung, liver, kidney, gall bladder, blood vessels, optic nerve, and meninges.

Diagnostic features of PEX include deposition of PEX material, endothelial pigmentation, loss of pupillary ruff, iris sphincter transillumination, Sampaolesi line, and pigment deposition in the trabecular meshwork. Pseudoexfoliation syndrome is associated with various ocular complications including elevated intraocular pressure, glaucoma, poor mydriasis, zonular weakness, corneal endotheliopathy, higher rate of vitreous loss during cataract surgery, postoperative complications such as capsular phimosis, and opacification. However, in most cases PEX remains asymptomatic. Since increased ocular pressure is generally painless, patients may be unaware of the disease until the condition becomes advanced. In some cases the patient may complain of impaired visual acuity (VA) or changes in their visual field. Pseudoexfoliation syndrome becomes problematic when the granular flakes become enmeshed in trabecular meshwork and block normal drainage of aqueous humor resulting in a build-up of increased ocular pressure, loss of vision, and even damage of the optic nerve.

Data on the clinical profile and prevalence of PEX is important due to the fact that the world population is aging, and the proportion of elderly is increasing globally. Exfoliation syndrome occurs worldwide, although reported prevalence rates vary extensively.[1-6] Reasons for this variation reflect a combination of true differences in prevalence on the basis of racial, ethnic, the age and gender distribution of the patient cohort

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or population group examined; the clinical criteria used for making a diagnosis of exfoliation syndrome; the ability of the examiner to detect early stages and/or more subtle manifestations of the disorder; and the thoroughness of examination, or other as yet unknown reasons. In particular, many cases go undetected because of failure to dilate the pupil, or to examine the lens with the slit lamp after dilation, and because of a low index of suspicion on the part of the examiner. The primary aim of this study was to assess the prevalence of PEX and associated ophthalmic complications among Saudi patients.

Methods. Saudi patients visiting Primary Care Clinics of Prince Sultan Military Medical City (PSMMC), Riyadh, Kingdom of Saudi Arabia between January 2009 and January 2010 were recruited for this study. The ethical committee of PSMMC approved this research, and written consent was obtained from all the participants after explaining the protocol of the study. Consented patients were examined for the presence of PEX. Patients who suffered from ocular trauma, an active eye condition, or had undergone ocular surgery were excluded from this study.

After recruitment, all the patients were subjected to interviews, and initial evaluation by the ophthalmic assistant. The information collected included demographic data such as age, gender, educational level, occupation, lifestyle factors such as type of food preference, exposure to sun light, occupation, duration of TV watching, use of sunglasses, smoking habit, use of coffee/tea, physical exercise, sports/swimming and history of eye problems. All patients were examined by an ophthalmologist for identifying the presence of PEX material. The patients suspected to have PEX were enrolled for further detailed studies conducted by the investigators in the Ophthalmology Department at PSMMC. External eye examination was performed to detect the dismorphic features. The re-checking and confirmation of PEX syndrome by the ophthalmologist was performed by slit lamp examination of the anterior segment, which included flakes on the pupillary margin, iris transillumination defects, flare in the anterior chamber and corneal edema, measurement of intraocular pressure (IOP) with Goldman tonometer, evaluation of anterior chamber depth, gonioscopy to record angle depth of PEX flakes, and/or hyperpigmentation on the trabecular meshwork. Examination after dilation, which included range of pupillary dilation, flakes on the anterior lens capsule, posterior synechiae, lens opacity, phacodonesis, and lens subluxation. Bilaterality and symmetry as well as optic nerve head cupping was recorded by optical coherence tomography. Statistical analysis was performed using Fisher's exact test (CalcFisher software) and Chi-square test (Easy Chi-square Calculator).

Results. A total of 1967 subjects (956 males, 1011 females) were screened for the presence of PEX. Out of the total patients screened, 69 patients including 35 (3.7%) males and 34 (3.4%) females were found to have PEX. The difference in frequency of PEX in male and female is statistically not significant ($p>0.05$, Chi-square test). Pseudoexfoliation syndrome was observed bilaterally in 26 (37.7%) patients, and unilaterally in 43 (62.3%) patients including 29 (67.4%) in the right eye, and 14 (32.6%) in the left eye. Among the bilateral PEX patients, symmetrical PEX was observed in 11 (42.3%) patients, and asymmetrical in 15 (57.7%) patients. The age distribution of the patients screened for the presence of PEX syndrome is shown in **Table 1**. The highest number of the patients screened (958) was in the age group of 50-60 years followed by 676 of <50 years, 269 of 61-70 years, 49 of 71-80 years, and 8 of 81-100 years. The prevalence of PEX increased with progressing of age. In this study, no significant relation was noticed between education level, occupation and life style of the patients and prevalence of PEX. The visual acuity without glasses and frequency of PEX are shown in **Table 2**. The prevalence of PEX increased with the decrease in visual acuity. The prevalence was highest in patients with VA of 6/30 followed by VA of 6/24, 6/12, and 6/6. The detailed analysis of PEX material distribution showed variation in the nature, extent, and location of pseudoexfoliation material in different patients. The frequency of factors associated with PEX are summarized in **Table 3**. Twenty-six percent of patients were found to have cataract. Forty-five percent of PEX positive patients were found to have high IOP. Flakes on the iris margin were found in 62.3% of the

Table 1 - Age specific prevalence of PEX syndrome in screened patients.

Age group	Total number of patients screened	Number of PEX positive patients	Frequency of PEX (%)*
<50 years	678	5	(0.7)
50 - 60 years	960	34	(3.5)
61 - 70 years	270	22	(8.15)
71 - 80 years	50	6	(12.0)
81 - 100 years	9	2	(22.2)

*Fisher exact test, $p<0.01$, when comparing the frequency in one age group with another, PEX - pseudoexfoliation syndrome

Table 2 - Association of the level of visual acuity without glasses and prevalence of pseudoexfoliation (PEX) syndrome.

Visual acuity	Frequency of PEX (%)
6/6	(2.3)
6/12	(3.2)
6/24	(5.6)
6/30	(9.0)

Table 3 - Factors associated with pseudoexfoliation (PEX) syndrome.

Factors	PEX patients (%)
High intraocular pressure	(45.0)
Cataract	(26.0)
Flakes on the iris margin	(62.3)
Poor pupil dilatation	(43.0)
Flakes on trabecular meshwork	(56.5)
Bilateral disease	(37.7)
Occludable angles	(9.5)

PEX patients whereas it was observed on trabecular meshwork in 56.5% of PEX patients. However, flakes like materials was also observed on pupil margin in 11 of the 1871 (0.59%) non-PEX subjects. Poor pupil dilation was observed more in the PEX positive patients than the PEX negative patients.

The results of the examination of the eyes by gonioscopy showed an open angle in 80% of patients, and occludable angle in 9.5% of patients. A closed angle was observed in the 11.5 cases. Trabecular hyperpigmentation was observed in the right eye of 27 (58.7%) patients, and in the left eye of 26 (55.3%) patients. Pseudoexfoliation syndrome material in the angle was observed the right eye in 11 (23.9%) patients, and the left eye in 7 (14.9%) patients. High IOP was observed in 45% of PEX positive cases.

Moderate anterior chamber depth was observed in the right eye of 7.35%, and the left eye of 10.1% of PEX positive patients. Deep anterior chamber depth was observed in the right eye of 63 (92.65%), and left eye of 62 (89.9%) patients positive for PEX syndrome. Moderate anterior chamber depth was observed in 0.3% of PEX negative subjects, and a deep anterior chamber depth was observed in the remaining 99.7% of PEX negative subjects. A strong and significant association of anterior chamber depth and PEX syndrome was observed (Fisher Exact test, $p<0.0001$).

Discussion. The prevalence of PEX among the Saudi patients visiting Primary Care Clinics of PSMMC Riyadh was found to be 3.5%. Our findings are significantly lower as compared with earlier reports on a Saudi population (9.3%) by Summanen and Tonjum.[7] Available data on epidemiology of PEX from neighboring middle eastern countries including Yemen and Jordan are also quite inconsistent.[8,9]

Besides significant variation in the prevalence of PEX in different parts of the world with an occurrence of 0% in Eskimos, 1.8% in the United States, 5-25% in the Scandinavian countries, and 38% in Navajo Indians. A highly significant variation in the prevalence of PEX within the same country or places at close geographical location has been reported by several investigators. Nearly 5 fold difference in the prevalence of PEX was found in 2 nearby cities: Brest (20.6%) and Toulon (3.6%) in France. The prevalence of 10.2%, 19.6%, and 21% in 3 closely situated municipalities in central Norway was reported. The reason for the vast variation in the prevalence of PEX in distant areas as well as within close vicinity is far from clear. Exposure to sunlight (ultraviolet radiation) may or may not be implicated, as may the dietary factors.[2] Persons living at higher altitude have greater prevalence in 2 series, but not in a third. In one series, PEX was more common in the eyes with blue irides than in eyes with brown iride. Another study found no association between prevalence of PEX and color of eyes.[10]

Assuming the similar genetic/racial makeup and identical geographical location, the variation in prevalence rates may be explained on the basis of difference in clinical criteria for diagnosis of PEX, assessment techniques, study design, sampling methods, or population size. The reported prevalence rate of PEX in a country can vary 3 folds or more depending upon examiner. Moreover many cases of PEX may remain undetected due the failure to dilate the pupil required for examination by slit lamp. A high percentage (60-80%) of missed cases of PEX have been reported even from the advanced ophthalmology centers.[10]

The results of this study show only 0.7% of PEX in Saudis below the age of 50 years (**Table 1**). The frequency of PEX age dependently increased to 22.2% in the subjects above the age of 80 years. Our results are in agreement with an earlier study on a Saudi population,[7] and neighboring Yemen[11] who also observed a similar increasing pattern of PEX with aging. The results of this study are comparable to a large number of previously published reports from other parts of the world suggesting that persons younger than 50 years of age are highly unlikely to have PEX where as prevalence gradually increases with the advancement of age.[1-3,5,8,10] Contrary to these reports, a prevalence of 6.4% PEX in

the 30-39 years old age group was observed in the South African Bantu Tribe. Other groups with early onset of PEX include Skolt Lapps, Icelanders at Husquik, and Australian aborigines, where the youngest reported PEX patient was 22 years of age.[2,10]

In this study, the prevalence of PEX among males was 3.7% as compared to 3.4% in females (with a male to female ratio of 1.1:1). Moreno et al[12] also reported equal frequency of PEX among men and women in a Spanish population. However, there are conflicting reports concerning PEX prevalence in men and women. Women have predominated in some series of exfoliation syndrome. In India, the male to female ratio of PEX sufferer was found to be 1:1.27.[13] Contrary to this exfoliation syndrome was more common in men in populations including Yugoslavs, Australian aborigines, Peruvian Indians, Asian Indians, and Turkish. In China, PEX is rare with 0.4% prevalence in males with no cases in females. In Nepal the prevalence of PEX among males was more than 4 times higher as compared with females.[14] Although the exact mechanism of higher prevalence of PEX in males is not clear, it has been attributed to the fact that men are exposed longer to the provoking climatic conditions.

There was a direct association between poor vision and frequency of PEX in Saudis (**Table 2**) as 43% of PEX positive patients had poor vision. Visual impairment due to PEX has been reported by several investigators,[3] which may be attributed to several possible mechanisms. Pericellular accumulating PEX material disrupts and destroys the basement membrane and the cells involved. The cell-matrix interaction may adversely affect the cells leading to cellular dysfunction and eventually cell degeneration known as degenerative fibrillopathy. In some cases of PEX, the patient may complain of impaired visual acuity or changes in their perceived visual field. This visual problem occurs when the granular flakes become enmeshed in trabecular mesh work and block normal drainage of aqueous humor leading to increased intraocular pressure and loss of vision. Pseudoexfoliation syndrome is also known to weaken ciliary muscle and adversely affect lens zonules. Rubbing off PEX material from the lens may result in loss of iris pigment, which can lead to transillumination defects. Poor pupillary response to dilatation is a subtle finding in PEX patients, which may adversely affect vision.

The results of this study showed an increase in IOP in 45% of PEX patients (**Table 3**). A close association between increased IOP and PEX has been reported by numerous investigators.[15] The mechanism by which PEX leads to the increase in ocular pressure is far from clear. It has been suggested that a build up of PEX material/protein clumps may block normal drainage of eye fluid/aqueous humor, which in turn results in buildup of pressure. An increase in IOP may also lead to glaucoma and loss of vision.

Twenty-six percent of the patients in this study were found to have cataract (**Table 3**). Pseudoexfoliation syndrome is a known risk factor for developing cataract. Several investigators have reported complicating factors such as poor mydriasis, zonular weakness, corneal endothelial dysfunction, high rate of vitreous loss, capsular phimosis, and opacification in PEX patients undergoing cataract surgery. The mechanism by which PEX material facilitates cataract is not clear. An increased hypoxia in the anterior chamber of PEX patient induces proliferation of lens epithelium and can cause cataract formation. The poor pupillary dilation in PEX patient has also been attributed to the degenerative changes in the stromal tissue, and atrophy of the muscular layer of the iris. Histopathologic examination of lenses after cataract extraction supports the idea that exfoliation syndrome is under diagnosed. Patients with exfoliation syndrome are much more prone to have complications at the time of cataract extraction than are patients without exfoliation syndrome. Patients with exfoliation syndrome dilate less well, and there are greater incidences of capsular rupture and vitreous loss. Pupil size may be the most important risk factor for vitreous loss. Zonular damage accounts for much of the increased complication rate. Zonular fragility increases the risk of lens dislocation or zonular dialysis up to 10 times.

In conclusion, our study confirmed that PEX is an age-related disorder, and the prevalence increases with age. The prevalence of PEX in the studied Saudi population was 3.5% with no significant difference between male and female. Pseudoexfoliation syndrome is associated with higher IOP, incidence of cataract, and poor vision. Further population based longitudinal studies are warranted to assess the prevalence of PEX and associated risk factors.

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