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Ultrasonographic assessment of vitreoretinal pathologies in white mature cataract

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ABSTRACT

Background: To evaluate the incidence of significant posterior segment abnormalities in eyes with white mature cataract and to assess association of vitreoretinal pathologies with different ocular and systemic disorders.

Materials and Methods: This cross-sectional study was conducted on 100 patients with white mature cataract presenting for cataract surgery. Detailed relevant history was noted. Complete ocular examination done and B-scan performed. Percentage of patients with abnormal B-scan findings in various groups were calculated and association of systemic/ ocular factors with vitreoretinal pathologies were evaluated using paired chi square test.

Result: Mean age of patients was 60.78±9.001 years with a female preponderance (58%). 92% cases had senile mature cataract, 3% were presenile, 3% were traumatic and 2% were complicated mature cataract. Most common pathological finding on B-scan was vitreous opacity seen in 16% cases, followed by posterior vitreous detachment seen in 6%. Vitreous hemorrhage was seen in 3% cases while 69% cases showed normal posterior segment. Patients were grouped into two categories- one comprised patients with relevant systemic and/ or ocular history (47%), while other category belonged to patients with no such history (53%). On comparing the number of patients with abnormal B-scan findings in the two categories, no statistical significance was noted. (p value=0.105).

Conclusion: B-scan ultrasonography is an important presurgical investigation in patients with dense cataracts for diagnosing posterior segment pathologies that may influence post operative visual outcome.

1. Introduction

Blindness due to cataract is one of the major public health concerns of the century accounting for approximately half (47.8%) of all cases of blindness worldwide.[1] In developing countries like India (particularly rural India), the patients with cataract usually present late for cataract surgery when the lens already becomes dense/hard in consistency obscuring details of posterior segment.[2–4] A white mature cataract is such advanced form of cataract where the lens become so opaque that the red fundus reflex is totally obscured. (Figure 1) Due to this, such cases posses higher risk of surgical challenges and complications. Moreover, the previous studies had reported the incidence of posterior segment pathologies in eyes with advanced cataract to vary from 19.6% to 66%.[5] Hence, visualization of posterior segment for presence of any pathology is utmost important for the surgeon to plan the surgery and to provide justifiable prognosis for vision after cataract surgery. Under such circumstances

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ultrasonographic examination plays a vital role because unlike other imaging modalities (for example: optical coherence tomography) that utilizes light waves which cannot penetrate through opaque media, this technique utilizes ultrasonic waves that can penetrate through opaque media. Higher proportion of fluid constituents of the eye and the advent of high frequency ultrasound probes makes USG ideal for imaging the eye.[6] B-scan (Brightness scan) ultrasonography is a non-invasive, efficient, reliable and inexpensive diagnostic technique, devoid of ionizing radiation and has a good spatial resolution.[7] It could also be performed at the patient's bedside for evaluation of ocular pathology**.**Also, previous studies by Anteby et al,[8] Salman et al,[9] Faheem sheikh et al[10] etc. reported higher incidence of posterior segment pathologies associated with certain systemic and ocular conditions. Thus, the present study is aimed to evaluate the proportion of significant posterior segment abnormalities in eyes with white mature cataract prior to cataract surgery and to evaluate whether the presence of certain systemic and ocular factors are correlated with a greater incidence of abnormalities on ultrasonography, which would allow surgeons in assessing the visual prognosis after cataract surgery.

2. Materials and Methods

After approval from the institutional ethical committee (IEC) and in accordance to the health Helsinki law, this observational cross sectional study was conducted on 100 eyes of patients presenting to eye OPD with white mature cataract over a period of one year.

2.1. Inclusion criteria

Patients > 40 years of age presenting to us with white mature cataract for surgery.

2.2. Exclusion criteria

1. Congential or developmental cataracts
2. Hypermature cataracts
3. Morgagnian cataracts
4. Cataracts with open globe injuries

Informed written consent was taken from all the patients willing to participate in the study. A detailed history was recorded to know the course of the disease and systemic associations, if any. Complete ocular examination was carried out including visual acuity in both eyes, IOP (intraocular pressure), anterior segment details by slit-lamp microscope. B-scan was performed to visualize any posterior segment pathology. A real time high frequency probe placed in contact with the eye through closed lids in supine position. This is called contact scan. Ultrasound coupling gel was placed on the closed lid and the B-scan probe was moved to different positions while Patients are asked to move their eyes swiftly to either side, for kinetic scanning of globe. The mobility of lesions, it's after movements & its attachment were evaluated by this technique. The ocular pathologies were evaluated in respect to location, size, shape and reflectivity**.** Transverse, longitudinal and axial scan images were obtained for all eyes in order to assess the globe completely. Findings were tabulated in detail and percentage of patients with some or the other B-scan findings in various groups were calculated. Finally, a paired chi square test was applied to check for the significance between two groups.

3. Results

Total 100 eyes with white mature cataract that presented to eye OPD for cataract surgery were taken in our study. Table 1 represents that mean age of patients with white mature cataract in present study was 60.78±9.001 years ranging from 42 to 83 years. The mean preoperative IOP measured by Applanation tonometry in our study was 16.80±2.3 (mmHg), ranging from 13 to 24mmHg.

58 Patients with white mature cataract in our study were females and 42 were males.

Table 2 number 2 depicts that out of all cases, the cause for mature cataract in 92% cases was senility. 3% cases developed mature cataract post trauma and 2% cases had complicated mature cataract. B-scan abnormalities of various types were noted in all the 3 cases (100%) of traumatic cataract and 1 case (50%) of complicated cataract following uveitis. Out of the senile mature cataract group, 27 cases (26.08%) had B-scan abnormalities. There were 3 patients in presenile cataract group, out of which 2 patients were diabetic and 1 patient had Eale's disease. In all 3 cases of presenile cataracts B-scan abnormalities were noted.

Table 3 shows the incidence of various posterior segment pathologies detected in our study population on B-scan imaging. The most common pathological finding was vitreous opacity seen in 16% cases, followed by posterior vitreous detachment seen in 6%. Vitreous hemorrhage was seen in 3% cases. Posterior staphyloma (Figure 2) and retinal detachment (Figure 3) seen in 2% cases each. None of the cases showed choroidal coloboma or detachment. Significant optic disc cupping was noted in 1 case (1%). 69% cases showed normal posterior segment on B-scan.

On assessing the incidence of abnormal B-scan findings in patients with underlying systemic conditions, following observations were made which are tabulated inTable 4. Amongst the systemic risk factors in our study population, maximum patients were found to be hypertensive (20%) out of which 4 cases (20%) showed some abnormality in B-scan. 16% patients had diabetes mellitus of which 4 cases (25%) had some B-scan abnormalities. Another 3 patients (3%) presented with history of bronchial asthma and all of them (100%) showed some abnormalities on B-scan. The type of abnormal finding noted on B-scan in each group

Table 1: Characteristics of the study population

Feature	Minimum	Maximum	Mean ± SD
Age	42 years	83 years	60.78±9.001 years
Intraocular pressure	13 mmHg	24 mmHg	16.80±2.3 mmHg

Table 2: Distribution of type of cataract

Type of mature cataract	Number of eyes	Number of eyes with B-scan abnormalities
Senile mature	92	24 (26.08%)
Traumatic mature	3	3 (100%)
Complicated mature	2	1 (50%)
Presenile mature cataract (<0 years)	3	3 (100%)

Table 3: Incidence of posterior segment abnormalities detected on preoperative B-scan

Abnormal findings on Bscan	Number of eyes (n=100)	Percentage
Vitreous opacity	16	16%
Posterior vitreous detachment	6	6%
Vitreous hemorrhage	3	3%
Posterior staphyloma	2	2%
Retinal detachment	2	2%
Glaucomatous optic atrophy	1	1%
Normal B-scan	69	69%

Table 4: Associated systemic factors and incidence of abnormal B-scan

Systemic risk factors	Total Number of patients with risk factors	Findings of Patients with abnormal B-scan	Total patients with abnormal B-scan	Percentage
Diabetes mellitus	16	1 Vitreous haemorrhage 1 Retinal detachment 2 Posterior vitreous detachment	4	25%
Hypertension	20	1 Vitreous haemorrhage 1 Glaucomatous optic atrophy 2 Posterior vitreous detachment	4	20%
Bronchial Asthma	3	1 PVD with Posterior Staphyloma 2 Vitreous opacities	3	100%
Nil	58	1 PVD with Post. Staphyloma 5 Vitreous opacities	6	10.34%

Table 5: Associated ocular findings and incidence of abnormal USG

Ocular findings	Number of patients with risk factors	Number of patients with abnormal B-scan	Percentage
Exotropia	6	2	33.33%
Esotropia	1	1	100%
Corneal scar	2	2	100%
Posterior synechiae	2	1	50%
Subluxated lens	1	1	100%
Elevated IOP	3	1	33.33%
Inaccurate projection of rays	2	2	100%

Table 6: Prevalence of B-scan abnormalities in patients with relevant history (systemic or ocular) and patients without relevant history

Groups	Number of patients with abnormal B-scan findings	Percentage	p-value
Total number of patients with relevant systemic/ocular history (n=47)	18	38.29%	0.105 (not significant)
Total number of patients without any relevant history (n=53)	10	18.86%	

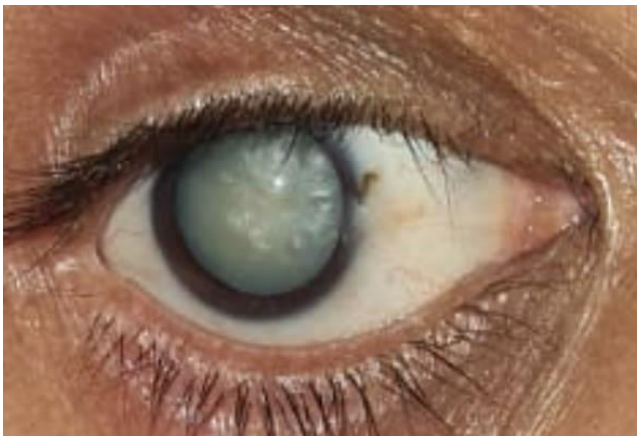

Fig. 1: White mature cataract (OD)

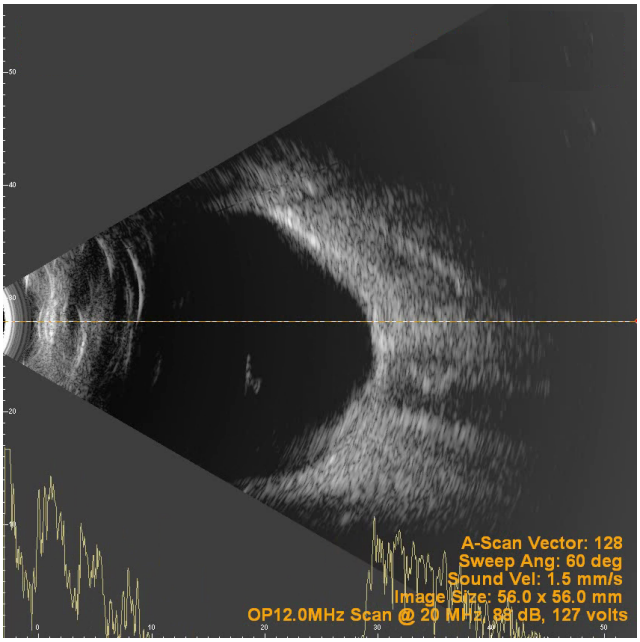

Fig. 2: Axial B-scan showing excavation of retina at posterior pole suggestive of posterior staphyloma involving optic nerve head

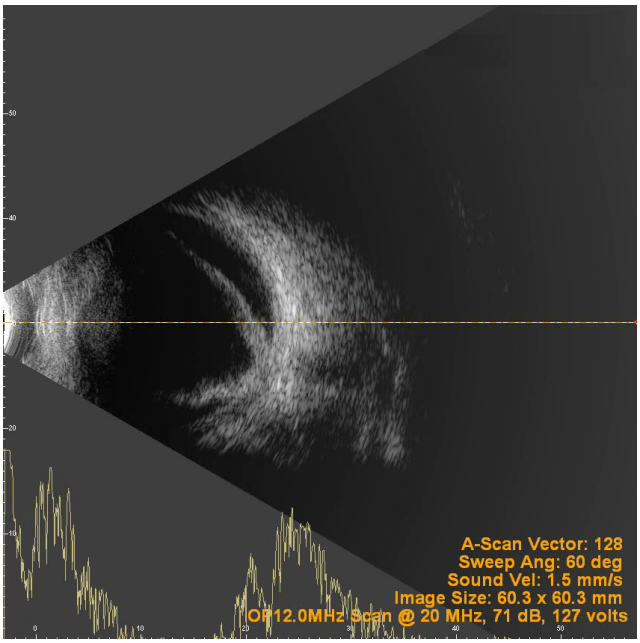

Fig. 3: Longitudinal B-scan showing thick echogenic membrane corresponding to high amplitude attached at optic disc (sign of retinal detachment)

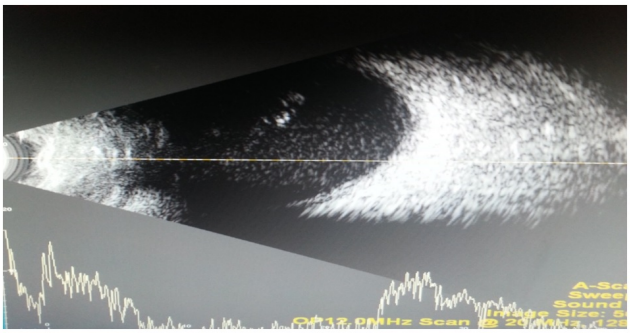

Fig. 4: B-scan of left eye of a young 42 years old male with mature cataract and untreated hypertension. This transverse section showed low to mid intensity dot echoes (<50% amplitude) in mid vitreous, suggestive of unorganized vitreous haemorrhage, raising suspicion of Eale's disease which was confirmed by a positive Mantoux test

is highlighted along with the number of cases in which it was found in the table below. For example; out of the 4 cases of diabetes mellitus that had some abnormal B-scan findings, 1 patient had vitreous hemorrhage, 1 patient had retinal detachment and 2 patients had posterior vitreous detachment.

There were 58 patients (58%) that did not have any known systemic comorbidity. Out of these, 6 cases (10.34%) were noted to have some abnormality on B-scan imaging.

The Table 5 shown below represents association of ocular findings with posterior segment abnormalities. Total 6 patients were found to have exotropia of various grades out of which only 2 (33.33%) had posterior segment abnormalities noted as posterior vitreous detachment. Similarly, intraocular pressure was found to be raised preoperatively in 3 cases, out of which 1 (33.33%) had significant optic disc cupping (Glaucomatous optic disc) that was perceived on B-scan. 2 cases of complicated mature cataract presented with posterior synechiae when viewed on slit lamp. Out of this, only 1 case (50%) showed posterior segment B-scan finding in the form of vitreous opacity. 1 case each of esotropia and subluxated lens were noted that showed posterior segment abnormalities also (100%). Similarly, 2 cases each of corneal scar and inaccurate projection of rays were noted where all 4 of them showed some finding on B-scan. (100%).

All patients were finally grouped into two categories- one category comprised of patients with relevant systemic history (that included diabetes, hypertension, bronchial asthma and those who developed cataract in <50 years of age) and/ or relevant ocular history (those with traumatic cataract or complicated cataract), while other category belonged to patients with no such history. As shown in Table 6, total number of patients with relevant history were 47 out of which 18 patients (38.29%) showed some abnormalities on B-scan. There were 53 patients without any relevant systemic or ocular history, out of which 10 patients (18.86.%) showed some B-scan abnormalities. On comparing the number of patients with B-scan findings in the two groups, no statistical significance was found. (p value=0.105)

4. Discussion

In many developing countries like India, cataract is one of the most important cause of reversible blindness but due to lack of awareness and resources, many patients presents late with more advanced stages of cataract (like mature cataract) that precludes visualization of posterior segment prior to cataract surgery.[1] Such visualization is considered important to provide accurate prognosis for vision after cataract surgery. Under such circumstances ultrasonographic examination through a B-scan can provide important information regarding any posterior segment abnormality.[5,6]

In the present cross-sectional study, which was conducted on 100 eyes of patients presenting with white mature cataract for surgery, our aim was to assess proportion of patients with hidden posterior segment abnormalities and to find its association with certain systemic and ocular risk factors using B-scan findings. Age range of patients in this study was 42 to 83 years. Mean age was 60.78±9.001 years and majority of the patients with white mature cataract in our study were females (58%) than males (42%). Our demographic findings were consistent with other studies in literature. In a study by Chakrabarty et al.,[11] the maximum cases of bilateral mature cataract were above 60 years of age with mean age 68.45±7.4 years with female preponderance. Another Indian study reflected the fact that prevalence of advanced cataracts increases with age and was higher in women.[6] Higher incidence of senile mature cataract in females can be due to multiple factors like inadequate nutrition, attitudinal barriers like "able to manage daily work", "fear of surgery" and "no accompanying person", confinement to household work which mostly require near vision and cultural insensitivity to a female's health needs, were also more commonly seen with females.[12]

Out of all our 100 cases, the cause for mature cataract in 95% cases was senility. 3% cases developed mature cataract post trauma (Traumatic cataract) and 2% cases had complicated mature cataract. Our study is unique because none of the studies in literature were found that focused only on white mature cataract cases in context of our interest. Also, none of them divided cataract cases on the basis of etiology as shown in our study. Most the studies related to our subject focused on all forms of advance cataracts and thereby divided the cases as mature cataract, hypermature cataract and higher grades of nuclear sclerosis. Our study showed that B-scan abnormalities of various types were seen in all the 3 cases (100%) of traumatic cataract and 1 case (50%) of complicated cataract outlining the higher incidence of posterior segment abnormalities in cases of cataract with trauma and associated ocular pathologies. The study by Anteby et al also reported that the prevalence of posterior segment pathologies was slightly higher in patients with a history of ocular trauma compared with the nontraumatic cataract group (29.6% versus 19.0% respectively).[8]

Our study showed that of the 100 eyes with white mature cataract, 31 eyes (31%) were found to have some ultrasonically detectable posterior segment pathologies. The incidence noted by Amjad Salman et al[13](8.4%) and Rehman H[14] showed that 11% of the patients of senile age group were found to have significant posterior segment pathologies. The values of ultrasonically detectable posterior segment pathologies in our study (31%) falls between the incidence reported in the study by Anteby et al[8] (19.6%) and that in the study by Haile and Mengistu[15] (66%). However, the latter study included cases with orbital

pathology and clear media (10%).

A study by Zafar Dawood et al[16] recorded most common posterior segment pathology in cataract patients to be vitreous opacity (8.8%). Similarly, the most common pathological finding on B-scan in our study group was vitreous opacity seen in 16% cases, followed by posterior vitreous detachment seen in 6% which was more than that reported by Jatin Garg[17] (4.43%) and M. Qureshi[18] (2%) in their studies.

Vitreous hemorrhage affecting 3 (3%) eyes was third most common finding in our study. Of these, one patient was 42 year old male with history of hypertension who had vitreous hemorrhage (with membranes) in both eyes and was suspected to be a case of Eales disease which was confirmed postoperatively, one patient was diabetic, and other one had history of ocular trauma. Anteby and colleagues[8] reported 2.5% cases of vitreous hemorrhage while Salman et al[13]reported only 1% of patients with vitreous haemorrhage in their study.

Posterior staphyloma was noted in 2 eyes (2%) eyes. Both eyes were associated with high myopia, posterior vitreous detachment and postoperative poor visual outcome. Our findings were similar to that of Salman et al[13] who reported 2% eyes with posterior staphyloma. Whereas, it was much less than that reported by Anteby et al[8] (7.2%).

Retinal detachment was seen in 2 (2%) eyes in which one had history of ocular trauma and was associated with vitreous haemorrhage and other one was diabetic. Anteby[8] and colleagues documented retinal detachment in 4.5%, which is more than our study. While Salman et al[13] reported (0.7%) cases of retinal detachment, one of them has been associated with vitreous hemorrhage. Meenakshi V et al.[19] and Jain A et al.[20] have also reported prevalence to be 3% and 2.5% respectively of RD which was close to our outcome.

The preoperative evaluation of various parameters are crucial before cataract surgery. One such parameter is intraocular pressure. The mean IOP in our study was found to be 16.80±2.3 mmHg, ranging between 13 to 24mmhg. Raised IOP can be an indicator of various posterior segment abnormalities like Vitreous hemorrhage, Glaucomatous optic nerve injury or atrophy etc., which in turn can grossly affect the post surgical visual outcome. One such patient (1%) with raised IOP showed Optic disc cupping. Salman et al[13] reported optic disc cupping in 1.4% cases in their study. Darnley-Fisch DA et al[21] have also found ultrasonography to be useful in providing a reliable estimate of cupping in eyes with opaque media.

While other studies also reported cases of chorioretinal coloboma, none of the cases in our study showed this finding.

We further studied whether certain systemic and ocular features could be used as predictors for associated posterior segment pathological findings on ultrasonography and found that among the significant systemic risk factors identified prior to surgery, diabetes mellitus was present in 16 (16%), hypertension in 20 (20%) and bronchial asthma in 3 (3%) cases. Another 3 (3%) cases were in presenile age group. We considered age limit for presenile cataract as < 50 years in our study based on study of Tsai CK et al.[22]

Salman et al[13] recorded significant association of diabetes (Odds ratio= 4.9, P= 0.003) and younger age group cataracts (Odds ratio= 15.4, P=0.001) with posterior segment abnormalities. Study by Faheem Sheikh et al[10] also shows significant association of young age (<50 years) and diabetes mellitus with posterior segment pathology on ultrasonography and association was insignificant with that of hypertension. Our study showed that, 4 cases (20%) out of 20 hypertensives had abnormal posterior segment findings, out of which 1 case was diagnosed as Eales disease, 1 patient had glaucomatous optic atrophy and 2 had posterior vitreous detachment. Out of total 16 diabetics in our study, 4 cases (25%) showed abnormal posterior segment findings, of which one had vitreous hemorrhage, 1 had retinal detachment and 2 patients had posterior vitreous detachment.

58 patients (58%) had no apparent systemic risk factors, yet, 6 patients (10.34%) showed some abnormality in posterior segment.

While focusing on ocular risk factors among eyes and its association with posterior segment pathology, it was observed that ocular findings like corneal scar, esotropia, subluxated lens, posterior synechiae and patients with inaccurate projection of rays were associated with very higher incidence of posterior segment pathologies. Contrary to our study, Salman et al[13] and Faheem sheikh et al[10] had showed significant association of posterior segment pathologies with ocular risk factors as posterior synechiae, keratic precipitates, inaccurate projection of rays, iris coloboma and association was insignificant with subluxated lens, exotropia, esotropia, ocular hypotony, corneal opacity in their studies.

Finally, all patients were grouped into two categories based on history- one category comprised of patients with relevant systemic history (that included diabetes, hypertension, bronchial asthma and those who developed cataract in <50 years of age) and/ or relevant ocular history (those with traumatic cataract or complicated cataract), while other category belonged to patients with no such history. On comparing the number of patients with B scan findings in the two groups (Table 6), it was found that the p value was statistically insignificant (p value> 0.05) which means that though the patients with relevant history have higher incidence of posterior segment pathologies but the patients without any relevant history may also have posterior segment abnormalities of various types and history should not be the deciding factor for whether a B-scan is to be done or not in patients with media opacities. Ali and Rehman

reported posterior segment lesions in 11% non traumatic cataract patients and in 65.85% patients with traumatic cataract.[23] The study by Anteby et al.[8] reported that the prevalence of posterior segment pathologies was slightly higher in patients with a history of ocular trauma, compared with the non traumatic cataract group (29.6% versus 19.0% respectively).

In a study by Salman et al,[13] 10.6% cases didn't achieved adequate visual acuity even after cataract surgery. Out of these 10.6% cases, 80.95% cases had poor visual outcome owing to pre existing posterior segment pathology. In such cases, the B-scan results can be used by surgeons for preoperative prognostication and effective counselling of patients, which in turn can help in reducing patient dissatisfaction post surgery.[24]

Thus, considering the high accuracy of prediction of posterior segment pathologies in opaque media, B-scan ultrasonography of eye is an important tool in ophthalmologist's diagnostic armamentarium especially with cases of opaque ocular media. Also, it is advantageous due to its high resolution and sensitivity, low cost, less time consumption and no radiation exposure and no risk of infection.

5. Conclusion

Posterior segment abnormalities are present in a significant proportion of population with white mature cataract and presence of certain systemic and ocular factors are associated with a high incidence of posterior segment abnormalities but a large proportion of patients without any relevant history may also have posterior segment abnormalities of various types and history should not be the deciding factor for whether a B-scan is to be done or not in patients with media opacities. Thus, ocular ultrasonographic evaluation via B-scan is an important pre surgical investigation in patients with cataracts to diagnose pathologies of posterior segment that may impact the visual outcome of patients after cataract surgery.

6. Source of Funding

None.

7. Conflict of Interest

None.

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