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Original Research Article

To determine the role of Anterior segment optical coherence topography (AS-OCT) pre- operatively to detect pre-existing weakness of the posterior capsule in patient of posterior polar cataract (PPC) effecting outcomes during phacoemulsification

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ABSTRACT

Aim/Purpose: To determine the role of anterior segment optical coherence topography (AS-OCT) pre-operatively to detect pre-existing weakness of the posterior capsule in patient of posterior polar cataract (PPC) effecting outcomes during phacoemulsification.
Materials and Methods: A prospective observational study was done in 26 eyes with clinically diagnosed PPC who underwent phacoemulsification between November 2018 to December 2019. AS-OCT was done preoperatively to detect pre existing dehiscence of posterior capsule in patient of PPC. The images obtained by AS-OCT were divided into either intact or dehiscent. Integrity of posterior capsule was also observed during operation by surgeon.
Results: In 26 eyes, dehiscence of posterior capsule was detected in 4 eyes (15.4%) by AS-OCT pre operatively, of posterior capsule in 3 eyes (11.5%) and intact posterior capsule in 23 eyes (88.5%). Rupture of posterior capsule occurred in 4 eyes during phacoemulsification. 3 out of 4 eyes who had rupture, had dehiscence of posterior capsule that was noted by AS-OCT and also intraoperatively while 1 eye was detected to have intact posterior capsule. The sensitivity of AS-OCT was 75% for detecting posterior capsule dehiscence and specificity was 95.65%.
Conclusion: AS-OCT can be used preoperatively to identify posterior polar cataract that are at risk of posterior capsule rupture. This provides preoperative information to surgeon and helps in proper counselling of patients about the prognosis.

1. Introduction

Posterior polar cataract is one of the important morphologies of various types of lens opacities. A posterior polar cataract is a rare form of congenital cataract with incidence ranging from 3 to 5 in 1000.[1–3] It was found to be bilateral in 65 -80% of cases.[4,5] Posterior polar cataract is a round, discoid & opaque mass consisting of malformed and distorted lens fibres located in the central posterior part of the lens. It is seen as a dense discoid opacity. Degenerated lens fibres make up the central fibrous mass, which is surrounded by several small globular vacuoles containing a refractile substance and some degenerative lens fibres material. Posterior polar opacity is sharply

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defined as an oval or round lens opacity situated posteriorly adjacent to the posterior capsule. It is most significant features as its location, proximity to posterior capsule & possible adherence with posterior capsule. Also, the posterior capsule itself may be weakened. Posterior polar cataract removal is a challenge to the surgeon because of its adherence to the posterior capsule or the associated weakness of the posterior capsule. Hence, posterior polar cataract surgery is associated with an increased incidence of rupture of the posterior capsule. Posterior capsule rupture can occur any time during hydro-dissection during phacoemulsification. Incidence of posterior capsular rupture ranges from 7.1% to 36%[1,4–6] in patients with posterior polar cataract. Different surgical strategies (capsulorrhexis), oval or circular, hydro delineation, prolapse of nucleus in anterior chamber), are described for the handling of this challenging entity, most of which emphasized the need for gentle maneuvering in dealing with these.

Anterior Segment Optical Coherence Tomography (AS-OCT) is an imaging technology for visualization of the anterior segment. It uses a super luminescent diode to generate a scan with axial resolution up to 18 microns, based on low coherence interoferometry. It has been used to evaluate the corneal thickness and anterior chamber angle, perform anterior segment biometry and evaluate lens density. Posterior polar cataracts also can be identified by Anterior Segment Optical Coherence Tomography (AS-OCT). The application of Anterior Segment Optical Coherence Tomography (AS-OCT DRI OCT TRITON VER 10.13) in posterior polar cataract is to find out the cases at high risk for posterior capsular rupture during phacoemulsification. Swept-source OCT with its extremely fast scanning speed and longer 1050 nm wavelength results in stunningly clear detailed images even into the deepest layers of the eye. With its short acquisition time, we can not only see the retina and vitreous but can also evaluate the anterior segment of eye like cornea, anterior chamber, iris & anterior and posterior capsule of lens. Due to optimized and invisible scanning light, Swept- source OCT is a major advancement over conventional OCT. Also, there is better detection of deep layers in the eye. Furthermore, this light also penetrates better through cataract, hemorrhage, blood vessels and sclera.

Images are of two types based on the integrity of posterior capsule: Type 1- in which an intact capsular margin was traced behind the posterior polar cataract without any defect and Type 2- dehiscent if the capsular margin could not be traced under the posterior polar cataract then discontinuity or any defect is present in the posterior capsule. By doing AS-OCT, we can detect posterior capsular defect pre-operatively, in the case of posterior polar cataract. We can adopt techniques like doing hydro delineation instead of hydro dissection, avoiding nuclear rotation and aggressive nuclear cracking techniques with wide separation of fragments, by changing phacoemulsification parameters (slow motion phacoemulsification with low parameters), irrigation and aspiration techniques. Thereby, we can reduce the incidence of posterior capsule rupture. Specifically, we anticipate that the incidence of posterior capsule rupture will be reduced dramatically if a defect is diagnosed pre-operatively. That is why we intended to conduct the study.

We studied role of Anterior Segment Optical Coherence Tomography (AS-OCT) preoperatively to detect pre-existing weakness of posterior capsule in patients of posterior polar cataract affecting outcomes during phacoemulsification".

2. Materials and Methods

The study was carried out at the Regional Institute of Ophthalmology, Prayagraj after obtaining ethical clearance from the ethical committee of M.L.N. Medical College, Prayagraj. As per hospital protocol, written informed consent was obtained from all patients. We included patients above 25 years of age of both genders and diagnosed with posterior polar cataract only or posterior polar cataract with nuclear sclerosis grade 1or grade 2 and pupillary dilatation greater or equal to 7 mm. Patients with posterior sub capsular or cortical cataract, history of significant ocular trauma, pseudo exfoliation syndrome, shallow anterior chamber, pre-existing corneal or retinal pathology were excluded from the study.

A total 26 patients met the inclusion criteria. In a detailed history, age of presentation, treatment history detailed antenatal and post natal history specially of any drug intake, x-ray exposure or febrile illness, during antenatal period was taken along with medical history of any systemic disease. Pre-operatively, all the subjects underwent general and ophthalmic evaluation and pre-operative workup for cataract surgery, which were included. General examination and required investigation: routine eye examination, Snellen's visual acuity unaided, best corrected visual acuity (BCVA), intraocular pressure (IOP), slit lamp examination (Topcon SL-D7). Anterior segment optical coherence tomography imaging (DRI OCT Triton Ver.10.13) was performed. Fundus examination was done after dilatating the pupil with tropicamide 1% eye drops with +78D/+90D lens by slit lamp biomicroscopy following which direct and indirect ophthalmoscopy was done. Keratometry was performed and IOL power was calculated using SRK-T formula. Phacoemulsification surgery were performed in all eyes by same surgeon of the institute Anterior Segment Optical Coherence Tomography Imaging (Topcon, DRI OCT Triton Ver.10.13) was performed after papillary dilatation using high resolution mode with a scan length of 12 mm and a depth of 4 mm. Both vertical and horizontal axial images of the posterior one third of the

crystalline lens with cataract were obtained after focusing on the posterior capsule. Posterior capsule was graded as "intact" if margin of capsule was traced below the posterior polar cataract with no discontinuity [Figure 1A]. It was graded as "dehiscent" if capsular margin is discontinuous or not traced under posterior polar cataract [Figure 1B].

3. Results

The study was carried out in 26 patients who were diagnosed as case of posterior polar cataract, attending outpatient department at Regional Institute of Ophthalmology (M.D. Eye Hospital, Prayagraj) during the year 2018-2019.

AS-OCT grading was compared with the gold standard of intra-operative posterior capsule rupture confirmation by the surgeon. Positive predictive value, sensitivity, specificity and negative predictive value were calculated.

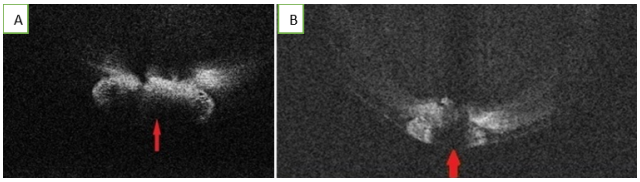

Fig. 1: A,B

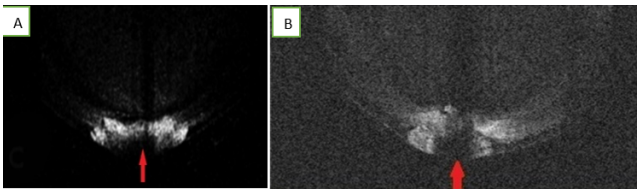

Fig. 2: A,B

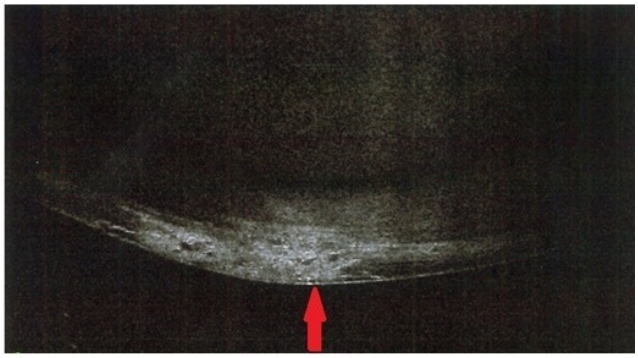

Fig. 3:

26 eyes of 26 patients upon grading of the pre-operative AS- OCT images showed that 22 eyes (84.6%) had an intact posterior capsule and 4 eyes (15.4%) showed a dehiscent posterior capsule. But intra- operatively, it was noted under the operating microscope that 23 eyes(88.5%) had intact posterior capsule and 3 eyes (11.5%) had posterior capsular dehiscence. Posterior capsule rupture during phacoemulsification occurred in 4 eyes (11.5%), 3 out of these 4 cases, had been diagnosed with dehiscence pre-operatively by AS-OCT and intraoperatively by surgeon under operating microscope. In 1 case, pre-operatively, posterior capsular dehiscence was not recognised on AS-OCT and per- operatively, even though, posterior capsule rupture occurred followed by vitreous loss during surgery. In all 21 eyes with intact posterior capsule on preoperative AS-OCT, no posterior capsule rupture occurred during surgery. One eye in which AS-OCT showed posterior capsule defect was actually found intact intra -operatively by the operating surgeon. Compared with the gold standard which is intra-operative evaluation by surgeon under operating microscope, sensitivity of AS-OCT for detecting posterior capsule dehiscence was 100% and specificity was (95.7%). In this study, sensitivity of AS-OCT was 100% (with confidence interval 29.24%) and specificity of AS-OCT was 95.65% with a confidence interval 78.05% to 99.89%. Positive predictive value was found to be 75% with confidence interval 30.61% to 95.33% and negative predictive value was found 75% with confidence interval 100%.

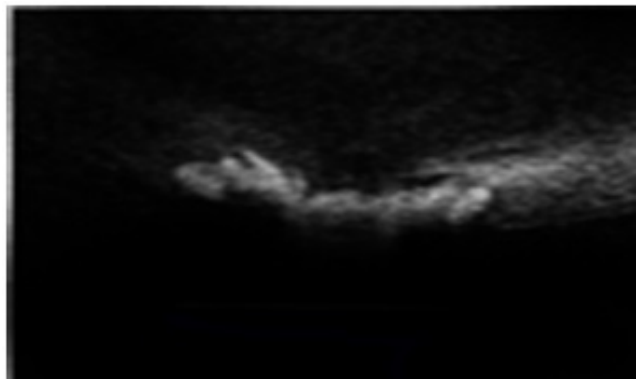

Fig. 4:

4. Discussion

Dealing with posterior polar cataract is quite challenging but good clinical expertise and taking adequate precautions during surgery results in lesser intra-operative complications and better outcomes with good post-operative vision. Slit Lamp examination is not always possible for identifying the pre-existing posterior capsule weakness or to identify the posterior capsular dehiscence. A reliable pre- operative means to identify the polar cataract that is at high risk for rupture of posterior capsule intra-operatively is AS-OCT. The pre- operative information which it gives to the surgeon and helps in counselling the patients

Table 1: Patient demographic and clinical information

Parameter	Value
Mean age (y) ± SD	55.46 ± 9.32
Sex (n%)	
Male	8 (30.8)
Female	18(69.2)
Laterality(n%)	
Right eye	11(42.3)
Left eye	15(57.7)
Cataract type (n%)	
PPC only	20(76.9)
PPC +nuclear sclerosis grade 1	2(7.7)
PPC +nuclear sclerosis grade 2	4(15.4)
Intra operative complication (n%)	
PC rupture with vitreous loss	4(15.4)
IOL implant (n%)	
In bag	22(84.6)
Sulcus	4(15.4)

Table 2: Intactness of posterior capsule on AS-OCT.

Anterior segment OCT	Number	Percentage
Intact	22	84.6
Dehiscent	4	15.4

Table 3: Distribution of vitreous loss.

	Number	Percentage
With Vitreous loss	4	15.4%
NO Vitreous loss	22	84.6%

Table 4: AS-OCT grading compared with gold standard of inoperative posterior capsule rupture confirmation by surgeon was assessed positive predictive value, sensitivity, specificity and negative predictive value.

	AS-OCT	Intra-operatively
Intact	22	23
Dehiscent	4	3

preoperatively about risk of posterior capsule rupture during phacoemulsification, is very valuable in planning the surgery. On performing AS - OCT, we identified dehiscence of the posterior capsule in cases of Posterior Polar Cataract as 4(15.4%). Since posterior capsular dehiscence was documented in the above mentioned 4 cases, we performed surgery taking care of all precautions mentioned specifically for surgery as in cases of dehiscence in posterior capsule.

The precautions included hydrodelineation in place of hydrodissection, Layer-by-layer phacoemulsification[7] without rotation and manipulation of the nucleus, inside out delineation, avoidance of posterior capsule polishing, more gentle maneuvering with avoidance of chamber collapse or over inflation. Slow motion phacoemulsification, nuclear emulsification was performed by direct chopping, in the presence of a harder nucleus, multiple small fragments of the nucleus were created by using step-by-step chop and lateral separation.[8] Viscodissection was performed to mobilize the epinucleus and cortex after completion of nuclear emulsification in such situations.[9] A posterior layer of lens cortex is preserved over posterior polar region till the conclusion of the phacoemulsification procedure to minimize the risk of loss of lens material into the vitreous cavity through the capsular defect. Masket S. et al[3] had also suggested that the central area should be kept attached until the last stage of the cortical aspiration. Low parameters of phaco machine were taken into due consideration. Inspite of these precautions, intra-operative posterior capsule ruptured.

Intra- operatively, we found that out of the total 4 cases, posterior capsular dehiscence was present only in 3 cases (75%), one case was having intact posterior capsule. While the case was detected as having false dehiscence on AS-OCT due to density of posterior polar opacity, where the plaque might have obstructed the imaging of the posterior capsule, causing an artefactual appearance of posterior capsule dehiscence (as shown in Figure 4). In these 3 eyes, a posterior capsule rupture occurred at the time of posterior polar cataract plaque removal during cortex aspiration, suggesting the adherence of posterior polar opacity plaque to posterior capsule or a pre-existing posterior capsule defect (Figure 2 A & B, Figure 3). Posterior capsule rupture occurred in one eye incidentally during surgery which was detected by an intact posterior capsule pre-operatively and intra-operatively.

Similarly, in the study of Gurudatha Pawan Kumar et al,[10] there were 8 cases found dehiscent preoperatively by AS-OCT, but only 5 of them were confirmed by the operating surgeon at the time of surgery. Also, these five cases underwent posterior capsule rupture during phacoemulsification. According to them, 3 false positive dehiscent cases detected by preoperative AS-OCT may be either due to artifactual effect of dense posterior polar opacity plaque or there may be presence of multiple minute areas of posterior capsular deficit. Sensitivity of AS-OCT for detecting posterior capsule dehiscence was 100% and specificity was 94.9%. In the similar study, Kymionis et al[11] also identified 2 cases out of 3 with pre -existing dehiscence by pre-operative AS-OCT and suggested the potential of this imaging modality for identifying high risk cases. Another study by Chan et al[12] also stated similar results that 8 cases out of 37 cases were found dehiscent on preoperative AS-OCT and all 8 cases underwent posterior capsule rupture during surgery. They found that AS-OCT had a sensitivity of 87.5% and specificity of 62.1 % in identifying pre existing tear. In our study, posterior capsule rupture with vitreous loss occurred in 4 cases (15.4%). Out of these three cases had dehiscent posterior capsule as detected preoperatively by AS-OCT and confirmed pre-opretively by surgeon. One out of the 4 cases had intact posterior capsule. In all these

4 cases, a 3-piece foldable IOL (ALCON) was implanted in the sulcus after anterior vitrectomy. Other 22 cases had a 1-piece foldable IOL (ALCON) implanted with an intact capsular bag. Our surgical observations are very much in accordance with Gurudatha Pawan Kumar et al[10] where on performing AS-OCT, posterior capsular dehiscence was documented in 8 cases (12.5%) but intra-operatively only 5 cases (7.81%) exhibited posterior capsular dehiscence.

This is clearly indicating the role of AS-OCT in detecting preoperative dehiscence of post capsule in Posterior Polar Cataract. Beyond doubt, effectivity of AS-OCT in detecting posterior capsule dehiscence in our study also can't be overlooked as in quite a good percentage (75%) of cases in our series, AS-OCT findings clearly correlated with intra-operative finding. However, predicting effectivity of any instrument by such small number of cases is not justified. We need to emphasize upon the effectivity of AS-OCT in identifying posterior capsular dehiscence in posterior polar cataracts by including some more number of cases. In our study, out of 26 cases operated for phacoemulsification by same experience surgeon, vitreous prolapse was observed in 4 cases (15.4%). Fortunately, in 3 out of 4 cases, posterior capsular dehiscence had already been documented by AS-OCT, and so surgery was started and performed with all pre and intra operative precautions. In one (3.8%) case only posterior capsule dehiscence was not documented by AS-OCT, posterior capsule rupture occurred during surgery. While observing detailed morphology of the eye of this patient, the size of posterior polar cataract was found to be more than 3 mm. Thus, we can safely interpret that complications are more likely to occur if the size of posterior polar cataract is more and it is associated with a soft nucleus.[13]

5. Conclusion

Preoperatively, AS-OCT can be used for identifying pre-existing weakness or dehiscence of posterior capsule in patients of posterior polar cataract. AS-OCT provides a sensitive tool to screen for eyes at risk for posterior capsule rupture by providing high resolution image posterior lens and capsule. This information can be very useful because it allows the surgeon to accurately segregate low risk cases from high risk cases. This would provide valuable pre-operative information to the surgeon and help in counselling the patients who are at high risk of posterior capsular rupture. This enables better surgical planning by the surgeon to prevent posterior capsular rupture and better management of complications.

6. Source of Funding

None.

7. Conflict of Interest

None.

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