

Role of B-Scan Ultrasonography in Pre-Operative Mature and Hyper-Mature Cataracts

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Abstract:

Introduction: Ultrasonography is a crucial way of considering the posterior area in visions with unclear media and delivers a way for analyzing fundamental changes in the posterior part of the vision in people with transparent media. On B-scan ultrasonography, the most common observations of postsurgical lesions linked with perforating and blunt trauma, as well as absent trauma, were macular dislocation, retinal haemorrhage, intraocular parasitic organism, cancer, and vitreous isolation. In addition, ultrasound is a risk-free method that is also less expensive, more readily available and offers greater affordability (MRI). Its application has grown to include biometric measures, tissue characterisation, therapies for involved vitreoretinal diseases, and the importance of intraocular groups, among other things.

Aims and Objectives: To evaluate the prevalence and nature of posterior segment pathologies detected by B-scan ultrasound in pre-operative mature and hypermature cataract patients and to study various patient risk factors that increase the likelihood of posterior segment pathology in predicting possible visual prognosis and to decide postoperative management.

Methods: This study had been designed as cross-sectional observational study. Detailed ocular, systemic, family history will be taken. Preoperative evaluation were recorded such as Visual acuity testing for distant vision using Snellen's chart, anterior segment examination by using of slit lamp biomicroscopy, measurement of IOP with schiotz tonometer and Goldmann's applanation tonometer after instilling paracaine eye drop and staining with fluorescein strip and B-scan examination. B-Scan results obtained according to the type of cataract, in various IOP status and ophthalmologic conditions. The required statistical analysis was carried out.

Results: In this study shows that out of 120 patients studied 75 patients had normal B-scan findings followed by 15 patients with posterior vitreous detachment, 14 patients with vitreous degeneration, 9 patients with asteroid hyalosis, 4 patients with retinal detachment, 2 patients had posterior staphyloma and vitreous haemorrhage was noted in 1 patient. The chi-square statistic is 16.42. The p -value is .000051. The result is significant at $p < 0.05$. The chi-square statistic is 16.5211. The p -value is .000048. The result is significant at $p < 0.05$.

Conclusion: The study concluded that B-scan is a reliable, safe, cheap, non-invasive and rapid investigation with no exposure to ionizing radiations. It is a quality diagnostic tool for

real-time imaging and applicable in evaluating the posterior segment in the presence of opaque ocular media in great detail and with great accuracy. It is the preferred screening modality in extraocular lesions also.

Keywords: B-scan, ultrasonography, cataract, ocular, visual acuity

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Introduction

Ultrasound is vibration radiation composed of particles moving within a medium. American ophthalmologists Mundt and Hughes were among the first to apply ultrasonography to ophthalmology in 1956. The intraocular tumour was assessed by using mode. Baum and Greenwood presented B-scan to ophthalmology treatment in 1958. For postsurgical lesion evaluation, both A-scan and B-scan approaches are required. B (Brightness) mode is beneficial for showing the structure and topological relation of postsurgical tumours more clearly. B-scan shows a cross-sectional picture of sick organs and is useful for discovering postsurgical diseases that were not previously described. 8–10 MHz is the band used in diagnosing ophthalmology ultrasonography for the posterior segment [1].

Ultrasound imaging has evolved significantly in the last 3 decades, enabling everyone to explore the hinder portion of the concept in the presence of unclear substances. The most popular method is for evaluating the postoperative region of eyes with digital loss of vision in contact mode. Ultrasonography is a crucial way of considering the posterior area in visions with unclear media and delivers a way for analyzing fundamental changes in the posterior part of the vision in people with transparent media. On B-scan ultrasonography, the most common observations of postsurgical lesions linked with perforating and blunt trauma, as well as absent trauma, were macular dislocation, retinal haemorrhage,

intraocular parasitic organism, cancer, and vitreous isolation [2].

Loss of vision brought on by cataracts is a significant issue all over the world in terms of public health. International cataracts have the major reason for blindness in poor countries. According to WHO indicate that cataracts are responsible for 47.8% of all cases of blindness worldwide. In India, however, cataracts are responsible for 51% of all cases of blindness [4]. The previous report has demonstrated that cataract operation has been regarded as among the fitness therapies that offer the best value for the money. It has been established beyond a reasonable doubt that cataract is the leading cause of blindness in both eyes in India.

Following the international vision 2020: the proper-to-sight task, India has reaffirmed its dedication to the objective of eradicating preventable forms of blindness by the year 2020 [5]. In a significant number of instances, the cataract has already progressed to the point where it is impossible to see the fundus before surgery. It is believed that such visualization is necessary to provide an accurate prediction for one's vision following a cataract operation. In the following situations, the ultrasonographic analysis may have provided details about anomalies. Operation for traumatic cataracts is a method that has the potential to be difficult. It is possible that careful ophthalmic imaging with the use of ultrasonography might outcomes in greater pre-surgery detail about lens support

systems [6]. In addition, this may provide the surgeon with an edge when planning surgery. In comparison to other imaging techniques such as computed tomography scans and magnetic resonance imaging.

In addition, ultrasound is a risk-free method that is also less expensive, more readily available and offers greater affordability (MRI). Its application has grown to include biometric measures, tissue characterisation, therapies for involved vitreoretinal diseases, and the importance of intraocular groups, among other things [7]. In the rotation, ultrasound including an eye doppler is used for the evaluation of extraocular tissues, retrobulbar optical nerve disease, vascular abnormalities and orbital abundance lesions. It is recommended to employ the B-scan method rather than the A-scan because it provides a clearer picture of the body and topographic association of lesions in the hinder area. In pre-operative mature and hyper-mature cataract patients, the goal of the study is to use B-scan ultrasonography to imagine the state of the posterior part to evaluate posterior segment diseases.

Materials and Methods

This study had been designed as cross-sectional observational study involving general population of Gandhinagar, Gujarat, India. The study had been conducted in department of ophthalmology, GMERS Medical College, Gandhinagar, Gujarat. The study was conducted from May 2021 to October 2022. Patients who visited the outpatient department in ophthalmology department in GMERS Medical College, Gandhinagar, were included in this study. The present study had been conducted in a tertiary care teaching hospital from outpatient departments by ophthalmologists and diagnosed as mature and hypermature cataract patients. Patients who were needed to meet the eligibility criteria have been enrolled in the study, a written and informed consent had been obtained from

all patients after explaining the procedure. Patient had been asked about the record of all the details. Detailed ocular, systemic, family history will be taken. Preoperative evaluation were recorded such as Visual acuity testing for distant vision using Snellen's chart, anterior segment examination by using of slit lamp biomicroscopy, measurement of IOP with schiottz tonometer and Goldmann's applanation tonometer after instilling paracaine eye drop and staining with fluorescein strip and B-scan examination. For B-scan procedure, patients had been briefly explained about the procedure for their co-operation. The patients have been examined in supine position on the examination table. They had been evaluated by Ultrasonic HiScan OPTIKON (B-scan), calibrated and equipped with 12.5 MHz probe placed in Ophthalmology department. Contact method of examination have been used. Ultrasonic probe had been placed over the closed eyelid after application of coupling gel then antero-posterior, longitudinal and transverse views of B-scan along with A-scan were taken. High gain (80 to 90dB) and low gain (60 to 70dB) sensitivity have been used in selected patients during ultrasonography. Investigations or interventions to be conducted on patient are visual acuity testing for distant vision using Snellen's chart, anterior segment examination by slit lamp biomicroscopy, measurement of IOP with schiottz tonometer and Goldmann's applanation tonometer after instilling paracaine eye drop and staining with fluorescein strip and B-scan examination.

Inclusion criteria and Exclusion criteria

All cases of mature and hyper mature cataract whether undergoing for cataract surgery or not.

Those who were having history of posterior segment lesions and those who had been previous history of ocular surgery specifically posterior segment surgery were excluded from the study were

congenital cataract, Grade 1-3 cataract, Macular lesions.

Ethical Approval

The research protocol had been presented to the Institutional Ethics Committee (IEC) and approval had been taken before commencement of the study. Participants had been explained clearly about the nature and purpose of the study in the language they understand and written informed consent had been obtained before enrolling them for the study.

Statistical Analysis

A sample size of 120 is obtained by using the hypothesis testing method by the formula below and based on some assumptions. The formula is,

$$\text{Sample size } n = \frac{[DEFF * Np(1-P)]}{[d^2 / Z^2 - 1.96^2 * (N-1) + p*(1-p)]}$$

The assumptions are 95% confidence intervals, prevalence of blindness in India 1.1% [6,7] and 2% margin of error. The calculated minimum sample had been inflated by 10% to account for anticipated subject non response. Sample size is calculated using Open Epi software, which is freely available. It has been represented as actual frequencies, percentage. For analysis of association chi-square test had been used and $p < 0.05$ will be considered significant ($\alpha = 0.05$).

Results

In this study female patient had been accounted for 52.5% patients and 47.5% patients had been accounted for male. In this study out of 120 patients, 63 patients were female and 57 patients were male. In this study, the majority of patients were between 40 to 60 years ($n=60$). Other age group more than 60 years (51). Only 9 patient were in less than 40 years. In this study, the majority of patients were between 40 to 60 years (50%). Other age group more than 60 years (42.5%). Only 7.5% patient were in less than 40 years. The socio-economic classification was done using Modified Prasad's classification. In this study shows that majorities of patients under lower socio-economic status. This may be due to the fact that the study was conducted government civil hospital and majority patients in OPD came from nearby rural areas. Only 12.5% of the patients belong to upper socio-economic class while remaining 39.17% of patients belong to middle socio-economic class. In this study 67 patients had dense lens changes in right eye, 50 patients had dense lens changes in left eye and 3 patients had bilateral cataract. Table 1 shows the detailed findings of the baseline characteristics.

Table 1: Baseline characteristics of the patients in this study

Sex	Number (n)	Percentage (%)
Male	57	47.5%
Female	63	52.5%
Total	120	100%
Age in years	Number (n)	Percentage (%)
<40	9	7.5 %
40 to 60	60	50 %
>60	51	42.5 %
Total	120	100 %
Socio-economic class	Number (n)	Percentage (%)
Upper	15	12.5
Middle	47	39.17
Lower	58	48.33
Total	120	100 %

Laterality*	Number (n)	Percentage %
RE	67	55.83 %
LE	50	41.67 %
BE	3	2.50 %

*RE: Right Eye; LE: Left Eye; BE: Both Eye

In our study shows that out of 120 patients, 55.83% patients were mature cataract and 44.17% patients were hypermature cataract. In this study 62 patients had vision of hand movements followed by 26 patients with counting fingers close to face, 25 patients with perception of light with projection of light in 4 quadrants, 4 patients with perception of light with projection of light defective, 3 patients with no perception of light. It is also found that 51.67% patients had vision of hand movements followed by 21.67% patients with counting fingers close to

face, 20.83% patients with perception of light with projection of light in 4 quadrants, 3.33% patients with perception of light with projection of light defective, 2.5% patients with no perception of light. In this study out of the 120 patients studied 91.67% had normal pupil followed by 2.5% patients with Relative afferent papillary defect, 2.5% patients with sluggishly reacting pupil and 1.67% patients had semidilated fixed pupil and 1.67% patients had synechiae in the pupillary area.

Table 2: Visual acuity, Intraocular Pressure (IOP) and B-Scan results obtained in the patients

Visual Acuity	Number (N)	Percentage (%)
CFCF (counting fingers close to face)	26	21.67 %
HM+	62	51.67 %
PL+ , PR in four quadrant	25	20.83 %
PL+, PR DEFECTIVE	4	3.33 %
NO PL	3	2.50 %
TOTAL	120	100 %
IOP	Number (N)	Percentage (%)
6	03	2.50 %
8	01	0.83 %
10	22	18.33 %
12	23	19.17 %
14	13	10.84 %
16	27	22.5 %
18	18	15 %
20	08	6.67 %
22	03	2.50 %
24	01	0.83
26	01	0.83
B-Scan Finding	Number (N)	Percentage (%)
Normal	75	62.5 %
PVD	15	12.5 %
Vitreous Degeneration	14	11.67 %
Asteroid Hydrosis	9	7.5 %
Retinal Detachment	4	3.33 %
Posterior Staphyloma	2	1.67 %

Vitreous Haemorrhage	1	0.83 %
Total	120	100 %

In this study shows that out of 120 patients studied 75 patients had normal B-scan findings followed by 15 patients with posterior vitreous detachment, 14 patients with vitreous degeneration, 9 patients with asteroid hyalosis, 4 patients with retinal detachment, 2 patients had posterior staphyloma and vitreous haemorrhage was noted in 1 patient. The chi-square statistic is 16.42. The p -value is 0.000051. The result is significant at $p < 0.05$. The chi-

square statistic is 16.5211. The p -value is 0.000048. The result is significant at $p < 0.05$.

Although we didn't find any significant p -value for above mentioned study, we found greater association of findings in B-scan. A study with larger sample size would be required to show significant association.

Table 3: B-Scan results obtained according to the type of cataract in the patients

B-Scan Finding	Senile Cataract	Non-Senile Cataract	Total
Positive	19	26	45
Normal	59	16	75
Total	78	42	120
B-Scan Finding	Diabetic Cataract	Non-Diabetic Cataract	Total
Positive	22	23	45
Normal	11	64	75
Total	33	87	120

Discussion

The power to properly analyse the posterior area of the vision in people with adult and hyper-mature cataracts is crucial for providing excellent surgical care to cataract patients. Furthermore, in people with adult and hyper-mature cataracts, the posterior area is inaccessible to control and avoiding ophthalmoscopy makes it difficult to diagnose and eliminate abnormalities in the posterior segment. Cataract patients who may also have coexisting posterior segment anomalies are therefore at risk for a poor visual prognosis. In addition, B-scan ultrasonography has delivered a strategy for assessing structural alterations in the posterior area in these people. Similarly, we were capable to indicate and demonstrate the dimensions, place, figure, and spot of lesions such as retinal separation, vitreous bleeding, an intraocular alien body, vitreous deterioration, hinder vitreous separation, asteroid hyalinosis reduced hindered lens

tablet and hinder staphyloma in 500 eyes [8].

Even, in this analysis, the majority of patients aged 60 (50%) were in the age category from 40 to 60 years observed with 42.5% in the group of more than 60 years and 7.5% in the group of fewer than 40 years. There were 63 females and 57 guys in our study. Moreover, in the research conducted by OP Sharma, ocular abnormalities were most prevalent between the fourth and fifth decades 100. This research indicates that the majority of patients have a lower socioeconomic position 48.33% [9]. This may be because the research was executed at a government clinic and the bulk of OPD patients came from nearby rural residents.

In addition, only 12.5% of the people belong to the upper socioeconomic class, whereas 39.17% belong to the centre socioeconomic class. In our investigation, 53 patients with mature cataracts and 67 issues of hyper-mature cataracts were

recognised. Similarly, out of 120 people, they had 70% senile cataracts, 27.5% diabetic cataracts, 3.33% complex cataracts, and 4.17% traumatic cataracts. In addition, it was exact to Qureshi's analysis, among the 750 people, who had 9.47% traumatic cataracts and 90.53% different kinds of cataracts. On the other hand, the majority of people had an eye of hand exercises, representing 51.67 % of people, observed by "counting fingers near the face" (CFCF) with 26 people, representing 21.67%, and perception of light with 25 people, describing 20.82 % [10].

Similarly, the least familiar visual acuity, perception of light with PR deficiency, was subsequently reported in 4(3.33%) and 3(2.5%) individuals, respectively. 2.5% (3) of the patients had a "relative afferent papillary defect" (RAPD), while 2.5% of the people had a sluggishly responding student. Synechiae were observed in the pupillary region of 1.67% of people with involved cataracts [11]. The majority of people (110), or approximately 91.67 %, exhibited normal Pupillary Reactions. Monitoring intraocular pressure in 120 individuals. The highest number of people accounting for around 22.5% of people had an IOP of 16 mm of hg [12]. In addition, 23 or 22 patients accounting for around 19.17% to 18.33% had an IOP of 12 mm of hg and 10 mm of hg, respectively.

Furthermore, near about 0.83 % of people, IOP readings of 8, 24, and 26 mm Hg were observed to be the least frequent. Before surgery, patients with retinal detachment, vitreous haemorrhage, vitreous degeneration, asteroid hyalinos, and Posterior Staphyloma were informed of their guarded visual prognosis. 75 (62.5%) of the 120 patients in this study had normal B-scan findings, followed by 15 (12.5%) people with hindered vitreous separation, around 11.67% patients with vitreous degeneration, 9 (7.5%) patients with asteroid hyalinos, (3.33%) patients

with retinal detachment, 2 (1.67%) patients with posterior staphyloma, and one (0.83%) patient with vitreous haemorrhage [13]. Retinal detachment in individuals includes both rhegmatogenous and tractional detachment. Long-lasting RD manifested as funnel-shaped or T-shaped membranes with limited after motions.

This was beneficial for pre-operative assessment, operation planning, and explaining the visual prognosis of these patients before surgery. Patients with posterior vitreous detachment had a highly reflective membrane upon movement. Pre-operative evaluation required ultrasonic examinations to evaluate changes such as absorption, additional organization, and amount of separation. In 14 individuals, deterioration of the vitreous was detected. Seven patients were diagnosed with senile cataracts, six patients with diabetic cataracts, two patients with PVD, and three patients with complex cataracts [14]. In patients with a history of vitreous haemorrhage, the density and position of the haemorrhage were documented, and a follow-up ultrasonic examination was performed to evaluate changes such as absorption and organization.

Mansoor research in the study conducted by Salman A, the retinal detachment was present in three individuals (2.59%), as indicated by the findings of Qureshi. In the Blumenthal trial, 4.5 per cent of participants had RD. These findings are comparable to our investigation, which revealed four patients with RD (3.33 per cent). In the study by Qureshi, 2 per cent of individuals had PVD [15]. Twelve per cent of the 15 participants in our study had PVD. In our investigation, 14 individuals (11.67%) exhibited degeneration of the vitreous. In the study by Qureshi, vitreous haemorrhage occurred in 24 participants (3%). In the study by Salman A, vitreous haemorrhage occurred in two participants (1.7%). 2.5% of individuals in the Blumenthal EZ study had a vitreous haemorrhage.

This is analogous to our study, which identified vitreous haemorrhage in 1 patient (0.83%). In the Qureshi trial, posterior staphyloma was observed in 5 patients (0.6%), while in the Blumenthal EZ study, it was observed in 7.2% of patients. Two patients (1.67%) in our study had posterior staphyloma. In Qureshi's study, 2% of patients had steroid hyalinoses, which is equivalent to our findings of 7.5% of patients. In the study by Qureshi, 660 patients had a normal B scan, in the study by Salman A, 110 patients (94.8%) had a normal B scan, and in the study by Blumenthal EZ, 80.4% of patients had a normal B scan, however in our study, 62.5% of patients had a normal B scan [16,17].

Conclusion

The study concluded that B-scan is a reliable, safe, cheap, non-invasive and rapid investigation. There is no exposure to ionizing radiations. The high frequency probe provides excellent quality real-time imaging.

B-scan helps in evaluating the posterior segment in the presence of opaque ocular media in great detail and with great accuracy. B-scan is useful for preoperative planning. It is the preferred screening modality in extraocular lesions also. Therefore, it can be concluded that ultrasonography can be considered for determining the nature of intraocular pathologies detected preoperatively in patients having dense cataracts. This has influence the surgical strategy and also the postoperative visual prognosis in limited resources settings.

Reference

1. Asbell PA, Dualan I, Mindel J, Brocks D, Ahmad M, Epstein S. Agerelated cataract. *The Lancet*. 2005 Feb 12; 365(9459):599-609.
2. World Health Organization. Visual impairment and blindness, 2014. URL <http://www.who>.

Int/mediacentre/factsheets/fs282/en. 2016

3. Murthy GV, Gupta SK, John N, Vashist P. Current status of cataract blindness and Vision 2020: the right to sight initiative in India. *Indian journal of ophthalmology*. 2008 Nov; 56(6):489.
4. Salman A, Parmar P, Vanila CG, Thomas PA, Jesudasan CN. Is ultrasonography essential before surgery in eyes with advanced cataracts? *Journal of postgraduate medicine*. 2006 Jan 1; 52(1):19.
5. Perry LJ. The evaluation of patients with traumatic cataracts by ultrasound technologies. In *Seminars in ophthalmology* 2012 Nov 1 (Vol. 27, No. 5-6, pp. 121-124). Taylor & Francis.
6. Qureshi MA, Laghari K. Role of B-Scan Ultrasonography in pre-operative cataract patients. *International journal of health sciences*. 2010 Jan;4(1):31
7. Theelen T, VerbeekAM. Cathy W. DiBernardo, Ellen F. Greenberg: *Ophthalmic ultrasound—A diagnostic atlas*.
8. Baum G, Greenwood I. *The Application of Ultrasonics Locating Techniques to Ophthalmology**: Heoretic Considerations and Acoustic Properties of Ocular Media: Part I. Reflective Properties. *American journal of ophthalmology*. 1958 Nov 1; 46(5):319-29.
9. Bronson NR, Turner FT. A simple B-scan ultrasonoscope. *Archives of Ophthalmology*. 1973 Sep 1; 90(3):237-8.
10. Purnell EW. B-mode orbital ultrasonography. *International opht - halmology clinics*. 1969 Oct 1;9(3):643-65.
11. Coleman DJ, Lizzi FL. Jack RL 1977. *Ultrasonography of the eye and orbit*. Lea and Febiger. Philadelphia
12. Aburn NS, Sergott RC. Orbital colour Doppler imaging. *Eye*. 1993 Sep; 7(5):639. 13. Williamson TH, Baxter

- GM, Dutton GN. Colour Doppler velocimetry of the arterial vasculature of the optic nerve head and orbit. *Eye*. 1993 Jan; 7(1):74.
13. Anteby II, Blumenthal EZ, Zamir E, Waindim P. The role of preoperative ultrasonography for patients with dense cataract: a retrospective study of 509 cases. *Ophthalmic Surgery, Lasers and Imaging Retina*. 1998 Feb 1; 29(2):114-8.
 14. Mundt GH, Hughes WF. Ultrasonics in ocular diagnosis. *American journal of ophthalmology*. 1956 Jan 1;41(3):488-98
 15. Baum G, Greenwood I. The application of ultrasonic locating techniques to ophthalmology: II. Ultrasonic slit lamp in the ultrasonic visualization of soft tissues. *AMA Archives of ophthalmology*. 1958 Aug 1; 60(2):263-79.
 16. Bronson NR, Turner FT. A simple B-scan ultrasonoscope. *Archives of Ophthalmology*. 1973 Sep 1;90(3):237-8.
 17. I, F., TM, B., S, D., OA, T., AM, K., B, S., F, C., L, T., & J, T. Eye health status and cause of visual impairment in survivors of Ebola virus disease in the Republic of Guinea: Etat de santé oculaire et cause de déficiences visuelles chez les survivants de la maladie à virus Ebola en République de Guinée. *Journal of Medical Research and Health Sciences*, 2022; 5(10): 2317–2323.