

B-Scan Ultrasonographic Evaluation of Posterior Segment Pathologies in Dense Cataract: A Prospective Cross-Sectional Study

Dr. Carol Godwin¹, Dr. B. Pravitha², Dr. G. Yuvalakumaran³, Dr. V. Prashanth⁴, Dr. Sivaranjinee⁵, Dr. Mohsina Aboobakar⁶

¹Postgraduate junior resident, Department of Radiodiagnosis, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Vinayaka Mission's Research Foundation (DU), Salem, India 636308
Email: carolgodwin2000@hotmail.com

ORCID ID: 0009-0002-2622-7572

²Assistant Professor, Department of Radiodiagnosis, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Vinayaka Mission's Research Foundation (DU) Salem, India 636308

Email: pravitha.baskar@gmail.com

ORCID ID: 0009-0004-5283-8064

³Professor & Head, Department of Radiodiagnosis, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Vinayaka Mission's Research Foundation (DU) Salem, India 636308

Email: yuvalakumaran@yahoo.com

ORCID ID: 0009-0004-3153-3982

⁴Assistant Professor, Department of Radiodiagnosis, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Vinayaka Mission's Research Foundation (DU) Salem, India 636308

Email: vprashanth33@gmail.com

ORCID ID: 0009-0008-2649-1326

⁵Assistant Professor, Department of Radiodiagnosis, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Vinayaka Mission's Research Foundation (DU) Salem, India 636308

Email: kssiva12@gmail.com

ORCID ID: 0009-0007-7383-278X

⁶Senior resident, Department of Radiodiagnosis, Vinayaka Mission's Kirupananda Variyar Medical College & Hospitals, Vinayaka Mission's Research Foundation (DU) Salem, India 636308

Email: muhsinaabooabaker@gmail.com

ORCID ID: 0009-0006-4357-2713

Abstract

Background: Dense cataracts frequently obscure direct visualization of the posterior segment, making preoperative assessment difficult. Undetected posterior segment abnormalities may adversely influence surgical planning, visual prognosis, and postoperative outcomes. B-scan ultrasonography provides a rapid, non-invasive, and reliable method for evaluating intraocular structures hidden behind opaque ocular media.

Objective: To evaluate the diagnostic role of B-scan ultrasonography in detecting posterior segment abnormalities among patients with dense cataracts undergoing preoperative assessment.

Materials and Methods: A prospective cross-sectional study was conducted in the Department of Radiodiagnosis at Vinayaka Mission's Kirupananda Variyar Medical College and Hospital (VMKV MCH), Salem, Tamil Nadu, India. A total of 185 patients with clinically diagnosed dense cataracts were included after obtaining informed consent. All participants underwent standardized ophthalmic B-scan ultrasonography using high-frequency linear transducers. Patient demographics, laterality, sonographic findings, and associated posterior segment abnormalities were documented and statistically analysed.

Results: Among the 185 patients evaluated, the majority belonged to the 51–60 years age group (43.2%), followed by 61–70 years (33.5%). Males constituted 53% of the study population. Cataracts involved the right eye in 51.9%, left eye in 33.0%, and both eyes in 15.1% of patients. The posterior segment appeared normal in most patients, while the remaining cases demonstrated various abnormalities, including vitreous degeneration, posterior vitreous detachment, vitreous haemorrhage, retinal detachment, choroidal abnormalities, and other vitreoretinal pathologies.

Conclusion: B-scan ultrasonography is an indispensable imaging modality for evaluating the posterior segment in patients with dense cataracts. It facilitates early detection of occult ocular abnormalities, assists ophthalmic surgeons in operative planning, improves prediction of postoperative visual outcomes, and contributes significantly to comprehensive preoperative assessment.

Keywords: B-scan ultrasonography, dense cataract, posterior segment, vitreous haemorrhage, retinal detachment, ocular ultrasound, preoperative evaluation.

Introduction

Cataract remains the leading cause of reversible blindness worldwide and continues to constitute a major public health challenge, particularly in developing countries. Although cataract surgery is among the most successful surgical procedures performed today, accurate preoperative assessment of the posterior segment is essential for

predicting visual prognosis and identifying coexisting ocular abnormalities that may influence surgical outcomes. In patients with dense or mature cataracts, direct visualization of the posterior segment using fundoscopy is frequently impossible because of media opacity. Consequently, clinically significant vitreoretinal diseases may remain undetected before surgery. Failure to identify these pathologies can lead to unexpected postoperative visual impairment despite technically successful cataract extraction. Therefore, imaging techniques capable of assessing intraocular structures behind opaque media have become an integral component of preoperative evaluation.

B-scan ultrasonography is a non-invasive, rapid, inexpensive, and highly informative imaging modality that enables real-time assessment of the vitreous, retina, choroid, sclera, optic nerve head, and intraocular masses even when direct ophthalmoscopic examination is precluded by dense cataracts. It provides valuable diagnostic information regarding retinal detachment, vitreous haemorrhage, posterior vitreous detachment, vitreous degeneration, choroidal detachment, intraocular tumours, posterior staphyloma, dislocated lens, intraocular foreign bodies, and other posterior segment abnormalities.

The widespread availability of high-frequency ultrasound equipment, coupled with its excellent diagnostic accuracy and absence of ionizing radiation, has established B-scan ultrasonography as the imaging modality of choice for evaluating ocular pathology in eyes with opaque media. Identification of these lesions before cataract surgery enables ophthalmologists to optimize surgical planning, counsel patients regarding expected visual outcomes, and initiate appropriate management when additional retinal or vitreous interventions are required.

The present prospective cross-sectional study was conducted at the Department of Radiodiagnosis, Vinayaka Mission's Kirupananda Variyar Medical College and Hospital (VMKV MCH), Salem, Tamil Nadu, India, to evaluate the usefulness of B-scan ultrasonography in detecting posterior segment abnormalities among patients presenting with dense cataracts. The study also aimed to analyse the demographic profile, distribution of ocular involvement, and spectrum of sonographic findings in this patient population, thereby assessing the clinical value of B-scan ultrasonography as a routine preoperative investigation in cataract patients with opaque ocular media.

Materials and Methods

Study Details

This prospective cross-sectional study was conducted in the Department of Radiodiagnosis, Vinayaka Mission's Kirupananda Variyar Medical College and Hospital (VMKV MCH), Salem, Tamil Nadu, India, in collaboration with the Department of Ophthalmology, to evaluate the diagnostic performance of B-scan ultrasonography in detecting posterior segment pathologies in patients with dense cataract. A total of 185 consecutive eligible patients with clinically diagnosed dense cataract were enrolled after obtaining written informed consent using purposive sampling.

Eligibility Criteria: Patients with clinically diagnosed dense cataract referred for preoperative posterior segment evaluation who provided written informed consent were included. Patients who declined participation or informed consent, or in whom an adequate B-scan ultrasonographic examination could not be completed, were excluded.

Study Procedure

A detailed clinical history was obtained from every participant before imaging. Routine ophthalmological evaluation including assessment of visual acuity, slit-lamp examination, and measurement of intraocular pressure was performed by the ophthalmology team.

All patients subsequently underwent B-scan ultrasonography of the affected eye or eyes in the Department of Radiodiagnosis.

Ultrasound Technique

B-scan ultrasonography was performed using GE Logiq expert ultrasound system equipped with a high-frequency linear transducer.

The examination was performed with the patient in the supine position through the closed eyelid using a liberal amount of sterile coupling gel.

The probe was gently positioned over the closed eyelid without exerting excessive pressure on the globe.

Multiple scanning planes were obtained, including:

- Axial (anteroposterior)
- Longitudinal
- Transverse

Dynamic ocular movements were performed whenever required to improve visualization of posterior segment structures and differentiate mobile vitreous lesions from retinal pathology.

Both eyes were examined whenever clinically indicated.

Image Interpretation

The following posterior segment structures were systematically evaluated:

- Vitreous cavity
- Retina
- Choroid
- Optic nerve head
- Posterior sclera
- Intraocular masses
- Lens position
- Posterior vitreous interface

Special attention was given to identifying:

- Vitreous degeneration
- Posterior vitreous detachment
- Vitreous haemorrhage
- Retinal detachment
- Choroidal detachment
- Posterior staphyloma
- Intraocular foreign body
- Intraocular tumours
- Lens dislocation
- Other posterior segment abnormalities

Whenever abnormalities were detected, their location, morphology, echogenicity, mobility, associated vascularity, and measurements were documented.

Outcome Measures

The primary outcome measure was the detection of posterior segment abnormalities on B-scan ultrasonography in eyes with dense cataract.

Secondary outcome measures included:

- Age distribution
- Gender distribution

- Laterality of cataract
- Spectrum of posterior segment abnormalities
- Frequency of each ultrasonographic finding

Statistical Analysis

The collected data were entered into Microsoft Excel and analysed using appropriate statistical software. Continuous variables were summarized using descriptive statistics, while categorical variables were expressed as frequencies and percentages. The findings were presented in the form of tables and charts for better interpretation.

Results

A total of 185 patients with clinically diagnosed dense cataracts were included in the study and underwent preoperative B-scan ultrasonographic evaluation of the posterior segment. Demographic characteristics, laterality, and ultrasonographic findings are summarized below.

Age Distribution

Table 1. Age distribution of the study population (n = 185)

Age Group (years)	Number of Patients	Percentage (%)
0-9	1	0.5
10-20	3	1.6
21-30	4	2.1
31-40	5	2.7
41-50	10	5.4
51-60	80	43.2
61-70	62	33.5
71-80	18	9.7
81-90	2	1.0
Total	185	100.0

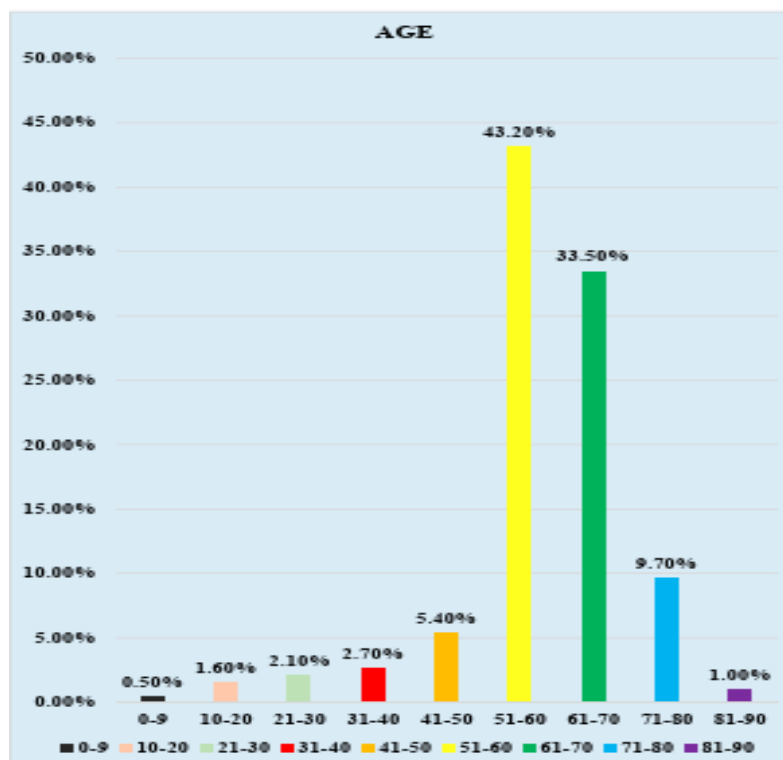


Figure 1. Age-wise distribution of patients.

Interpretation

The majority of patients belonged to the 51–60 years age group (43.2%), followed by the 61–70 years age group (33.5%). Only one patient (0.5%) belonged to the 0–9 years age group. Overall, nearly three-fourths of the study population were between 51 and 70 years of age.

Gender Distribution

Table 2. Gender distribution of the study population

Gender	Number of Patients	Percentage (%)
Male	98	53.0
Female	87	47.0
Total	185	100.0

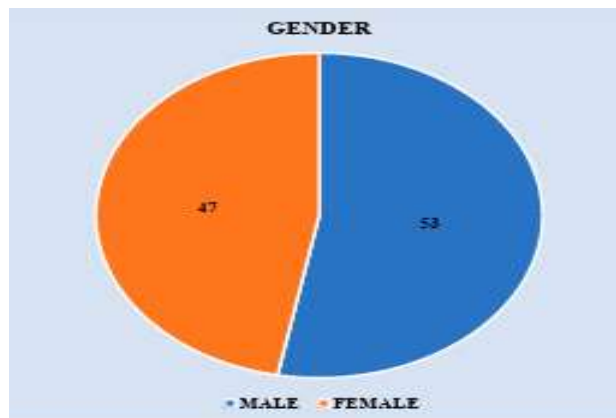


Figure 2. Gender distribution of patients.

Interpretation

Of the 185 patients, 98 (53.0%) were males and 87 (47.0%) were females, demonstrating a slight male predominance in the study population.

Laterality of Cataract

Table 3. Laterality of cataract involvement

Eye Involved	Number of Patients	Percentage (%)
Right eye	96	51.9
Left eye	61	33.0
Bilateral	28	15.1
Total	185	100.0

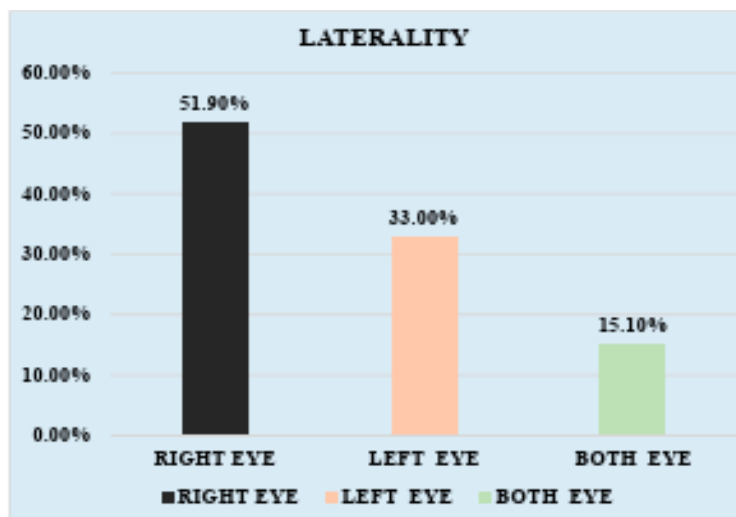


Figure 3. Distribution according to laterality.

Interpretation

Right eye involvement was observed in 96 patients (51.9%), whereas 61 patients (33.0%) had left eye involvement.

Bilateral cataracts were present in 28 patients (15.1%). Thus, unilateral right eye involvement was the most frequent presentation.

B-Scan Ultrasonographic Findings

Table 4. Posterior segment abnormalities detected on B-scan ultrasonography

B-Scan Finding	Number of Patients	Percentage (%)
Normal posterior segment	128	69.1
Vitreous degeneration	43	23.7
Retinal detachment	2	1.0
Vitreous haemorrhage	3	1.6
Posterior vitreous detachment	2	1.0
Asteroid hyalosis	3	1.6
Posterior vitreous detachment with vitreous degeneration	2	1.0
Retinal detachment with vitreous haemorrhage	1	0.5
Intraocular foreign body	1	0.5
Posterior staphyloma	0	0.0
Total	185	100.0



Figure 4. Distribution of posterior segment findings on B-scan ultrasonography.

Interpretation

Normal posterior segment findings were observed in 128 patients (69.1%). Among abnormal findings, vitreous degeneration was the most common lesion, detected in 43 patients (23.7%). Vitreous haemorrhage and asteroid hyalosis were each identified in 3 patients (1.6%), while retinal detachment and posterior vitreous detachment were each detected in 2 patients (1.0%). Combined posterior vitreous detachment with vitreous degeneration was also observed in 2 patients (1.0%). One patient (0.5%) demonstrated retinal detachment associated with vitreous haemorrhage, and one patient (0.5%) had an intraocular foreign body. No cases of posterior staphyloma were identified.

Summary

Among 185 patients undergoing preoperative B-scan ultrasonography, the highest proportion belonged to the 51–60-year age group, with a slight male predominance. Right eye involvement was more common than left-sided or bilateral disease. B-scan ultrasonography demonstrated a normal posterior segment in approximately 69% of patients, whereas 31% had occult posterior segment abnormalities. Vitreous degeneration was the predominant abnormality, followed by vitreous haemorrhage, asteroid hyalosis, posterior vitreous detachment, retinal detachment, and intraocular foreign body. These findings underscore the value of routine preoperative B-scan ultrasonography for detecting clinically occult posterior segment lesions in patients with dense cataracts.

Discussion

The present prospective cross-sectional study evaluated the role of B-scan ultrasonography in detecting posterior segment abnormalities in patients with dense cataracts undergoing preoperative assessment. Dense cataracts frequently prevent direct visualization of the fundus, making preoperative identification of vitreoretinal pathology challenging. In such cases, B-scan ultrasonography serves as an invaluable imaging modality by providing real-time assessment of the posterior segment through opaque ocular media.

A total of 185 patients with clinically diagnosed dense cataracts were evaluated. The highest proportion of patients belonged to the 51–60 years age group (43.2%), followed by the 61–70 years age group (33.5%), indicating that dense cataracts predominantly affect the elderly population. This observation is consistent with the natural age-related degeneration of the crystalline lens and agrees with previous studies by Nzeh et al., Qureshi et al., and Ali et al., who reported a higher prevalence of dense cataracts among patients over 50 years of age.

A slight male predominance was observed in the present study, with 53.0% males and 47.0% females. Similar gender distributions have been reported in previous Indian and international studies. The observed difference may reflect healthcare-seeking behaviour, occupational exposure, socioeconomic factors, and regional demographic characteristics rather than a true biological predisposition.

Regarding laterality, the right eye was affected in 51.9% of patients, the left eye in 33.0%, while 15.1% had bilateral dense cataracts. Comparable distributions have been reported in earlier studies evaluating cataract patients undergoing routine preoperative ultrasonography. The predominance of unilateral involvement emphasizes the importance of individually assessing each eye before surgical intervention.

In the present study, 69.1% of patients demonstrated a normal posterior segment on B-scan ultrasonography. Although these patients showed no detectable abnormalities, ultrasonography was essential in excluding occult vitreoretinal disease before cataract surgery. Similar proportions of normal scans have been reported by Nzeh et al. and Qureshi et al., highlighting that B-scan not only identifies pathology but also provides reassurance regarding the absence of significant posterior segment lesions.

Among abnormal findings, vitreous degeneration was the most frequent abnormality (23.7%). Degenerative changes of the vitreous are commonly associated with ageing and are frequently encountered in elderly patients with cataracts. Similar findings have been documented in several previous studies, confirming vitreous degeneration as

the most prevalent posterior segment abnormality in eyes with opaque media.

Vitreous haemorrhage was detected in 1.6% of patients. The ability of B-scan ultrasonography to identify low-level mobile echoes within the vitreous cavity makes it particularly valuable in diagnosing vitreous haemorrhage when ophthalmoscopy is impossible. Early recognition allows ophthalmologists to modify surgical planning and investigate underlying retinal vascular disorders or trauma before cataract extraction.

Retinal detachment was identified in 1.0% of patients, with an additional 0.5% demonstrating retinal detachment associated with vitreous haemorrhage. Retinal detachment is one of the most clinically significant posterior segment abnormalities because failure to detect it before cataract surgery may result in poor postoperative visual outcomes despite technically successful surgery. B-scan ultrasonography reliably demonstrates detached retinal membranes, their extent, mobility, and associated vitreous abnormalities, thereby facilitating appropriate referral for vitreoretinal management.

Posterior vitreous detachment was observed in 1.0% of patients, while another 1.0% exhibited posterior vitreous detachment associated with vitreous degeneration. Dynamic B-scan examination is particularly useful in differentiating posterior vitreous detachment from retinal detachment based on membrane mobility and attachment characteristics. Accurate distinction between these entities is essential because their clinical management and prognosis differ substantially.

Asteroid hyalosis was identified in 1.6% of patients. The characteristic highly reflective mobile echoes seen on ultrasonography enable confident diagnosis even when dense cataracts preclude fundus visualization. Although asteroid hyalosis often has minimal impact on vision, its identification helps avoid diagnostic confusion with vitreous haemorrhage or inflammatory vitreous opacities.

One patient (0.5%) was found to have an intraocular foreign body, highlighting the importance of B-scan ultrasonography in patients with a history of ocular trauma. Prompt detection of retained intraocular foreign bodies significantly influences surgical planning and prevents serious vision-threatening complications.

No cases of posterior staphyloma were detected in the present study. Although posterior staphyloma is commonly associated with pathological myopia, its absence may be attributed to the demographic characteristics of the study population.

Overall, approximately 31% of patients demonstrated previously undetected posterior segment abnormalities. This finding emphasizes that a considerable proportion of patients with dense cataracts harbour occult ocular pathologies that cannot be identified through routine clinical examination alone. Preoperative B-scan ultrasonography therefore provides valuable information that directly influences surgical planning, prognosis, patient counselling, and postoperative expectations.

The findings of the present study are consistent with published literature demonstrating the high diagnostic accuracy of B-scan ultrasonography in evaluating opaque ocular media. The technique is non-invasive, inexpensive, rapid, widely available, and free from ionizing radiation, making it an indispensable component of preoperative assessment in patients with dense cataracts, particularly in resource-limited settings.

Strengths of the Study

- Prospective cross-sectional study design.
- Adequate sample size of 185 patients.
- Standardized B-scan ultrasonographic examination for all participants.
- Comprehensive evaluation of posterior segment abnormalities in dense cataracts.
- Study conducted in a tertiary care teaching hospital, enhancing clinical applicability.
- Findings provide valuable information for ophthalmologists regarding preoperative surgical planning and visual prognosis.

Limitations

- Single-centre study, which may limit generalizability.
- Relatively modest sample size compared with multicentre studies.
- Histopathological or intraoperative confirmation was not available for every posterior segment lesion.
- Long-term postoperative visual outcomes were not evaluated.
- Advanced imaging modalities such as optical coherence tomography could not be performed because of dense lens opacity.

Conclusion

B-scan ultrasonography is a highly effective, non-invasive, and reliable imaging modality for evaluating posterior segment abnormalities in patients with dense cataracts where direct ophthalmoscopic examination is not feasible. In the present study, B-scan ultrasonography successfully identified occult posterior segment pathologies in approximately one-third of patients, with vitreous degeneration being the most common abnormality, followed by vitreous haemorrhage, retinal detachment, posterior vitreous detachment, asteroid hyalosis, and intraocular foreign body.

The findings demonstrate that routine preoperative B-scan ultrasonography provides valuable diagnostic information that significantly influences surgical planning, patient counselling, and prediction of postoperative visual outcomes. Early identification of clinically unsuspected vitreoretinal abnormalities enables timely referral for appropriate ophthalmic intervention and helps prevent unexpected visual impairment following cataract surgery. Based on the results of this study, routine B-scan ultrasonographic evaluation should be considered an integral component of the preoperative assessment of all patients with dense cataracts, particularly when posterior segment visualization is obscured by opaque ocular media.

Clinical Implications

- B-scan ultrasonography effectively detects occult posterior segment abnormalities hidden by dense cataracts.
- Preoperative ultrasonographic evaluation improves surgical planning and risk stratification.
- Early identification of retinal and vitreous pathologies facilitates timely vitreoretinal referral.
- Routine B-scan examination enhances prediction of postoperative visual outcomes.
- The technique is rapid, safe, non-invasive, inexpensive, and readily available, making it particularly valuable in tertiary care centres and resource-limited settings.

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