International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Role of B-Scan Ultrasonography in Detecting Posterior Segment Pathology in Eyes with Opaque Ocular Media: A Prospective Observational Study

Dr. Rachana.D[1], Dr. M. Narayan[2], Dr. G. Hemeswari[3], Dr. K. Harshitha[4], Dr. Salma Sheik Begum[5], Dr. Bollempalli Sri Sai Chaitra[6]

[1]M.S ophthalmology , 3rd year postgraduate , PES institute of medical sciences and research
[2]M.S ophthalmology , head of the department (Ophthalmology) PES institute of medical sciences and research
[3,4,5,6]M.s ophthalmology, 3rd year postgraduate, PES institute of medical sciences and research

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Corresponding Author:

Dr. Rachana. D
M.S ophthalmology , 3rd year postgraduate , PES institute of medical sciences and research

Received: 03-05-2026
Accepted: 22-05-2026
Available online: 10-06-2026

ABSTRACT

Background: Evaluation of the posterior segment is often challenging in the presence of opaque ocular media, where direct visualization of the fundus is not possible. B-scan ultrasonography serves as a valuable diagnostic tool for assessing posterior segment abnormalities in such situations.
Aim: To evaluate the role of B-scan ultrasonography in detecting posterior segment pathology in eyes with opaque ocular media.
Materials and Methods: This prospective observational study was conducted in the Department of Ophthalmology, PES Institute of Medical Sciences and Research, Kuppam, from July 2025 to January 2026. A total of 105 patients comprising 110 eyes with opaque ocular media were included. All patients underwent detailed ophthalmic examination followed by B-scan ultrasonography. The indications for B-scan examination and posterior segment findings were recorded and analyzed.
Results: Of the 105 patients, 56 (53.33%) were males and 49 (46.67%) were females. Lenticular opacity was the most common indication for B-scan ultrasonography, accounting for 63 eyes (57.27%), followed by vitreous opacity in 26 eyes (23.64%). B-scan examination revealed a normal posterior segment in 59 eyes (53.64%), while posterior segment abnormalities were detected in 51 eyes (46.36%). Vitreous disorders constituted the most common abnormality and were observed in 33 eyes (30.00%). Vitreous hemorrhage associated with retinal detachment was identified in 9 eyes (8.18%), isolated retinal detachment in 8 eyes (7.27%), and dislocated posterior chamber intraocular lens in 1 eye (0.91%). Among vitreous disorders, vitreous hemorrhage was the most frequent finding (54.55%). Diabetes mellitus was the most common etiological factor for vitreous hemorrhage, accounting for 33.33% of cases.
Conclusion: B-scan ultrasonography is a reliable, non-invasive, and effective imaging modality for evaluating posterior segment pathology in eyes with opaque ocular media. It facilitates early diagnosis of occult posterior segment lesions, aids in treatment planning, and remains an indispensable investigation when direct fundus examination is not feasible.

Keywords*: B-scan ultrasonography, opaque ocular media, posterior segment pathology, vitreous hemorrhage, retinal detachment, ocular ultrasound.*

INTRODUCTION

Evaluation of the posterior segment is a vital component of comprehensive ophthalmic assessment. Many sight-threatening conditions involving the vitreous, retina, choroid, and optic nerve require timely diagnosis and management to preserve visual function. Clinical examination of the posterior segment is commonly performed using direct ophthalmoscopy, indirect ophthalmoscopy, and slit-lamp biomicroscopy; however, these techniques depend upon adequate transparency of the ocular media.[1]

A variety of ocular conditions, including dense cataract, vitreous hemorrhage, corneal opacity, hyphema, inflammatory membranes, endophthalmitis, and ocular trauma, can result in opaque media and prevent direct visualization of the fundus.[2,3] In such circumstances, accurate assessment of the posterior segment becomes difficult, and important pathological conditions may remain undiagnosed. Failure to identify these abnormalities can adversely affect treatment planning, visual prognosis, and surgical outcomes.[4]

B-scan ultrasonography is a valuable diagnostic imaging technique that overcomes these limitations by providing real-time cross-sectional images of intraocular and orbital structures irrespective of media clarity. It is a non-invasive, safe, rapid, economical, and readily available investigation that can be performed even in eyes with severely compromised visualization.[1,5] The technique enables detailed evaluation of the vitreous cavity, retina, choroid, sclera, and optic nerve and is particularly useful in detecting retinal detachment, vitreous hemorrhage, posterior vitreous detachment, choroidal detachment, intraocular foreign bodies, intraocular tumors, and dislocated intraocular lenses.[6,7]

Numerous studies have demonstrated the clinical utility of B-scan ultrasonography in evaluating eyes with opaque ocular media. Nanda et al. reported that B-scan ultrasonography is an indispensable tool for detecting posterior segment abnormalities when fundus examination is not possible.[8] Agrawal and Ahirwal, Kumar et al., and Sujatha et al. observed that vitreous hemorrhage and retinal detachment were among the most frequently detected abnormalities on ultrasonographic examination.[5,6,9] Pallamreddy et al. further emphasized the role of B-scan ultrasonography in preoperative evaluation of patients with dense cataract by identifying occult posterior segment pathologies that could influence surgical management and visual prognosis.[2]

Despite significant advances in ophthalmic imaging modalities, B-scan ultrasonography continues to retain an important role in the assessment of patients with opaque ocular media because many modern imaging techniques require a relatively clear optical pathway. Therefore, B-scan ultrasonography remains an indispensable diagnostic tool in ophthalmic practice. The present study was undertaken to evaluate the role of B-scan ultrasonography in detecting posterior segment pathology in eyes with opaque ocular media and to analyze the spectrum of abnormalities encountered in a tertiary care hospital setting.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Ophthalmology, PES Institute of Medical Sciences and Research, Kuppam, over a period of seven months from July 2025 to January 2026. The study was approved by the Institutional Ethics Committee and Scientific Review Committee. Written informed consent was obtained from all participants or their guardians prior to enrolment.

Study Population

A total of 105 patients comprising 110 eyes with opaque ocular media were included in the study. Consecutive eligible patients presenting to the Ophthalmology outpatient department during the study period were recruited until the desired sample size was achieved. The sample size was determined based on previous published studies evaluating posterior segment pathology using B-scan ultrasonography in eyes with opaque media and the number of eligible patients presenting during the study period.

Inclusion Criteria

- Patients of all age groups and both sexes.
- Patients willing to provide informed consent.
- Presence of opaque or hazy ocular media, including dense cataract, vitreous hemorrhage, corneal opacity, hyphema, anterior chamber membranes, or other conditions preventing adequate visualization of the posterior segment.

Exclusion Criteria

- Patients with active ocular surface infection.
- Patients with open globe injuries associated with extrusion or risk of extrusion of intraocular contents.
- Patients unwilling to participate in the study.

Clinical Evaluation

All patients underwent a comprehensive ophthalmic examination, which included assessment of visual acuity, refraction, external ocular examination, slit-lamp biomicroscopy of the anterior segment, intraocular pressure measurement using Goldmann applanation tonometry, and indirect ophthalmoscopy whenever visualization of the fundus was possible.

B-Scan Ultrasonography

Following clinical examination, all patients underwent B-scan ultrasonography for evaluation of the posterior segment. The examination was performed using a standard ophthalmic ultrasound machine equipped with a 10–12 MHz probe.

The contact technique was employed through closed eyelids after application of a coupling gel. Patients were examined in a reclining or supine position.

Scanning was performed in axial, transverse, longitudinal, and oblique planes to ensure complete visualization of the posterior segment. Dynamic (kinetic) echography was utilized whenever necessary to assess the mobility of membranous structures and to differentiate vitreous, retinal, and choroidal pathologies. Variable gain settings were used to evaluate lesion reflectivity and internal characteristics.

Posterior segment findings such as vitreous hemorrhage, posterior vitreous detachment, retinal detachment, choroidal detachment, vitreous degeneration, asteroid hyalosis, dislocated posterior chamber intraocular lens, and other abnormalities were documented in a standardized proforma. The ultrasonographic diagnosis was correlated with clinical findings wherever possible and was utilized for subsequent management planning.

Data Collection

Demographic details, laterality, indications for B-scan examination, and ultrasonographic findings were recorded and analyzed. All ultrasonographic observations were systematically documented for further statistical evaluation.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical methods. Categorical variables were expressed as frequencies and percentages. The results were presented using tables and charts wherever appropriate.

RESULTS AND OBSERVATIONS

Table 1. Gender Distribution of Study Participants

Gender	Number of Patients (n=105)	Percentage (%)
Male	56	53.33
Female	49	46.67
Total	**105**	**100**

Among the 105 patients included in the study, 56 (53.33%) were males and 49 (46.67%) were females, showing a slight male predominance.

Table 2. Laterality Distribution

Laterality	Number of Patients	Number of Eyes	Percentage (%)
Right Eye	59	59	53.64
Left Eye	41	41	37.27
Bilateral	5	10	9.09
Total	**105**	**110**	**100**

Of the 110 eyes evaluated, 59 (53.64%) were right eyes and 41 (37.27%) were left eyes. Bilateral involvement was observed in 5 patients, accounting for 10 eyes (9.09%). Right eye involvement was more common than left eye involvement.

Table 3. Indications for B-Scan Ultrasonography

Indication	Number of Eyes (n=110)	Percentage (%)
Lenticular opacity	63	57.27
Vitreous opacity	26	23.64
Anterior chamber membrane and hyphema	12	10.91
Corneal opacity	9	8.18
Total	**110**	**100**

Lenticular opacity was the most common indication for B-scan ultrasonography and was present in 63 eyes (57.27%). Vitreous opacity accounted for 26 eyes (23.64%), followed by anterior chamber membrane and hyphema in 12 eyes (10.91%). Corneal opacity was the least common indication, observed in 9 eyes (8.18%).

Table 4. B-Scan Ultrasonographic Findings

Finding	Number of Eyes (n=110)	Percentage (%)
Normal posterior segment	59	53.64
Vitreous disorders	33	30
Vitreous hemorrhage with retinal detachment	9	8.18
Retinal detachment	8	7.27
Dislocated PCIOL in vitreous	1	0.91
Total	**110**	**100**

B-scan ultrasonography revealed a normal posterior segment in 59 eyes (53.64%). Posterior segment abnormalities were detected in 51 eyes (46.36%). Vitreous disorders constituted the most common abnormal finding and were observed in 33 eyes (30.00%). Vitreous hemorrhage associated with retinal detachment and isolated retinal detachment were identified in 9 eyes (8.18%) and 8 eyes (7.27%), respectively. A dislocated posterior chamber intraocular lens was detected in 1 eye (0.91%).

Table 5. Distribution of Vitreous Disorders

Vitreous Disorder	Number of Cases (n=33)	Percentage (%)
Vitreous hemorrhage	18	54.55
Posterior vitreous detachment	9	27.27
Vitreous degeneration	4	12.12
Asteroid hyalosis	2	6.06
Total	**33**	**100**

Among the 33 eyes with vitreous disorders, vitreous hemorrhage was the most frequently encountered pathology, accounting for 18 cases (54.55%). Posterior vitreous detachment was observed in 9 cases (27.27%), followed by vitreous degeneration in 4 cases (12.12%). Asteroid hyalosis was the least common vitreous abnormality and was detected in 2 cases (6.06%).

Table 6. Etiology of Vitreous Hemorrhage

Etiology	Number of Cases (n=18)	Percentage (%)
Diabetes mellitus	6	33.33
Trauma	5	27.78
Hypertension	3	16.67
Diabetes mellitus + Hypertension	3	16.67
Idiopathic	1	5.56
Total	**18**	**100**

Among the 18 cases of vitreous hemorrhage, diabetes mellitus was the most common etiological factor and was present in 6 cases (33.33%). Trauma was responsible for 5 cases (27.78%). Hypertension alone and combined diabetes mellitus with hypertension each accounted for 3 cases (16.67%), while the etiology remained idiopathic in 1 case (5.56%). Diabetes-related systemic disease constituted the most important underlying risk factor for vitreous hemorrhage in the present study.

DISCUSSION

Evaluation of the posterior segment becomes particularly challenging when visualization of the fundus is obscured by media opacities. In such circumstances, B-scan ultrasonography serves as an effective diagnostic tool by providing valuable information regarding the status of the vitreous, retina, and choroid. The present study assessed the role of B-scan ultrasonography in detecting posterior segment abnormalities in eyes with opaque ocular media and demonstrated its usefulness in routine clinical practice.

Among the 105 patients included in the study, males constituted 53.33% of the study population, while females accounted for 46.67%. A similar gender distribution has been documented by Nanda et al.[7] and Kumar et al.[5]. The slight male predominance observed may be related to increased exposure to occupational hazards and trauma, as well as differences in healthcare-seeking behavior.

Lenticular opacity was the leading indication for B-scan examination, accounting for 57.27% of the eyes studied. This observation is in agreement with reports by Pallamreddy et al.[2] and Sharma et al.[4], who also identified dense cataract as the principal cause of non-visualization of the posterior segment. These findings emphasize the importance of ultrasonographic screening before cataract surgery, particularly in patients with advanced lens opacification.

More than half of the eyes examined in the present study showed no detectable posterior segment abnormality on B-scan ultrasonography. However, clinically significant pathology was identified in 46.36% of eyes. This finding highlights an important clinical aspect: although many eyes with opaque media may have a normal posterior segment, a considerable proportion harbor abnormalities that cannot be detected without ultrasonographic evaluation. Similar observations have been reported in previous studies evaluating opaque ocular media.[6,7]

Among the pathological findings, vitreous disorders represented the largest category. Vitreous hemorrhage emerged as the most frequently encountered vitreous abnormality, followed by posterior vitreous detachment, vitreous degeneration, and asteroid hyalosis. Comparable patterns have been described by Agrawal and Ahirwal,[8] Kumar et al.,[5] and Sujatha et al.[9] The predominance of vitreous hemorrhage may be explained by the fact that hemorrhage itself often obscures fundus visualization and necessitates ultrasonographic assessment.

Retinal detachment remains one of the most critical diagnoses that can be established using B-scan ultrasonography. In the present study, retinal detachment was detected either as an isolated finding or in association with vitreous hemorrhage. Similar observations have been documented in several published studies.[5,7,10] Accurate identification of retinal detachment is essential because timely vitreoretinal intervention can significantly influence visual outcomes. The ability of ultrasonography to distinguish retinal detachment from other membranous vitreous abnormalities further enhances its clinical utility.

Analysis of vitreous hemorrhage cases demonstrated diabetes mellitus as the most common underlying etiology, followed by trauma. This pattern is consistent with the increasing prevalence of diabetic retinal disease and with observations reported by previous investigators.[5,8,9] The findings underscore the role of B-scan ultrasonography in evaluating eyes where diabetic vitreous hemorrhage precludes retinal examination and in identifying associated retinal complications.

The findings of the present study support the continued relevance of B-scan ultrasonography despite advances in retinal imaging technology. Unlike several contemporary imaging modalities that require a relatively clear optical pathway, ultrasonography can provide reliable diagnostic information even in the presence of dense media opacity. In addition to aiding diagnosis, the information obtained from B-scan examination assists clinicians in treatment planning, patient counselling, and estimation of visual prognosis.[10-13]

The present study was limited by its single-center design and relatively modest sample size. Furthermore, detailed age-based analysis and long-term follow-up correlation were not available. Nevertheless, the prospective nature of the study and inclusion of a wide spectrum of media opacities provide useful insight into the pattern of posterior segment abnormalities encountered in routine ophthalmic practice.

Overall, the present study demonstrates that B-scan ultrasonography remains an indispensable investigation for evaluating eyes with opaque ocular media. Its ability to detect clinically significant posterior segment pathology in a rapid, safe, and non-invasive manner makes it an essential component of ophthalmic diagnostic practice.

CONCLUSION

B-scan ultrasonography is a valuable, non-invasive, safe, and cost-effective diagnostic modality for the evaluation of posterior segment pathology in eyes with opaque ocular media. It provides reliable information regarding vitreoretinal status when direct visualization of the fundus is not possible. In the present study, B-scan ultrasonography successfully identified a wide spectrum of posterior segment abnormalities, with vitreous disorders being the most common finding and vitreous hemorrhage representing the predominant vitreous pathology. The technique proved particularly useful in detecting retinal detachment and other clinically significant lesions that could influence visual prognosis and management. Therefore, B-scan ultrasonography remains an indispensable investigation in the assessment of patients with opaque ocular media and plays an important role in diagnosis, treatment planning, and patient counselling.

LIMITATIONS OF THE STUDY

1. The study was conducted at a single tertiary care center, which may limit the generalizability of the findings.
2. The sample size was relatively small and may not represent the entire spectrum of posterior segment pathology encountered in the general population.
3. Long-term follow-up and correlation of ultrasonographic findings with surgical outcomes were not performed in all cases.
4. Detailed age-based subgroup analysis was not undertaken.
5. Inter-observer variability in interpretation of B-scan findings was not assessed.

Funding

No external funding was received for this study.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Ethical Approval

The study was approved by the Institutional Ethics Committee of PES Institute of Medical Sciences and Research, Kuppam. Written informed consent was obtained from all participants prior to enrolment in the study.

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