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TO STUDY ROLE OF B SCAN ULTRASOUND IN DIAGNOSIS OF POSTERIOR SEGMENT PATHOLOGIES OF EYE

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ABSTRACT

Background: Posterior segment evaluation is essential in diagnosing sight-threatening ocular pathologies. However, media opacities such as dense cataracts, corneal opacities, and vitreous hemorrhage often preclude direct visualization. B-scan ultrasonography (Brightness-mode scan) is a valuable imaging tool in such cases, providing real-time, non-invasive cross-sectional images of intraocular structures.This study aimed to evaluate the role of B-scan ultrasonography in diagnosing posterior segment pathologies in patients with opaque ocular media and to correlate ultrasonographic findings with clinical diagnoses.

Materials and Methods: A prospective observational study was conducted on 140 eyes from 100 patients with opaque media at Index Medical College Hospital & Research Centre, Indore, over 12 months. All patients underwent detailed clinical examination followed by B-scan ultrasonography using a 10 MHz probe. Findings were documented and analyzed to determine the prevalence and pattern of posterior segment pathologies.

Results: Of the 140 eyes examined, 63 eyes (45%) showed posterior segment abnormalities. Vitreous disorders were most common (60%), followed by retinal detachment (14.2%) and combined retinal detachment with vitreous hemorrhage (11.6%). B-scan findings supplemented the clinical diagnosis in 70% of eyes and correlated in 27%. In 3% of eyes, B-scan failed to detect optic nerve pathologies due to dense hemorrhage. Lenticular opacity was the most frequent cause of media opacity (68%).

Conclusion: B-scan ultrasonography is a reliable, accessible, and non-invasive modality for evaluating posterior segment disorders in eyes with opaque media. Despite limitations in detecting optic nerve pathologies, it significantly enhances diagnostic accuracy and supports clinical decision-making in ophthalmic practice.

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

INTRODUCTION

The human eye is susceptible to a broad spectrum of pathological conditions affecting individuals from infancy to old age. Accurate diagnosis, particularly of posterior segment lesions, is crucial for effective management. [1] While slit-lamp examination and fundoscopy are the mainstays in ophthalmic evaluation, their utility becomes limited in the presence of opaque ocular media

caused by conditions such as corneal opacities, dense cataracts, vitreous hemorrhage, or anterior chamber inflammation. In such scenarios, ultrasonography (US), especially B-scan ultrasonography, plays a vital role by allowing visualization of structures that are otherwise obscured [2].

B-scan (Brightness-mode scan) is a two-dimensional imaging modality that utilizes high-frequency sound waves to generate real-time cross-sectional images of the eye. It is safe, painless, cost-effective, and can be performed without anesthesia or sedation, making it suitable even in outpatient settings [3]. The modality is particularly useful in assessing the posterior segment of the eye, helping detect retinal detachment, vitreous hemorrhage, choroidal detachment, intraocular tumors, subretinal hemorrhage, and inflammatory lesions [4,5].

Even when the ocular media is clear, B-scan serves as a complementary tool in diagnosing unexplained inflammatory conditions like retinitis and choroiditis and in differentiating intraocular tumors. In ocular trauma, especially in young adults, B-scan can detect intraocular foreign bodies not visible on X-rays and assess associated damage to the lens, vitreous, or retina, thereby aiding therapeutic decision-making [6,7]. Moreover, Color Doppler imaging enhances diagnostic accuracy by evaluating tumor vascularity and distinguishing vitreous hemorrhage from retinal detachment.

Given its high diagnostic value, B-scan is often the first-line imaging technique for evaluating vitreo-retinal pathologies when conventional methods are inconclusive. It is also beneficial for follow-up, as it poses no radiation risk and can be repeated without harm [8].

This study aims to determine the prevalence and pattern of posterior segment disorders in patients with opaque ocular media using B-scan ultrasonography and to correlate ultrasonographic findings with clinical diagnoses. The goal is to reinforce the role of B-scan as a crucial diagnostic and prognostic tool in ophthalmic practice.

MATERIAL AND METHODS

This prospective cross-sectional observational study was conducted in the Department of Ophthalmology at Index Medical College Hospital & Research Centre, Indore, over a period of 12 months, from July 2023 to June 2024, after obtaining approval from the Institutional Ethics and Scientific Review Committee. Written informed consent was obtained from all participants (or guardians, in the case of minors) in their vernacular language before enrolment.

A total of 140 eyes from patients with suspected posterior segment pathologies and opaque ocular media were evaluated using B-scan ultrasonography. The sample size was determined based on prior studies to ensure adequate representation and statistical validity.

Inclusion Criteria

- Patients aged more than 5 years
- Patients providing informed consent
- Presence of opaque or hazy ocular media (e.g., corneal opacity, dense cataract, vitreous hemorrhage) precluding visualization of the posterior segment by conventional methods

Exclusion Criteria

- Age ≤ 5 years
- Refusal to provide informed consent
- Ruptured globe
- Clear ocular media where posterior segment evaluation could be done using ophthalmoscopy
- Active ocular surface infections

Methodology

All patients underwent a detailed ophthalmic evaluation which included:

- Visual acuity testing (uncorrected and best corrected)

- Refraction using autorefractometer and subjective refraction
- External ocular examination
- Slit-lamp biomicroscopic evaluation
- Intraocular pressure (IOP) measurement using Goldmann Applanation Tonometry (GAT)
- Indirect ophthalmoscopy, wherever feasible

Subsequently, all patients underwent B-scan ultrasonography, performed using the ECHOSCAN 4000 imaging system with a transducer frequency of 10 MHz. The procedure was conducted through closed eyelids with the application of a coupling gel. Scans were taken in transverse and longitudinal planes. The aim was to identify and document any posterior segment pathology and correlate ultrasonographic findings with clinical suspicion and diagnosis.

Outcome

The primary outcome was to determine the prevalence and pattern of posterior segment disorders in eyes with opaque media and to correlate ultrasonographic findings with clinical diagnosis, where possible.

Statistical Analysis

Data were compiled in Microsoft Excel and analyzed using IBM SPSS Statistics version 26.0. Continuous variables (e.g., age) were expressed as mean ± standard deviation (SD) and compared using the unpaired t-test. Categorical variables (e.g., gender, specific diagnoses) were expressed as frequencies and percentages and analyzed using the Chi-square test. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 140 eyes from 100 patients with opaque ocular media were evaluated using B-scan ultrasonography. Among these, 63 eyes (45%) showed evidence of posterior segment pathologies, while 77 eyes (55%) had normal B-scan findings. [Figure 1]

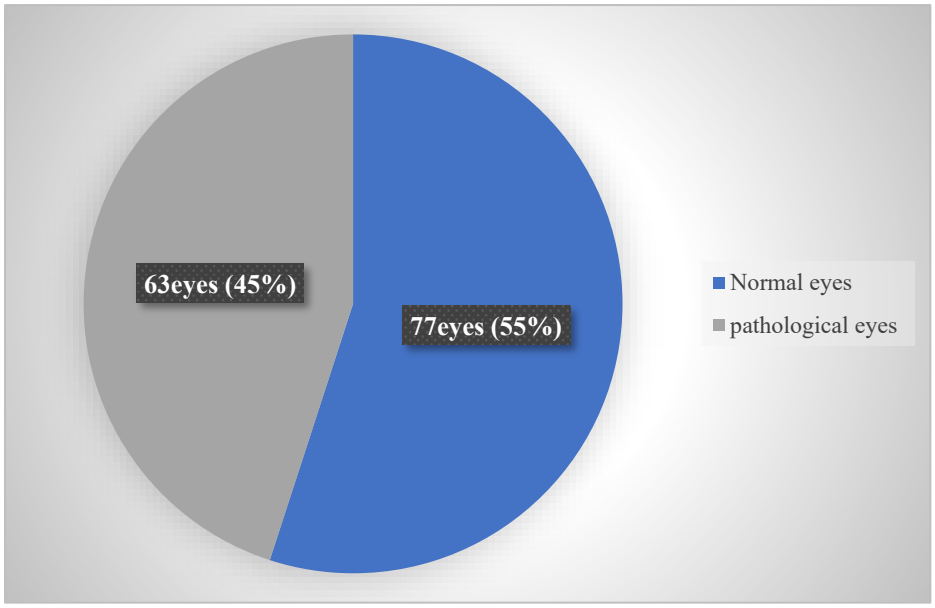

Figure 1. Distribution of Normal and Pathological Eyes Based on B-Scan Findings

The age-wise distribution revealed that most participants were between 51–70 years (56 patients, 40%), followed by 31–50 years (48 patients, 34%), 11–30 years (18 patients, 13%), >70 years (14 patients, 10%), and <10 years (4 patients, 3%). Males constituted 55% of the participants and females 45%. [Table 1]

Table 1: Demographic Profile of Study Participants

Parameter	No. of Patients	Percentage
Age Group (Years)		
<10	4	3%
11–30	18	13%
31–50	48	34%
51–70	56	40%
>70	14	10%
Gender		
Male	55	55%
Females	45	45%

According to the Distribution of Opaque Ocular Media, the most common cause of media opacity was lenticular opacity, observed in 95 eyes (68%), followed by corneal opacities (28 eyes, 20%), vitreous opacities (12 eyes, 8%), and anterior chamber membrane or hyphema (9 eyes, 4%). [Table 2]

Table 2: Distribution of Opaque Ocular Media

Type of Opacity	No. of Eyes	Percentage (%)
Lenticular opacity	95	68%
Corneal opacities	28	20%
Vitreous opacities	12	8%
Anterior chamber membrane/hyphema	9	4%

According to the distribution of Posterior Segment Pathologies, among the 63 eyes showing abnormal findings on B-scan, vitreous disorders were the most common pathology, observed in 38 eyes (60%), followed by retinal detachment in 9 eyes (14.2%) and combined retinal detachment with vitreous hemorrhage in 7 eyes (11.6%). Less frequently observed were posterior staphyloma (5 eyes, 8%), choroidal detachment (3 eyes, 4.7%), and retinoblastoma (1 eye, 1.5%). [Table 3, Figure 2]

Table 3: Distribution of Posterior Segment Pathologies

Posterior Segment Disorder	No. of Eyes	Percentage (%)
Vitreous disorders	38	60.0%
Retinal detachment	9	14.2%
Retinal detachment + Vitreous hemorrhage	7	11.6%
Posterior staphyloma	5	8.0%
Choroidal detachment	3	4.7%
Retinoblastoma	1	1.5%

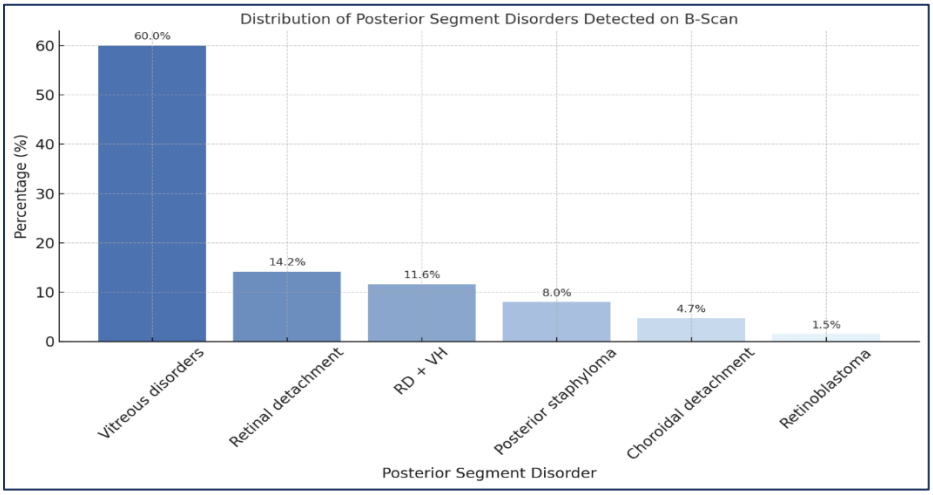

Figure 2. Distribution of Posterior Segment Disorders Detected on B-Scan

According to the distribution of vitreous disorders observed in this study, out of the 38 eyes diagnosed with vitreous pathology on B-scan ultrasonography, vitreous hemorrhage was the most common finding, identified in 21 eyes (56.6%). This was followed by posterior vitreous detachment, seen in 10 eyes (26.41%). Less frequently encountered conditions included vitreous degeneration in 4 eyes (7.5%) and asteroid hyalosis in 3 eyes (5.6%). These findings highlight the predominance of hemorrhagic and degenerative changes among the vitreous pathologies detectable through ultrasonography in eyes with opaque ocular media. [Table 4, Figure 3]

Table 4: Distribution of Vitreous Disorders

Vitreous Disorder	No. of Cases	Percentage (%)
Vitreous hemorrhage	21	56.6%
Posterior vitreous detachment	10	26.41%
Vitreous degeneration	4	7.5%
Asteroid hyalosis	3	5.6%

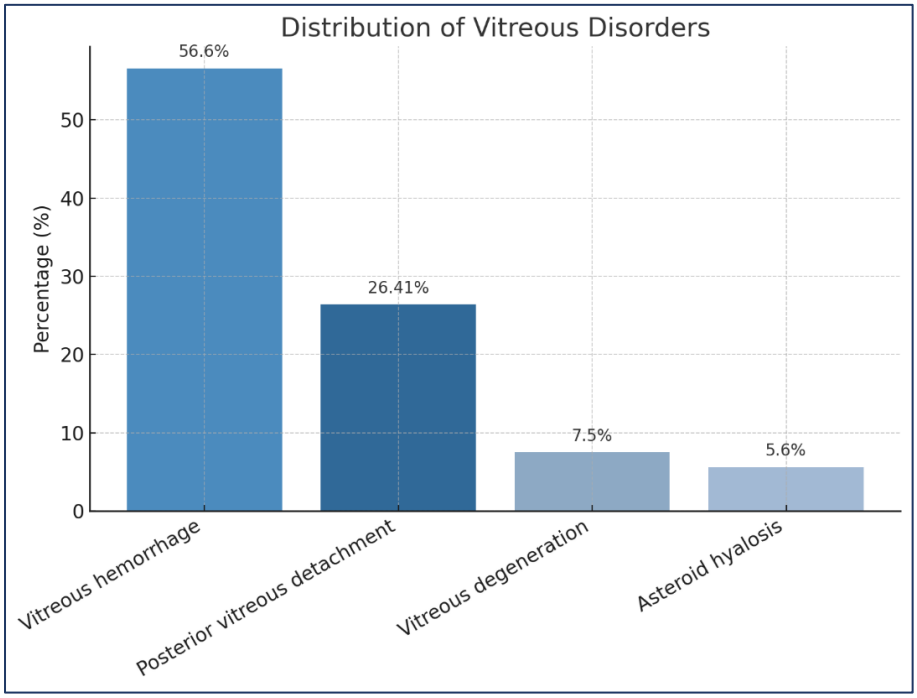

Figure 3. Distribution of Vitreous Disorders

The correlation between clinical diagnosis and final diagnosis based on B-scan ultrasonography findings was evaluated in all 140 eyes. In 98 eyes (70%), B-scan supplemented the clinical diagnosis, providing additional information that influenced or confirmed the final diagnosis. In 38 eyes (27%), the B-scan findings directly correlated with the clinical diagnosis, affirming the initial clinical impression. However, in 4 eyes (3%), the diagnosis was missed on B-scan. These cases had initially presented with features suggestive of vitreous hemorrhage, including absence of fundus glow, but upon further evaluation and follow-up, were diagnosed with optic neuropathy and optic nerve avulsion, underscoring the limitations of ultrasonography in certain posterior segment pathologies. [Table 5, Figure 4]

Table 5: Correlation of Clinical and Final Diagnosis

Observation	Evaluation	No. of Eyes	Percentage (%)
Supplemented	FD = CD + US	98	70%
Correlated	FD = CD	38	27%
Missed	—	4	3%

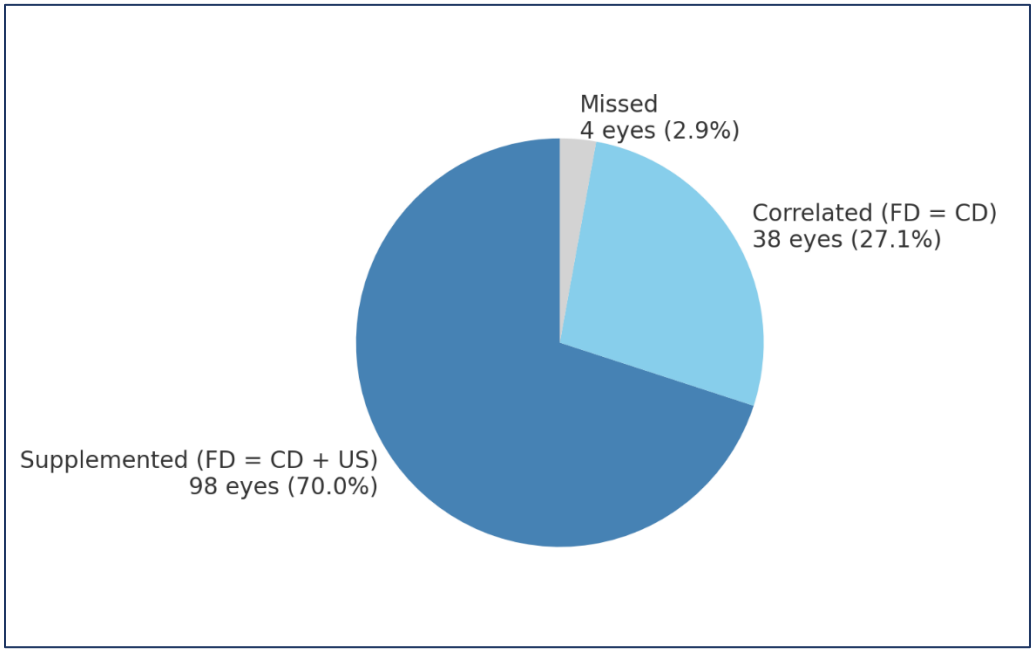

Figure 4. Correlation of Clinical and Final Diagnosis Based on B-Scan Findings

DISCUSSION

The posterior segment of the eye comprises critical structures such as the vitreous, retina, choroid, and optic nerve head. Evaluation of these components is often impeded in the presence of opaque ocular media—resulting from conditions like dense cataracts, corneal opacities, hyphema, or vitreous hemorrhage—rendering ophthalmoscopic examination inconclusive. In such scenarios, B-scan ultrasonography has proven to be a reliable, non-invasive imaging modality, enabling visualization of otherwise inaccessible posterior segment abnormalities.

This prospective observational study, involving 140 eyes from 100 patients, demonstrated a posterior segment pathology detection rate of 45%, corroborating findings from prior literature that emphasize the role of B-scan in diagnostic evaluation where traditional methods fail [2,9]. The age distribution showed a predominance in the 51–70 years age group (40%), followed by the 31–50 years group (34%), consistent with Sharma OP et al. [9], likely reflecting the natural increase in cataract and vitreoretinal pathologies with age. A male predominance (55%) was noted, aligning with reports from McLeod D et al. [10], Rajimwale G et al. [2], and Chaudhari H et al. [11], who found ocular abnormalities to be more frequent in males—possibly due to greater occupational exposure and trauma risk.

The most common cause of media opacity in our study was lenticular opacity (68%), followed by corneal opacities (20%), which mirrors the findings of Rajimwale G et al. [2] and Zvornicanin J et al. [12]. This underscores the routine preoperative need for posterior segment evaluation in cataract patients to identify co-existing pathologies that may impact surgical outcomes or prognosis.

Among abnormal findings, vitreous disorders were predominant (60%), which included vitreous hemorrhage (56.6%), posterior vitreous detachment (26.41%), vitreous degeneration (7.5%), and asteroid hyalosis (5.6%). These results parallel those reported by McLeod D et al. [10], Sharma OP et al. [9], and Ahmed J et al. [13], all of whom documented vitreous abnormalities as the leading pathology in cases with opaque media. In particular, Sharma OP [12] and Ahmed J [13] found vitreous hemorrhage to be the most frequent posterior segment lesion, similar to our observations. Haile M et al. [14] further support this with vitreous opacities being the second most common abnormality in their study.

Retinal detachment (14.2%) was the second most frequently diagnosed condition, comparable to the rates reported by Hassani and Bard (13.8%) [1], Ejaz Ahmed Javed et al. (14.7%) [15], and Haile M and Mengistu Z (39%) [14]. The variation across studies likely reflects differing clinical

demographics and case selection. Reports by Coleman DJ [16] and Taneja et al. [17] showed RD incidences of 25% and 7.6%, respectively.

Regarding diagnostic performance, B-scan ultrasonography supplemented clinical findings in 70% of cases, correlated in 27%, and missed in only 3%, mostly involving optic nerve pathologies obscured by dense hemorrhage. This limitation has also been documented by McLeod D et al. [10] and Zvornicanin J et al. [12], who acknowledged the challenge of imaging subtle optic nerve and retrobulbar lesions via ultrasonography alone. Nevertheless, Rajimwale G et al. [2] reported a diagnostic sensitivity of 97.7% and specificity of 80%, while Coleman DJ et al. [16] in a review of 100 cases, demonstrated near-perfect accuracy in identifying intraocular tumors with B-mode ultrasound.

Despite its strengths, this study had limitations. B-scan ultrasonography is operator-dependent and may miss subtle optic nerve pathologies in dense hemorrhagic media. Additionally, the lack of adjunct imaging (e.g., OCT, MRI) and single-center design may restrict the generalizability of findings.

Conclusion

This study reinforces the clinical value of B-scan ultrasonography as a frontline diagnostic tool for posterior segment evaluation in eyes with opaque media. It offers significant utility in detecting vision-threatening conditions such as vitreous hemorrhage, retinal detachment, and intraocular tumors—particularly when direct fundus examination is not possible. Although limitations exist in assessing optic nerve pathologies, the widespread availability, non-invasive nature, and diagnostic accuracy of B-scan make it an indispensable adjunct in ophthalmic imaging.

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