



Research Article

## B SCAN ULTRASOUND AND ITS SIGNIFICANCE IN DIAGNOSING POSTERIOR SEGMENT PATHOLOGIES OF EYE: TO SEE THE UNSEEN

Pratik Narendra Mohod., Dharmendra Kose and Shadwala Bharti

Jalapurti Colony Vidhyut nagar Vmv Road, India

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B-scan, Ultrasound, posterior segment, hazy media.

### ABSTRACT

**Objective:** To assess the diagnostic value of B-scan ultrasonography in evaluation of posterior segment disorders of eye in clear and hazy media, to correlate with clinical diagnosis, to comprehend its role in the management and to assess the limitations of B-scan ultrasound.

**Material and Methods:** In this Hospital Based Observational Descriptive Cross-Sectional Study of B-scan, 200 patients from august 2015 to April 2016 with known and suspicious posterior segment pathology were evaluated. Detailed ocular and systemic history, a thorough ocular examination including visual acuity, refraction, keratometry, ocular movement, and slit lamp and fundus examination with indirect ophthalmoscopy were done. B scan was done using E-Z Scan™ 5500+ Series Ophthalmic Ultrasound Scanner. Then analysis of the images was done in real-time and after freezing the images.

**Results:** 220 eyes of 200 patients with posterior segment pathologies were included in final data analysis, 124(62%) were male and 76(38%) were female. Majority of patients were in the age group of 51 to 70 yrs (51.5%), followed by 31 to 50 yrs (25%). No significant laterality preponderance. Majority of sample was made up of opaque media cases i.e. 183 eyes (83.18%) and meager number of cases presented with clear media i.e. 37 eyes (16.82%). On basis of final diagnosis, retinal detachment was diagnosed in 81 eyes (36.81%), followed by Vitreous Haemorrhage in 44 eyes(20%), posterior vitreous detachment found in 38eyes (17.27%). Intraocular Foreign body was seen in 3eyes. Correlation of clinical diagnosis with final diagnosis. Results were showed as supplemented (S), Correlated (C) and missed (M) Out of total scans, 162 eyes (73.63%) supplemented, 55 eyes (25%) correlated and 3 eyes (01.36%) missed the clinical diagnosis.

**Conclusion:** B-scan ultrasound is simple, non invasive, non-ionizing and cost effective imaging modality to detect and helps in efficient management of posterior segment pathologies of eye mainly in opaque media.

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### INTRODUCTION

Ultrasound is the sound that is above the audible frequency range of human hearing i.e. greater than 20kHz.<sup>1</sup> In 1793, Lazzaro Spallanzani in his experiment discovered that bats position themselves with the help of sound whistles while flying in darkness. This was the origin of modern ultrasound application.<sup>2</sup>

Ultrasound has become one of the most widely used technologies in medicine in 1930 after Sokolov proposed the first “acoustic microscope” to image tissues.<sup>3</sup> In 1956, two American ophthalmologists, Mundt and Hughes was first used ultrasound in the field of ophthalmology. They used industrial ultrasound equipment to examine enucleated normal eye and eyes with intra-ocular tumours.<sup>4</sup>

Ultrasonographic techniques are commonly used for the imaging of various tissue structures and organs, including the eyeball and orbit. Ophthalmic ultrasonography is the main diagnostic imaging modality of the eye predominantly in opaque media. Eyeball has a fluid content and its superficial position make it ideally suited for examination with ultrasound.<sup>5,6</sup> It is a safe, noninvasive diagnostic tool that provides instant feedback for the evaluation of various ophthalmic disorders

### MATERIAL AND METHODS

It was Hospital based Observational Descriptive Cross-Sectional study conducted at Department of Ophthalmology, tertiary care hospital in rural central area of India over a period from October 2015 to December 2017 on 220 eyes with the posterior segment pathology or suspected of having posterior segment pathology. The study includes patient with/ suspected posterior segment pathology, Age more than 5yrs, Hazy media, unexplained visual loss whereas all cases suspected to

\*Corresponding author: Pratik Narendra Mohod  
Jalapurti Colony Vidhyut nagar Vmv Road, India

have isolated anterior segmental and orbital lesions, Unstable/poor general health condition, age less than 5 years, patient with high risk of or apparent extrusion of intraocular contents were excluded from study.

Approval was taken from Institutional Ethical Committee of our institute for conducting this study. An informed consent was taken from all patients. After detailed ocular and systemic history, a thorough ocular examination including visual acuity, refraction, keratometry, ocular movement, and slit lamp and fundus examination with indirect ophthalmoscopy were done. B scan was done using E-Z Scan™ 5500+ Series Ophthalmic Ultrasound Scanner.

The patients were examined in supine position. The transducer was first cleaned and then gently placed on the closed eyelid after application of the thick layer of commercially available sonographic gel. Gel used was water soluble viscous gel (Arihant's Scan care gel) which was employed for sonographic examination of superficial layers. Entire eye was scanned. Scanning was done with contact B-scan probe coated with coupling gel.

**B-scan Probe Orientation**

1. Transverse scan – The Probe is kept at the limbus with the axis of marker circumferential at limbus. The area of the marker is displayed in the upper part of screen. This can be horizontal, vertical and/or oblique transverse scans.
2. Longitudinal scan – The marker is perpendicular to the limbus.
3. Axial Scan - Is done with the patient fixing in primary gaze and probe centred in the cornea. It displays lens and optic nerve in the centre of the echogram. This is useful for evaluation of macula.

During basic screening, the entire globe was examined, from the posterior pole out to the far periphery. Using a limbus-to-fornix approach, each quadrant is evaluated carefully. The 4 major quadrants include the 12-o'clock, 3-o'clock, 6-o'clock, and 9-o'clock positions, each centred on the right side of the echogram in transverse approaches. Because approximately 6 clock hours are imaged at once, by examining each quadrant, the areas examined overlap, thereby reassuring the examiner that the entire periphery of the globe is visualized. Next, document the posterior pole with a horizontal axial scan, which incorporates both the optic nerve and the macula in one echogram. If no additional pathology is detected, these 5 echograms complete the examination.

The study was conducted from high sensitive setting of 80db to 40db to differentiate various tissue densities. Necessary care was taken to avoid artefacts. The required images were frozen and a thermal print out was taken. Then patient's eyes were cleaned by cotton pads. Then analysis of the images was done in real-time and after freezing the images.

**RESULTS**

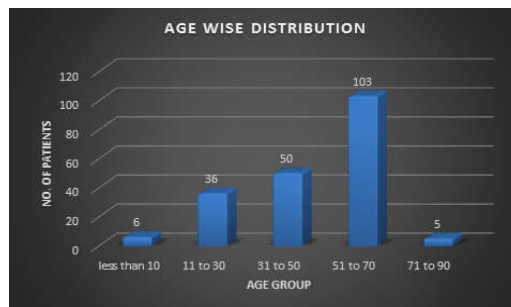


Fig 1 Bar diagram Showing age wise distribution



Fig No.2 shows gender wise distribution of patients. Out of total 200 patients 124 (62%) were male and 76 (38%) were female.

Table No 3 Distribution of patients according to affected eye/s

	No of Patients	Percent
RIGHT	87	43.5
LEFT	93	46.5
BOTH	20	10
Total	200	100

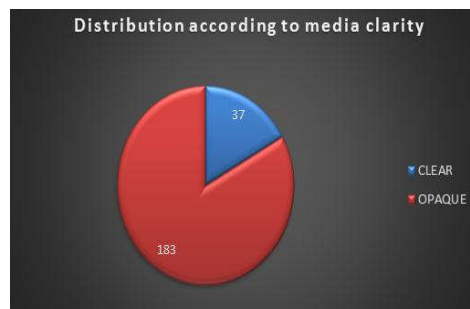


Fig No. 4 Pie diagram showing distribution of cases according to media clarity

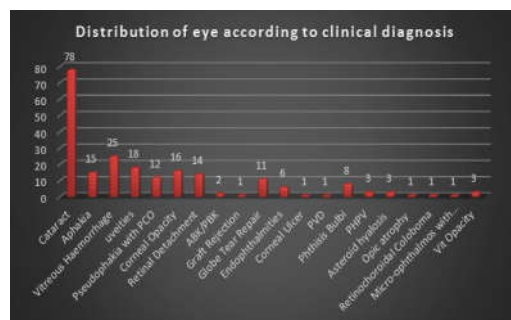


Fig No.5 Distribution of eye according to clinical diagnosis

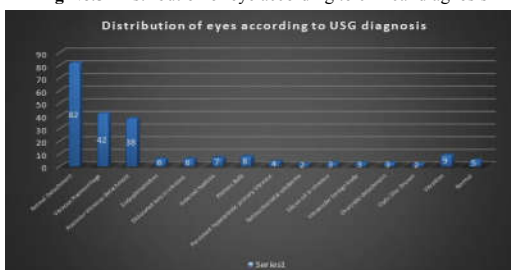


Fig No. 6 Distribution of eyes according to USG diagnosis

**Table No 7** Correlation of clinical diagnosis with final diagnosis

Observation	Evaluation	No. of eyes	Percent (%)
Supplemented (S)	FD= CD+ US	162	73.63
Correlated ( C )	FD = CD=US	55	25.00
Missed ( M)	M	03	01.36
Total		220	100

(FD- Final Diagnosis, CD- Clinical Diagnosis, US- Ultrasound diagnosis)

Results were showed as supplemented (S), Correlated (C) and missed (M).

When ultrasound findings were gives added information to clinical diagnosis to make final diagnosis (CD + US = FD) then it denoted as Supplemented (S).

When ultrasound findings were gives similar information to clinical diagnosis to make final diagnosis (CD = US = FD) then it denoted as correlated (C).

When the clinical findings were missed by ultrasound then it denoted as Missed (M).

In maximum cases clinical diagnosis was supplemented by ultrasound in 162 eyes (73.63%), clinical diagnosis was confirmed or correlated with ultrasound in 55 eyes (25%) and ultrasound missed the finding was diagnosed clinically in 3 eyes (01.36%).

## DISCUSSION

Use of ultrasonography in the investigation of ocular and orbital diseases was first used by Mundt and Hughes<sup>4</sup> in 1956. It has become an indispensable diagnostic tool that has increased our ability to detect and differentiate many ocular and orbital diseases especially in opaque ocular media. In the subsequent discussion, our findings will be discussed in correlation with those of other authors.

In the present study, 200 patients underwent B-scan ultrasound of 220 eyes including cases of both sexes and of age groups from 5 years with the youngest and 80 years with the eldest. Maximum number of the patient. i.e. 103 (51.5%) were in the age group of 51-70 years followed by 50 patients (25%) in the age group of 31 to 50 years in our study. This is comparable with studies conducted by OP Sharma<sup>7</sup>, Amjad Salman *et al*<sup>8</sup>. In this hospital based study, most of population belongs to this age group and presented for cataract surgery hence correlated with the most common indication for Bscan. This probably was also the reason maximum number of eyes had painless diminution of vision.

In this study, 183 (83.18%) eyes had opaque media and 37 (16.81%) eye with clear media. Most Common indication for performing B scan was inability to view the posterior segment due to media opacity. This explains the overwhelmingly high number of eyes with opaque media in present study. The remaining 16.81% of eyes with clear media were included in study as they had detectable B scan pathologies and this helped us in co-relating the Bscan findings with clinical findings. In eyes with clear media, most common fundus finding was retinal detachment in 15 (6.81%) eyes due to various causes, diabetic retinopathy in 8 (3.63%) eyes, intraocular mass was seen in 5 (2.27%) eyes, 3 (1.36%) myopic eyes were evaluated, one case each of chorioretinal degeneration, retinitis pigmentosa, persistent fetal vasculature, optic atrophy and retinochoroidal coloboma.

The most common abnormalities revealed by ultrasound were retinal detachment in 90 out of 220 eyes (40.91%), followed by Posterior vitreous detachment in 62 eyes (28.18 %), and vitreous haemorrhage in 62 eyes (28.18 %). These numbers are not mutually exclusive; it includes the given pathology associated with other pathologies as well. Retinal detachment was the most common (40.91%) posterior segment abnormality detected in the study due to traumatic (8.82%) and non-traumatic (20.59%) causes and second most common when associated other significant posterior abnormalities (29.41%). This correlates with other studies conducted by Amjad Salman *et al* (4.1%)<sup>8</sup>, S.B. Adebayo *et al* (40.54%)<sup>9</sup>, while in studies by Hassani and Bard (13.8%)<sup>10</sup>, wherein retinal detachment was the most common posterior segment abnormality. Morphologic characteristics of RD with anchoring of detached leaflets at optic disc and ora serrata in total retinal detachment were studied. Both rhegmatogenous and non-rhegmatogenous types were noticed. Extent wise, partial and complete RD were studied. Morphologically the classical V shapes, Y shape with preretinal vitreous proliferation "Morning glory" were also noticed. In the current series, 2 patients presented with bilateral RD. The morphology of various types of RD in our study was consistent with the study and observation made by D.J.Coleman, M.J.Rondeau *et al*<sup>11</sup>, Azzolini C, Pierro L *et al*<sup>12</sup>, Haile M *et al*<sup>13</sup>, Aniruddha Agarwal *et al* in 2016<sup>14</sup>.

Vitreous haemorrhage was the third most common finding in the present study when associated with other pathologies in 62 eyes (28.18%) and an isolated major pathology in 28 eyes (12.72%). Vitreous haemorrhage is a common complication of diabetic retinopathy, hypertension, trauma and a number of other systemic and Ophthalmic disorders. All cases were managed by Vitrectomy on the basis of ultrasound examination. After vitrectomy procedure was over, retinal detachment was seen. Our results and experience is correlated with the study by Sandinha MT, Kotagiri AK, *et al*<sup>15</sup> published in July 2017 on accuracy of B-scan ultrasonography in acute fundus obscuring vitreous haemorrhage using a standardized scanning protocol.

Capsular tear and a metallic foreign body with posterior reverberation artefact was located in the mid vitreous surrounded by exudates with occult scleral perforation in one eye and two patient had Intraocular foreign body with retinal detachment. B scan showed 100% sensitivity and specificity in diagnosing intraocular foreign body in all cases which were correlated with recent study by Nie S, Wang Z, *et al*<sup>16</sup> in 2013. Endophthalmitis was diagnosed in six eyes. On B-scan, these eyes had moderate to severe exudates in vitreous with posterior vitreous detachment. These patients were treated with systemic, topical and intravitreal antibiotics. Their improvement after treatment was seen as decreased pain, redness, improvement in vision and decreased exudates on follow up B-scan. One eye also had retinal detachment and choroidal detachment. Dacey MP, Lopez PF<sup>17</sup> studied the echographic findings in infectious endophthalmitis. Ultrasonographic findings such as increased thickness of the posterior wall and dense organization of the vitreous can be useful in the clinical evaluation, prediction, and treatment of postoperative endophthalmitis.

Four eyes with PHPV presented with unilateral leucocoria with microphthalmos. B-scan showed a retrolental membrane of varying density; persistent hyaloid artery extending from the

retrolental region to the optic disc. This characteristic appearance correlates well with study done by Patrick M. Azcarate *et al*<sup>18</sup> in 2016. They concluded that B-scan echography has a high true positive rate and a low false-negative rate for detecting Persistent fetal vasculature in a population with a high pretest probability, which supports its role in the preoperative evaluation for cataract extraction and management of congenital cataracts.

In the present study, 4 eyes showed choroidal melanoma. Among these 2 cases showed exudative retinal detachment and choroidal melanoma on clinical examination but in 2 cases only retinal detachment was seen whereas choroidal melanoma was not seen. Mass shows a moderately reflective and high acoustic absorbency with some attenuation of the beam on B scan; melanoma was confirmed. These patients were referred to higher center for further management. Coleman in his review of 100 cases also showed 100% specificity and sensitivity of B mode ultrasonography in detecting and characterizing intra-ocular lesions.

Echography supplemented the diagnosis in 73.63%, correlated with clinical diagnosis in 25 % and missed in only 1.36% of eyes.

## CONCLUSION

The study reports further importance of the procedure in a developing country. In areas where other imaging techniques are not available, the procedure is a valuable method of evaluating the eye and for planning management. Posterior segment echography may be a very useful diagnostic tool. Its value may be optimized in certain subsets of patients. Considerations such as these may contribute to more cost-effective allocation of resources. The direct access of the Ophthalmologist to the echography enables the correlation between the anamnestic and clinical datum with those obtained by echographic explorations, meaning a more precise diagnosis.

Hence B-mode real time ultrasonography with high frequency probe provides non-ionizing, cost-effective, non-invasive technique which can be performed safely as an outpatient procedure, even in children without any use of anesthetics or sedatives.

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