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Original Research Article

Study on Disorders of Posterior Segment of Eyeball using B-Scan Ultrasound in Hazy or Opaque Media

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Abstract

Introduction: Ophthalmologists have historically been the sole practitioners of ocular B- mode ultrasonography (US), frequently employing specialized tools. The morphology and spatial association of lesions in the posterior segment can be better visualized using B-mode. A cross-sectional representation of sick tissues and organs is provided by B-scan. It is useful in identifying posterior segment illness. This technique allows for an accurate assessment of common disorders such as cataracts, retinal detachment, ocular trauma, vitreous degeneration, retinoblastoma, and choroidal melanoma. Cost-effectiveness, which is crucial in a rural area, is a benefit of B-scan USG.

Aims and Objective: To determine the pathologies and posterior segment lesions using B-scan ultrasound in hazy or opaque media.

Methods: This cross-sectional study was carried out in the Radio-Diagnosis Department, K J Somaiya Medical College and Research Centre, Mumbai and using approval for this study was obtained from the institutional ethical and scientific committee from November 2015 to November 2016. 123 consecutive patients suspected of having opaque or hazy ocular media clinically. All patients who were subjected to B-scan ultrasonography for evaluation the malignant and benign lesion of posterior chamber of eye in hazy ocular media., were evaluated using a standard USG machine (PHILIPS HD 7) equipped with a real-time high-frequency (8-12HZ) probe with the patient in the supine position and contact method.

Results: In the present study, majority of the pathologies were benign (82.5%), followed by traumatic (13%). Congenital accounted for 04% of lesions, and vascular (1.5 %). The study found that there are 10 and 13 patients, or 8% and 10%, respectively, with axial lengths of less than 2.2 cm in both the right and left eyes. Of the lesions involving the posterior segment of eye in hazy media, maximum number of lesions were recorded as vitrous membranes (42 & 35%) followed by acute vitreous haemorrhage (22 &17%) and vitrousdeattachment (20 &14% each).

Conclusion: The study concludes that B scan ultrasonography proved to be a very useful noninvasive tool in accurately diagnosing the posterior segment pathologies in hazy media. The quicker and faster investigation, easy availability, less susceptibility to patient motion as well as relatively lower cost are its advantages.

Keywords: B-scan, Ultrasound, Posterior Segment, Disorders of Posterior Segment.

Introduction

The American ophthalmologists Mundt and Hughes employed ultrasound in ophthalmology for the first time in 1956. They evaluated an intraocular tumor using the A-scan mode, but Baum and Greenwood introduced the B-scan in 1958 [1]. For the identification of a posterior segment lesion, both the A and B-scan approaches are crucial. The morphology and spatial association of lesions in the posterior segment can be better visualized using B-mode. A cross-sectional representation of sick tissues and organs is provided by B-scan. It is useful in identifying posterior segment illness. The diagnostic ophthalmic ultrasonography B Scan uses a frequency of 8–10 MHz [2,3].

Ophthalmologists have historically been the sole practitioners of ocular B- mode ultrasonography (US), frequently employing specialized tools. The use of generic (multipurpose) ultrasound equipment and high-frequency tiny parts probes by radiologists, however, is growing [4,5]. Because they may be accurately assessed by clinical inspection, slit-lamp examination, ophthalmoscopy, and US biomicroscopy employing frequencies up to 50 MHz, the cornea, anterior chamber, iris, posterior chamber, and lens rarely need US [6-9]. However, any condition that obstructs the light-conducting media may make it difficult to see the posterior segment of the globe during a clinical examination, necessitating the use of B-mode ultrasound to rule out tumors, tumor-like lesions, and other pathologic conditions that affect the posterior segment of the eye [10,11]. Additionally, useful information about diseases identified during the ophthalmoscopic examination can be obtained through the US. It is the quickest and easiest way to photograph the eye, and it also offers high-resolution images and allows for dynamic examination. Ocular US can be performed by qualified specialists utilizing a systematic study methodology with the proper training [12].

Although magnetic resonance imaging (MRI) and computed tomography (CT) are highly helpful in many ocular and orbital disorders, they cannot be used to evaluate the vitreous, retina, or choroid, and they have a worse spatial resolution [13-15].

Eye ultrasonography has developed into a secure, non-invasive diagnostic imaging technique that offers immediate feedback for the assessment of a variety of ophthalmic problems. Evaluation of vitreoretinal diseases in eyes with cloudy ocular media is one of the primary indications for diagnostic ultrasonography [16,17]. It is most helpful when there are opaque ocular media, which makes a clinical assessment and ophthalmoscopic screening challenging and least informative due to anterior chamber opacities, corneal opacities, dense opacities in vitreous, and dense cataracts [18]. On a conventional A-scan, the normal, transparent vitreous appears as a flat baseline while on a B-scan, it seems black or acoustically empty. A straightforward, non-invasive method for identifying lesions in the posterior portion of the eyeball is B-scan ultrasonography (USG) [19]. This technique allows for an accurate assessment of common disorders such as cataracts, retinal detachment, ocular trauma, vitreous degeneration, retinoblastoma, and choroidal melanoma. Cost-effectiveness, which is crucial in a rural area, is a benefit of B-scan USG. Additionally, it is readily available, noninvasive, and produces repeatable results [20,21].

Materials and Methods

This cross-sectional study was carried out in the Radio-Diagnosis Department, K J Somaiya Medical College and Research Centre, Mumbai and using approval for this study was obtained from the institutional ethical and scientific committee from November 2015 to November 2016. 123 consecutive patients suspected of having

opaque or hazy ocular media clinically or by previously performed ultrasonography, underwent will be evaluated using a standard USG machine (PHILIPS HD 7) equipped with a real-time high-frequency (8-12HZ) probe with the contact method. Images were labelled and saved on work station in our department. All patients who were subjected to B-scan ultrasonography for evaluation the malignant and benign lesion of posterior chamber of eye in hazy ocular media., were evaluated using a standard USG machine (PHILIPS HD 7) equipped with a real-time high-frequency (8-12HZ) probe with the patient in the supine position and contact method. The probe is placed over the closed eyelid after application of coupling gel. It is usually done with the eye lid closed and other eye kept open fixing at a target. Coupling medium like methylcellulose is applied on the probe. (In case of trauma or recent ocular surgery, probe has to be cleaned before use.). Patients, who were in a supine position on the examining couch, underwent Ultrasound with the transducer placed gentle on the closed eyelid. Through-the- lid contact imaging was employed with a standard water-soluble coupling gel, using a very gentle technique to cause minimal discomfort to the eye.

The contact (or applanation method) of biometry is accomplished by gently placing the probe on the corneal vertex and directing the sound beam through the visual axis. This handheld method is most easily and accurately performed with the patient in a reclined position with the patient's head placed in front of the display screen. The examiner is seated on an adjustable stool to the other side of the patient, resting his or her arm on the patient's shoulder and the side of his or her hand on the patient's cheek. The patient is instructed to look at a target affixed to the ceiling. Using a gentle on-and-off technique allowed for less corneal compression since the examiner's hand will be braced more firmly. It is also easier for the patient to brace the head against the headrest in this reclined position and for the examiner to simultaneously monitor both the display screen and the patient's fixation.

The sonographic were analyzed under the following headings:

- Axial length of each eye
- Location of the lesion
- Margins of lesion
- After movement pattern of lesions
- Presence of calcification and air foci.
- Extension into adjoining structures
- Presences or absences of vascular involvement
- Unilateral or bilateral involvement
- Associated systemic involvement

The sample size has been estimated using Open Epi software on:

- Prevalence of various posterior segment pathologies are different, among the hazy ocular media, of which least prevalent is staphyloma and foreign body with prevalence 1.2% and 0.6%.[126]
- Absolute precision is 12 ±5%. At 95% confidence level and 80% power of study, the estimated Sample size is 123

In the present study we have included 130 patients.

Inclusion criteria and exclusion criteria

The patients clinically presenting with opaque light conducting ocular media, patients clinically presenting with opaque light conducting ocular media and those who had the event of non-visualization of fundus, were all included in the study. The patients who were excluded had active extra ocular infection and those with high risk of / with extrusion of intraocular contents. All patients, who did not give consent to be a part of the study

Statistical analysis

Data will be entered in the Microsoft excel –frequency, percentage, bar diagram, pie diagram will be used for data summarization and presentation. Cohen kappa statistics with P value, chi square test

will be used to assess agreement and sensitivity, specificity, positive predictive value and negative predictive value calculated to assess validity of CT-SCAN. Significance of the result assess by using SPSS (statistical package social sciences) software version 17.

Table 1: Formula used for evaluation of a screening test in this research

Screening test results	Diagnosis (diseased)	Diagnosis (Not diseased)	Total
POSITIVE NEGATIVE	a(true positive) c(false negative)	b(false positive) d(true negative)	a + b c + d
TOTAL	a + c	b + d	a + b + c + d

$$\text{Sensitivity: } \frac{\text{true positive}}{\text{true positive + false negative}} \times 100$$

$$\text{Specificity: } \frac{\text{true negative}}{\text{false positive + true negative}} \times 100$$

$$\text{Predictive value of a positive test: } \frac{\text{true positive}}{\text{true positive + false positive}} \times 100$$

$$\text{Predictive value of a negative test: } \frac{\text{true negative}}{\text{true negative + false negative}} \times 100$$

$$\text{Diagnostic accuracy: } \frac{\text{true positive+ true negative}}{\text{total number of cases}} \times 100$$

Ethical Approval

The written consent was obtained from each patient before the collection of data. The study method was explained to the patients and the hospital's Ethical Committee has approved the study method.

Results

The present study was conducted in the Department of Radiodiagnosis in co-ordination with the Ophthalmology Department at K. J. Somaiya Hospital Mumbai. A total of 130 patients underwent B scan sonography. The imaging diagnosis was confirmed with surgery and other clinical proof. The distribution and observations in these patients show that there are 50 female patients, or 38.5% of the total, and 80 male patients, or 61.5% of the total (Figure 1).

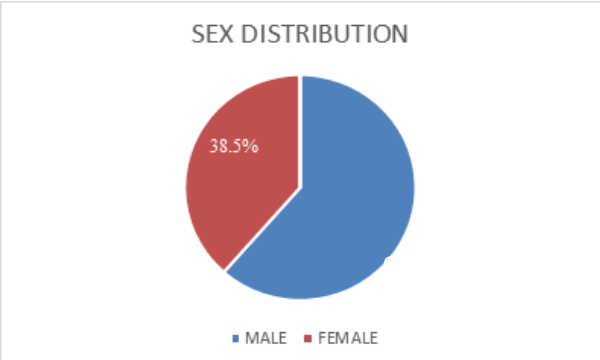

Figure 1: Sex distribution of cases. As evident from the above table in the present study there is male preponderance (61.5%), with Females accounting for 38.5% of total patients.

The study found that there are 11 patients from 1 to 20 years, which accounts for 8.5% of the total, and from 21 to 40 years old, there are 24 patients, which accounts for 18.5% of the total. In the third segment, which includes patients between the ages of 41 and 60, with 60 representing 46% of the total patients in this category. There are 32 patients in the age range of 61 to 80, which accounts for 24.6% of the total, and 3 patients in the 81 and older age group, which represents 2.4% of the total (Figure 2).

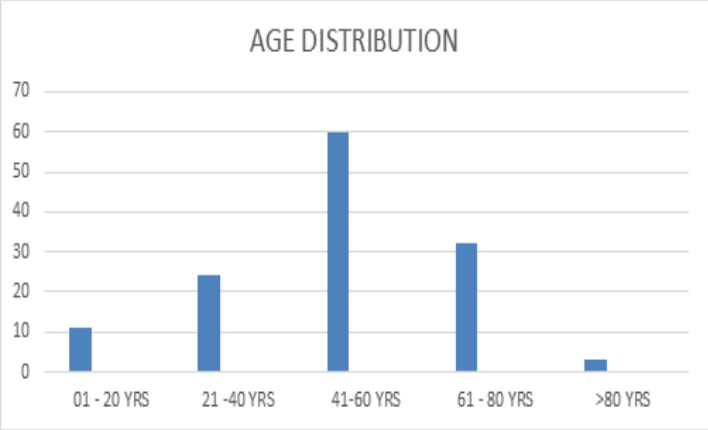

Figure 2: Age distribution between the patients of this study

As evident from the above table, majority of patients were in the age group of 41 to 60 years (n= 60), followed by 61 to 80 years (n= 32) and 21 to 40 years (n = 24). The minimum and maximum age of presentation was 1 year and 88 years with overall mean average of 48 yrs. There were 130 cases in all, 117 of which were positive, and 13 were negative, or 90% and 10%, respectively (Figure 3).

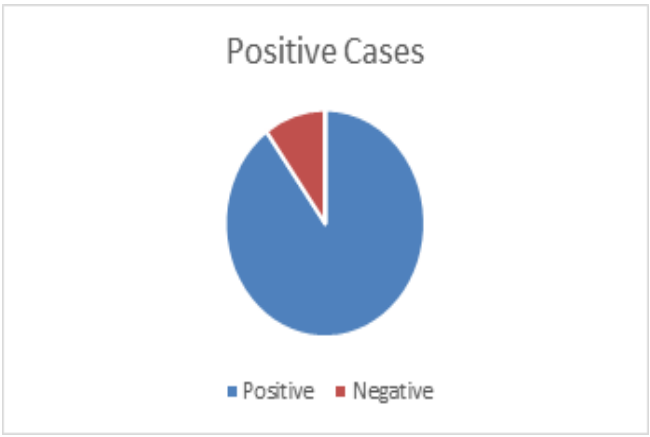

Figure 3: Distribution of positive and negative cases in this study

As evident from the pie diagram (Figure 4), majority of the cases showed positive pathologies (90%) in cases of hazy ocular media patients ; whereas only 10% of the cases were normal with no pathologies. Regarding the distribution of the different diseases, which have a total of 130 patients, 107 patients each for benign and malignant, respectively, accounting for 82.5% and 1.5% of the total. Traumatic has 17 patients overall, which represents 13% of the total number of patients, and congenital pathology includes 4 individuals, which represents 3% of the total.

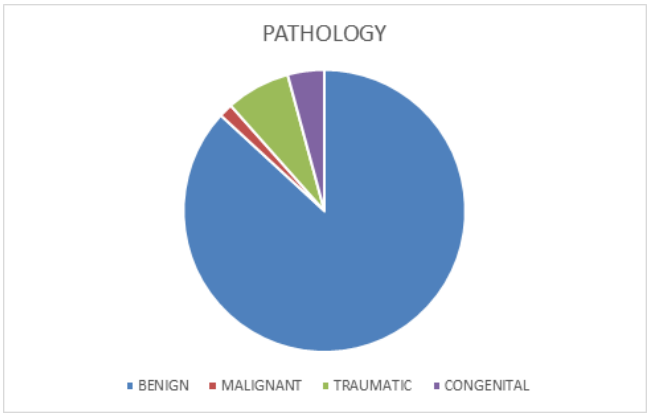

Figure 4: Distribution of pathologies found in this study

In the present study, majority of the pathologies were benign (82.5%), followed by traumatic (13%). Congenital accounted for 04% of lesions, and vascular (1.5 %). The study found that there are 10 and 13 patients, or 8% and 10%, respectively, with axial lengths of less than 2.2 cm in both the right and left eyes. Similar numbers are 97 and 98 with 75% and 75%, respectively, for 2.2 to 2.5 cm, and 23 and 19 with 17% and 15%, respectively, for greater than 2.5 cm.

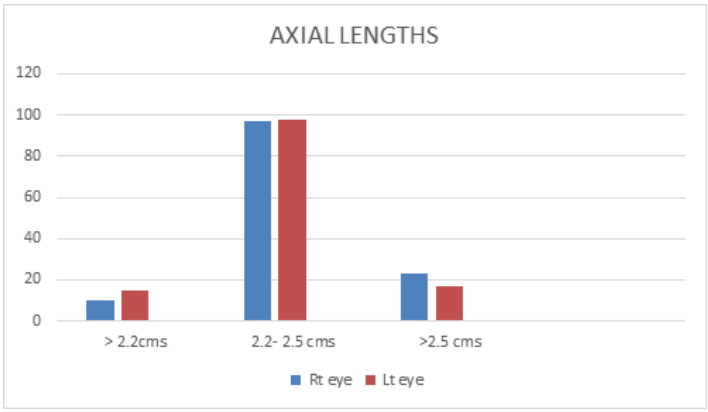

Figure 5: Axial lengths of the right and left eye

In the present study, majority of the axial lengths were within normal limits (75%). Around 15-17% showed increased axial lengths and 8-10% showed reduced axial lengths.

Table 2: Distribution of pathologies and its respective percentage for each eye

S. No.	Space involved	No. of patients		Percentage	
1	Vitreous Deattachmenent	26	18	20%	14%
2	Retinal Deattachement	18	14	14%	11%
3	Vitreous membranes	55	46	42%	35%
4	Vitreous haemorrhage	29	23	22%	17%
5	Choroidaldeattachment	10	3	7%	2%
6	Posterior staphyloma	12	8	9%	6%
7	Subhyloid haemorrhage	10	8	7%	6%
8	Intra ocular foreign body	6	1	4%	0.70%
9	Retinoblastoma	2	0	1.50%	0.60%
10	Misc	11	11	8%	8%

In addition to RE & LE. There are 18 LE and 26 RE patients with vitreous detachment, respectively, with 20% and 14% of patients. 80 and 14 individuals, respectively, with 14% and 11%, respectively, for RE and LE, are affected by retinal detachment. Re and LE make up 42% and 35% of the vitreous membranes, which have 55 and 46 respectively. 29 and 23 individuals, respectively, with 22% and 17% of RE and LE have vitreous haemorrhage. Ten and three patients with RE and LE and 7% and 2%, respectively, have choroidal deattachment. With 9% and 6% respectively, posterior staphyloma has 12 and 8 RE and LE cells. Patients with subhyloid haemorrhage include 10 and 08 RE, LE, and 7% and 6%, respectively. With 4% and 0.7% of patients each, there are 6 cases of intra ocular foreign bodies.Retinoblasoma has 2 and 0 patients with RE & LE who have 1.5% and 0 respectively, and Misc has 11 and 1 patients with RE & LE who have 8% and 8% respectively.

Of the lesions involving the posterior segment of eye in hazy media, maximum number of lesions were recorded as vitrous membranes (42 & 35%) followed by acute vitreous haemorrhage (22 &17%) and vitrousdeattachment (20 &14% each). In the present study, most of the non-traumatic lesions of the posterior segment including the benign, congenital and malignant causes were above the age of 20 years, with higher incidence among males, with a male-to-female ratio of 1.8: 1. Most of the traumatic lesions were above the age of 20 years, with higher incidence of among females, with a female to male ratio of 1.5: 1.

Table 3: Incidence of posterior segment lesions for each pathology for male and female

S. No.	Pathology	Number of Male	Number of Female
1	RD	8	16
2	VD	26	12
3	VM	46	30
4	VH	29	12
5	CD	9	4
6	Post Staphyloma	11	4
7	IOFB	3	4
8	Subhyloid	5	9
	H'GE.		
9	Retinoblastoma	0	2
10	MISC.	4	3

Incidence of the posterior segment by sex and pathology will be examined. The first is called RD, and it has a male of 8 and a female of 16. There are 12 women and 26 men in VD. VM has 30 females and 46 males. 29 men and 12 women work at VH. CD has 4 females and 9 males. 11 men and 4 women have poststaphyloma. Iofb consists of 3 men and 4 women. 5 men and 9 women make up Subhyloidh'ge. 0 men and 32 women have retinoblastoma. 3 females and 4 males make up Misc.

In the present study, the most common pathologies were vitreous membranes and vitreous haemorrhage with male to female ratio being 1:1.5and 2.4: 1 respectively.

Discussion

An essential adjunct for the clinical evaluation of a number of eye illnesses is ocular B-mode ultrasonography (US). When ophthalmoscopy is not an option, typically because the transparent media are opaque (e.g., due to a mature cataract or vitreous hemorrhage), US can help the ophthalmologist diagnose the condition and determine the best course of action [22]. US is the best technology for imaging the eye

because of the eye's cystic structure and superficial position. Additionally, dynamic study aids in the differentiation of a number of disorders that, in some clinical settings, would be challenging to do so, such as vitreous, retinal, and choroidal detachment. Radiologists can provide this helpful imaging modality to patients and referred clinicians by having a basic awareness of the anatomy of the eye, the US technique, and frequent entities that impact the ocular globe [23-25]

An investigation was made into the precision and prognostic value of B-scan ultrasonography in the post-repair evaluation of open globe damage. The diagnostic accuracy of ultrasound for IOFB and retinal detachment was 100%. At the time of the final follow-up, the diagnoses of hemorrhagic choroidal detachment, disorganized posterior contents, kissing choroidal detachment, and uneven posterior contour was linked to lower visual acuity. Poorer results were associated with disorganized posterior contents. According to the study's findings, B-scan ultrasonography is a tried-and-true imaging technique for treating open globe injuries that is also reasonably priced. This instrument may provide both prognostic and diagnostic data, which is helpful for both surgical treatment and ongoing medical care [26]

A study was done to document the first clinical experience of using 25-gauge pars plana vitrectomy and intraoperative B-scan ultrasonography for severe open globe injury with hemorrhagic retinal and choroidal separation. The diagnosis of retinal detachment, extensive subretinal hemorrhage in two eyes, and choroidal hemorrhage was made possible by intraoperative B-scan ultrasonography in all patients (five eyes). Additionally, serial real-time B-scan imaging enabled successful external drainage of the choroidal hemorrhage and the significant subretinal hemorrhage, expanding the vitreous space and enabling the pars plan vitrectomy without difficulties linked to the entry site. Following surgery, all patients experienced good retinal attachment and no loss of light sensitivity. According to the study's findings, severe open globe injury repair with intraoperative B-scan ultrasonography is feasible and may even be more effective and safe [27].

The value of B-scan ultrasonography was investigated, as well as the relative frequency of the situations for which an ultrasound B-scan examination was sought in ophthalmology. The study comes to the conclusion that diagnostic ultrasound has proven to be a very useful approach for ophthalmology medical diagnosis. The most frequent issues were vitreous opacities and retinal detachments, both of which were treated with ultrasonography. Correlating the results of the B-scan with the patient's clinical state is also crucial [28].

Ophthalmoscopic evaluation of the posterior portion of the eye is challenging in diffuse ocular media. In these situations, B-scan ultrasonography is a crucial tool. In order to assess the condition of the posterior portion of the eyes in individuals with opaque ocular media due to any reason, a study was carried out. According to the study, preoperative fundoscopic evaluation is almost difficult for individuals with opaque ocular media, making B scan ultrasonography an indispensable technique for posterior segment inspection [29].

In order to evaluate the diagnostic utility of B-Scan ultrasonography in assessing posterior segment abnormalities of the eye and to connect the findings with clinical diagnosis, a study was carried out. In 50 eyes (29.43%), ultrasound verified the preliminary diagnosis, and in 119 eyes (70.2%) it complemented or subclassified the diagnosis. These individuals either underwent surgical intervention depending on the clinical findings and the results of the B-scan, or a more thorough diagnosis could be made after the B-scan [30,31].

Conclusion

The study concludes that B scan ultrasonography proved to be a very useful noninvasive tool in accurately diagnosing the posterior segment pathologies in hazy media. The quicker and faster investigation, easy availability, less susceptibility to patient motion as well as relatively lower cost are its advantages. Majority of the cases were positive (90%), with presence of pathology, in cases of hazy ocular media patients; whereas only 10% of the cases were normal with no pathologies. The non-traumatic lesions of the posterior segment including the benign, congenital and malignant causes were above the age of 20 years, with higher incidence among males, with a male to female ratio of 1.8: 1. The most common pathologies were vitreous membranes and vitreous haemorrhage with male to female ratio being 1:1.5 and 2.4: 1 respectively. The retinal detachment were seen in 53% of traumatic patients and 13.2% of non-traumatic patients with female predominance; of M:F ratio of 1:2. Considering surgical findings as the gold standard, the sensitivity of B scan in detecting presence/absence of posterior segment pathologies was 95.8% with a specificity of 97.8%. The positive predictive value was 95.8% and the negative predictive value 97.8%. The study put forward a significant findings of disorders of posterior segment of eyeball using B-scan ultrasound which would contribute clinical management of posterior segment diseases.

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