

Clinical study of B-scan USG in posterior segment disorders of the eye

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Abstract

Aims and Objectives: To assess the diagnostic value of B - Scan ultrasonography in evaluation of posterior segment disorders of eye and correlate the results with clinical diagnosis.

Material and Methods: A descriptive cross-sectional study of ultrasound B-scan was performed on 170 eligible eyes of 136 patients.

Results: Maximum 72 (52.94%) cases belong to 51-70 age group. 86/136 (63.24%) were males and 50/136 (36.77%) were females. 148 (87.05%) cases presented with opaque media and 22(12.94%) with clear media. 52 (30.59%) patients had a history of trauma and 34 (25%) subjects presented for issue of blindness certificate. Most common final diagnosis was retinal detachment in 42 (24.70%) eyes, posterior vitreous detachment in 35 (20.6%) eyes, vitreous haemorrhage in 32 (18.82%) eyes, globe tear in 8 (4.70%) eyes, dislocated lens in vitreous in 8 (4.70%) eyes, asteroid hyalosis in 8 (4.70%) eyes, phthisis bulbi in 7 (4.11%) eyes, dislocated PCIOL in 6 (3.52%), endophthalmitis in 5 (2.94%) eyes, s/p scleral buckling in 5 (2.94%), retinoblastoma in 4 (2.35%) eyes, persistent hyperplastic primary vitreous in 3 (1.76%) eyes, retinochoroidal coloboma in 2 (1.17%) eyes, silicon oil vitreous in 2 (1.17%) eyes, and 1 (0.58%) eye each with metallic intraocular foreign body with endophthalmitis with occult scleral perforation, choroidal detachment and optic disc drusen.

Conclusions: Ultrasound confirmed the provisional diagnosis in 50 eyes (29.41%) and supplemented or subclassified the diagnosis in 119 eyes (70%). Depending upon the clinical findings and B-scan these patients were either intervened surgically or a more complete diagnosis could be documented after B-scan.

Keywords: Posterior vitreous detachment, Retinal detachment, Ultrasound, Vitreous haemorrhage.

Introduction

Ultrasound is defined as sound that is above the range of human hearing (greater than 20 kHz).¹ Discovery of modern ultrasound dates back to 1793, when it was observed by Lazzaro Spallanzani (Italy) that bats utilize echoes of their whistles to orient while flying in dark.² The location and acoustic properties of the eyeball's contents makes it ideally suitable for ultrasound examination.³ The first use of ultrasound in ophthalmic diagnosis was reported in 1956 by Mundt and Hughes and the first clinical use of the time-amplitude technique (the A-scan) in problems in ocular diagnosis was presented in 1957 by Oksala and Lehtinen.^{4,5} The use of the intensity-modulated B-scan (Brightness modulation scan) in ophthalmic diagnosis was described by Baum and Greenwood in 1958.⁶ It is based on physical principles of pulse-echo technology and tissue acoustic impedance mismatch. It employs crystal transducers which produce ultrasonic pulses and retrieve echoes that are displayed after processing.⁷ The present study is aimed to assess the diagnostic value B - Scan ultrasonography in evaluation of posterior segment ocular lesions both in clear and opaque media.

Aims and Objectives: 1) To assess the diagnostic value B - Scan ultrasonography in evaluation of posterior segment disorders of eye in opaque and clear media. 2) To correlate the results of B-Scan ultrasonography with clinical diagnosis.

Material and Methods

A descriptive cross-sectional study of ultrasound B-scan was performed on 170 eyes of 136 patients having or suspected of having posterior segment pathology. The study was conducted in the ophthalmology department of Dr. Vaishampayan Memorial Government Medical College, Solapur from December 2009 to November 2011. The instrument used was Oti scan – 3000 with contact ultrasonic probe of 10 MHZ frequency.

Inclusion Criteria:

Patients with posterior segment pathology or suspected of having posterior segment pathology detectable on B-scan were included in the study.

A complete case history was taken in each patient, including previous history of ocular trauma, surgery, diabetes, hypertension, tuberculosis etc. Thorough general and ophthalmic examination was carried in each patient which included refraction, tonometry, slit lamp examination, fundus examination, anterior segment photos were taken in few cases and finally B-scan was performed after taking consent and explaining the procedure to the patient.

Scanning was done using contact B – scan probe coated with coupling gel with open eyelids in co-operative patients and with closed eyelids in cases of unco-operative and apprehensive patients. The patient was asked to open the other eye and look in the required

direction. The globe was scanned thoroughly using transverse, longitudinal, oblique and axial scans. The study was conducted from high sensitivity setting of 80db to 40db to differentiate various tissue densities. Analysis of the image was done both in realtime and after freezing the image.

As a routine, B-scans of both the eyes were performed in every case; from which first 170 eyes with posterior segment abnormalities detected on B-scan

were included in the study irrespective of the status of the media.

Results

The results of the present study are given in a tabulated form below:

Table 1: Distribution of eyes according to clinical diagnosis

Sr. No	Clinical Diagnosis	(n)	
1	Cataract i. Senile a) Mature b) Immature c) Immature with DR ii. Traumatic iii. Complicated	18 (10.58%) 8 (4.70%) 2 (1.17%) 9 (5.29%) 1 (0.58%)	38 (22.35%)
2	Aphakia i. Post-operative, IOL drop ii. Traumatic iii. Surgical iv. With DR s/p scleral buckling v. High myopia vi. High myopia s/p sclera buckling vii. With choroidal detachment viii. With retinitis pigmentosa	6 (3.52%) 3 (1.76%) 6 (3.52%) 2 (1.17%) 1 (0.58%) 1 (0.58%) 1 (0.58%) 1 (0.58%)	21 (12.35%)
3	Vitreous Haemorrhage	21 (12.35%)	
4	Uveitis i. Idiopathic ii. Traumatic iii. Post-operative iv. Post-operative, nucleus drop v. With silicon oil in AC vi. With retinal detachment	6 (3.52%) 5 (2.94%) 1 (0.58%) 1 (0.58%) 1 (0.58%) 1 (0.58%)	15 (8.82%)
5	Pseudophakia with PCO	13 (7.64%)	
6	Corneal opacity i. Adherent leucoma ii. Corneal opacity	11 (6.47%) 4 (2.35%)	15 (8.82%)
7	Retinal detachment i. Retinal detachment ii. With diabetic retinopathy iii. With high myopia iv. With proliferative vitreoretinopathy v. With retinitis pigmentosa	1 (0.58%) 5 (2.94%) 3 (1.76%) 1 (0.58%) 1 (0.58%)	11 (6.47%)
8	Globe tear i. Corneal tear with hyphaema ii. Sclera tear with hyphaema iii. Corneal tear with traumatic cataract	5 (2.94%) 2 (1.17%) 1 (0.58%)	8 (4.70%)
9	Endophthalmitis i. Post-operative ii. Traumatic	3 (1.76%) 2 (1.17%)	5 (2.94%)
10	Phthisis Bulbi	7 (4.11%)	
11	Traumatic hyphaema	5 (2.94%)	
12	Retinoblastoma	4 (2.35%)	
13	Persistent hyperplastic primary vitreous	2 (1.17%)	

14	Asteroid hyalosis	2 (1.17%)
15	Optic Atrophy under investigation	1 (0.58%)
16	Retinochoroidal coloboma	1 (0.58%)
17	Micro-ophthalmos with cataract	1 (0.58%)
18	Total	170 (100%)

Table 2: Distribution of eyes according to usg findings

Sr. No.	USG FINDINGS	(n)	
1	Retinal detachment		
	i. Retinal detachment	22	43 (25.29%)
	ii. With vitreous haemorrhage	(12.94%)	
	iii. With high myopia	7 (4.11%)	
	iv. With posterior vitreous detachment	5 (2.94%)	
	v. With vitreous haemorrhage, posterior vitreous detachment	4 (2.35%)	
	vi. With posterior vitreous detachment, vitreous exudates	2 (1.17%)	
	vii. With vitreous exudates	1 (0.58%)	
	viii. With high myopia, s/p scleral buckling	1 (0.58%)	
	1 (0.58%)		
2	Vitreous haemorrhage		
	i. Vitreous haemorrhage	24	32 (18.82%)
	ii. With posterior vitreous detachment	(14.11%)	
	8 (4.70%)		
3	Posterior vitreous detachment		
	i. Posterior vitreous detachment	17 (10%)	35 (20.6%)
	ii. With vitreous opacities	8 (4.70%)	
	iii. With high myopia	4 (2.35%)	
iv. With vitreous exudates	6 (3.52%)		
4	Endophthalmitis		
	i. Endophthalmitis	1 (0.58%)	5 (2.94%)
	ii. With posterior vitreous detachment	3 (1.76%)	
iii. With PVD, RD, CD	1 (0.58%)		
5	Dislocated lens in vitreous		
	i. Dislocated lens in vitreous	5 (2.94%)	9 (5.29%)
	ii. With vitreous haemorrhage	2 (1.17%)	
	iii. With posterior vitreous detachment	1 (0.58%)	
iv. With high myopia, retinal detachment	1 (0.58%)		
6	Dislocated Intraocular lens (PCIOL) with vitreous opacities	6 (3.52%)	
7	Asteroid hyalosis	8 (4.70%)	
8	Phthisis bulbi		
	i. Phthisis bulbi	6 (3.52%)	7 (4.11%)
ii. With retinal detachment	1 (0.58%)		
9	Retinoblastoma	4 (2.35%)	
10	Persistent hyperplastic primary vitreous	3 (1.76%)	
11	s/p Scleral buckling		
	i. With high myopia	2 (1.17%)	4 (2.35%)
ii. With posterior vitreous detachment	2 (1.17%)		
12	Scleral tear		
	i. With vitreous haemorrhage, retinal detachment	2 (1.17%)	4 (2.35%)
ii. With vitreous haemorrhage	2 (1.17%)		
13	Posterior staphyloma		
	i. With high myopia, posterior vitreous detachment	1 (0.58%)	2 (1.17%)
ii. With high myopia, retinal detachment	1 (0.58%)		
14	Retinochoroidal coloboma	2 (1.17%)	

15	Silicon oil in vitreous	2 (1.17%)
16	Metallic Intraocular foreign body with endophthalmitis	1 (0.58%)
17	Choroidal detachment	1 (0.58%)
18	Posterior capsular tear	1 (0.58%)
19	Optic disc drusen	1 (0.58%)
20	Total	170 (100%)

Table 3: Distribution of eyes according to final diagnosis

Sr. No.	Final Diagnosis	(n)	
1	Retinal detachment	16 (9.41%)	42 (24.70%)
	Retinal detachment only	5 (2.94%)	
	With vitreous haemorrhage	5 (2.94%)	
	With diabetic retinopathy	5 (2.94%)	
	With high myopia	2 (1.17%)	
	With posterior vitreous detachment	2 (1.17%)	
	With vitreous haemorrhage, posterior vitreous detachment		
	With uveitis, posterior vitreous detachment	2 (1.17%)	
	With uveitis	2 (1.17%)	
	With high myopia, posterior staphyloma	1 (0.58%)	
	With proliferative vitreoretinopathy	1 (0.58%)	
With retinitis pigmentosa	1 (0.58%)		
2	Vitreous haemorrhage	20 (11.76%)	32 (18.82%)
	Vitreous haemorrhage only	8 (4.70%)	
	With posterior vitreous detachment	4 (2.35%)	
	With uveitis		
3	Posterior vitreous detachment	15 (8.82%)	35 (20.6%)
	Posterior vitreous detachment	8 (4.70%)	
	With vitreous opacities	4 (2.35%)	
	With high myopia	4 (2.35%)	
	With uveitis	2 (1.17%)	
	With diabetic retinopathy	1 (0.58%)	
	With high myopia, posterior staphyloma	1 (0.58%)	
With post-operative uveitis	1 (0.58%)		
4	Endophthalmitis	2 (1.17%)	5 (2.94%)
	Post-operative endophthalmitis, posterior vitreous detachment	1 (0.58%)	
	Traumatic endophthalmitis, posterior vitreous detachment	1 (0.58%)	
	Traumatic endophthalmitis	1 (0.58%)	
5	Globe tear	2 (1.17%)	8 (4.70%)
	Corneal tear, vitreous haemorrhage, retinal detachment	1 (0.58%)	
	Corneal tear, dislocated lens	1 (0.58%)	
	Corneal tear, posterior capsular tear	2 (1.17%)	
	Corneal tear, scleral perforation, vitreous haemorrhage, retinal detachment	2 (1.17%)	
	Scleral perforation, vitreous haemorrhage		
6	s/p scleral buckling	2 (1.17%)	5 (2.94%)
	posterior vitreous detachment, diabetic retinopathy	2 (1.17%)	
	with high myopia	1 (0.58%)	
7	Asteroid hyalosis	8 (4.70%)	
8	Phthisis bulbi	6 (3.52%)	7 (4.11%)
	With retinal detachment	1 (0.58%)	
9	Dislocated lens	3 (1.76%)	
	Traumatic dislocation of lens		

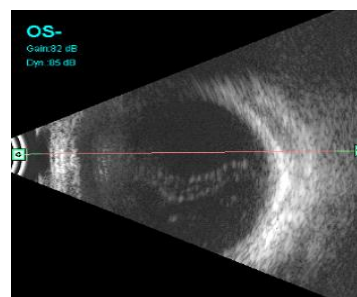
	Dislocated lens in vitreous Traumatic dislocation of lens, vitreous haemorrhage Traumatic dislocation of lens, posterior vitreous detachment With high myopia, retinal detachment With postoperative uveitis	1 (0.58%) 1 (0.58%) (0.58%) 1 (0.58%) 1 (0.58%)	8 (4.70%)
10	Dislocated Intraocular lens with vitreous opacities	6 (3.52%)	
11	Intraocular foreign body with endophthalmitis with occult scleral perforation	1 (0.58%)	
12	Retinoblastoma	4 (2.35%)	
13	Persistent foetal vasculature syndrome	3 (1.76%)	
14	Retinochoroidal coloboma	2 (1.17%)	
15	Silicon oil in vitreous With uveitis Silicon oil in vitreous	1 (0.58%) 1 (0.58%)	2 (1.16%)
16	Choroidal detachment	1 (0.58%)	
17	Optic disc drusen	1 (0.58%)	
18	Total	170 (100%)	

Table 4: Correlation of clinical diagnosis with Final diagnosis

Sr. No	CD vs FD	(n)
1	Supplemented with US Scan (FD = CD + US)	119 (70%)
2	Correlated (FD = CD)	50 (29.41%)
3	Missed	1 (0.58%)
4	Total	170 (100%)

Discussion

In the present study 136 patients underwent B-scan ultrasound of 170 eyes. Age ranges between 3 years and 80 years (mean 47.01+₋19.82 years). Most of the patients (52.94%) were in the age range of 51-70 years. This is the age where senile cataract is more common,⁸ which was the commonest indication for B-scan in present study as it was a hospital based study and most of geriatric population presented for cataract surgery or issue of a blindness certificate (25%). This probably was also the reason maximum number of eyes had painless diminution of vision (55.29%); a history of old trauma was present in 15.29% of eyes. Out of 136 patients in this study, 86 (63.24%) were male and 50 (36.77%) were female. In the present study, the left eye (39.71%) was slightly more commonly affected than right eye (35.29%) and in the remaining 25% of patients both the eyes were affected. Bilateral cases mostly had other systemic or ocular risk factors. It was noted that diabetes mellitus (16.18%), hypertension (8.82%), or both (2.21%) were the most common systemic associations seen in our patients. One case each of rheumatoid arthritis, haemophilia, AIDS, leprosy and Eales' disease were noted.

**Fig. 1: Persistent foetal vasculature**

In this study 87.05% of eyes were with opaque media and 12.95% of eyes with clear media. The eyes with clear media were included in study as they had detectable B scan pathologies and this helped us in co-relating the B scan findings with clinical findings. In eyes with clear media, most common fundus finding was retinal detachment in 12 eyes.

32.35% of eyes had a presenting visual acuity of perception of hand movements, followed by 27.05% of patients who had perception of light with inaccurate projection of rays. Total 96.45% of eyes had presenting visual acuity of 6/60 or worse. The presence of inaccurate projection of rays (OR = 15.1, P = 0.002) was significantly associated with risk of abnormal posterior segment pathology on ultrasonography. This is consistent with the findings of present study.^{9,10}

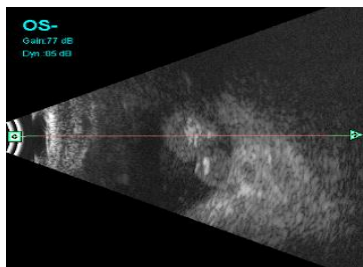


Fig. 2: Retinoblastoma

The results of the present study demonstrated that out of the 170 eyes, 32.94 % presented with posterior vitreous detachment, which can be a natural occurrence during senescence. Posterior vitreous detachment was the second most common (20%) isolated pathology in this study but highest (32.94%) when counted with other posterior pathologies. In the present study 13.5% cases were due to aging, 9.1% due to trauma along with vitreous haemorrhage and retinal detachment in few cases, 4.7% due inflammatory causes like uveitis and endophthalmitis, 2.94% with high myopia and 2.7% due to diabetes mellitus. Of particular mention are 3 patients who presented for issue of blindness certificate of which 2 were high myopic with opaque media in both eyes with accurate projection of rays in one eye; with only PVD on ultrasonography. They were operated for cataract surgery after taking consent for a guarded visual prognosis; vision improved to 6/60, 3/60 in 2 patients and 1/60 in third patient with posterior staphyloma. Blindness certificate was issued at a later date.

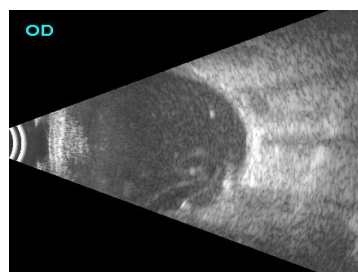


Fig. 3: Dislocated IOL in the vitreous

The most common abnormalities revealed by ultrasound which could compromise the visual function were retinal detachment (29.41%), followed by vitreous haemorrhage (27.64%), globe tear (5.29%), endophthalmitis (3.53%) and retinoblastoma (2.35%). These numbers are not mutually exclusive and include the given pathology associated with other pathologies as well. eg- According to table no. 2 retinal detachment was found in 25.29% of eyes but here we mention that retinal detachment was seen in 29.41% of eyes. The addition comes from retinal detachments associated with endophthalmitis, posteriorly dislocated lens, pthisis bulbi, scleral tear and posterior staphyloma. Hence the apparent difference in numbers. This is true for discussion of all other pathologies as well. Retinal detachment was the most common (24.70%) 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%). In our study, 6.5% eyes had both RD and vitreous haemorrhage. Nine eyes with tractional retinal detachment were examined. The causes of tractional retinal detachment in our patients were advanced diabetic eye disease in 7 eyes and old penetrating ocular trauma in 1 eye and Eales' disease in 1 eye. Table top and tent like configurations were observed on B-scan. One HIV positive patient had severe uveitis and vitritis with opaque media in right eye. The same patient also had exudative retinal detachment and hazy media in left with focal inferior exudative retinal detachment on fundus examination which could not be located on B-scan. The possible reasons could be that the detachment was shallow and localized and hence likely to be missed on B scan; other reason could have been deficiencies in examination technique. In traumatic group retinal detachment was present in 15 eyes of which 4 eyes presented with recent perforating ocular injury. Retinal detachment was present in 7 (4.12%) eyes with high myopia. Retinal detachment was the main diagnosis in 18 (34.62%) out of 52 eyes of patients who presented for issue of blindness certificate; maximum patients were with opaque media and 5 patients had a history old trauma of which one patient had pthisis bulbi; thus B-scan helped us to arrive at a more complete diagnosis in these patients. The characteristic echographic appearances of silicon buckle were studied in 5 eyes, of which 2 eyes were in diabetic patients and 3 eyes in high myopic eyes; retina was attached in all eyes except in one high myopic eye. Silicon filled eyes were noted in 2 cases (1.17%).

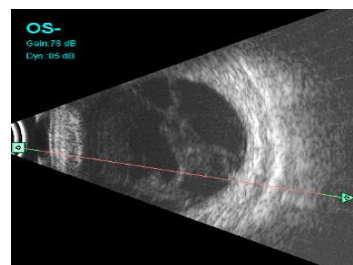


Fig. 4: Choroidal detachment (Kissing choroids)

Vitreous haemorrhage was the third most common finding in the present study when associated with other pathologies 46 eyes (27.64%) or as isolated major pathology 32 eyes (18.82%). History of ocular trauma was present in 22 eyes, diabetes in case of 9 eyes, hypertension in 7 eyes and both (diabetes and hypertension) in 2 eyes. 3 eyes were in immediate post-operative period, 2 eyes had uveitis and Eales' disease was seen in one eye. In the trauma series in this study vitreous haemorrhage was the most common finding in 22 eyes with scleral perforation in 4 eyes, followed by retinal detachment in 15 eyes, posterior

vitreous detachment in 14 eyes, dislocated lens in 6 eyes, endophthalmitis in 3 eyes with IOFB in 1 eye and phthisis bulbi in 3 eyes. In this study five patients presented with leucocoria, which was bilateral in two cases and unilateral in three cases. The conditions associated with leucocoria were correctly diagnosed as retinoblastoma in bilateral cases (2.35%) and persistent foetal vasculature syndrome (1.76%) in unilateral cases. Three eyes with PHPV presented with unilateral leucocoria with microphthalmos. Two of them were correctly suspected of having PHPV on clinical examination except in one case who was a 13 yrs old female with severe microphthalmos and complicated cataract. Two of these patients presented via school health programme; benign nature and nil visual prognosis was explained to these patients and they further requested for blindness certificate which was issued.

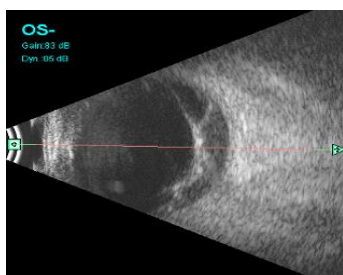


Fig. 5: Tractional retinal detachment (table top configuration)

In this study, 9 (5.3%) eyes with dislocated lens were found. Of which 6 (3.53%) were due to trauma, one high myopic young female with spontaneous dislocation of lens and retinal detachment, one postoperative patient with dropped nucleus. In all the 6 cases of dislocated IOL, B-scan could accurately locate the IOL in the vitreous. One eighty years old male patient with vascularized leucomatous corneal opacities in both eyes was considered for a penetrating keratoplasty in left eye which had a normal posterior segment on B-scan. The patient was kept aphakic and during postoperative period, there was no improvement in vision and B-scan demonstrated total choroidal detachment with classical 'kissing choroids' sign. In this study, 8 (4.70%) eyes had asteroid hyalosis, 6 cases were unilateral and 1 case was bilateral. Phthisis bulbi may be the end result of long standing inflammation, tumor or organized haemorrhage. They result in a small deformed shrunken globe which is nonfunctioning with extensive calcification. Present study had 7 (4.11%) such cases (3 due to old trauma, 2 due to inflammation). Two (1.17%) eyes in present study had posterior staphyloma and two eyes (1.17%) presented with retinochoroidal coloboma. B-scan in colobomatous fundus shows choroidal excavation with sharp edges as compared to posterior staphyloma.

The results and observations of the current study are in accordance with the available literature. B-scan ultrasound confirmed the provisional diagnosis and pre-echography management plan in 50 eyes (29.41%). It supplemented or subclassified the diagnosis in 119 eyes (70%). In developing countries it can be optimally and cost-effectively utilized as an out patient procedure such as in patients attending for issue of blindness certificate in our study.

This study confirms that B-scan ultrasonography is useful in the assessment of ocular traumatic and non-traumatic lesions and supplements clinical examination with valuable information.

References

1. Byrne SF. Ultrasound of the Eye and Orbit. Mosby Incorporated;2002.
2. Wong D. Hearing by Bats: Springer Handbook of Auditory Research Vol. 5 (edited by Arthur N. Popper and Richard R. Fay). TRENDS IN NEUROSCIENCES. 1996;19:565.
3. John A. The eye and orbit, Fielding. Clinical Ultrasound. 2001:659-95.
4. Mundt GH, Hughes WF. Ultrasonics in ocular diagnosis. American journal of ophthalmology. 1956 Jan 1;41(3):488-98.
5. Oksala A, Lehtinen A. Diagnostic value of ultrasonics in ophthalmology. Ophthalmologica. Journal international d'ophtalmologie. International journal of ophthalmology. Zeitschrift fur Augenheilkunde. 1957 Dec;134(6):387.
6. Baum G, Greenwood I. The Application of Ultrasonics Locating Techniques to Ophthalmology*: Heoretic Considerations and Acoustic Properties of Ocular Media: Part I. Reflective Properties. American journal of ophthalmology. 1958 Nov 1;46(5):319-29.
7. Coleman DJ, Silverman RH, Rondeau MJ, Lloyd HO, Daly S. Explaining the current role of high-frequency ultrasound in ophthalmic diagnosis. Expert review of ophthalmology. 2006 Oct 1;1(1):63-76.
8. Shaikh FU, Narsani AK, Jatoti SM, Shaikh ZA. Preoperative Posterior Segment Evaluation by Ultrasonography in Dense Cataract. Pak Journ of ophthalm. 2009.
9. Salman A, Parmar P, Vanila CG, Thomas PA, Jesudasan CN. Is ultrasonography essential before surgery in eyes with advanced cataracts?. Journal of postgraduate medicine. 2006 Jan 1;52(1):19.
10. Sharma OP. Orbital sonography with it's clinico-surgical correlation. Indian Journal of Radiology and Imaging. 2005 Nov 1;15(4):537.