

# Role of USG in Ocular Pathologies

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## A B S T R A C T

**Introduction:** Ultrasound is a noninvasive procedure to diagnose orbital pathologies. It can be used to differentiate ocular and extraocular diseases, to evaluate patients with orbital trauma, to localize intraocular foreign body and in assessment of orbital tumor. It is of great help where ophthalmoscopy is impossible. Aim of present study was to evaluate the role of USG in orbital diseases and in differentiating ocular and extraocular diseases.

**Material and Methods:** Study was done on 50 patients who were clinically diagnosed with some ocular pathology by ophthalmologist and sent to Radiology department of Pandit Deendayal Upadhyay medical college, Rajkot between the months of December 2017 to May 2018. Examination was done using Philips IU 22 machine and the images obtained were interpreted and results were obtained.

**Results:** Orbital pathologies were most commonly found in elderly patients and males were more frequently affected than females. Choroidal detachment was the most common finding in our study group followed by vitreous hemorrhage, retinal detachment, PHPV (Persistent hyperplastic primary vitreous), thyroid ophthalmopathy, retinoblastoma and lastly optic nerve tumor.

**Conclusions:** USG is useful in diagnosing ocular conditions like tumors, traumatic lesions, lesions of lens and posterior segment. Thus B-mode real time ultrasonography with high frequency probes provide a cost-effective, radiation free, non-invasive technique in patients with ocular pathologies.

**Key words:** Choroidal Detachment, Orbital Trauma, Retinal Detachment, Ultrasound, Vitreous Hemorrhage

## INTRODUCTION

Ultrasound is a non-invasive and non-ionizing imaging modality that provides significant information which cannot be obtained by any other means. Mundt and Hughes in 1956 were first to apply ultrasound in diagnosing orbital pathologies. Baum and Greenwood in 1958 contributed to cross-sectional B-scan display.<sup>1</sup> In 1992, techniques for accurate measurement of eye length, anterior chamber length and lens - thickness were described by Coleman and colleagues.<sup>2,3</sup> Real-time display of moving eye ball is of great importance in diagnosing many orbital pathologies.

### Anatomy

The eye lies in the anterior region of the orbit, close to the lateral and superior walls. The wall of the ocular globe has three layers: the retina (neurosensory surface); choroid (vascular); and the cornea (outer supportive). Aqueous humor is contained mainly in anterior chamber between the cornea and lens and, to a lesser extent in the posterior chamber between the iris and lens. The lens is supported by ciliary bodies and vitreous posteriorly, which fills the posterior chamber. The eye is divided into two segments: the anterior segment - which contains the cornea and lens (anterior chamber); iris, and ciliary bodies (posterior chamber); and the posterior segment - which contains the vitreous, retina,

choroid, and sclera.<sup>4-7</sup>

### The indications for ocular ultrasound

Evaluation of posterior segment when obscured by the opacities of cornea, aqueous, papillary spaces, lens or vitreous.

1. Differentiating solid and cystic masses.
2. Determination of size, length or volume of eye ball.
3. Examination of retro bulbar soft tissue masses.
4. Foreign body localization.
5. Prior to vitreoretinal surgery.

Aim of present study was to evaluate the role of USG in orbital diseases and in differentiating ocular and extraocular diseases, to evaluate patients with orbital trauma, to localize intraocular foreign body. In assessment of orbital tumor to know its location, configuration, extent and relationship to adjacent structures and to evaluate the role of USG in cases where direct vision by ophthalmoscopy is difficult.

## MATERIAL AND METHODS

The present study was conducted on 50 patients who were clinically diagnosed with some ocular pathology by ophthalmologist and sent to Radiology department of Pandit Deendayal Upadhyay Medical College, Rajkot between the months of December 2017 to May 2018. Informed consent was taken from each and every patient. Clearance from ethical committee was obtained and then the study was

started. Each patient underwent B scan ultrasonography with Philips IU 22 machine with the help of high frequency linear probe with frequency range (7-15 hzs). Each patient was examined in supine position with the eye closed and transducer placed over the closed eye lid after the application of USG jelly over the probe. Patients were asked to do ocular movements whenever necessary. Appropriate frequency and gain setting were used as per necessity and USG done and images were obtained. Patients of all the age groups with some clinically noticeable visual disturbance were included in study. Patients not willing to participate were excluded from the study.

### STATISTICAL ANALYSIS

Statistical analysis was done using Microsoft office plus 2016. Patients affected with different levels of involvement by disease were identified and percentage obtained.

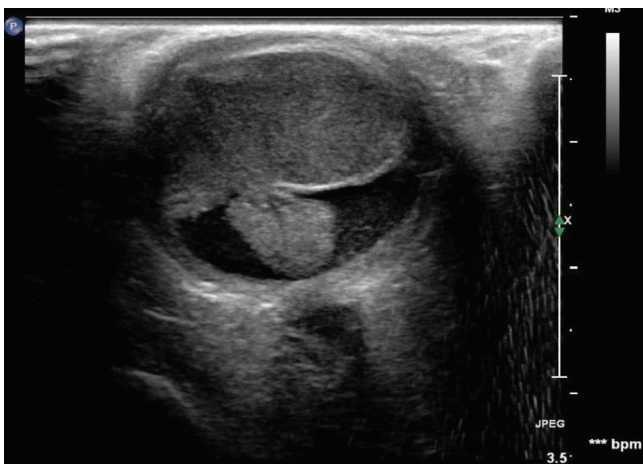


Figure-1: Vitreous hemorrhage

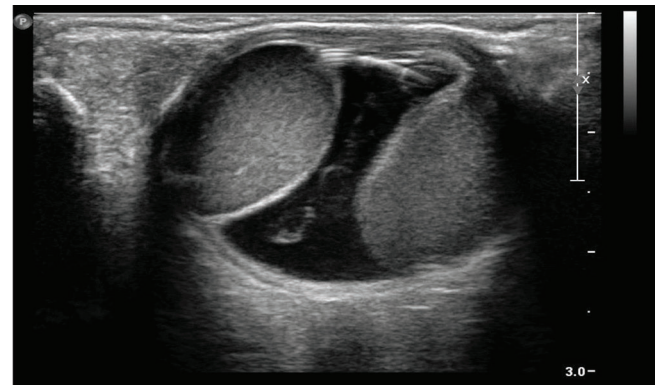


Figure-2: Choroidal detachment

### RESULTS

There were 36 males and 14 females. Right eye was affected in 12 patients, left eye was affected in 22 patients and 16 patients showed both eye involvement.

Though maximum cases were in 4th and 5th decade of life, the age wise incidence has been shown in table 1. Traumatic pathology was more commonly found in young adults. All cases of retinoblastoma belonged to age group of 1 to 5 years. Intraocular disease was observed in 43 cases while extraocular disease was noted in 7 cases.

Choroidal detachment was the most commonly encountered pathology in our study group followed by vitreous hemorrhage, retinal detachment, PHPV (Persistent hyperplastic primary vitreous), thyroid ophthalmopathy, retinoblastoma and lastly optic nerve tumor.

### DISCUSSION

Coleman classification for ocular problems is as follows:

1. Retinal detachment
2. Intraocular mass
3. Vitreous hemorrhage
4. Trauma and Foreign body
5. Miscellaneous condition i.e. Choroidal detachment<sup>8</sup>

#### Retinal detachment

Following are 2 types of retinal detachment.

- a. Rhegmatogenous (arising from retinal break or tear)
- b. Non-rhegmatogenous (or secondary retinal detachment)

Rhegmatogenous retinal detachment appears as thin continuous acoustically opaque (white) line of echoes separate from Choroid-Scleral Complex. Partial retinal detachment is a relatively flat band which has a narrow acoustically empty space between detached retina and globe wall. Minimum 1 mm of retinal elevation can be detected.

A total retinal detachment appears as an elevated convex white line extending into the globe from its attachment and points anteriorly at the nasal side and temporal ora serrata and posteriorly at optic disc. A freshly detached retina will appear as a thin white line whereas old retinal detachment appears as a thick membrane which often shrinks to form a chord like structure from optic disc to ora serrata ("FUNNEL-SHAPED" or "MORNING GLORY" configuration) with / without cyst like structure within. A vitreous veil may mimic retinal detachment. However vitreous veil does not insert into optic nerve head and its echoes are of low amplitude

Age (in years)	Number of patients (Total 50)	Percentage (%)
0-10	2	4
11-20	4	8
21-30	3	6
31-40	16	32
41-50	10	20
51-60	4	8
>60	11	22

Table-1:

Findings	Number of patients (Total 50)	Percentage (%)
Retinal detachment	8	16
Choroid detachment	16	32
Vitreous hemorrhage	11	22
Persistent hyperplastic primary vitreous	5	10
Retinoblastoma	3	6
Optic nerve tumor	2	4
Thyroid ophthalmopathy	5	10

Table-2:

than the retina. Often rhegmatogenous retinal detachments result from traction of vitreous membranes or bands on the retina. Sites of vitreous membrane attachment and associated traction on the retina can indicate the "stress" site at which retinal holes may have occurred. These holes themselves cannot be seen on USG. Retinal schisis (separation of two layers of retina) also produce similar appearance.

Uveal effusion will have a concave curvature rather than convex curvature of a retinal detachment and is usually limited to 2-3 mm elevation at the posterior pole.

Non-rhegmatogenous retinal detachment show a solid choroidal mass behind the elevated retina. Posterior to detached retina, an acoustically opaque (white) mass lesion is seen instead of an acoustically clear space. Retinal detachment may be secondary to inflammatory, exudative and cicatricial condition and may mimic a rhegmatogenous detachment. Inflammatory changes may be detected in the sclera, tenons capsule or optic nerve. Echoes posterior to retinal detachment may be seen in exudative conditions like Coat's disease.

The detached membranes attached to optic disc and collection showed slight movement on asking the patient to turn the eye ball side to side.

In our study out of 8 cases of retinal detachment, 5 were complete and 3 were partial detachment. 2 cases were due to trauma.

### **Vitreous Hemorrhage**

Vitreous is acoustically clear in normal eye. Unclotted blood (fresh blood) can't be visualized by this technique. However, as cells aggregate, reflectivity also increases. Small granular dot like echoes are seen on the display screen as the beam is directed at involved areas. The intensity of these echoes can be minimized by reducing the gain of the system. Vitreous veil (cellular aggregates or fibrinous changes along the posterior limiting membrane of a retracted vitreous) may resemble retinal detachment. But in veil, membrane cannot be traced back to the optic disc. Also the echoes are of weaker amplitude and show quick, jerky after movements on moving the eye during dynamic testing.

On USG Vitreous debris seen with uveitis appears similar to vitreous hemorrhage and are not differentiated with each other.

"Asteroid hyalosis" (accumulation of calcium soaps in vitreous) can mimic a dense central vitreous hemorrhage but can be differentiated by a rapid shift of gaze as the vitreous echoes show extremely fast, marked and prolonged after movements after the eye motion has stopped, otherwise the echoes of asteroid hyaloids are highly intense. Vitreous hemorrhage can be seen as a part of changes in diabetic eye disease, and it must be differentiated from epiretinal fibrosis, retinitis proliferans in Diabetic retinopathy. Retinitis proliferans appears as an echo configuration forming a stalk that arises from retina and these echoes diverge as the stalk extends forwards in vitreous humor.

In our study 11 patients had vitreous hemorrhage, both fresh and old with a sonographic accuracy of 95% in its diagnosis. Vitreous hemorrhage was seen as localized collection of echoes in 5 cases, dispersed echoes in 4 cases, diffusely scattered echoes in 2 cases. These hemorrhages either cleared

completely on follow up (2-7 weeks time) or sometimes appeared in form of organized membrane. Vitreous membranes formed and retracted with time and if adherent to retina can produce tractional retinal detachment.<sup>9,12</sup>

### **Ocular Trauma and Foreign Body**

Orbital trauma may lead to contusion (Blunt) injury, perforating injury and foreign body. In present study, 5 patients presented with history of trauma.

Vitreous hemorrhage and retinal detachment were the commonest findings. Out of 8 cases of retinal detachment, 2 were traumatic. Out of 11 cases of vitreous hemorrhage, 3 were traumatic. Hemorrhage into anterior or vitreous chamber prevents visibility of posterior segment. The lens may become swollen and opaque following laceration of globe or penetration by foreign body. Ultrasound is useful in the localization of intraocular foreign bodies particularly metal, glass or reflective material. The foreign bodies are seen as small bright areas with marked reverberation artifacts posteriorly. Foreign body stuck in the sclera or in retro orbital fat are more difficult to visualize than those in vitreous chamber. Foreign body in vitreous may show movement with motion of the eye ball. Traumatic eye may lose its shape especially in chronic injury, the globe may lose volume, show scleral thickening and/or calcification and become deformed which is called Pthisis Bulbi.<sup>13</sup>

### **Vitreous Detachment**

It is the separation of vitreous from retina. It could be diagnosed easily on ultrasound. Diagnostic criteria were a thin sheet of low amplitude echoes or membrane seen in posterior part of vitreous cavity which is freely mobile on dynamic scanning and not attached to optic nerve head. Clinical and ophthalmoscopy examination both revealed a fibrovascular stalk attaching the membrane to optic disc. Posterior vitreous detachment presented either as a thin sheet of echoes along the posterior hyaloid interface usually inserting into retina just anterior to equator and occasionally showing attachment to optic disc or diffuse or dispersed echoes to one or other vitreous compartment. This membrane and echoes move with ocular motion. In our study, 11 patients showed vitreous detachment along with vitreous hemorrhage.

### **Choroidal Detachment**

The choroid is elevated and sub choroid space is filled with either fluid or blood. There were 16 cases of choroidal detachment in our study. It could be seen as two opposite echogenic convex lines extending into the vitreous cavity. The lines may show linear color uptake on Doppler study due to vascularity of choroid. Retinal detachment is also commonly associated. These echogenic lines did not involve the optic nerve head. The detached membranes and echoes move with ocular motion.

### **Retinoblastoma**

In our study, it is the commonest primary intraocular tumor of childhood occurring 1 in 20,000 live births. We had 3 patients with retinoblastoma, 1 patient showed bilateral involvement. It presents with leucocoria (white pupil) in its late stage. 2 (out of 3 reported cases) are sporadic and 1 (out of 3 reported cases) showed positive family history of retinoblastoma. Tumor age is 18 months on average. The



tumor projects from retina into vitreous compartment as a white or pinkish mass. Optic nerve involvement beyond the point of surgical resection is associated with a 65% mortality rate. On USG, it may be seen as heterogeneous soft tissue mass of varying size adjacent to the layers of eye ball with some calcification producing acoustic shadowing and thickening of anterior part of optic nerve.

### Grave's Ophthalmopathy

All 5 cases of grave's ophthalmopathy were asymmetrical with medial rectus being the most commonly involved with predominant enlargement of belly of the muscle with loss of normal well defined outline. Dysthyroid orbitopathy is most common cause of proptosis. There may be restriction of eye movements but diplopia is rare and pain is not that common. The posterior 2/3 of muscle is usually involved (tendons are spared) compressing the optic nerve at orbital apex. The disease is bilateral with multiple muscles involvement. The inferior and medial rectus muscle are most commonly involved followed by superior rectus muscle complex and the lateral rectus. Unilateral involvement is uncommon. Isolated lateral rectus muscle involvement has not been reported.

In contrast to Grave's disease, inflammatory pseudo tumor commonly presents with pain. The disease is usually unilateral and tendons are not spared.<sup>14</sup>

### Optic Nerve Tumors

Optic nerve tumors include mainly glioma, meningioma and neurofibroma. In our study, 2 cases of optic nerve tumor (meningioma in both cases) were seen as a fusiform hypoechoic mass with well-defined margins encasing the optic nerve known as "Tram-track sign". Calcification was not appreciated on ultrasonography.

## CONCLUSION

USG is useful in ocular examinations and depicts multiple conditions such as inflammatory, tumors, and in some cases, traumatic lesions, which may involve any structure of the globe. 70% of referrals for USG were with opaque media, whilst 30% had clear media in which USG was used to compliment clinical diagnosis. The distinction between intraocular and extraocular pathologies was made in 100% of cases with the help of orbital USG. Vitreous hemorrhage was the commonest intraocular pathology while Grave's ophthalmopathy was the commonest extraocular pathology. Retinal detachment showed diagnostic accuracy of 99%. B-scan USG shows nearly 100% accuracy in diagnosis and characterization of optic nerve tumors. Thus B-mode real time ultrasonography with high frequency probes provide a cost-effective, radiation free, non-invasive technique in patients with ocular pathologies.

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