*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*
*e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 10 Ver. XIII (Oct. 2017), PP 60-70*
*www.iosrjournals.org*

# Overview of Orbital pathologies by B Scan Ultrasonography- Our Experience

Dr Parthasarathy K R[1], *Dr Aisha M Manzoor[2],Dr Vinay M[3]
[1](Professor and HOD, Department of Radiodiagnosis, SSIMS&RC/ RGUHS, India)
[2,3](Junior Residents, Department of Radiodiagnosis, SSIMS&RC/ RGUHS,India)
Corresponding Author: *Dr Aisha M Manzoor

***Abstract:*** *B scan ultrasonography of eye is simple, easily available, non-invasive,non ionizing and cost effective imaging modality. The aim of our study is to highlight the importance of B scan orbit even in this era where Ct and MRI has taken over many other fields. Total of 100 cases were included in the study/At the end of our study we were to conclude that B scan of orbit helps in accurately identifying the pathologies of eye in both opaque and non-opaque media and thereby helping in its effective management.*

***Keywords:*** *B-scan, Cataract, Orbit, Vitreous, Retinal detachment*

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Date of Submission: 29 -07-2017 Date of acceptance: 30-09-2017

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## I. Introduction

Ultrasonography of Orbit has become an important adjuvant for the clinical assessment for pathologies of orbit. The use of B scan of orbit can be traced back to 1956 when two ophthalmologists Mundts and Hughes used it to for the first time[1].Since then B scan ultrasonography of orbit plays a vital role in diagnosis of orbital pathologies. This can be attributed to the cystic nature of the eye and its superficial location .It plays an unavoidable role especially in cases where slit lamp examination and fundoscopy fails when the media is opaque or cataractous change prevents the visualization of posterior segments. Our study thus attempts to help the radiology residents as well as the ophthalmology residents in getting familiarized with some of the orbital pathologies that can be accurately diagnosed by B scan of Orbit.

## II. Aims And Objectives

To evaluate the role of B scan ultrasonography in pathologies of orbit.
To evaluate the role of B scan ultrasonography of orbits with opaque light conducting media where ophthalmoscopy and slit lamp examination fails.
To find out the most common orbital pathologies encountered in our institution.

## III. Materials And Methods

B scan ultrasonography images depicting the pathologies of orbit, stored in InstaRISPACS system in Department of Radio diagnosis, SSIMS &RC, Davangere during the period of 2017 January to 2017 July were retrospectively reviewed and datas were retrieved.100 cases of Bscan with orbital pathologies were reviewed. All images presented in this article were obtained using GE Voluson 7E equipped with 11-3MHz real-time high-frequency probe with the contact method.

## IV. Results

100 orbital cases were reviewed in which 78 patients were male and 22 patients were females. Males outnumbered females in our study. Fig.1

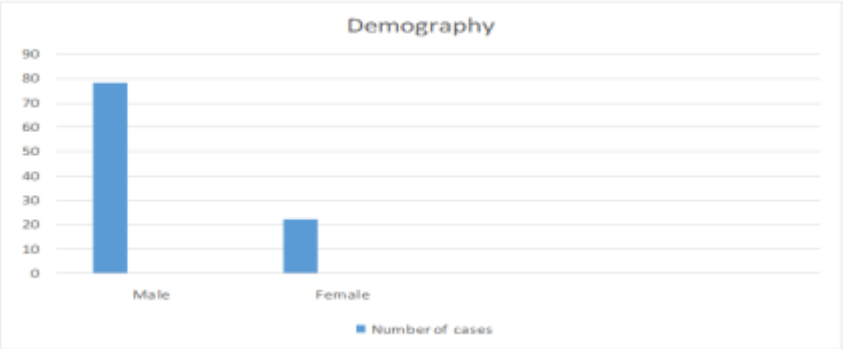



**Figure 1:** Bar chart showing the demography of cases.

The orbital pathologies encountered in our study was classified under different categories for convenience such as Congenital, Degenerative, Traumatic, Infective and Neoplastic [Table.1]. Degenerative cases was the most common among them, which included synchysis syntillans, asteroid hylosis, and cataract in which catarctous cases outnumber them.Fig.2 Among the cases reviewed congenital cases included Persistent Hyperplastic Primary vitreous(PHPV),Congenital cataract and coloboma.2 cases of retinoblastoma was the neoplastic lesion encountered in our study. Although Retinal detatchment, Vitreous Hemorrhage and choroidal detachment can be caused by many causes in our study majority of them were secondary to trauma and thus are classified under traumatic pathology .Similiarly phtisis bulbi although can occur secondary to severe ocular insult such as trauma and infection,6 out of 7 cases of the phthisis bulbi encountered in our study was secondary to infection and hence included under infection.

| **Orbital Pathologies** | **Number of cases** |
|---|---|
| Congenital | 8 |
| Degenerative | 40 |
| Traumatic | 32 |
| Infectious | 18 |
| Neoplastic | 2 |

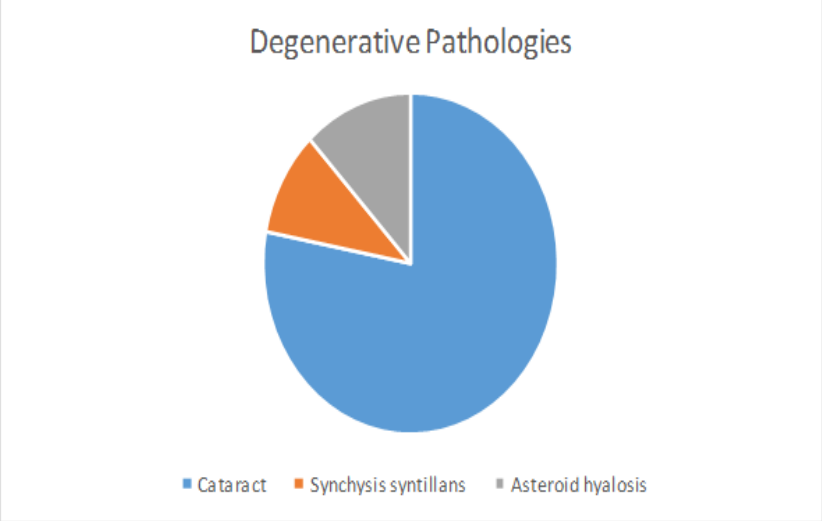



**Figure 2:** Pie chart showing distribution of degenerative cases.

## V. Discussion

### 5.1 Normal anatomy and B scan

The eyeball is embedded in fat in the orbit which is a skeletal cavity that protect it from various injuries. It has been divided in to smaller anterior segment filled with aqueous humor and a larger posterior segment filled with vitreous humor by the lens. The anterior segment is further divided into anterior chamber and posterior chamber by the iris. The eyeball has 3 layers, namely the sclera, choroid, and retina. Sclera is the dense outer layer which is thickest posteriorly at the entry of optic nerve and thinnest at equator and attachment of recti. Anteriorly sclera continues as a thin transparent layer –the cornea. The choroid is a highly vascular layer lining about posterior five sixth of eye and is the middle layer. The retina is a thin and innermost layer of eye and is thickest near optic disc. Anteriorly the retina is limited by the orra serrata. Internal to the retina is hyaloid membrane of vitreous cavity.Fig.3

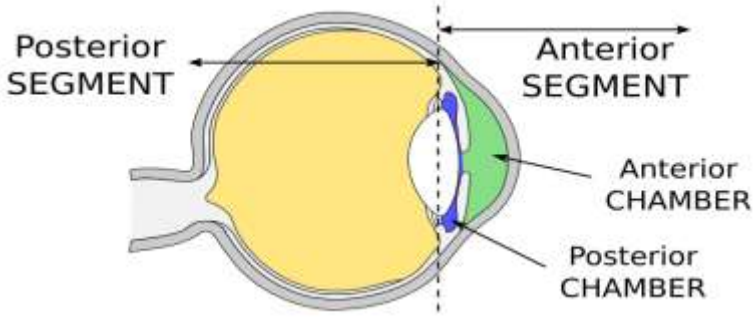



**Figure 3:**Horizontal section through human eyeball showing the chambers and segments

B-scan is a two dimensional ultrasonography technique which uses high frequency sound waves. B in B scan stands for Bright echoes. It is performed by keeping the transducer directly over the eye after application of a coupling agent or by immersion technique.Fig.4.

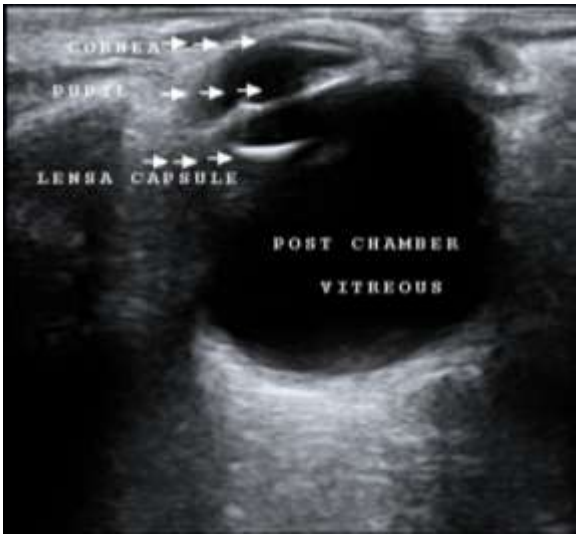



**Fig 4:**Transverse section of normal eyeball.

**5.2 Measurements**

**5.2.1Axial length and variations**

The axial length of emmetropic eyeball is about 24mm [3] with anterior chamber depth being 3.11mm [4]and posterior chamber depth between 14.4to 16mm[5]. According to studies variation in this occurs with age, gender, height, weight and refractory errors. In myopic eyes good positive correlation was found between axial length, and vitreous chamber depth and height whereas a negative correlation was found in hypermetropics[6].Fig:5

**Figure 5:** The axial length of a normal eyeball (Left) and that in a patient with myopia(Right).Positive correlation exists between axial length of eyeball and myopia.

**5.2.2 Optic nerve and Optic nerve sheath Diameter**

According to studies Optic Nerve sheath Diameter (ONSD) and Optic Nerve Diameter (OND) measurement by B-scan is a simple way of detecting intracranial hypertension. These are measured 3mm behind the globe using electronic calibre. The mean ONSD is 5.1 mm. Elevation in intracranial pressure is directly transmitted through the subarachnoid space into the optic nerve sheath and hence causes increase in ONSD[7].Fig:6.

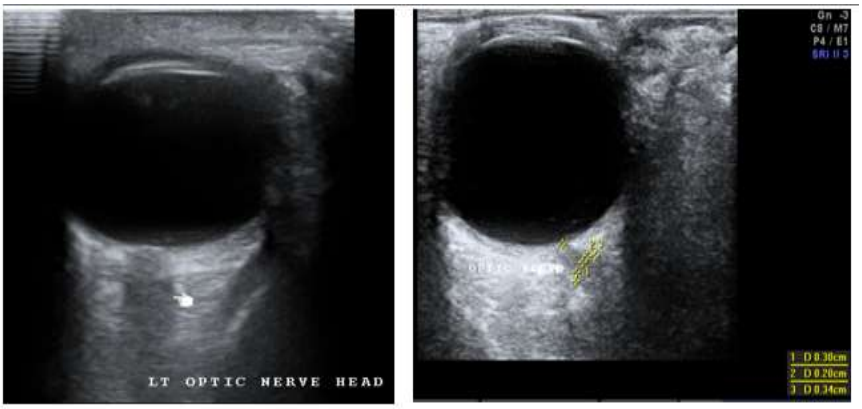



**Figure 6:** Transverse section of eyeball showing normal optic nerve(Left) and method of measurement of optic nerve and optic nerve sheath diameter(measurement on image 2-OND,3-ONSD).

**5.3 Congenital**

**5.3.1 Congenital cataract**

In India cataract accounts for 7.4-15.5% of childhood blindness with the prevalence being 1-15/10000 children [8]. In India main causative factor is idiopathic [8]. Other causative factors include hereditary factors, ocular or systemic disorders and trauma. On B Scan ultrasonography cataractous lens appears swollen and appears echogenic due to calcification[9].Fig.7

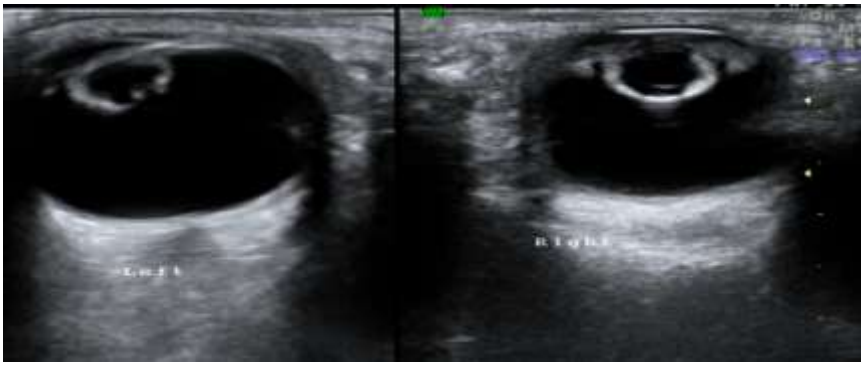
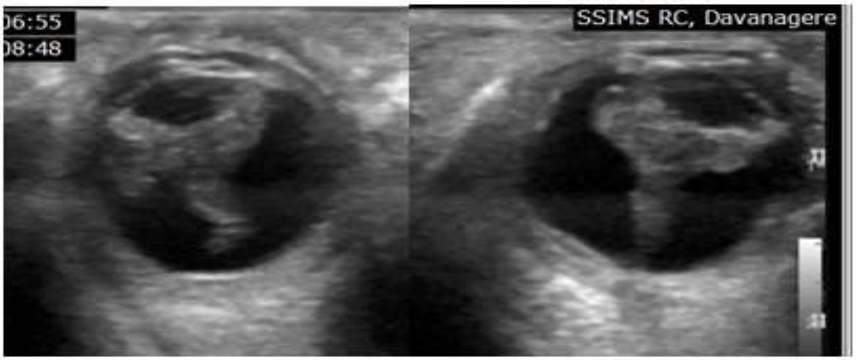


**Figure 7:** Transverse section of eyeball in an infant born to a mother with Rubella infection during pregnancy presented with bilateral congenital cataract. The lens is echogenic with calcification.

**5.3.2 Persistent Hyperplastic Primary Vitreous (PHPV)**

The hyaloid artery is found in the primary vitreous during the development phase. By around 3months of gestation secondary vitreous replaces it and the primary vitreous becomes condensed into cloquets canal. The cloquets canal extends from the optic disc to the posterior aspect of lens. The persistence of primary vitreous and hyaloid vasculature results in PHPV[10].The usual clinical feature is leukocoria of which retinoblastoma, congenital cataract, retinopathy of prematurity etc. forms a good differentials. Bilateral leukocoria is rare.[10]. On B scan ultrasonography PHPV has atypical imaging appearance. It shows a echogenic band extending from the posterior surface of the lens to the optic disc with arterial flow demonstrated within this band in Doppler .Fig.8



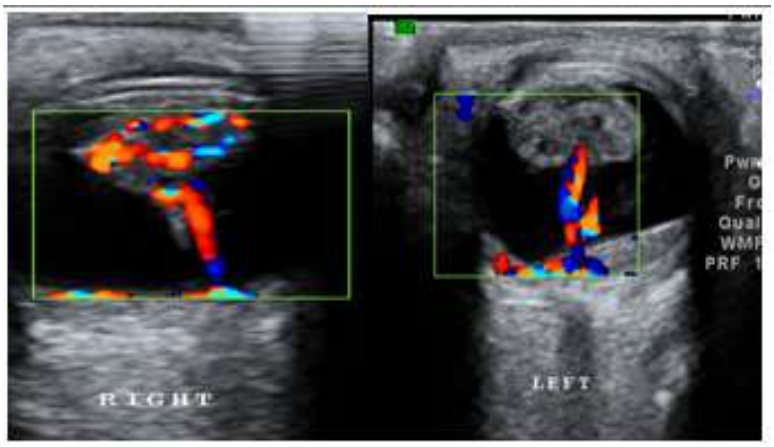



**Figure 8:** Axial B scan in a 3month old baby presenting with bilateral leukocoria suspected of retinoblastoma, Gray scale with Doppler demonstrates typical appearance of PHPV**.**

**5.3.3 Coloboma**

Coloboma is a collective term used for focal defect in the structure of eye. The most common pathology being failure of choroidal fissure to close posteriorly. It usually occurs along inferomedial aspect of globe and optic nerve. Many congenital syndromes are associated with coloboma[11].Fig.9


**Figure 9:** Axial section of eyeball showing inferomedial defect of eyeball-consistent with coloboma.

**5.3.4 Retinopathy of Prematurity/Retrolental fibroplasia.**

Retinopathy of prematurity is a bilateral condition seen in preterm premature infants supplemented with oxygen in postnatal period. The baby usually presents with leukocoria. On B scan dense retrolental membrane is visulaised, which is nothing but retrolental fibroplasia that is secondary to fibrotic changes in anterior vitreous.[12].Fig.10

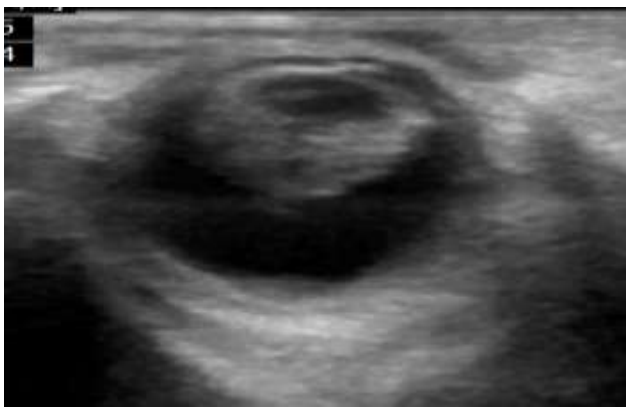


**Figure 10:** A preterm baby following oxygen supplementation, at 3months presented with leukocoria B scan reveals retrolental fibroplasia.

**5.4 Degeneration**

**5.4.1 Cataract**

Cataract is nothing but the opacification of thickening of lens. It can occur secondary to many causes such as trauma, degenerative,infection,radiation etc.In our study 98% of patients with cataract were due to degenerative changes in the old age, and hence was included under degenerative pathologies. On B scan ultrasonography the lens appears thickened with heterogeneous echotexture.[13]Fig.11

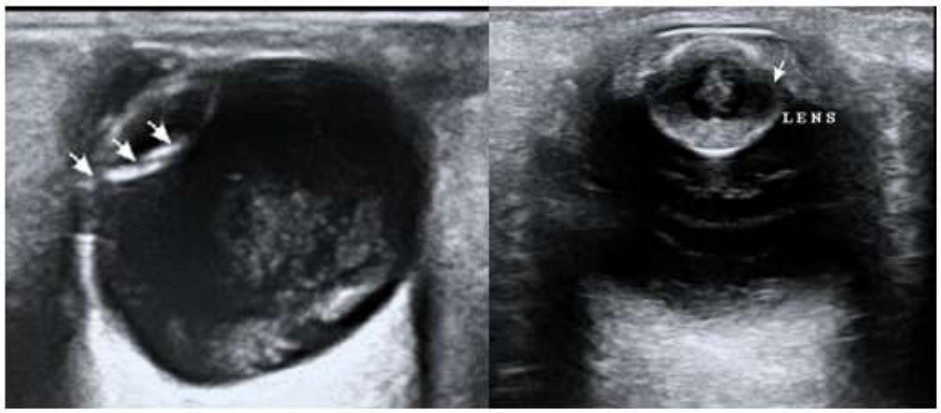



**Figure 11.**Axial B scan of B scan in two patients showing thickened lens with heterogeneous echotexture consistent with cataract.

**5.4.2 Synchysis syntillans**

It is nothing but liquefied vitreous with cholesterol crystals. On dynamic B scan it reveals multiple hyper reflective foci that shows after movements. The patient usually will have no symptoms[14].Fig.1

**Figure 12:** Axail B scan showing synchysis syntillans.

**5.4.3 Asteroid hyalosis**

Like Synchysis syntillans, asteroid hyalosis is vitreous degeneration resulting in calcium soaps suspended in vitreous.B scan reveals bright echoes without posterior acoustic shadowing[9].Although idiopathic it is seen in majoriy of diabetics[15].Fig.13

**Figure 13:** Axial scan showing asteroid hyalosis.

**5.4.4 Posterior vitreous detachment (PVD)**

With age and time the vitreous gel undergoes degeneration and it becomes liquid and further gets condensed. Eventually it starts getting separated from the retina since cannot fill the entire vitreous cavity as before. The patient may be asymptomatic but may presents with floaters and flashes if complicated with vitreous haemorrhage or retinal detachment. On B scan ultrasonography PVD presents as hyperechoic linear density within the posterior globe. The main differential is Retinal detachment(RD), in which it does not show after movement following eye movement whereas PVD does.In addition RD shows its attachment at optic disc.[12] Fig.14

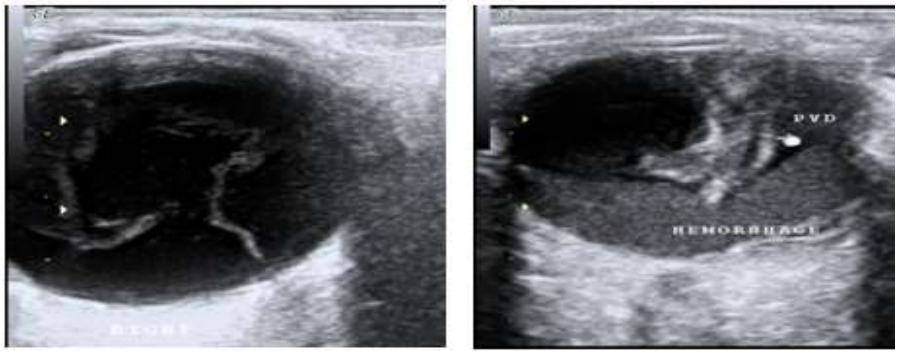



**Figure:14** Axial B scan of orbit shows PVD and PVD complicated with hemorrhage.

**5.5 Infections**

**5.5.1 Preseptat cellulitis.**

It is limited to the soft tissue anterior to orbital septum and is often managed with oral antibiotics. It is different from orbital cellulitis which is otherwise termed as post septal cellulitis and is more severe form as compared with pre septal cellulitis.Fig.15

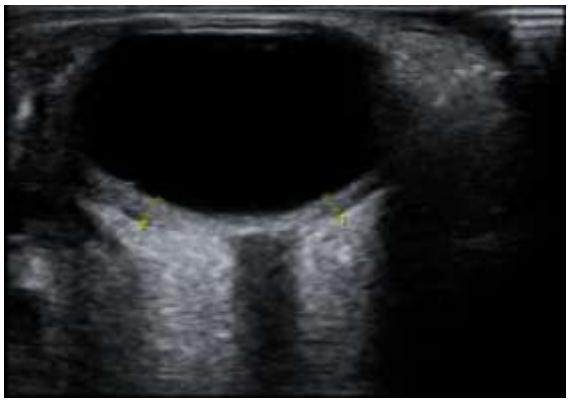


**Figure:15** Axial B scan of right orbit showing heterogenous inflammatory induration and edema and early abscess formation in the right preseptal soft tissue -Suggestive of Preseptal Cellulitis

**5.5.2 Endophthalmitis**

It is intraocular inflammation and is a potentially sight threatening situation. It involves the inflammation of intraorbital cavities namely aqueous and vitreous cavities. Fig.16

**Figure:**16 Axial section of usg orbit showing endophthalmitis.

**5.5.3 Panophthalmitis**

It is the purulent inflammation of eye involving all layers of the eye, including the sclera and cornea and intraocular structures.Fig.17

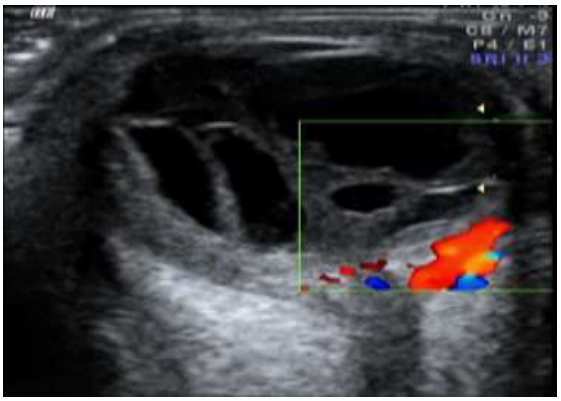


**Figure:17** Axial section of orbit showing heterogeneous echoes with multiple thin septations involving the sclera and cornea.

**5.5.4 Pseudotumour**

Orbital pseudotumour is an idiopathic inflammatory condition .It most commonly affects the extraocular muscles and the patient typically presents with proptosis and responds well with steroids.Fig.18

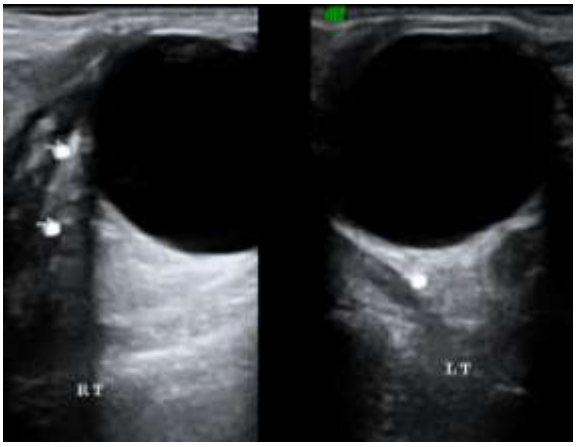



**Figure 18:** 18 year old female who presented with proptosis,B scan Orbit revealed inflammatory hypertrophy of left medial rectus compared to right.

**5.5.5 Pthisis Bulbi**

Pthisis bulbi is also called as end stage eye and occurs secondary to severe ocular insults such as trauma or infection. The eye will be blind, reduced in size and non-functioning with loss of normal ocular shape and intraocular calcifications.[12].Fig.19

**Figure:19** Right eye was relatively smaller compared to left with loss of normal ocular shape and specks of calcification.

**5.6 Trauma**

**5.6.1 Vitreous hemorrhage**

Vitreous hemorrhage occurs secondary to vitreoretinal traction, diabetic retinopathy and most commonly secondary to trauma. On B scan ultrasonography it shows widespread low level echoes with marked after movement on dynamic scanning[12].Fig.20

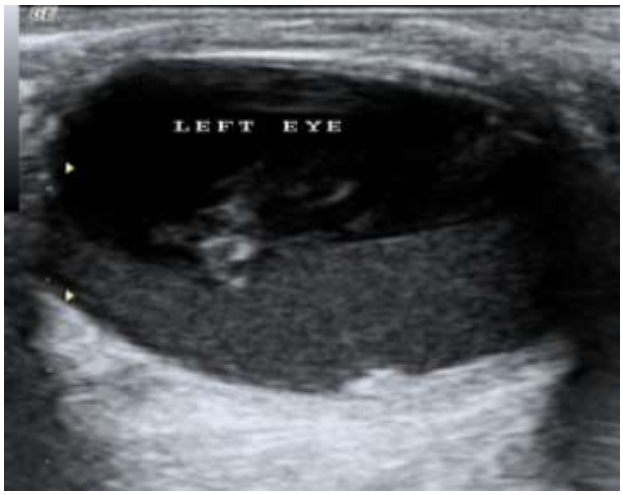



**Figure 20:** Axial B scan ultrasonography reveals low level internal echoes in vitreous chamber with marked after movement on B scan.

**5.6.2 Choroidal detachment**

Choroidal detachment occurs secondary to fluid or hemorrhage in sub choroidal space. B scan of orbit reveals detachment usually sparing posterior third of globe and may extend anteriorly beyond the ora serrata as compared to Retinal detatchment. Complete choroidal detachment is called as 'kissing choroid 'due to its typical appearance.[12].Fig.21

**Figure 21:**Axial B scan reveals choroidal detachment.

**5.6.3 Retinal Detachment (RD)**

RD usually occurs secondary to tear or break in the retina.It will be usually attached at orra serrata anteriorly and optic nerve head posteriorly giving total RD a complete funnel shape. Sometime it may be attached to choroidal detachment.[12].Fig.22

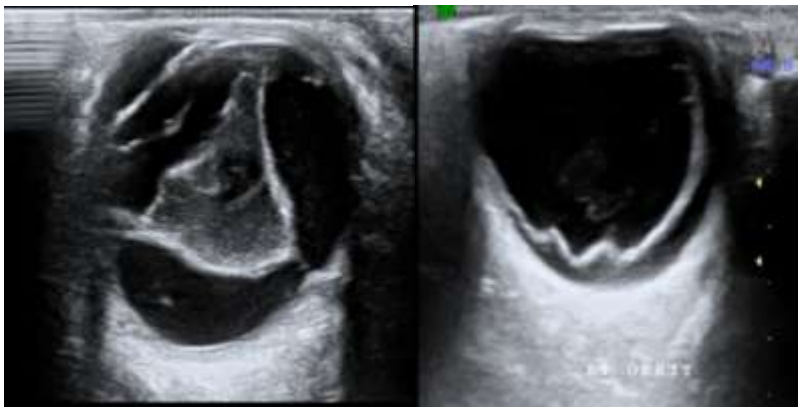


**Figure:22** Axial B scan reveals total retinal detachment (left) and partial RD(right).

**5.7. Neoplastic**

**5.7.1 Retinoblastoma**

It is the most common primary intraocular tumor of childhood. The child presents with leukocoria. The pathognomonic feature on B scan is intraocular irregular tumor with calcification .B scan also helps in detection of optic nerve involvement resulting from extra-ocular spread of tumor.[12].Fig.23

**Fig 23:** 2 year old female baby presented with leukocoria, Axial B scan showing intraocular tumour with calcification-consistent with retinoblastoma.

## VI. CONCLUSION

B scan ultrasonography of eye is simple, easily accessible, non-invasive, non-ionizing and cost effective imaging modality. Even though it is operator dependent the role of USG in orbit pathologies cannot be replaced by CT or MRI because of its high resolution, eye being a superficial structure .The B scan also plays an important role in pre-operative evaluation of orbit especially when the media is opaque or conditions such as cataract which prevents the visualization of posterior chamber by direct or indirect ophthalmoscopy. Thus the role of B scan ultrasonography is irreplaceable by CT, MRI or routine ophthalmology instruments. Our study helped us in concreting these facts further, since almost all intra-ocular pathologies can be accurately diagnosed with B scan ultrasonography.

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