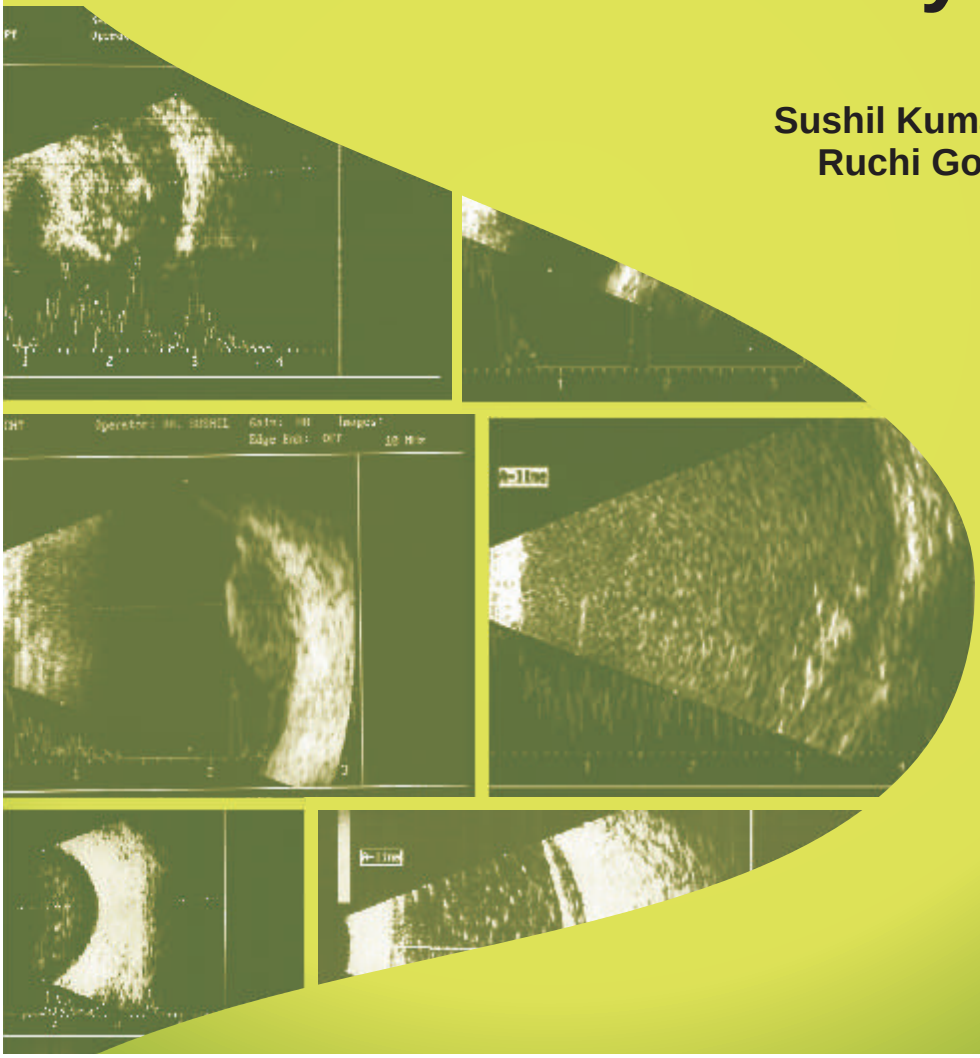
AIOS, CME SERIES (No. 24)

Diagnostic Ultrasonography of the Eye

Sushil Kumar
Ruchi Goel



ALL INDIA OPHTHALMOLOGICAL SOCIETY

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About CME .....

Dear Colleagues,

As I write about this CME , I am reminded of a Court Case against an Ophthalmologist wherein Diagnostic Ultrasound of the Eye, through advised, was not done. Hence the need & usefulness of this CME series No. 24 by AIOS.

Preferably to be done by the examining Ophthalmologist himself - In hazy / opaque media, ultrasound helps us `SEE` what we can't. In clear media, ultrasound helps in tissue characterization.

Although largely surpassed by CT scan (mainly because of lethargy or lack of training on part of Ophthalmologist). Ultrasound offers wealth of useful information, as outlined in this very useful and handy booklet authored by Drs Sushil Kumar & Ruchi Goel.

Hope, our members will find it useful in their day to day practice.

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Foreword

Dear Colleagues,

It has been said that ocular ultrasound takes a weekend to learn and a lifetime to master. But I do not agree with this fully as I feel learning is a steep process and hence everyone should learn thoroughly. Significant training goes into learning what various ocular pathologies look like in a 2D cross-sectional view. Clearly, this is a bit more complicated than taking a simple IOP measurement. Nevertheless, B-scan ultrasonography is a particularly important part of an ophthalmologist's armamentarium. But in the same way that our proficiency with the technology has improved with time and experience, so have the diagnostic tools. Innovations in image resolution, acquisition, and subsequent digital image evaluation, provide for a higher level of diagnostic confidence than before.

When direct observation of intraocular anatomy is obscured, the B-scan is the tool of choice for the evaluation of the eye and its orbit.

With understanding of the indications for ultrasonography and proper examination technique, one can gather a vast amount of information not possible with clinical examination alone.

In this issue of AIOS CME series titled “Diagnostic Ultrasonography Of the Eye”, the authors have presented the basics of this diagnostic tool including the principles, indications and techniques in a simplified and illustrated manner. It also gives a clear understanding of echographic characteristics of various ocular pathologies. I am sure this will stimulate every ophthalmologist to know about Ultrasonography and those interested will master the technique all for the benefit of the patients.

I would like to appreciate the efforts of Dr Sushil Kumar and Dr Ruchi Goel in compiling an excellent practical guide on Ophthalmic Ultrasonography.

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FROM DARKNESS TO LIGHT
तमसो मा ज्योतिर्गमय

Introduction

The emergence of ultrasonography as a diagnostic tool has steadily increased eversince it was first used in the field of Ophthalmology by Mundt and Hughes .[1] Oksala et al reported the sound velocities in the various components of the eye.[2]

Baum and Greenwood[3] came up with two dimensional, immersion scan which was subsequently improved upon by Purnell and Coleman.[4,5] Contact Bscan was introduced by Bronson[6] and it being portable, became part of everyday use in ophthalmology. There have been constant improvements in both, the standardized Ascan (Time amplitude scan) and Bscan(Brightness mode, two dimensional scan).

Standardization of Ascan was carried out by Ossoinig[7] He later combined the standardized Ascan instrument with contact Bscan, which ultimately led to the development of Standardized Echography, a diagnostic modality for highly accurate detection and differentiation of oculo-orbital disorders. Lately colour Doppler ultrasound has become a part of the present day's Standardized Echography.

Ultrasonography is **used for**

- **Biometry** (Ascan) for axial length and corneal thickness measurement.
- **Standardized Ascan** (diagnostic) for the echostructure assessment. It is a part of the Bscan in most of the contemporary machines with cross vector facility.
- **Diagnostic Bscan** (two dimensional) has to be coupled with the standardized Ascan to arrive at a correct diagnosis.
- **Doppler ultrasonography** is especially important in vascular lesions with different blood flow rates.

During the echoexamination the two scans, A & B are complimentary

to each other. Since ultrasonography is a dynamic procedure, a real time evaluation for diagnosis is possible. This is in contrast to radiological evaluation where still pictures are obtained.

During examination, the following systematic approach is universally recommended:

1. **Screening** for lesion detection: A + Bscan.
2. **Topographic examination** for shape, border, location and extension (if possible) of the lesion: Bscan.
3. **Quantitative Echography** to know the reflectivity, sound attenuation & internal structure of lesion. It helps in determining the texture of the lesion: A scan.
4. **Kinetic echography** provides information about the mobility, aftermovement and vascularity (Valsalva manoeuvre) on Bscan. It also includes colour Doppler assessment for blood flow.

Indications for Ultrasonography

Ophthalmic ultrasonography is a special investigation and it is mandatory that a detailed history, ophthalmic examination, relevant investigations and a provisional diagnosis be provided to the ultrasonologist. *To reiterate, all the tests and investigations are complimentary to arrive at the final diagnosis*. One must also keep in mind the danger of infection while ordering for ultrasonography in open globe injuries and freshly operated cases! In a nutshell, a comprehensive work up and its judicious use help in optimal use of ultrasonography in interpretation of the various ocular disorders.

Ultrasonography is used for:

1. Evaluation of intraocular details obscured from visualization by the ocular media opacities.
2. Evaluation of retinochoroidal lesions especially tumors even with clear media.

3. Differentiation of solid from cystic and homogenous from heterogeneous masses.
4. Examination of retrobulbar soft tissue masses and normally present orbital structures (to differentiate proptosis from exophthalmos).
5. Identification, localization and measurement of non radio-opaque/radio-opaque foreign bodies. Assessment of collateral damage in trauma cases.
6. Biometry and pachmetry.
7. Follow up evaluations.

References

1. Mundt GH, Hughes WE. Ultrasonics in ocular diagnosis. Am J Ophthalmol 1956; 41:488-498.
2. Oksala Lehtinen A. Diagnostic value of ultrasonics in ophthalmology. Ophthalmologica 1957; 134:387-395.
3. Baum G, Greenwood I. The application of ultrasonic location, techniques to ophthalmology: theoretic considerations and acoustic properties of ocular media: Part 1, Reflective properties. Am J Ophthalmol 1958;46:319-329.
4. Purnell E W. B mode orbital ultrasonography. Int Ophthalmol Clin 1969;9:643-665.
5. Coleman D J, Lizzi FL, Jack RL. Ultrasonography of the eye and orbit. Philadelphia: Lea & Febiger,1977.
6. Ossoinig KC. Standardized echography: basic principles, clinical applications and results. Int Ophthalmol Clin. 1979; 19:127-210.
7. Byrne SF, Green RL. Examination techniques for the globe in Ultrasound of the Eye and Orbit , Mosby year book, 1992, page 42.

Examination Techniques & Intraocular Diseases

Probe positions and marker direction

Ascan probe is a small, pencil sized probe without a mark and easy to manoeuvre. With this probe the ultrasound beam are parallel and non-focussed. The probe should be placed at right angle to the area of interest in order to obtain appropriate spike height and thereby maximum information. The probe can be kept directly over the globe after local anaesthesia or on the lid skin for which the overall gain of the machine has to be increased by 3-5db.

Most of the scanners have standardized Ascan that is the probe is of 8MHz emitting parallel sound beam of 5mm width at the highest decibel gain and 0.5mm at the lowest. The sound amplification in these scanners has S-shaped amplifier with flat upper and lower curves and a steep mid segment with a dynamic range of 33-36db. A test tissue block is provided to set the gain in the machine.

Bscan probes on the other hand are thick, with a mark and emit focussed sound beam at a frequency of 10MHz. Pictures obtained with Bscan probe are two dimensional as compared to Ascan probe. The **mark on the Bscan** probe indicates beam orientation so that the area towards which the mark is directed appears at the **top of the echogram** on display screen. Bscan probe can also be put directly on the anaesthetized globe after applying eye speculum; but mostly the Bscanning is done transpalpebrum with slightly increased overall gain.

To obtain high quality Bscan pictures one must ensure that

- Lesions are placed in the center of the scanning beam
- The beam is perpendicular to the interfaces at the area of interest

- The lowest possible decibel gain consistent with the maintenance of adequate intensity should be used to optimize the resolution of images.

Bscan pictures can be obtained by axial, transverse and longitudinal sections.

During the procedure the probe is moved from limbus to fornix in different clock hour meridians and the picture seen is of diagonally opposite meridian as follows:

Clock hour- Probe position	Clock area-Area screened
3-Limbus	9-Posterior
3-Equator	9-Equator
3-Fornix	9-Anterior
6-Limbus	12-Posterior
6-Equator	12-Equator
6-Fornix	12-Anterior

Probe can be moved antero-posteriorly as well as sideways. Patient is instructed to fix the gaze so that the probe is perpendicular to the area being examined. (Figure 1,2)

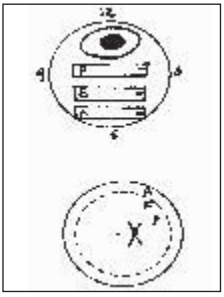


Figure 1

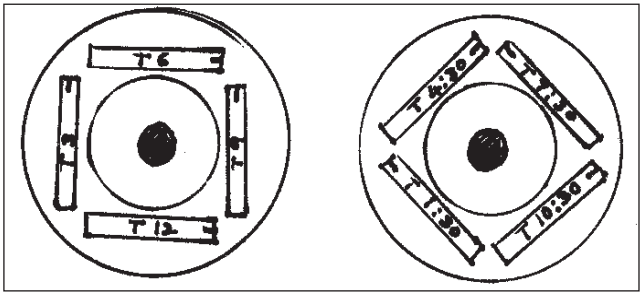


Figure 2

For **macular screening**, the four basic Bscan probe positions that allow perpendicular sound beam exposure to the macula are

horizontal axial, vertical transverse, longitudinal and vertical macula approaches. In axial section the probe is placed over the anaesthetized cornea and the beam is directed towards the posterior pole. In this section there is marked attenuation of the sound beam due to the crystalline lens in the path so the picture may not be suitable for macular thickness measurement. The lens is avoided by placing the probe at the limbus and it is 9.00 P position in the right eye and 3.00 P position in the left eye.

Axial section: The patient fixates in the primary gaze and the probe is placed on the globe and directed axially. Depending on the clock hour location of the marker, axial-horizontal, axial-vertical and axial-oblique pictures are obtained. These sections demonstrate lesions at the posterior pole and the optic nerve head.

Transverse section: The mark is kept parallel to the limbus and probe is shifted from limbus to the fornix and also sideways. This scan gives the lateral extent of the lesion.

Longitudinal section: The mark is kept at right angle to the limbus to determine the antero-posterior limit of the lesion. (Figure 3)

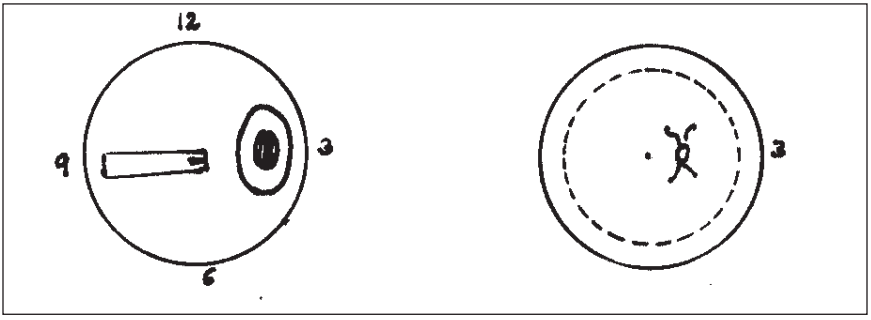


Figure 3

With contact type of scanning there is a dead zone of about 7.5mm adjacent to the probe, so that the lesions in this region are missed. To visualize this area, one can keep the probe on the opposite side at right angle or use immersion scan technique.

For echoexamination, ultrasound uses high frequency sound waves of >20,000 cycles/sec. These sound waves have different velocities in

different media as given below:

Velocity(m/s)	Medium
1480	Fresh water
1532	Aqueous & Vitreous
1640	Clear lens
1550	Solid tissues

Sound waves are generated at the tip of the transducer which has a piezo-electric crystal of quartz or ceramic. These high frequency waves from the probe are transmitted to the area of interest and also received back as radiofrequency signals. After processing these signals magnified pictures are displayed as echograms. The wavelength which is the distance between two particles in the same phase of oscillation of sound wave is expressed in mm and in ocular tissues it is approximately 0.2mm. For deeper penetration, lower frequency probes (like 5MHz in abdominal scanning) are used but the image resolution gets compromised. Higher frequency probes result in lesser penetration but better resolution of image. In clinical practice, a compromise between the two is done to obtain optimum information (10 MHz for Bscan & 8 MHz for Ascan).

Present day ultrasound machine has Bscan probe with cross vector facility in which the Ascan spikes are generated in the area where the cross vector is placed. The three special examination techniques already mentioned (topographic, kinetic and quantitative) are used together to arrive at an echographic diagnosis.

Topographic examination performed using the Bscan probe throws light on the

1. Size, shape and contour of the mass lesion
2. Membranous opacity
3. Discrete vitreous opacities (single or multiple)
4. Abnormalities in globe contour

Kinetic Echography is required to determine the tissue mobility and vascularity in the lesion. For this, at times colour Doppler instruments are used in conjunction with Bscan.

Quantitative Echography is performed with Ascan more objectively and precisely in contrast to Bscan which yields semi-quantitative information. The knowledge obtained regarding reflectivity, internal structure and sound attenuation helps in its differentiation from similar lesions. The various reflectivity categories are as follows[7]:

Category	Spike height, %
Extremely low	0-5
Low	5-40
Medium	40-60
Medium-high	60-80
High	80-100

Contact Bscan with cross vector is routinely used for the assessment of the posterior segment of the eye i.e. vitreoretinal status, macula, ONH (Optic Nerve Head) and anterior two-third of the orbital cavity for any space occupying lesion or oculo-orbital trauma. Extraocular muscles can also be evaluated. For the anterior segment evaluation, UBM (ultrasound biomicroscopy) and OCT (optical coherence tomography) are used. For the posterior one third of the orbit, especially the apical region CT and MRI are better modalities.

Some of the common eye conditions where diagnostic ultrasonography is helpful are:

A. Dense cataract which when associated with marked and rapid decrease in visual acuity, afferent pupillary defect, diabetes mellitus, uveitis, trauma, myopia and rubeosis-iridis, warrants the need to rule out retinal detachment(RD), intraocular tumor with calcification, posterior staphyloma, vitreous haemorrhage, asteroid hyalosis, optic nerve head cupping, abnormal growth over optic nerve head or axial length disparity.

B. In **vitreous haemorrhage**, on echoevaluation one may pick up retinal tear with detachment, disciform degeneration, melanoma, fibrovascular fronds with tractional RD or subhyloid haemorrhage.

C. The cause of **leucokoria** whether due to retinoblastoma, PHPV, Coat's disease, Retinopathy of prematurity or old haemorrhage can be deduced.

D. In **vitritis/endophthalmitis**, it helps in ruling out foreign body (FB) and rupture of intraocular cyst and helps in assessing the response to treatment.

E. In a **painful blind eye**, it is indicated to rule out uveal melanoma, old RD with chronic uveitis, intraocular/subretinal cyst, lens dislocation, failed RD surgery, inflamed phthisical eye, e.t.c.

F. Patients planned for **penetrating keratoplasty** with opaque anterior segment.

G. Patients with **clear media** where on indirect ophthalmoscopy suspicious lesions suggestive of intraocular tumors like choroidal melanoma, haemangioma, metastatic carcinoma, osteoma, etc are seen. Orbital screening should be performed in patients with abnormal choroidal folds and posterior scleritis.

H. In **oculo-orbital trauma**, it is imperative to look for sclero-choroidal rupture with RD, intraocular/orbital FB, lens displacement, optic nerve avulsion and orbital haemorrhage.

I. In **postoperative cases** to assess endophthalmitis/toxic anterior segment syndrome, lens fragment/ intraocular lens(IOL) displacement into the vitreous cavity, choroidal detachment/ haemorrhage, status of retina post RD surgery, etc.

Echodescription of common intraocular conditions:

1. **Vitreous floaters** appear as one or more echo dots of less

brightness in the mid /posterior vitreous cavity which show mobility with after movement display on Bscan. These may be associated with enlarged globe size. On Ascan, these echodots have extremely low to low reflectivity (2-20%) and to appreciate them better overall gain may be increased by 5-6db.

2. **Vitreous haemorrhage** may be fresh, resolving, organizing, organized with membrane formation and at times can lead to tractional RD.

- To pick up fresh vitreous haemorrhage, the overall gain can be increased by 10 db. They appear as multiple fine echo opacities dusting the vitreous body which do not extend beyond the posterior vitreous border. They are usually attached to the retinal surface but may get detached and are then seen as PVD (posterior vitreous detachment). Depending on the grade and location of the haemorrhage the PVD may or may not be stained. On A scan, these haemorrhagic spots (echo pulses) show low reflectivity (5-10%). (Figure 4)

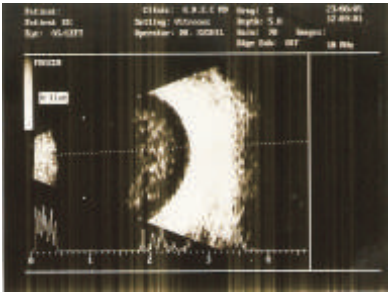


Figure 4

- In older haemorrhage, the echodots are denser and show higher reflectivity (up to 60%) on Ascan. Stained PVD may also be seen. (Figure 5 & 6)

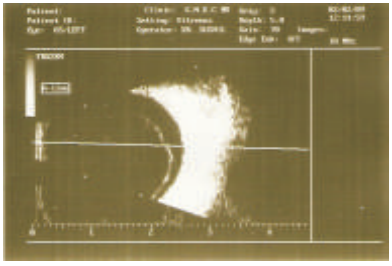


Figure 5

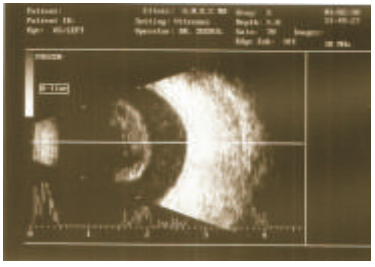


Figure 6

- In resolving vitreous haemorrhage, in comparison with older scans, echodots on Bscan show decrease in brightness and numbers.

- Subhyaloid haemorrhage is situated typically at the posterior pole between the anterior surface of retina and posterior vitreous face. It may be fluid in nature or may get organized. Sometimes an organized old pre-retinal haemorrhage may be seen in all the quadrants of the globe. Lifting of this organized vitreous haemorrhage during vitrectomy can produce iatrogenic retinal breaks and retinal detachment.

- An old organized vitreous haemorrhage can result in vitreous-membrane formation (seen as echogenic lines on Bsan) mimicking RD. The attachment of the echomembrane on/upto the optic nerve head and Quantitative echography II(difference in decibel setting 6-15db for retina and >20 db for vitreous membrane) help to differentiate RD from vitreous membranes. At times these vitreous membranes, especially in cases of recurrent haemorrhage, become extremely thick and after attaching to the retina exert a tractional force on it resulting in a tractional RD. This is usually seen in proliferative retinopathy of different varieties like in diabetics, hypertensives, sickle cell disease, trauma, etc.

- Subtle findings like retinal break, scleral rupture, tumors like melanoma breaking into the Bruch's membrane, disciform degeneration, imbedded FB, etc can be picked up giving an insight to the etio-pathogenesis of the vitreous haemorrhage.

3. In **endophthalmitis/ vitritis** the inflammatory cells which are seen dotlike on Bscan, are multiple, scattered diffusely or may be localised to the anterior, mid or the posterior one third of the vitreous cavity depending on the etiology. (Figure 7,8) On A scan, these dot like opacities show low to medium reflectivity (10-60%). It is not possible to differentiate vitritis from vitreous haemorrhage in **still** pictures unless clinical

details are available. These inflammatory cells organize very rapidly to form vitreous membranes and therefore frequent examinations should be performed.(c.f. from vitreous haemorrhage)

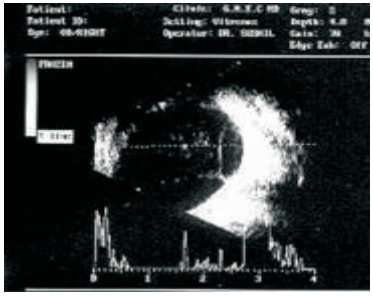


Figure 7

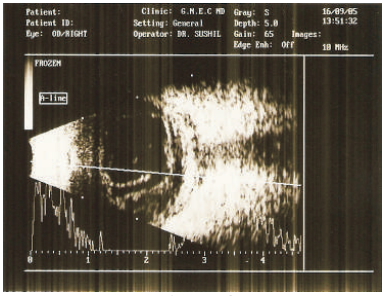


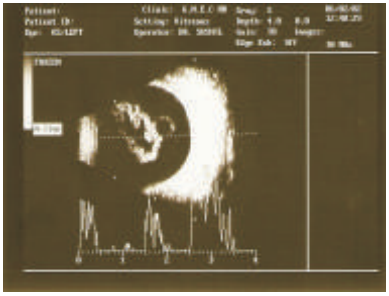
Figure 8

4. **Asteroid Hyalosis** is characterized clinically by presence of calcium crystals embedded in an amorphous matrix which on Bscan appears as multiple, densely packed, homogeneously distributed echodense dots of medium to high reflectivity (50-100%) which are usually localized to the core of vitreous body. One may find clear retrovitreal or pre-retinal space.

5. **Posterior vitreous detachment (PVD):** Normally vitreous is attached to the retina and a clear vitreous cavity is seen in front of the retinochoroidoscleral complex. In PVD which may occur due to senility, trauma or vitreous haemorrhage one sees echogenic membrane concentric to the globe, infront of the retinochoroidoscleral complex with clear subvitreal space. It may be small, interrupted, peripheral or continuous and total. If lined with red blood cells its echo density increases. On A scan, the reflectivity of this membrane is low if the PVD is thin but it may be high if it is thick and lined with red blood cells. PVD usually does not show attachment to the optic nerve head.

6. **Retinal detachment** means separation of neurosensory retina from the pigmentary retina. It may be total/subtotal, localized/peripheral or fresh/old with proliferative vitreoretinopathy(PVR) changes. On Bscan, it appears as echogenic dense membrane, biconvex or biconcave with

100% attachment at the optic nerve head (ONH) and 90-100% reflectivity on Ascan. Attachment at ONH is not seen in localized, peripheral RD where membrane is visible only in a single quadrant. In uncomplicated cases, there is a clear space between the detached retina and the ocular coat spike indicating transudative nature of the subretinal fluid. Fine echodots may also be seen in the subretinal space indicating the presence of haemorrhage or debris. In PVR cases, vitreous body shows debris dots or membrane formation depending upon its grade and cystic degeneration may be present in an old RD. (Figure 9-12)



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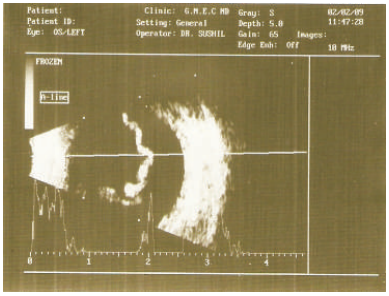


Figure 10

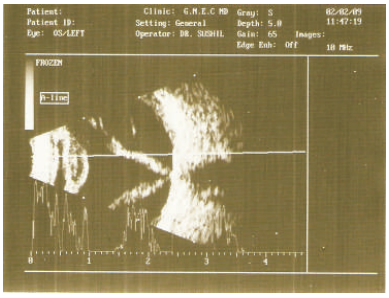


Figure 11

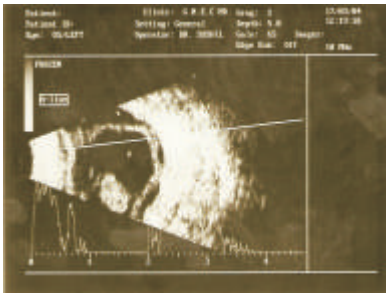


Figure 12

After movement if present is suggestive of fresh RD. In **rhegmatogenous RD**, retinal tears especially operculated tears/ giant tears and even the trickle of vitreous haemorrhage from the break site into the vitreous cavity may be picked up. In **tractional RD**, fibrovascular frond within the vitreous cavity or along the vitreous face may be seen. This frond

when exerts tractional force on the retina, produces tent like elevation from the retina as an echogenic membrane which may be localized or extensive enough to become total. (Figure 13) It does not show after-movement and vitreous cavity may show evidence suggestive of old haemorrhage. On Ascan this thick membrane produces 100% reflectivity. At times thick vitreous may be difficult to differentiate from RD as it may have an attachment to the ONH and Quantitative echography II may be used to differentiate the two.

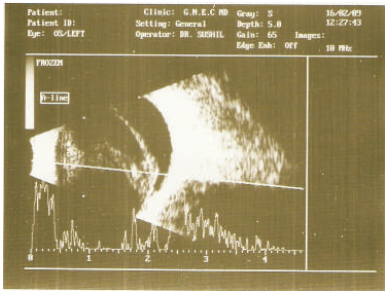


Figure 13

7. **Scleral Explants** are used in rhegmatogenous RD surgeries where buckle or sponge is applied to indent the globe. On Bscan they appear as echogenic spots with the globe indentation towards the vitreous body and echolucent spot (shadowing) behind the scleral explant. The explant shows high reflectivity on Ascan. Silicone buckle is less echodense in comparison to the sponge.

8. **Vitreous expanders** like silicone oil or perfluorocarbons may be seen in operated RD cases. Emulsified silicone oil produces marked sound attenuation hindering the visualization of posterior segment.(Figure 14) It also results in a larger vitreous cavity which is relatively echofree. Perfluorocarbons on the other hand show multiple, highly reflective liquid bubbles in the posterior vitreous. (Figure 15,16)

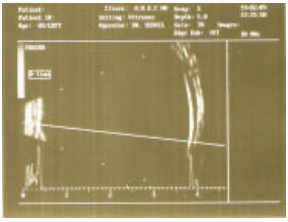


Figure 14

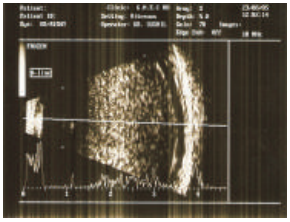


Figure 15

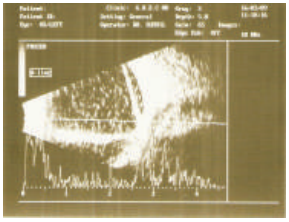


Figure 16

9. **Choroidal detachment** is usually in the periphery and may be localized or total. (Figure 17) When seen after glaucoma filtering surgery, it is seen as dome shaped elevation with clear sub choroidal space on Bscan and 90-100% double peaked tall spike on Ascan. There is none or very little after movement on kinetic echography. In cases with impending expulsive haemorrhage or traumatic choroidal detachment, the sub choroidal space shows haemorrhage as multiple dot like opacities on Bscan. There may be two or more domes which may meet in the vitreous cavity to form kissing choroidals. (Figure 18) Choroidal detachment needs to be differentiated from RD and PVD. (Table 1)

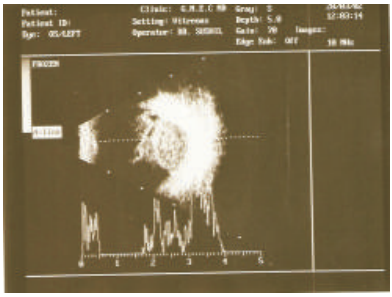


Figure 17

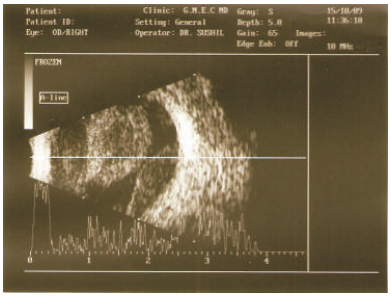


Figure 18

Features	Choridal detachment	RD	PVD
Shape	Dome	Linear V/U	V/U
Location	Periphery (Pre-equator)	Variable	Variable
Attachment to ONH	No	Yes	Variable
Other findings	Kissing choroidals, vortex vein (limiting)	Folds, breaks, PVR changes	Prominently seen inferiorly
Spike height on Ascan	90-100%	80-100%	40-90%
Spike peak	Double	Single	Single
Mobility	Minimal	Moderate	Marked
After movement	–	Minimal	Marked

10. **Intraocular tumors** which commonly require Bscan evaluation are retinoblastoma, choroidal melanoma, hemangioma, metastasis, diktyoma and osteoma.

Retinoblastoma is seen as a solid tumor arising from the retinal layer obliterating the vitreous cavity. It has to be differentiated from other couses of leucocoria. Calcification within the tumor mass is typical of retinoblastoma. (Figure 19) There may be shadowing effect behind the lesion in the orbital mass. Concomitant RD may be sometimes present. On A scan, spikes with moderate internal reflectivity may be seen but in presence of necrosis and calcification, highly reflective, irregular spikes are observed. Sound attenuation is moderate to high. The globe is usually normal in size except in glaucomatous stage when it becomes enlarged, whereas, in **persistent hyperplastic primary vitreous**, the globe size may be smaller and the vitreous cavity shows persistence of the primary vascular system seen as echo membranous track from optic nerve head to the back of the lens.(Figure 20) **Retinopathy of prematurity** is characterised by multiple vitreous membranes and RD in the periphery. The size of the globe may be smaller in these cases.

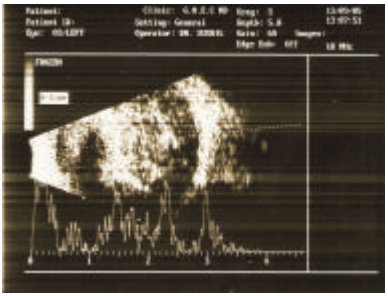


Figure 19

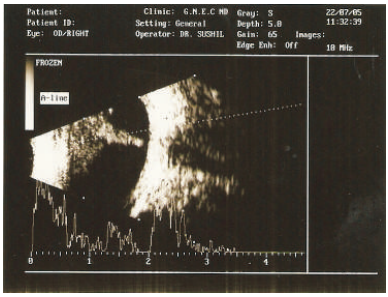


Figure 20

In **Coat's disease** there is unilateral involvement and there may be presence of an exudative RD with turbid subretinal fluid or cholesterol crystals in the subretinal space.

Choroidal naevus/melanoma appears as a small dome shaped, localized, solid lesion, elevated from the ocular coats with low to medium reflective Ascan spike (40-60%). Tuberculoma may have a similar appearance on Bscan. (Figure 21,22)

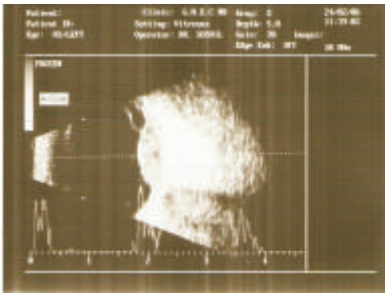


Figure 21

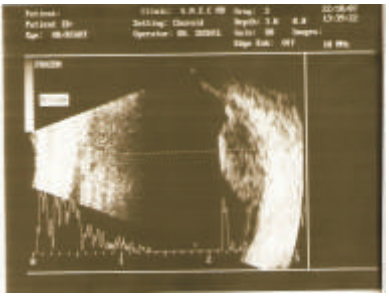


Figure 22

Larger melanoma is seen typically as solid dome shaped mass, arising from the choroidal layer with strong border echoes, projecting into the vitreous cavity with solid RD and retromass shadowing effect. (Figure 23) Internal hollowing if present indicates tumor cell necrosis. At times vascularity, may be noticed with distinct aftermovement. On Ascan, the internal echospikes show low to medium reflectivity.

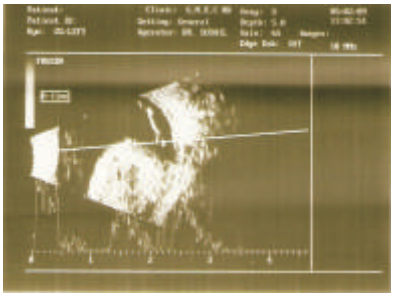


Figure 23

Choroidal haemangioma and **osteoma** are characterized by internal echospikes of high reflectivity. In haemangioma, the Ascan spikes show a honeycomb pattern because of multiple tissue interfaces.

Lesions in **choroidal metastasis** have variable shape, reflectivity and sound attenuation. They are usually present at the macula and may be associated with RD.

Diktyoma is a rare tumor in which a iris/ciliary body cyst or a free floating cyst in the aqueous/ vitreous humor may be seen. Young adults may present with severe anterior segment inflammation and vitritis. A whitish mass may be seen in the ciliary body region in children.

11. **Oculo-orbital trauma** may have varied manifestation namely:

    - Hyphaema with iridodialysis

- Soft globe with scleral rupture
- Crystalline lens/intraocular lens dislocation into the vitreous cavity
- Vitreous haemorrhage with or without RD
- Expulsive haemorrhage with orbital haemorrhage
- Phthisis bulbi
- Intraocular foreign body (IOFB)/ orbital FB

Ultrasound biomicroscopy(UBM) is required for evaluation of hyphaema with iridodialysis instead of contact Bscan which is more useful for posterior segment assessment.

In a **ruptured globe** with low intraocular pressure, there may be scleral dehiscence with vitreous haemorrhage, vitreous/uveal tissue prolapse or vitreous haemorrhage with RD. Scleral dehiscence usually occurs at the site of extraocular muscle insertion and may be concentric to the limbus. (Figure 24) In cases of small scleral rupture, a trickle of haemorrhage into the vitreous cavity is noticed on Bscan.

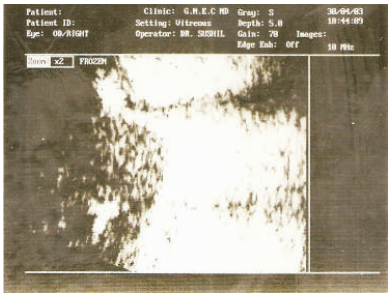


Figure 24

Posteriorly dislocated crystalline **lens** into the vitreous cavity is seen as a biconvex body which may be mobile or fixed. Lens fragment in vitreous usually produces vitritis. The intraocular lens in

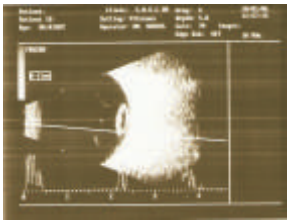


Figure 25

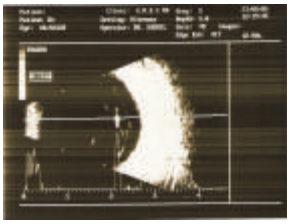


Figure 26

vitreous cavity appears like a FB and shows high reflectivity and shadowing effect behind it. (Figure 25,26)

Hyphaema, vitreous haemorrhage with choroidal haemorrhage and scleral rupture with orbital haemorrhage may be seen in combination and the condition may appear as haemophthalmos. (Figure 27) Black eye (lid haemorrhage) may coexist with it.

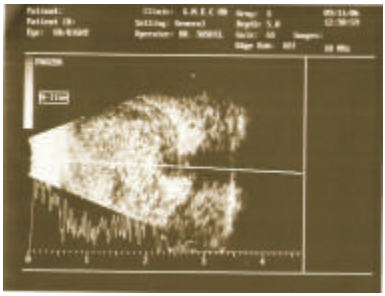


Figure 27

The final outcome may be a **phthisis bulbi** in which the globe is small, soft, deshaped and there is thickened retinochoroidal complex. (Figure 28) Intraocular calcification or bone formation may occur in choroidal layer in long standing cases which is better appreciated on decreasing the gain by 15-20db. Retro globe shadowing may also be visible.

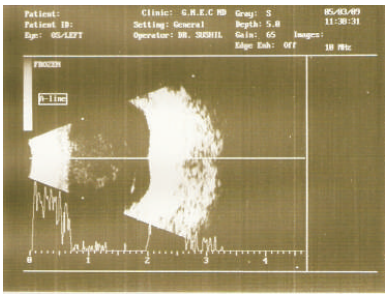


Figure 28

IOFB are seen as echodense spots with a 100% reflectivity on Ascan spike irrespective of the nature of the FB and ultrasonography enables its exact sizing and localization. Shadowing effect is usually seen. (Figure 29, 30& 31)Decreasing the gain on the machine by 10db helps in differentiating it from dense blood clot and lens fragment. Also, shadowing is not seen with lens fragments. Foreign bodies less than 0.2mm in size and those in the orbit which are obscured by haemorrhage are best picked up by CTscan. **Spherical FB** like gunshot pellets, have an anterior and posterior surface and between them there are multiple internal reverberations/echoes. These echoes are seen as echogenic opacities with a wedge shaped trail of spikes. The trail disappears on decreasing the overall gain of machine but the initial echodense spot remains as such.

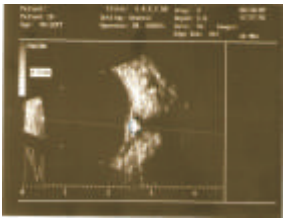


Figure 29

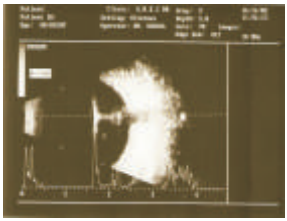


Figure 30

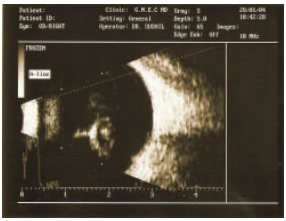


Figure 31

Optic nerve avulsion may be partial or total. On Bscan, the optic nerve head may be absent or there may be haemorrhage in the vitreous cavity with the globe being soft.

12. Miscellaneous conditions

- **Fundal coloboma** is a congenital abnormality seen in the inferonasal quadrant as defect in the retinochoroidal layer of the globe on Bscan. If the coloboma involves the ONH region, there is absence of ONH. (Figure 32)

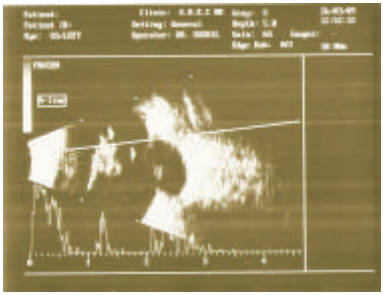


Figure 32

- **Posterior staphyloma** is a common finding observed in high myopes. It appears as a sudden bowing backward of the globe with thinning of the retinochoroidal layer. It is usually seen at the posterior pole and the axial length of the globe is increased, indicating axial myopia. There may be presence of vitreous debri.

- **Post operative endophthalmitis** can be differentiated from toxic anterior segment syndrome (TASS). In TASS, the severe inflammation is visible only in the anterior segment whereas in endophthalmitis there is severe vitritis and exudation in the vitreous cavity. Also, Bscan is useful in evaluating the response to intravitreal injection in endophthalmitis. (Figure 33)

- **Cysticercosis** can occur in any ocular tissue. It is more common in vitreous cavity, subretinal space and sub conjunctival space but other sites like extraocular muscles and optic nerve may also be involved. Bscan reveals a well defined cystic lesion with clear contents and a hyperechoic area suggestive of scolex. Serial echography helps in followup of the patient and resolution is indicated by disappearance of the scolex. (Figure 34, 35 &36)

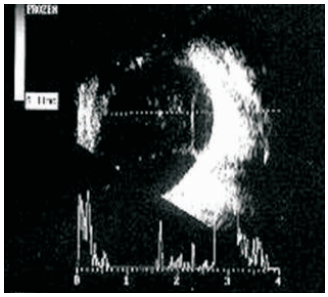


Figure 33

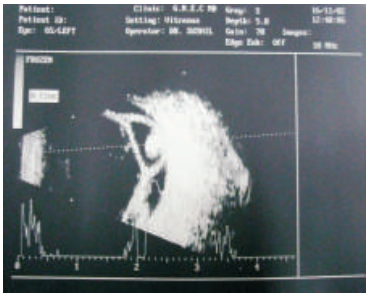


Figure 34

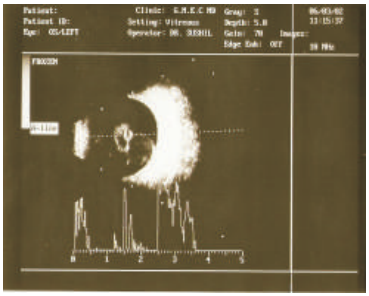


Figure 35

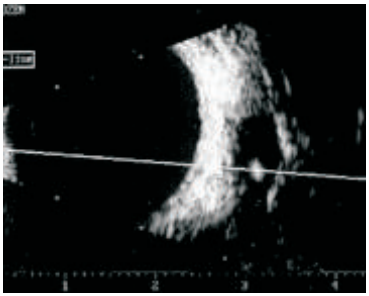


Figure 36

Legends for Table

1. Differentiation of posterior vitreous detachment, total retinal detachment and choroidal detachment.

Legends for figures

1. Transverse-12 Bscan of the right eye showing the probe and marker location on the eye, and corresponding beam orientation on the fundus.
2. Bscan screening of the entire globe being performed using four overlapping transverse sections at 12,3,6 and 9 clock hours along with additional four sections centred at 1.30, 4.30, 7.30 and 10.30 clock hours. Each quadrant of the fundus wall is scanned twice postero-anteriorly.
3. Longitudinal-3 Bscan of the right eye showing the probe's position on the globe and beam orientation on the fundus.
4. Vitreous haemorrhage in posterior 1/3rd of vitreous cavity with clear retrovitreal space.
5. Vitreous haemorrhage with blood staining of posterior vitreous detachment.
6. Vitreous haemorrhage with blood stained posterior vitreous detachment with blood in pre-retinal area.
7. Early endophthalmitis with membrane formation and cells in posterior 1/3rd of vitreous cavity.
8. Vitreous exudates, membrane formation and 'T" sign in endophthalmitis.
9. Old retinal detachment with convolutions, closed funnel and cystic degeneration.
10. Old retinal detachment with convolutions.
11. Old retinal detachment with attachment at optic nerve head.
12. Ovarian carcinoma with secondaries in vitreous cavity and total retinal detachment.
13. Fibrovascular frond projecting into the vitreous cavity arising from optic nerve head in a case of Proliferative diabetic retinopathy.
14. Expanded globe with silicone oil causing obscuration of orbital soft tissue.
15. Perfluorocarbons in vitreous cavity producing expansion of globe showin low internal reflectivity on Ascan.
16. Perflurocarbons in vitreous cavity with unsettled retinal detachment.
17. Choroidal detachment with haemorrhage in subchoroidal space.
18. Haemophthalmos with kissing choridals.

19. Endophytic retinoblastoma with calcification showing high reflectivity on A scan.
20. Persistent hyperplastic primary vitreous showing small globe size and persistent primary vasculature from optic nerve head to posterior surface of lens.
21. Choroidal melanoma appearing as a small dome shaped homogeneous mass near the optic nerve head with localized retinal detachment.
22. Tuberculoma is seen as localized granuloma on the retinal surface showing low internal reflectivity.
23. Large choroidal melanoma projecting in the vitreous cavity showing shadowing, acoustic hollowing within and retinal detachment.
24. Scleral dehicense with 'T' sign with vitreous haemorrhage following perforating injury of the globe.
25. Nucleus drop seen on the retinal surface with vitritis.
26. Nucleus fragment drop causing vitritis and posterior vitreous detachment. There is 100% reflectivity without shadowing unlike foreign body.
27. Haemophthalmos with scleral dehiscence.
28. Pre-pthisical eye with small, deshaped globe, thickened retinochoroidal complex and vitreous debri.
29. Intra-retinal foreign body with acoustic shadowing.
30. Intra vitreal foreign body with acoustic shadowing.
31. Posteriorly dislocated intraocular lens in a buphthalmic eye showing 100% reflectivity.
32. Fundal coloboma showing defect in defect in the retinochoroidal layer with pectinate ligament.
33. Early endophthalmitis showing membranes with cells in posterior 1/3rd of vitreous.
34. Intraocular subretinal cysticercosis with retinal detachment.
35. Intravitreal cysticercosis.
36. Intraorbital cysticercosis.

Orbital Ultrasonography

Standardized ultrasonography still has a place in management of orbital lesions in this era of sophisticated imaging modalities. A quick examination of children without sedation/ radiation, insight of the kinetic properties and ease of follow-up examinations make it a useful office tool. But CT and MRI are better for orbital apex lesions.

The orbital examination comprises of (1) orbital soft tissue assessment; (2) extraocular muscle evaluation; and (3) retrobulbar optic nerve examination using transocular (examination through the globe) or paraocular (examination next to the globe) approach. The techniques include transverse, longitudinal and axial views. Transverse scans show the lateral extent of the lesion whereas the longitudinal scans provide an anterior-posterior view of the orbit. In the horizontal paraocular scans the marker is directed nasally, in the vertical and oblique scans it is directed superiorly. (Figure 1) In the longitudinal paraocular scan, the marker is directed towards the orbital rim in positions 1-5 and towards the globe in positions 6-8. (Figure 2)

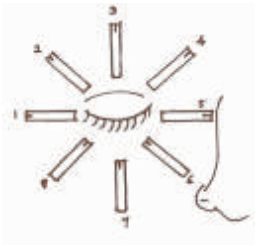


Figure 1

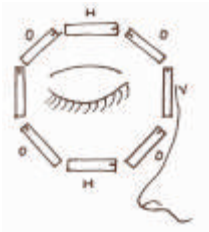


Figure 2

The axial scan (transocular approach) is performed in the primary gaze. In the horizontal scan, the marker is directed nasally; in the vertical scan, superiorly; and in oblique scan, towards the upper of the two meridians being examined.

Indications of orbital ultrasonography:

- Proptosis and globe displacement

- Abnormal lid positions and edema
- Some cases of motility disturbances
- Some cases of ocular/orbital pain
- Uniocular injection & rise in intraocular pressure
- Some cases of optic disc edema/atrophy and vascular retinal occlusion
- Choroidal folds
- Orbital trauma

Bscan screening is performed from superior-nasal-inferior-temporal quadrants posterio-anteriorly. Lacrimal gland region is assessed using longitudinal approach. Lesions near the posterior ocular wall, optic nerve and the muscle cone are evaluated using axial scan. Compressibility is checked by pressing the probe lightly on the globe. Narrowing of echogram, results with normal soft tissues which are easily compressible. A Valsalva maneuver can be performed to look for orbital varix.

When an orbital mass lesion is found a topographic, quantitative and a kinetic echography is done for lesion differentiation as follows :

Topographic echography:

- Location: position, meridians
- Shape
- Borders
- Contour abnormalities: Bone-excavation, defects or hyperostosis; globe-indentation or flattening

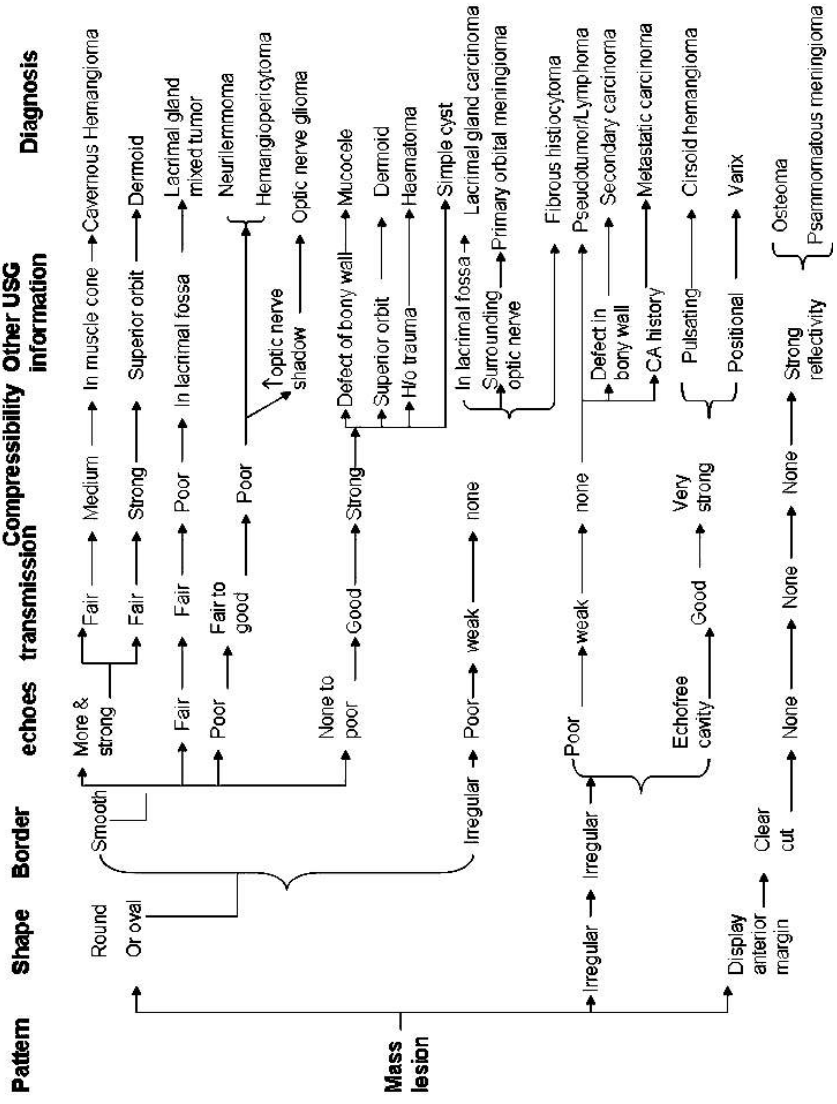
Quantitative echography:

- Internal reflectivity: spike height
- Internal structure: histologic architecture
- Sound attenuation: absorption or shadowing

Kinetic echography:

- Consistency: soft vs hard
- Vascularity: blood flow
- Mobility of lesion or its contents

This exercise helps in arriving at a tentative diagnosis. (Table 1)



For topographic echography, the patient fixates towards the lesion and the probe is placed on the globe opposite the lesion, first at the limbus and then shifted towards the fornix. Quantitative echography correlates with the lesion's histologic structure. Reflectivity is determined by measuring the spike height on Ascan and signal brightness on Bscan. Sound attenuation which occurs due to scattering, reflection or absorption of sound energy is indicated by decrease in spike height on A scan and echodensity on Bscan either within or posterior to the lesion. **Angle kappa** by **Ossoing** is formed by an imaginary line drawn through the peaks of the internal spikes and the horizontal baseline, on an A scan. The steeper the angle greater the attenuation. Substances such as bone, calcium and foreign bodies produce strong sound attenuation.

Dynamic assessment of motion of or within a lesion is done by kinetic echography. Presence of fast, spontaneous flickering motion in the internal lesion echoes with the eye and probe stationary indicates vascularity.

Mobility is checked by observing the Bscan as the patient blinks or during a saccade. Shifting fluid is seen in lymphangiomas with haemorrhage, hematomas and cysts.

A continuous convection like motion occurs in cholesterol within a hematic cyst and aftermovements are seen with membranes within the globe or septa within a lymphangioma.

Tumors of the orbit:

1. Pseudotumor and lymphoma: These comprise of small densely packed cells with regular internal structure resulting in low-medium internal reflectivity, weak sound attenuation and variable borders/shape. (figure 3)

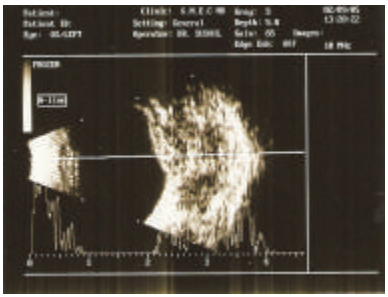


Figure 3

2. Rhabdomyosarcoma: They are differentiated from other tumors like capillary haemangioma, lymphangioma and dermoid cyst common in this age group. They can be located anywhere in the orbit. They are usually well circumscribed, variable shape, low-medium internal reflectivity, moderate sound attenuation and internal blood flow. (figure 4)

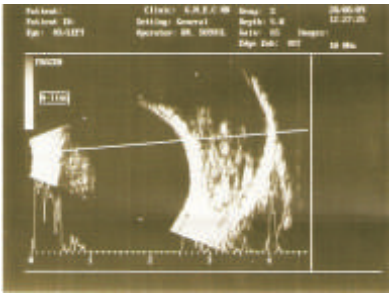


Figure 4

3. Schwannoma(Neurilemmoma): They are oval, encapsulated with low-medium reflectivity, regular internal reflectivity, moderate sound attenuation and with some degree of vascularity. (figure 5)

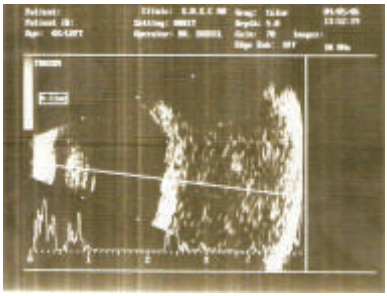


Figure 5

4. Neurofibroma: Plexiform type is irregularly shaped with irregular internal structure, high internal reflectivity, minimal sound attenuation. (Figure 6 & 7)

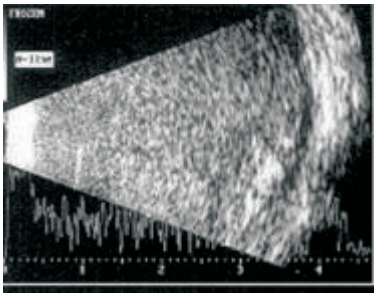


Figure 6

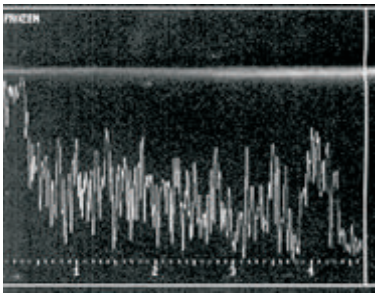


Figure 7

5. Fibrous histiocytoma: It has low-medium internal

reflectivity, regular internal structure, moderate sound attenuation and absence of vascularity.

6. Metastatic carcinoma: If infiltrative are irregular, poorly outlined, medium-high reflectivity, irregular internal structure, weak sound attenuation and may be associated with bony defects.

Vascular lesions of the orbit:

These can be neoplasms or vascular malformations as follows:

Neoplasms

- Cavernous hemangioma
- Capillary hemangioma
- Lymphangioma
- Hemangiopericytoma

Vascular malformations

- Carotid-cavernous sinus fistula
- Dural –cavernous sinus fistula
- Superior ophthalmic vein thrombosis
- Orbital varix
- Arteriovenous malformation
- Orbital aneurysm

1. **Cavernous Hemangioma:** These are round/oval, well outlined with high internal reflectivity, regular internal structure, moderate sound attenuation and absence of vascularity. (Figure 8)

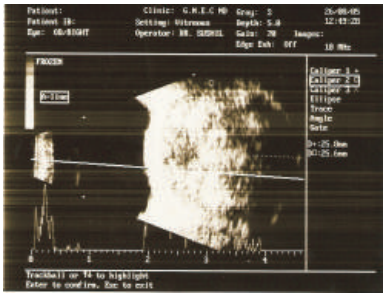


Figure 8

2. **Capillary Hemangioma:** The hallmark is presence of vascularity. These are irregular,

poorly outlined with high internal reflectivity, irregular internal structure and variable sound attenuation.

3. **Lymphangioma:** These consist of multiple lymph filled spaces (that are low reflective) with endothelium lined walls (that are highly reflective) resulting an irregular structure and large dilated lymphatic spaces. The borders are indistinct like capillary hemangioma but internal vascularity is lacking. (Figure 9,10)

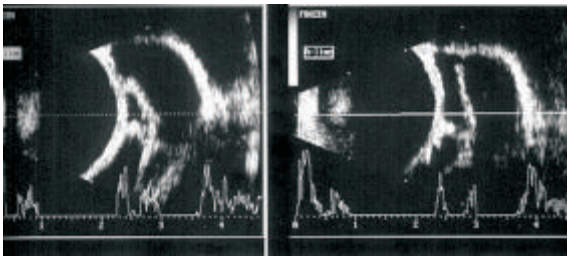


Figure 9

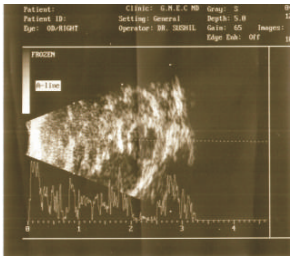


Figure 10

4. Carotid-cavernous sinus fistula(Fast flow): The characteristic finding is the dilated superior ophthalmic vein which is low reflective and has marked blood flow. Other features are orbital soft tissue swelling, mild enlargement of extraocular muscles and widening of optic nerve pattern.

5. Orbital varix: These are venous malformations which present as intermittent proptosis, exacerbated with bending of the head or performance of a Valsalva Maneuver. (Figure 11, 12)

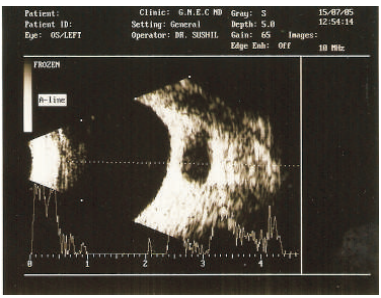


Figure 11

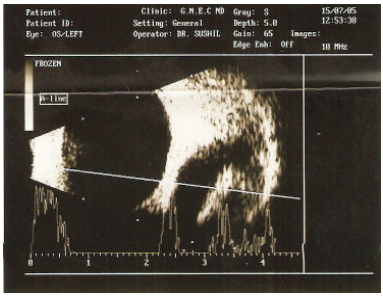


Figure 12

Cystic lesions of the orbit

These have a smooth contour, round to oval shape, sharp outline and absence of internal vascularity. The commonly found cystic lesions in the orbit are dermoid cyst, epidermoid cyst, dermolipoma, epithelial inclusion cyst, hematic cyst, microphthalmos with cyst, congenital cystic eye, teratoma, lacrimal ductal cyst and mucocele.

Dermoid cyst is the most common orbital cyst which appears usually in the superotemporal or superonasal quadrant. (Figure 13) It can be superficial or deep. In superficial cysts the echography is done to determine its posterior extension. Deeper cysts can erode the adjacent bony wall. Dermoid cysts are filled with keratin, sebaceous materials, hair follicles and inflammatory cells. The internal reflectivity on Ascan varies depending on the contents of the cyst. They can not be differentiated from epidermoid cysts echographically. Histopathologically, the epidermoid cyst wall does not contain adenexal structures.

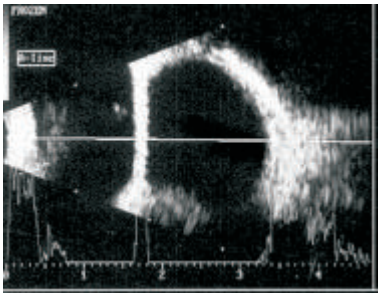


Figure 13

Orbital abcess appear as low to medium reflective lesions that can be solitary or multiloculated. They need to be differentiated from haematomas which have a tendency to layer. They can be aspirated under echographic guidance. (Figure 14)

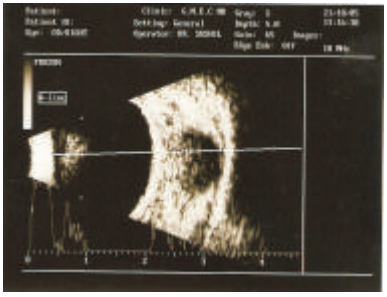


Figure 14

Extraocular muscle examination: The extraocular muscles may be thickened due to Grave's disease, idiopathic orbital myositis, congestion, tumors (e.g. metastatic carcinoma), hematoma, e.t.c.[1,2]

The normal values of extraocular muscles are as follows[3]:

Muscle	Normal range(mm)	Difference between contralateral muscles
Superior rectus/ levator complex	3.9-6.8	0.8
Lateral rectus	2.2-3.8	0.4
Inferior rectus	1.6-3.6	0.4
Medial rectus(thickest)	2.3-4.7	0.5
Sum of all muscles	11.9-16.9	1.2

Transverse Bscan of the muscle is performed by placing the probe on the globe near the equator, on the opposite side and then the probe is angled posteriorly. The marker is directed superiorly for medial and lateral rectus muscle and nasally for superior and inferior rectus muscles.

Thyroid ophthalmopathy: It is the commonest cause of extraocular muscle enlargement involving the muscle belly with sparing of the inserting tendon. (Figure 15) The frequency of muscle involvement in decreasing order is superior rectus/ levator complex, medial rectus, inferior rectus and lateral rectus.

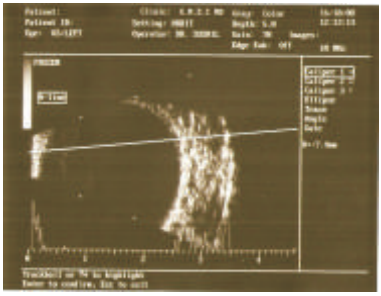


Figure 15

The differential diagnosis of extraocular muscle disorders is given below[4]:

Disorder	Reflectivity	Internal structure	Insertions
Thyroid ophthalmopathy	Medium-high	Irregular	Normal
Myositis	Low	Regular	Thickened
Tumors	Low-Medium	Regular	Normal
Venous congestion	Medium-high	Variable	Normal
Hematoma	Low-medium	Regular	Variable

Optic nerve lesions

The optic nerve is best displayed with the probe placed on the globe temporally. A similar probe orientation is employed while comparing the two eyes.

Retrobulbar optic nerve disorders can cause widening of optic nerve pattern due to the thickening of optic nerve parenchyma (eg. tumor or inflammation) and thickening of perineural sheaths (eg. tumor or inflammation) and increased subarachnoid fluid (eg. pseudotumor cerebri). The differentiation is based on the degree of thickening, internal reflectivity, structure of the nerve and thirty degree test as follows[5]:

Disorder	Reflectivity	Internal structure	Thirty degree test
Increased subarachnoid fluid	Variable	Irregular	Positive
Glioma	Low-medium	Regular	Negative
Meningioma	Medium-high	Irregular	Negative

Thirty degree test [6]

This was developed by Ossoinig et al to differentiate increased subarachnoid fluid from thickening of optic nerve parenchyma or the perineural sheaths using A scan technique. The maximum thickness

of the optic nerve is measured both anteriorly and posteriorly in primary gaze and with the patient fixating 30^0 or more towards the probe. The test is considered positive if the nerve pattern decreases by at least 10% at 30^0gaze as compared to the primary gaze. It is positive in patients with increased subarachnoid fluid.

Optic nerve **Glioma** appears as smooth, fusiform or ovoid mass that replaces the normal optic nerve void with low –medium reflectivity. (Figure 16)

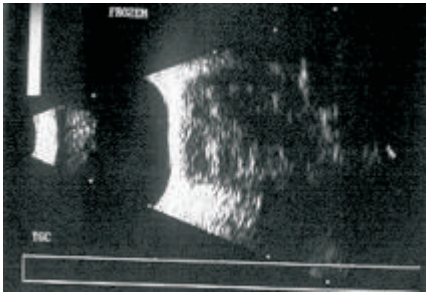


Figure 16

Optic nerve sheath **meningioma** in comparison to gliomas are irregular and nodular on Bscan. (Figure 17)

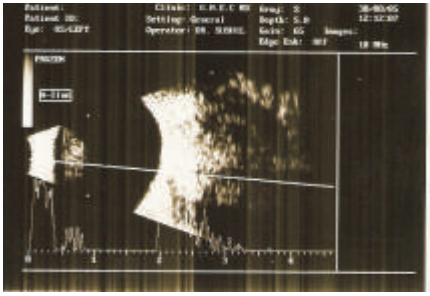


Figure 17

Optic nerve head conditions: Abnormal growths like melanocytoma, medullated nerve fibres, epipapillary membranes, etc are seen as dense echogenic masses or membranes. Advanced glaucomatous cupping may also be picked up by an experienced echographer. ONH edema/papillitis appears as fullness in the region of ONH with presence of a few vitreous cells anterior to it.

References

1. Ossoing KC: Ultrasonic diagnosis of Grave's ophthalmopathy, in Gorman CA, Waller RD, Dyer JA(eds): The eye and orbit in Thyroid disease. New York, Raven Press, 1984.
2. Jakobiec FA, Font RL: Orbit, in Spencer WH: Ophthalmic Pathology-An atlas and Textbook, ed 3. Philadelphia, WB Saunders Co, 1986, p 2766.
3. Byrne SF, Gendron JS, et al: Diameter of normal extraocular recti muscles with echography. Am J Ophthalmol 1991;112:706.
4. Byrne SF, Green RL. Extraocular muscles in Ultrasound of the Eye and Orbit , Mosby year book, 1992, page 376.
5. Byrne SF, Green RL. Optic nerve in Ultrasound of the Eye and Orbit, Mosby year book, 1992, page 403.
6. Ossoinig KC, Cennamo G, Byrne SF: Echographic differential diagnosis of optic nerve lesions, in Thijssen JM, Verbeek AM(eds): Ultrasonography in Ophthalmology, Dordrecht, Dr W Junk,1981, p 327.

Legends

1. Paraocular transverse Bscan positions showing marker orientation. (H horizontal –marker nasal, V vertical-marker superior & O oblique-marker superior)
2. Paraocular longitudinal Bscan positions the marker being directed towards the orbital rim in position 1-5 and towards the globe in positions 6-8.
3. Pseudotumor of orbit seen as a well circumscribed mass with low to medium internal reflectivity, indenting the globe with moderate sound attenuation.
4. Rhabdomyosarcoma appearing as firm, well circumscribed mass in supero-nasal quadrant with low-medium reflectivity and moderate sound attenuation.
5. Schwannoma of the orbit is a solid mass with regular, homogenous structure showing low to medium internal reflectivity with indentation of the globe.
6. Paraocular scan of plexiform neurofibroma showing an illdefined heterogenous solid mass in the lid region with multiple interfaces.
7. Ascan of plexiform neurofibroma.
8. Cavernous haemangioma appearing as a well circumscribed mass with multiple interfaces, moderate to high internal reflectivity, marked attenuation and producing hyperopia due to globe indentation.
9. Transocular Bscan of lymphangioma which is a diffuse mass having multiple lymph filled large interspaces and more compressible in comparison to cavernous haemangioma.

10. Paraocular scan of lymphangioma.
11. Orbital varix before Valsalva maneuver.
12. Orbital varix showing dilatation after Valsalva maneuver.
13. Transocular scan of a dermoid cyst indenting the globe.
14. Orbital cellulitis with orbital abcess in the superior peripheral space with prominent subtenon's space.
15. Thyroid orbitopathy with thickened muscle belly.
16. Axial scan showing presence of a globular mass with widening of the optic nerve area with regular internal structure suggestive of glioma.
17. Meningioma seen as a solid mass in the optic nerve region with irregular internal reflectivity.

Diagnostic Ultrasonography of the Eye

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