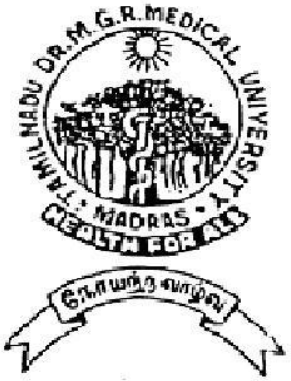
‘B MODE ULTRASOUND’ ITS DIAGNOSTIC ROLE IN THE EVALUATION OF OCULAR AND ORBITAL DISEASES

DISSERTATION SUBMITTED FOR

MASTER OF SURGERY DEGREE

BRANCH – III - OPHTHALMOLOGY

APRIL 2012



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CERTIFICATE

This is to certify that the dissertation entitled **'B MODE ULTRASOUND' ITS DIAGNOSTIC ROLE IN THE EVALUATION OF OCULAR AND ORBITAL DISEASES "** is the bonafide work of **Dr. SHARANAPRASAD HOSAPETI**, in partial fulfillment of the university regulations of the Tamil Nadu Dr. M.G.R. Medical University, Chennai, for M.S (Branch III) Ophthalmology examination to be held in April 2012.

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DECLARATION

I, **Dr. SHARANAPRASAD HOSAPETI,** solemnly declare that, I carried out this dissertation "**B MODE ULTRASOUND' ITS DIAGNOSTIC ROLE IN THE EVALUATION OF OCULAR AND ORBITAL DISEASES**" is a bonafide record of work done by me at the Department of Ophthalmology, Govt. Rajaji Hospital, Madurai, under the guidance of **Prof. Dr. P. THIYAGARAJAN, M.S., DO.,** Head of the Department, Department of Ophthalmology, Madurai Medical college, Madurai.

This dissertation is submitted to The Tamil Nadu Dr. M. G. R. Medical University, Chennai in partial fulfillment of the rules and regulations for the award of M.S degree (Ophthalmology) Branch-III; examination to be held in April 2012.

Place: Madurai

Date:

Dr. SHARANA PRASAD HOSAPETI

ACKNOWLEDGEMENT

I wish to thank the **Dean,** Madurai Medical College, for permitting me to utilize the clinical materials of the hospital to carry out this study.

I express my sincere gratitude to **Prof. Dr. P. THIYAGARAJAN, M.S., DO.,** Professor and Head of the Department of Ophthalmology, Madurai Medical College, Madurai, for his valuable guidance in doing this project.

I am extremely thankful to **Prof. Dr. G.S. SRINIVASAN, M.S., DO.,** Additional professor for his immense support and guidance in doing this study.

I express my deep gratitude to my Assistant Professors**, Dr. T. BADRINARAYANAN, M.S., DO., Dr. A.R. ANBARASI, M.S., D.O., Dr. N. PARAVATHASUNDARI, M.S., D.O., Dr. S.V. CHANDRAKUMAR, M.S., D.O., Dr. V. ANBUKANI, D.O. & Dr SELVAKADUNGO VAZHIYATHAN, D.O.** for their whole hearted support and useful suggestions which helped to shape up this dissertation.

I am particularly thankful to my fellow post graduate colleagues and friends for their valuable support which enabled this study.

Last but not the least, I also wish to record my deep sense of appreciation and gratitude to the patients who have co-operated and rendered themselves for this study.

CONTENTS

INTRODUCTION

Ocular ultrasound takes a weekend to learn and a life time to master! B Scan ultrasonography is an important adjuvant for clinical assessment of various ocular and orbital diseases. With proper use one can gather vast amount of information not possible with clinical examination alone.

In the past two decades, clinical use of ophthalmic ultrasound has come of age. The equipment has grown in sophistication and our understanding of its merits and scope of clinical application has been steadily increasing. This has increased the ability to detect and differentiate a wide variety of ocular and orbital disorders using ultrasound.

Today, ultrasonography (USG) is an indispensable tool in the preoperative evaluation of the posterior segment behind an opaque ocular media (which prevents the examination by other methods) to obtain good surgical results and to avoid inadvertent complications during surgery. In the differentiation of intraocular tumours and in the accurate calculation of intraocular lens power. The recent development of ultrasound biomicroscopy (UBM) has provided us with the magnified in vivo images of the anterior segment structures. The availability of high resolution scanners, combined with colour Doppler has permitted us to venture into the orbit.

Ultrasound is a safe, non invasive procedure which can be performed in the outpatient department, without any sedation and radiation exposure. The

relative low cost and less time consumption of ultrasound in comparison to CT and MRI gives it a distinct and practical advantage that will maintain its value along with other imaging modalities for the foreseeable future.

Hence, the study to determine the role of ultrasound in the evaluation of ocular and orbital diseases assumes importance especially in a developing country like India.

HISTORY AND EVOLUTION

The word ‘ultrasonic’ is derived from ultra + sonus pertaining to sound waves having frequencies above the range of human hearing i.e. above 20 kHz.

The origin of ultrasound dates back to First World War in 1916, when a quartz crystal device which was capable of sending and receiving ultrasound waves was developed to detect underwater targets.

Ultrasound was introduced to medicine in 1952 by Howry Bliss.

It was first used in ophthalmology in 1956, by two American ophthalmologists, Mundt and Hughes.[15] They described the use of pulse echo (A-scan) for the detection of intraocular tumours.[3] Soon afterwards Oksala and associates in Finland published data regarding the sound velocities of various components of eye.[15]

In 1958, Baum and Greenwood developed the first two dimensional immersion B-scan ultrasound instrument.[6] Further pioneering work with immersion B-scan was carried out by Purnell, followed by Coleman and associates.[15] In the year 1972, Bronson and Turner introduced the first contact B-scan machine, a portable instrument which could be placed over the lids. They recognized the loss of resolution for anterior segment, but compromised for convenience and avoidance of reduplication artifacts.[14]

In the meantime, throughout the 1960s and 1970s, painstaking work by Dr. Karl Ossoinig and till culminated in the development of standardized A-scan instrument to which they later added the use of B-scan instrument. This concept eventually evolved into what is known today as standardized echography. This method has proved to be highly accurate for the detection and differentiation of both intraocular and orbital lesions.[15]

In early 1990, Pavlin and associates developed a method of anterior segment imaging with the use of a high frequency ultrasound instrument known as ultrasound biomicroscope.[57]

Doppler ultrasound has been used in ophthalmology since the early 1970s.[15] In the late 1980s, colour Doppler imaging began to be used for the assessment of ocular and orbital disorders The digitalization of ultrasound has led to the development of three-dimensional ultrasound imaging in ophthalmology.[15]

PHYSICS AND INSTRUMENTATION

Ultrasound is an acoustic wave that consists of oscillation of particles within a medium. By definition ultrasound waves have frequencies greater than 20 KHz (i.e., 20,000oscillations/sec), rendering them inaudible to the human ear.[15]

Ultrasound propagates within a medium in a longitudinal manner as alternate condensations and rarefactions characterized by velocity, frequency and wavelength. The relationship between these factors is as follows:

Velocity = Wavelength x Frequency.[63]

Velocity: Velocity is the speed of sound propagation and is expressed in meters/second. Velocity is mainly dependent on the medium through which sound propagates.[15]

Medium	Velocity (meters / seconds)
Water	1480
Aqueous / Vitreous	1532
Soft tissue	1550
Crystalline lens	1641
Bone	3500

Frequency: Frequency is the number of cycles per second and is measured in Hertz, defined as one cycle per second. Ophthalmic ultrasound uses high frequencies in the range of 6-20 MHz (1 mega Hertz = 1 million cycles / second), which provide high resolution.[63]

Wavelength: Wavelength is the distance between two particles in the same phase of oscillation. It is denoted by lambda (λ) and is expressed in millimeters (mm). The lower the wavelength the lesser the penetration.[63]

Ultrasound waves emanating from a transducer form the emitted sound beam, which can be focused or non focused.

Non focused beam:

Non focused beam has parallel borders, allowing pattern recognition at different distances from the ultrasound probe. It is used in standardized A-scan echography. [63]

Focused beam:

Focused beam has a focal point where the sound beam is most narrow. The area anterior and posterior to the focal point is called the focal zone. The resolution of echosource is maximum within the focal zone. A focused beam is used in B-scan echography.[63]

Beam width:

The beam width depends on the system design, but can be varied by the examiner. A narrow beam provides a higher resolution.[63]

Resolution:

The smallest distance between two targets necessary to register them as two separate entities is called resolution. [63]

Attenuation:

The decrease in the energy of the sound beam, as it propagates within ocular and orbital tissues is called attenuation. [63] It results from

a. Spreading: The ultrasound energy spreads in different directions but the main flow follows the axis of the beam.

b. Absorption: A part of the ultrasound energy is absorbed and converted into heat as it passes through the medium. The amount of heat generated by diagnostic ultrasound is extremely low and has no harmful effect. Higher frequency, higher sound velocity and increased thickness results in greater absorption and hence reduces penetration.

c. Reflection.

d. Scattering.

Acoustic interfaces:

Acoustic interfaces are the junctions of two media having different acoustic impedance. Acoustic impedance of a medium is determined by its sound velocity and density.

(Acoustic impedance = Sound velocity X density) [15]

Large interface:

An interface with diameter larger than 0.5 mm is called large interface (e.g. anterior surface of cornea). Ultrasound beam reaching a large interface is reflected or refracted, following the rules of optics. [63]

Small interfaces:

Clinically an interface is small if its diameter is smaller than 0.5 mm (e.g. fat globules within the orbit). Small interfaces are responsible for scattering which is the diffraction of sound wave in multiple directions. [63]

Returning sound beam (Echoes):

The returning sound beam consists of the portion of the ultrasound beam that returns to the transducer, because of regular, irregular or scattered reflections. The transducer also acts as the receiver.[63] The returning echoes are affected by the following factors.[15]

1. Angle of sound incidence.

The angle of incidence of the sound beam is equal to the angle of reflection. So, when the beam strikes in a perpendicular manner, the echo is reflected back towards the direction from which it originated and a strong echo is produced. If the incident sound beam strikes an interface at an oblique angle, some of the incident energy is directed away from the direction of its origin, resulting in a weaker echo.

2. Size, shape and smoothness of acoustic interface

Assuming that sound beam incidence is perpendicular, a smooth, straight interface (e.g. retina) reflects all the sound wave back to its source. A smooth, convex surface (e.g., collar button melanoma), reflects some of the sound wave away from the origin resulting in a weaker echo. If an interface is

REFLECTIONS FROM PLANAR AND ROUGH INTERFACE AT NORMAL AND OBLIQUE INCIDENCE AND CURVED SURFACES

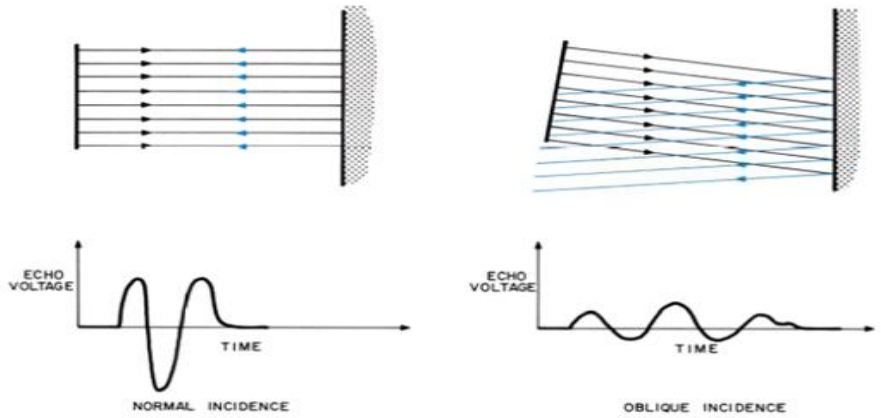


Figure 1.11. Reflections from planar interface at normal (*left*) and oblique (*right*) incidence. Oblique incidence results in lowered echo amplitude and increased duration as a result of the variation in transit times along different rays.

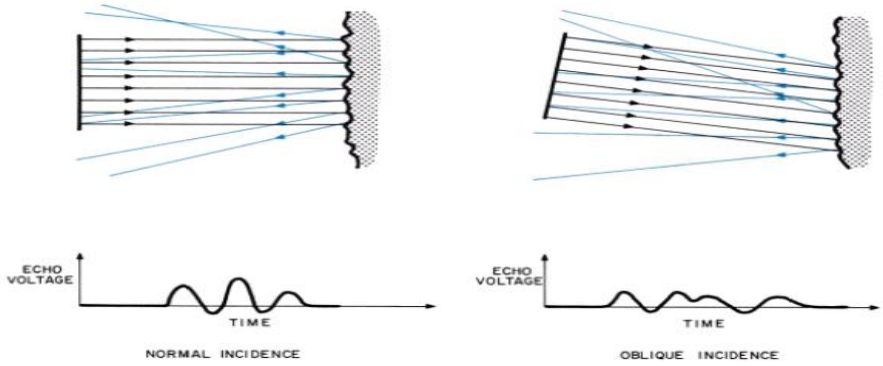


Figure 1.12. Reflection from rough interface. Surface roughness redirects energy in a variety of directions, causing decreased echo amplitude and increased duration. Oblique incidence does not affect echo amplitude to the extent encountered with smooth surfaces.

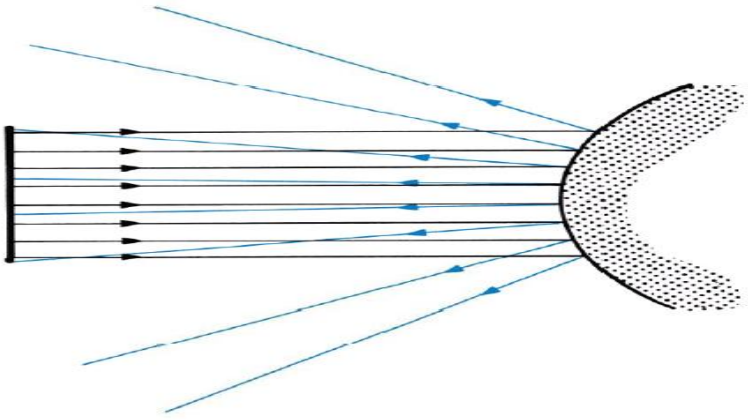


Figure 1-13. Reflection from curved surface. Beam spreading upon reflection reduces echo amplitudes.

not smooth, but has coarse and irregular surface (e.g., ciliary body), part of echo will be scattered, resulting in a weaker echo. Very small interfaces (e.g., clumps of cells) produce even more scattering.

3. Refraction:

Refraction occurs when the sound beam is directed obliquely at an acoustic interface. Refraction can be undesirable, producing artifacts or it may be beneficial by displaying the desired interfaces (eg. Optic nerve, extraocular muscles).

BASIC TECHNOLOGY

Pulse echo system

Clinical echography depends on pulse echo technology, that emits multiple, short pulses of ultrasound energy with a brief interval between the pulses. The interval allows the returning echoes to be detected, processed and displayed.[15]

An ultrasound unit is composed of four basic elements: pulser, receiver, display unit and transducer. The pulser, the receiver and the display unit are all contained within the same chassis and connected to the transducer located at the tip of the probe by an electrically shielded cable.[63]

Probe / Transducer

Sound waves are formed at the tip of the probe where a transducer consisting of piezoelectric element (typically a quartz or ceramic crystal) is

SCHEMATIC DIAGRAM OF AN ULTRASOUND SYSTEM

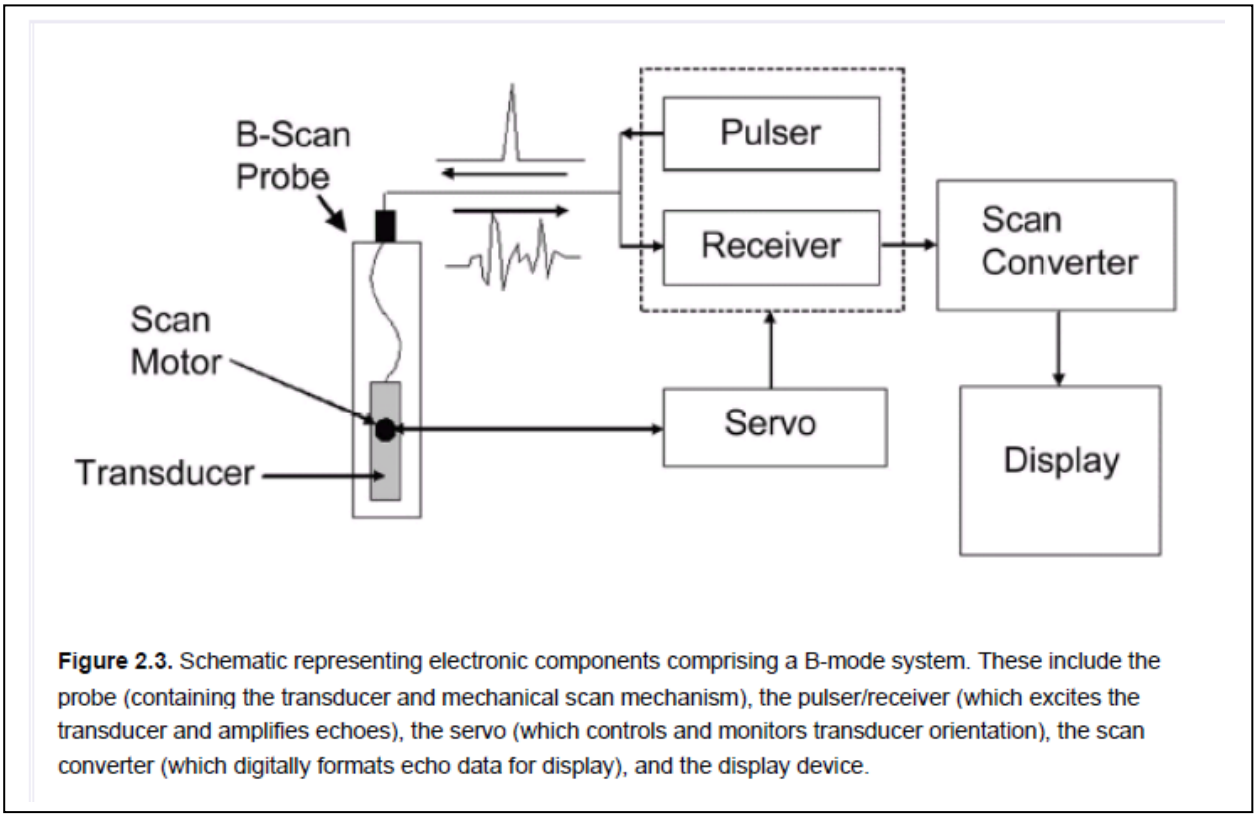


Figure 2.3. Schematic representing electronic components comprising a B-mode system. These include the probe (containing the transducer and mechanical scan mechanism), the pulser/receiver (which excites the transducer and amplifies echoes), the servo (which controls and monitors transducer orientation), the scan converter (which digitally formats echo data for display), and the display device.

located.[15] when stimulated by electric energy; it undergoes mechanical vibration, causing a longitudinal ultrasound wave to be propagated through the medium. A pause of several microseconds then occurs, allowing the transducer to receive returning echoes, which create another mechanical vibration as they strike the crystal. The vibration in turn produces an electric signal that is transmitted to the receiver and the display screen. This process of generating a sound wave, alternating with receiving an echo, is repeated a thousand or more times per second to produce a 'real time' display.[15]

The sound beam is made up of two zones, the near field and the far field. The resolution of echoes is greatest when the echosource is located within the near field. Transducer with a larger diameter and / or higher frequency will have a longer near field.

Signal processing

The transducer transforms the returning ultrasound wave into an electrical impulse and transmits to the receiver as a very weak radiofrequency (RF) signal. The signal then undergoes complex processing which includes amplification, compensation, compression, demodulation and rejection.[15]

Amplification:

The size of the received radiofrequency signal is amplified without any change in the information. This amplification is manually controllable through sensitivity setting of the unit, which is calibrated in decibels. Two factors

affect the amplification of radiofrequency signal, the frequency band width and amplifier curve.[63]

In ophthalmic ultrasound instruments, one of the three different types of amplification is generally used: 1) linear, 2) logarithmic or 3) S-shaped. The type of amplification used determines the dynamic range, i.e., the range of echo intensities that can be displayed by the system. The dynamic range is described in units of decibels. Linear amplifiers have small dynamic range which can display minor differences in echo strength, but the range of echo intensities that can be displayed is very limited. Logarithmic amplifiers have a large dynamic range (60 dB) and can display a wide range of echo intensities, but cannot show slight differences between the echo signals. S-shaped amplification curve, developed by Ossoinig combines the wide range of logarithmic amplifier and great sensitivity of linear amplifier.[15]

Gain:

Gain or sensitivity setting of the instrument is the adjustment of the amplification of overall echo signals by the examiner. Gain is measured in decibels (dB). Changing the gain does not change the amount of energy emitted from the transducer. It only changes the intensity of the returning echoes displayed on the screen. The higher the gain level, the greater the ability of the instrument to display weaker echoes (e.g., vitreous opacities). On lowering the gain, stronger echoes (e.g., retina and sclera) will continue to be

displayed. Lowering the gain increases both axial and lateral resolution and decreases the depth of beam penetration.[15]

Time gain compensation (TGC):

Time gain compensation enhances the weak echoes displayed from the deeper tissue layers, thus equalizing echo signals from similar tissues located at varying distances from transducer. Most of the presently available instruments have an automatic, internal TG control. Some instruments offer manual TGC mode.[15]

Instrumentation

A-scan

A-scan stands for amplitude mode scan A-scan echography is a one-dimensional acoustic display in which echoes are represented as vertical spikes of various heights and distances from the initial signal on a baseline.[3] Spacing of the spikes is dependent on the time required for the sound beam to reach a given interface and for its echo to return to the probe. The time can be converted into distance by knowing the sound velocity of the medium from which echoes are received using the formula: distance = velocity x time.[15] The height of the spikes indicates the strength (amplitude) of the echoes.

There are various types of A-scan displays used in ophthalmology. [15]

1. A-scan used for axial length measurement employs linear amplification, focused transducer and a frequency of 10 to 15 MHz.

2. The vector A-scan occurs simultaneously on a B-scan echogram. It uses logarithmic amplification, focused transducer and a frequency of 10 MHz.
3. Standardized A-scan incorporates S-shaped amplification curve, with a dynamic range of 36 dB. Nonfocused 8 MHz transducer which emits a parallel sound beam is used. The beam width varies from 5mm at its highest decibel gain to 0.5 mm at its lowest.[3] Results obtained with standardized A-scan are comparable and reproducible.[63]

Standardization:[60]

The manufacturer provides an "internal standardization" which consists of accurately setting certain parameters that affect signal processing. In addition, the examiner can perform external standardization by establishing tissue sensitivity and calibrating the electronic scale.

Tissue sensitivity:

Tissue sensitivity is the sensitivity setting of each unit-probe combination needed for a standardized examination. It is the only sensitivity setting that allows tissue differentiation of lesions.[63]

B-scan

B-scan stands for brightness mode scan. B-scan produces two-dimensional acoustic sections composed of coalescing dots of varying degrees of brightness depending on the reflectivity of echo source.[3] Most of the

ophthalmic B-scan instruments use logarithmic amplification and a focused, narrow sound beam. Their transducers operate at a frequency of 10MHz.[15]

An echo is represented as a dot on the screen and the strength of the echo is depicted by the brightness of the dot. The coalescence of multiple dots forms a two-dimensional representation of examined tissue section.[15]

Factors affecting the B-scan image,[15]

1. The area of the eye or orbit that can be imaged at any one time is directly related to the sector angle of the moving transducer which varies from 45 to 60 degrees, depending on the instrument.
2. The speed of the transducer oscillation which varies from 10 to 60 oscillations per second.
3. The gray scale: The greater the number of gray levels an instrument can display, the greater is its ability to quantitate differences in echo intensity.

Standardized echography:

The combined use of standardized A-scan and contact B-scan (along with Doppler for the orbit) is referred to as standardized echography.[15]

Three-dimensional B-scan imaging

Three-dimensional B-scan imaging involves obtaining multiple sections using a mechanically rotated probe and software that reconstructs the two-dimensional image into a three-dimensional format.[15]

Ultrasound biomicroscopy

Pavlin CJ and coworkers have developed ultrasound instrumentation using high frequency (50-100MHz) transducer capable of producing cross sectional images of anterior segment of the eye. This provides resolution ranging from 20-60 μm with a depth of penetration of 4mm.[56,57] They have applied the term ultrasound biomicroscopy to this technique because of its similarities to optical biomicroscopy.

Doppler:

Recent advances have incorporated the use of Doppler instruments with conventional B scan, allowing the demonstration of blood flow through the vessels in the eye and the orbit.[47]

EXAMINATION TECHNIQUES

The procedure of ultrasound examination should be explained to the patient. And the patient should be seated on an examination chair, in such a way that the patient's head and the instrument are placed close together thus enabling the probe position and the screen to be viewed simultaneously.

Methylcellulose (2%) is applied to the face of the B-scan probe as a coupling agent to prevent sound absorption by air. The 'contact method' of examination is carried out by placing the probe directly over the closed lids.

OCULAR EXAMINATION (in eyes with opaque media)

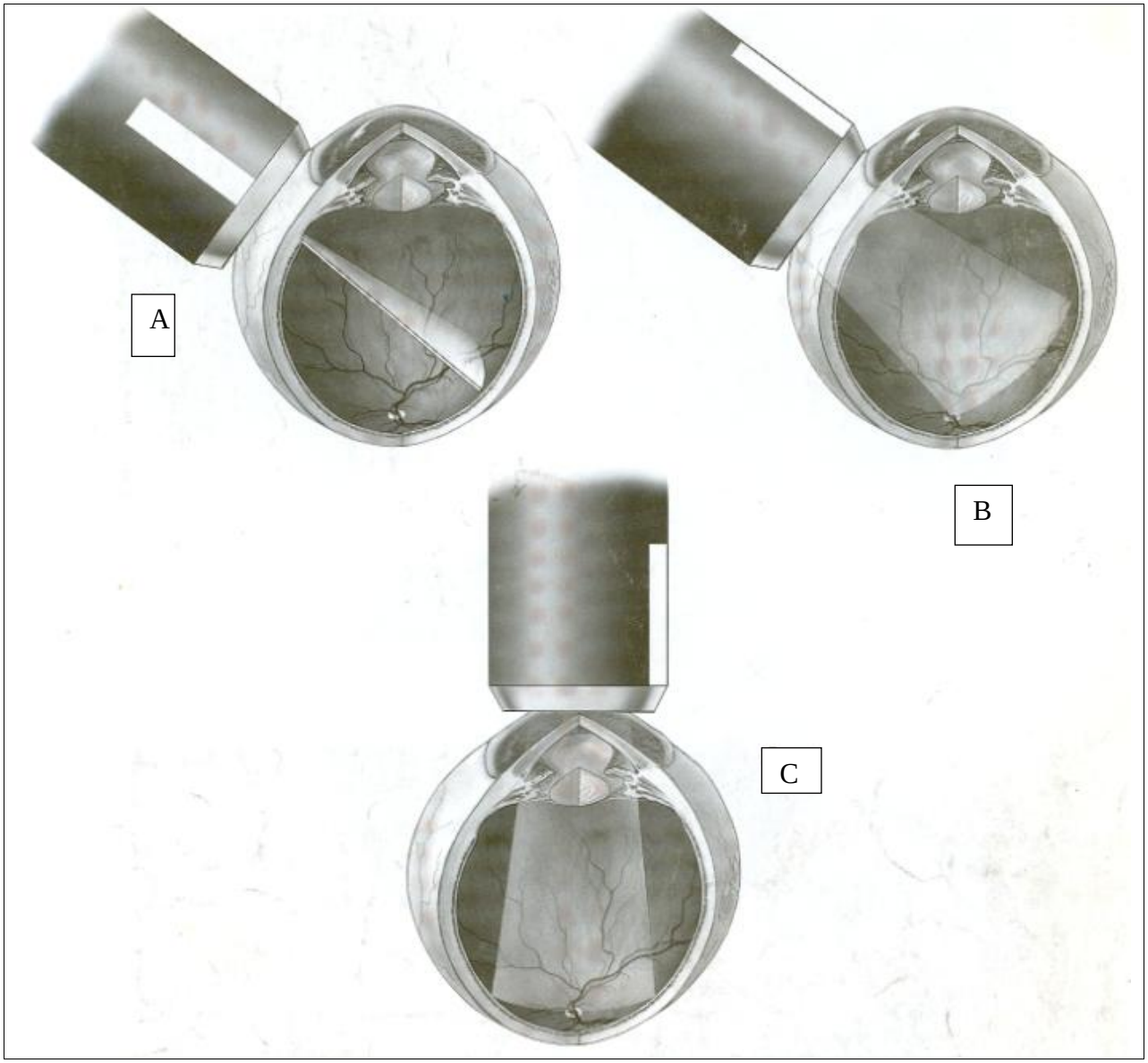
Initially ocular screening examination is carried out with eight overlapping transverse scans.

Horizontal transverse scan of 12 0' clock is carried out by placing the probe parallel to the limbus of 6 0' clock position with the marker directed nasally. The patient's gaze was directed towards the 120' clock meridian away from the probe. In a single arc movement the probe is shifted from the limbus to the fornix, thus scanning the 120' clock meridian from posterior to anterior.

Vertical transverse scan of 3 0' clock is performed by placing the probe at 9 0' clock, parallel to the limbus, with the marker oriented superiorly. The patient's gaze is directed towards the 3 0' clock meridian.

Similarly, **horizontal transverse scan of 6 0' clock** is carried out with the probe at 12 0' clock, marker directed nasally and patient's gaze directed towards the 6 0' clock meridian.

Three primary probe orientations
(A-Transverse; B-Longitudinal; C-axial)



Vertical transverse scan at 9 0’ clock is undertaken, by keeping the probe at 3 0’ clock, parallel to the limbus, the marker directed superiorly and patient’s gaze directed towards the 9 0’ clock meridian.

Four **transverse oblique scans at 1.30 0’ clock meridian, 4.30 0’ clock meridian, 7.30 0’ clock meridian and 10.30 O’clock** meridian are carried out by placing the probe at the opposite meridians with the marker directed superiorly.

If an abnormality is detected during the initial screening examination then topographic, quantitative and kinetic echography is carried out.

Topographic examination

The shape, size and extent of the lesion are assessed by a combination of transverse, longitudinal and axial scans.

Transverse scans as explained above are carried out to determine the lateral extent of lesion.

Longitudinal scans are performed with the probe placed perpendicular to the limbus and marker directed towards the centre of the cornea. The patient’s gaze was always directed towards the meridian being scanned, away from the probe position. The probe should be shifted from the limbus to the fornix, thus scanning the meridian from posterior to anterior. Longitudinal scans not only showed the anteroposterior extent of the lesion but also the insertions of the membranous lesion to the optic disc and ora serrata.

Axial scans are performed with the patient fixating in the primary gaze and the probe centered on the cornea. The probe marker is directed nasally to obtain a horizontal axial scan, superiorly to obtain vertical and oblique scans. In axial scans, the lens and the optic nerve were displayed in the centre of the echogram, thus documenting the relationship of the lesion to them.

Quantitative echography

The reflectivity of the lesion is estimated by comparing the brightness of the echo with the normally high reflective sclera or low reflective vitreous cavity. Also, the lesion's spike height is compared with that of vitreous baseline (0%) and initial spike height (100%). The difference in the height of spikes on A-scan and echodensity on B-scan was noted in order to estimate the internal structure of the lesion.

Standard pattern of reflectivity is usually classified as.

Extremely Low	0-5%	Vitreous degeneration Long standing dispersed vitreous haemorrhage
Low	5 – 40%	Recent vitreous haemorrhage
Medium	40 – 60%	Melanoma
Medium - High	60 – 80%	Organized vitreous haemorrhage
High	80-100%	Organized vitreous haemorrhage, metastatic carcinoma and choroidal hemangioma
Very High	100%	Retinal detachment, Junius Kuhnt lesion, Retinoblastoma, intraocular foreign body

Kinetic echography

Mobility and vascularity are evaluated.

Lesion mobility

After movement with the patient fixating a target, the lesion is imaged on the screen. Then the patient was instructed to shift the gaze a short distance

PROBE MARKER ORIENTATIONS FOR TRANSVERSE, LONGITUDINAL AND AXIAL SCANS

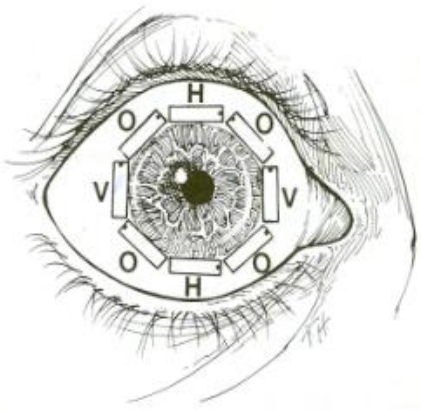
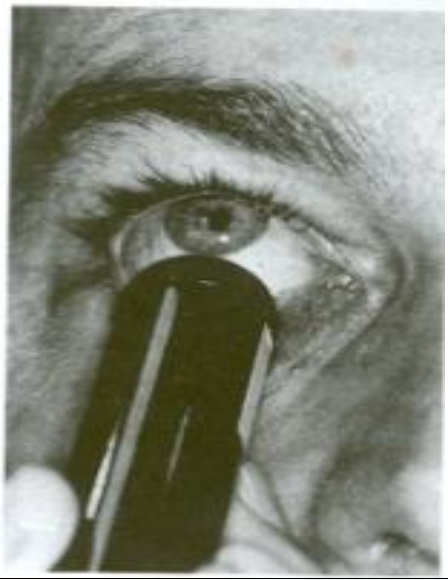


Figure 2-6 Probe marker orientation for various transverse B-scan approaches. *H*, Horizontal probe positions; *O*, oblique probe positions; *V*, vertical probe positions. Note that the marker is always oriented above the horizontal for vertical and oblique scans.



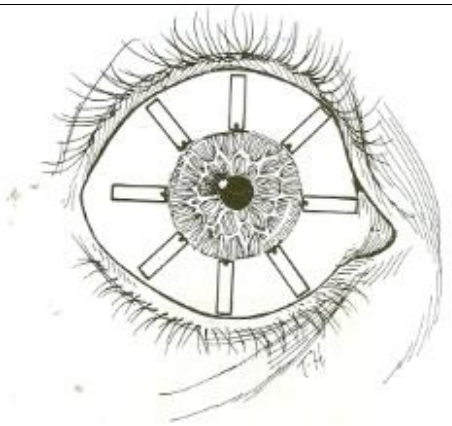
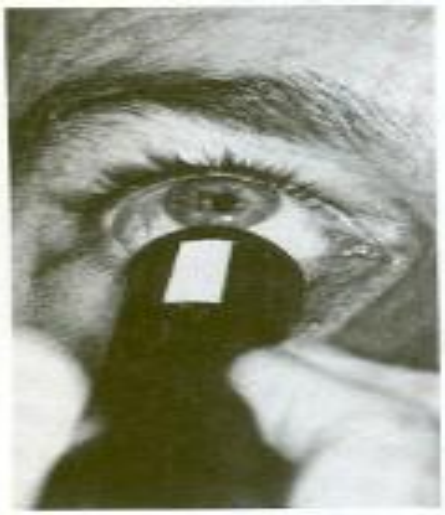


Figure 2-8 Probe marker orientation for various longitudinal B-scan approaches. Note that the probe marker is always oriented toward the center of the cornea as well as the meridian being scanned.



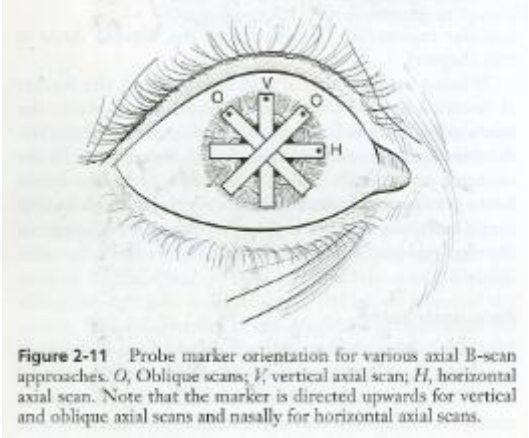


Figure 2-11 Probe marker orientation for various axial B-scan approaches. *O*, Oblique scans; *V*, vertical axial scan; *H*, horizontal axial scan. Note that the marker is directed upwards for vertical and oblique axial scans and nasally for horizontal axial scans.

away and then quickly back to the target. The echogram was continuously monitored to evaluate any movement of the lesion.

Vascularity (Spontaneous motion)

This is detected on A scan as low amplitude flickering of internal lesion spikes. This may also appear as varying brightness of the dots in B scan. This phenomenon helps in characterizing tumors.

ORBITAL EXAMINATION: (for orbital lesions)

For examining the orbit, the paraocular approach is used by placing the transducer over the closed lids near the orbital bony rim so that the sound beam entered the orbit between the globe and the orbital wall.

Paraocular transverse scan is carried out by placing the probe parallel to the orbital rim and directing the probe marker nasally for horizontal scans and superiorly for vertical scans respectively. The probe is placed over the meridian to be examined.

Paraocular longitudinal scan is performed by placing the probe in such a way that the longest diameter of the oval shaped face of the probe was perpendicular to the orbital rim, and the marker always directed superiorly. The probe is placed over the meridian to be examined.

Topographic evaluation, quantitative examination and kinetic echography are carried out in a manner similar to the ocular examination.

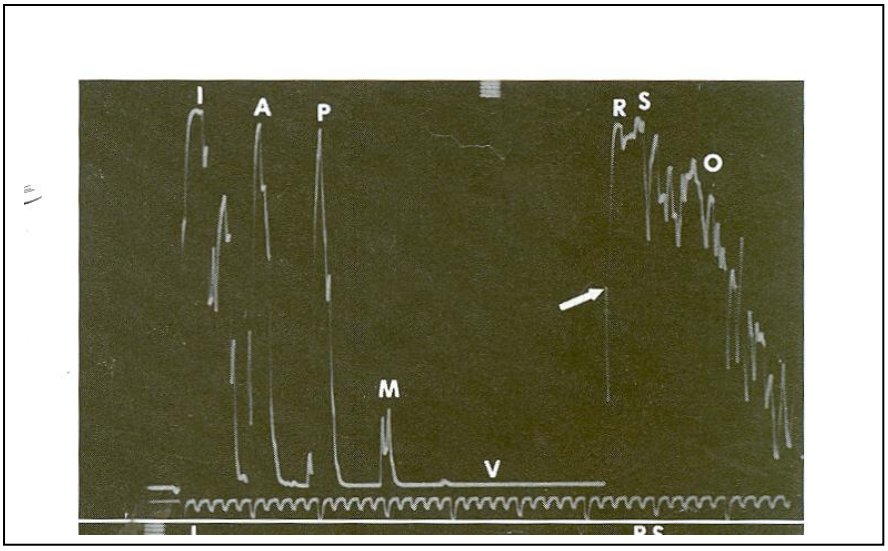
ULTRASOUND OF THE NORMAL EYE AND ORBIT

The eye is an ideal organ for ultrasonography. It is spherically shaped and divided into two compartments - the anterior chamber and the vitreous compartment. These are normally filled with optically and acoustically clear fluids that possess acoustic properties of normal saline.[25]

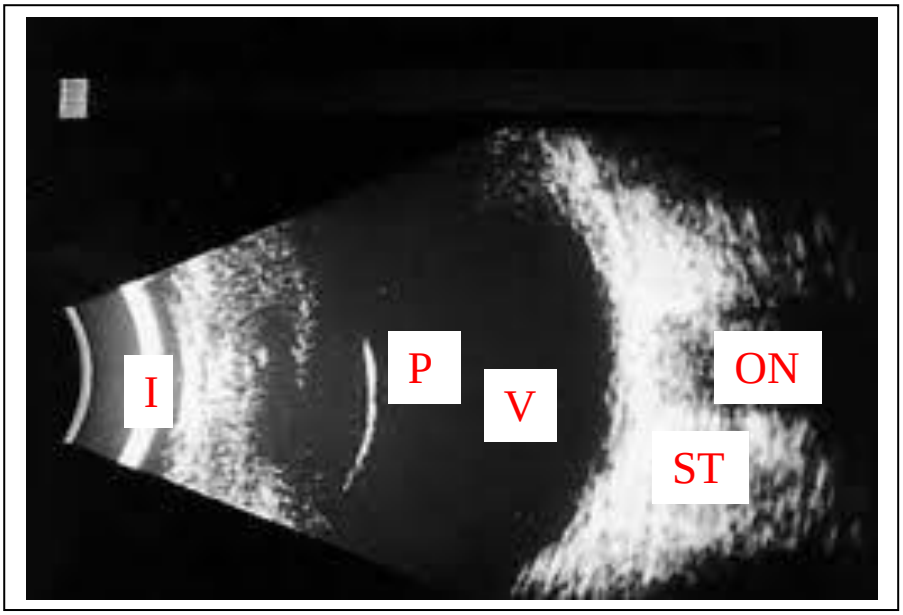
The A mode imaging of the normal eye is as follows.[63]

1. The initial spike (I) represents the reverberations generated at the tip of the probe. This initial spike has no clinical significance.
2. The second spike (A) is from the anterior surface of the lens.
3. The third spike (P) is from the posterior surface of the lens.
4. The vitreous cavity (V) produces a horizontal baseline because of the homogeneity of the vitreous body and the absence of larger interfaces.
5. The retinal spike (R) is straight, high rising echo spike perpendicular to the baseline. A jagged echo spike is a sign of non perpendicularity.
6. The choroidal spikes are multiple high reflective echo spikes located between the retinal spike and the scleral spike. The high reflectivity results from the presence of multiple interfaces formed by choroidal vessels.
7. The scleral spike (S) is difficult to differentiate from the choroidal spike, when examination is done at tissue sensitivity setting.

NORMAL STANDARDIZED A – SCAN ECHOGRAM



B – SCAN IMAGING OF NORMAL EYE



I - Initial line corresponding to probe face on cornea

P - Posterior lens capsule

V - Vitreous Cavity

ST - Orbital soft tissue

ON - Optic Nerve

8. The orbital spikes (O) are multiple echo spikes behind the scleral spike. The initial ones are highly reflective; the latter ones are less reflective because of sound attenuation in the orbit.

B-scan imaging of the normal eye at high sensitivity reveals the following:

- An echogenic area on the left representing the reverberations at the tip of the probe. This has no clinical significance.
- The vitreous cavity appears as an echo free area, due to the absence of interfaces. In young individuals, normal vitreous is clear and jelly like and produces no echoes. Scattered vitreous opacities of very low reflectivity may be detected in the aging eye.[15]
- The echogenic area on the right represents the retina, choroid, sclera and orbital tissue behind it. The proximal surface is concave and represents the retina. The distal surface is jagged and represents attenuation of the sound beam within the orbital tissue.
- Optic nerve shadow is noted within the orbital fat whenever it is centered in the ultrasound beam.

The three ocular coats cannot be separated from one another.[10] Examination of the normal globe at a decreased sensitivity allows a better evaluation of retina and choroid.[63]

It is advisable not to include the lens shadow to prevent artifacts in the vitreous. The B-mode image should always be studied with vector A-scan.[10]

ULTRASOUND OF THE NORMAL ORBIT [48]

Normal orbit produces a consistent picture on ultrasonography. The globe portion of the scan shows clear delineation as a rounded structure. The retro bulbar pattern is derived primarily from the large fat pad, which has a triangular shape and is bounded anteriorly by the globe concavity and on the sides by extraocular muscles extending from the globe equator towards the orbital apex. The fat is very heterogeneous, being composed of fat globules, fibrous septa, vessels and nerves, all of which are highly reflective. High amplitude echoes are produced throughout the fatty tissue complex, giving it a filled-in appearance on B-scan. On A-scan, decaying high amplitude pattern is produced. The extraocular muscles and optic nerve are more compact, well organized, homogenous structures which appear as relatively echo free areas in contrast to the adjacent fat. B-scan section at the level of the optic nerve produces a W-shaped area of echoes posterior to the globe with muscles and optic nerve seen in negative contrast. The bony orbital walls are represented by a few low amplitude echoes when the beam is in an axial position, because the beam is not perpendicular to the walls.

ULTRASOUND FINDINGS IN COMMON OCULAR AND ORBITAL DISEASES

A. DISEASES OF THE VITREOUS

The accurate characterization of vitreoretinal disorders is important in the management of eyes with opaque media.[15] The ability of B-scan to provide detailed reliable "acoustic sections" of the vitreous is of paramount importance.[28]

Asteroid hyalosis

Calcium soaps produce bright point like diffuse or focal echoes on B-scan. These are freely mobile. An area of clear vitreous is normally present between the posterior boundary of the opacities and the posterior hyaloid. On A-scan, asteroid hyalosis produces spikes of medium to high reflectivity that move with the vitreous gel.[15]

Vitreous Haemorrhage

Ultrasonography yields excellent diagnostic results and is a useful adjunct to clinical examination in cases of vitreous haemorrhage: Ultrasound provides information regarding the cause of vitreous haemorrhage and helps to determine the type, location, extent and density of haemorrhage, all of which have prognostic significance.[14,28]

Light, diffuse, unclotted, blood produces little or no echo response so that the vitreous may appear acoustically clear or 'sonolucent'.[28] In fresh, mild

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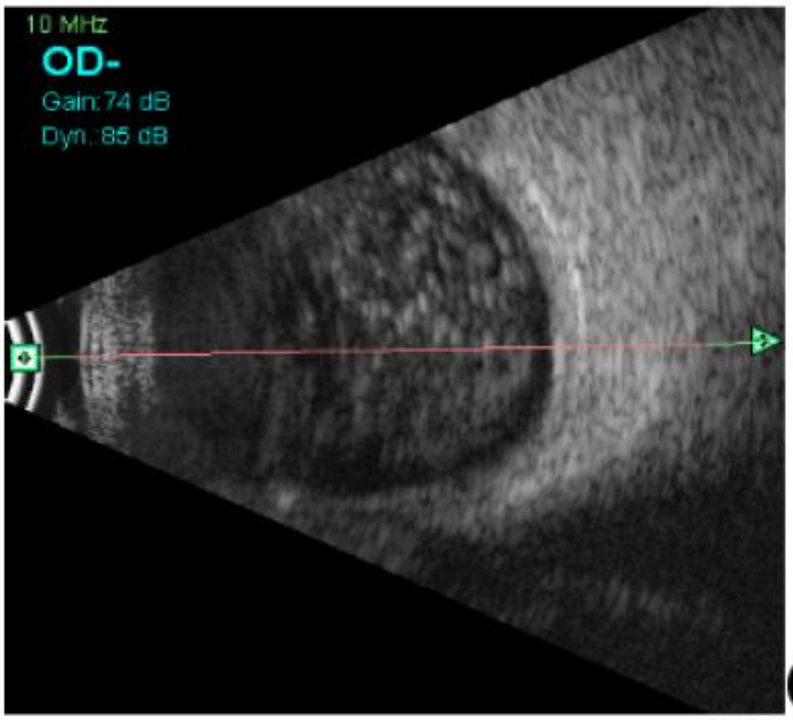
OTI SCAN REPORT

Patient Name : A. Ganesan **Date : 19-12-2010**
Patient ID : 26578
Date of Birth : 11-2-1951
Diagnosis : Asteroid hyalosis



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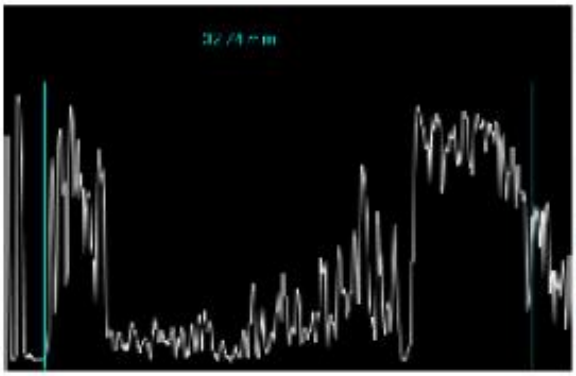

vitreous haemorrhage, dots or short lines are displayed on B-scan, and a chain of low amplitude spikes on A-scan.[15]

The denser the haemorrhage the greater the number of opacities and the higher their reflectivity.[15] If organization of blood occurs, large interfaces are formed, resulting in membranous surfaces on B-scan and higher reflectivity on A-scan mimicking retinal detachment. These pseudomembranes can be differentiated from retinal detachment by three ways.[14]

- On reducing the sensitivity, the echo of pseudomembranes disappears but that of retinal detachment persists.
- Pseudomembranes terminate in the vitreous gel whereas retinal detachment inserts into the retina.
- Pseudomembranes demonstrate thinning as they extend superiorly.

Subhyaloid haemorrhage:

Unlike the intragel haemorrhage, subhyaloid haemorrhage does not clot and appears as dispersed, small, mobile, low reflective echoes requiring high gain to be documented.

Posterior hyphaema:

Chronic subhyaloid haemorrhage may gravitate inferiorly forming an interface between a thick, highly reflective layer of blood and less dense floating blood cells, known as posterior hyphaema. This can be made to slide

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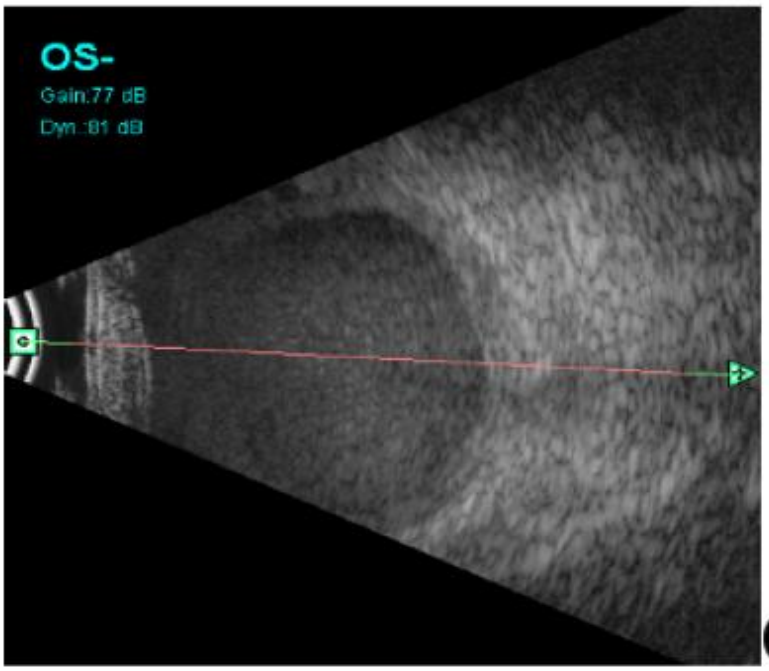
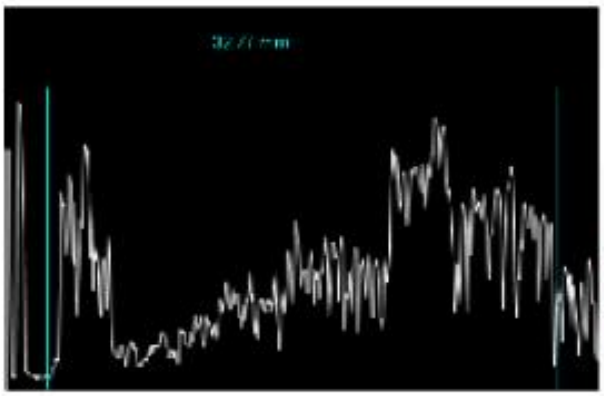
OTI SCAN REPORT

Patient Name : Jeganathan **Date :16-5-11**
Patient ID : 121560
Date of Birth : 18-9-1981
Diagnosis : Fresh Vitreous haemorrhage



OS



along the globe wall with eye movements, distinguishing it from shallow retinal detachment.[3]

The advent of vitreous surgery provides a chance of visual recovery to patients with vitreous haemorrhage, though careful selection of cases and their preoperative evaluation for the choice of surgical procedure are crucial.[28] Studying vitreous haemorrhages and their course in detailed manner has not been possible prior to the use of ultrasound.

Posterior vitreous detachment (PVD)

PVD can occur in the normal aging eye, or may be associated with vitreous haemorrhage or inflammation. PVD may be focal or extensive, complete or incomplete, (with vitreoretinal adhesions at the optic disc, areas of neovascularisation or at the impact site following a penetrating trauma). [15]

On B-scan, PVD appears as a smooth, linear, thin membrane with a very fluid undulating movement. Weiss ring with two closely spaced opacities at the level of PVD maybe seen overlying the optic disc. On A-scan, the reflectivity may vary from extremely low to extremely high. Kinetic evaluation shows marked horizontal and vertical spike aftermovements.[15]

Vitreous inflammation (Endophthalmitis /vitritis)

With the high gain setting on B-scan, vitreous opacities appear as fine dots and lines of varying intensity. On A-scan, they produce chains of low amplitude spikes. The echographic appearance of vitreous opacities is similar

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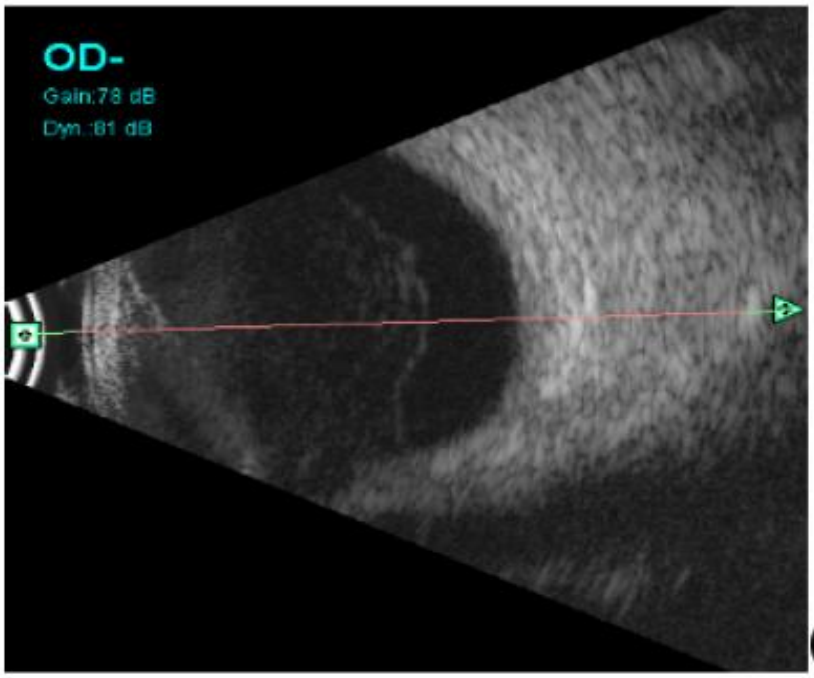
OTI SCAN REPORT

Patient Name : Panju **Date :21-8-2010**
Patient ID : 24435
Date of Birth : 03-08-1946
Diagnosis : Posterior Vitreous Detachment



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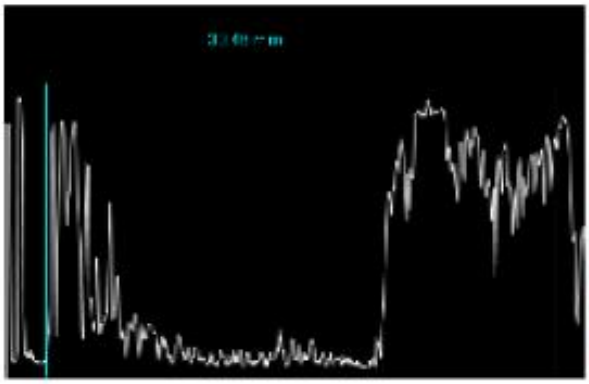

to that of vitreous haemorrhage, but the increased occurrence of pseudomembranes and extensive PVD along with vitreous haemorrhage helps to differentiate the two. Associated retinal, macular, choroidal and optic nerve abnormalities on USG help to clinch the diagnosis of endophthalmitis. Thus USG helps in determining visual prognosis and in planning the treatment for patients with endophthalmitis.[30]

Posterior vitreoschisis

Splitting of the posterior cortical vitreous, producing a schisis cavity containing unclotted blood is seen in eyes with proliferative diabetic retinopathy with vitreous haemorrhage. The appearance of the inner wall of the schisis cavity is similar to that of detached vitreous.[18]

B. RETINAL DISEASES

One of the most important roles of echography is to evaluate the status of retina in the presence of opaque media.[15]

Retinal tears

A retinal tear on B-scan appears as a small, focal, echo-dense membrane extending from the surface of retina, to which the posterior hyaloid is attached[15]. On A-scan, retinal tear shows a highly reflective spike.[32]

Retinal detachment (RD)

Retinal detachment on B-scan appears as a bright, continuous, somewhat folded membrane. On A-scan, RD appears as a highly reflective

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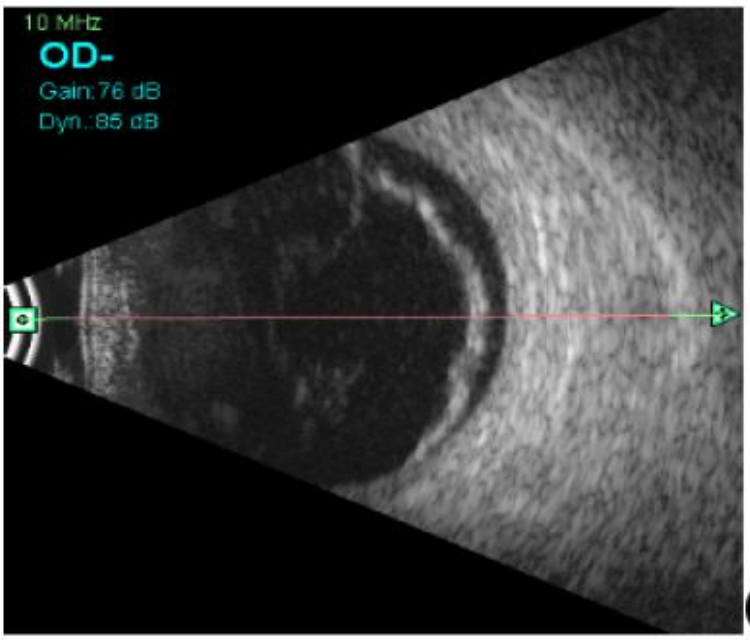
OTI SCAN REPORT

Patient Name : Rajapandi **Date : 9-6-11**
Patient ID :121690
Date of Birth : 23-06-1953
Diagnosis :Shallow Retinal Detachment



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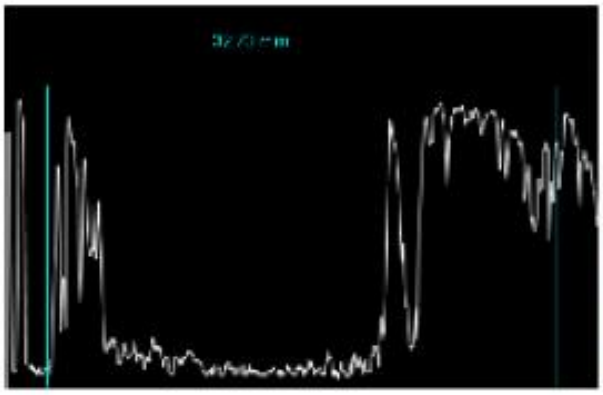

spike except in cases of atrophy, severe folding or disruption of retina when the reflectivity may be less than 100%. An extensive or total RD inserts to the optic disc posteriorly and ora serrata anteriorly. A partially detached retina inserts into the retina in areas in which it remains attached.[15] Retinal detachment exhibits tethered, restricted after movement. Certain factors affect the mobility of the detached retina - fresh bullous retinal detachments and longstanding detachments with proliferative vitreoretinopathy may be quite stiff. Exudative detachments show greater shifting of subretinal fluid than the rhegmatogenous detachments. Atrophic retina (e.g., in endophthalmitis) may exhibit marked mobility.

The configuration of RD may vary from shallow, flat and smooth to bullous and highly folded. Extensive RD can be funnel shaped. Funnel shaped detachments can be open or closed, concave, triangular or T-shaped. Detachments that are triangular / T-shaped or that have fixed retinal folds indicate proliferative vitreoretinopathy (PVR). [15]

Retinoschisis

On B-scan, retinoschisis appears as a smooth, thin, sharply demarcated, dome shaped non-mobile membrane. On A-scan, retinoschisis produces a high, single peaked spike which may demonstrate slight vertical after movement.[15]

C. MACULAR DISEASES

Macular edema: Macular edema is characterized echographically by an elevated, dome shaped lesion just temporal to the optic nerve.[15]

Macular hole:

Ultrasound and optical coherence tomography (OCT) [37] are the two methods currently available for imaging vitreoretinal relationships in the macular region. Ultrasound has the ability to assess kinetic properties of the vitreous[33] and also to provide a broad perspective of the vitreomacular relationships.[43]

Echographic findings of macular hole are very subtle. Directing the sound beam perpendicular to the macula is very important to detect the perifoveal vitreous detachment in the early stages of hole formation. Horizontal axial and vertical macula scans are preferred probe positions. In a fully developed macular hole, ultrasound shows an elevation in the macular region with a central depression corresponding to the hole.[15,40] Ultrasound can be useful to detect the presence of PVD in the fellow eye which significantly lowers the risk of macular hole formation.[41,43]

D. CHOROIDAL DISEASES

Choroidal detachment

On B-scan, choroidal detachment presents as a thick, dome shaped membrane, occupying the fundus periphery and inserting abruptly into the globe wall[3]. On kinetic echography, choroidal detachment produces minimum mobility and very slight or no after movement.[3] On A-scan, choroidal detachment produces, 100%, double peaked spike.[16] In some cases of 360

degree highly elevated choroidal detachments, apposition of the temporal and nasal detachments may occur in the central aspect of the vitreous cavity producing kissing or appositional choroidal detachments.[16]

Depending on the cause, the suprachoroidal space may be anechoic, as in choroidal effusion or contain dispersed opacities as in haemorrhagic detachment.[3] In cases of haemorrhagic detachments, ultrasound can be used for follow up of patients. As the blood liquifies, the density of Clot changes from high irregular internal reflectivity to a low, regular reflectivity.[16] This is extremely helpful in the management as surgical intervention is most effective when clot lysis is near completion.[16,17]

Choroidal folds:

On echography, choroidal folds show flattening of posterior ocular wall thickening of retinochoroidal layer and distention of the Optic nerve sheath. These eyes frequently have a shorter than normal axial length.[2]

Choroidal thickening:

Ultrasound can be used to measure in vivo choroidal thickness. Choroidal thickening either diffuse or focal may be caused by edema or inflammatory infiltration (eg. Vogt-Koyanagi Harada syndrome). On A-scan, choroidal thickening exhibits low to medium internal reflectivity. Ultrasound is, more reliable than CT and MRI in differentiating choroidal from Scleral thickening.[15]

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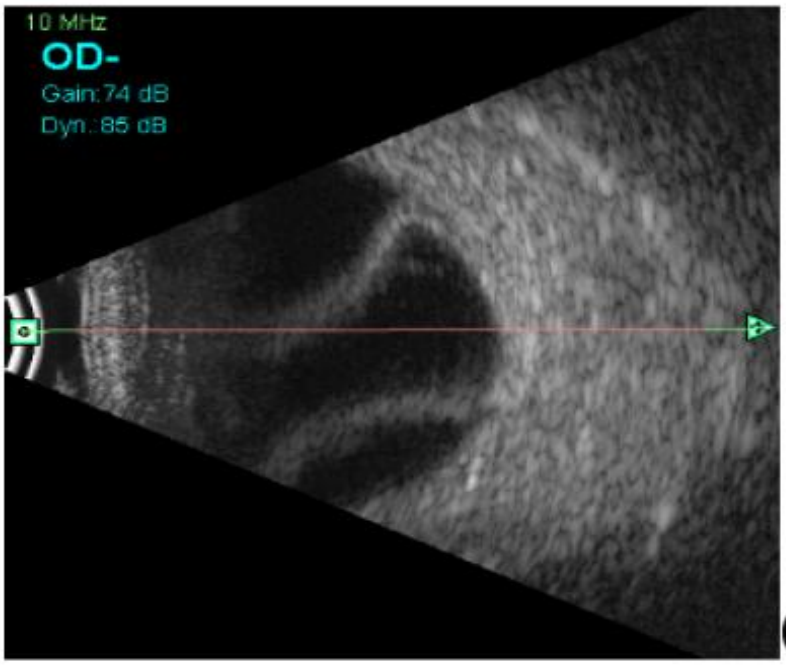
OTI SCAN REPORT

Patient Name : Mangammal **Date :31-8-10**
Patient ID : 24334
Date of Birth : 25-3-1946
Diagnosis : Choroidal detachment (Kissing choroid)



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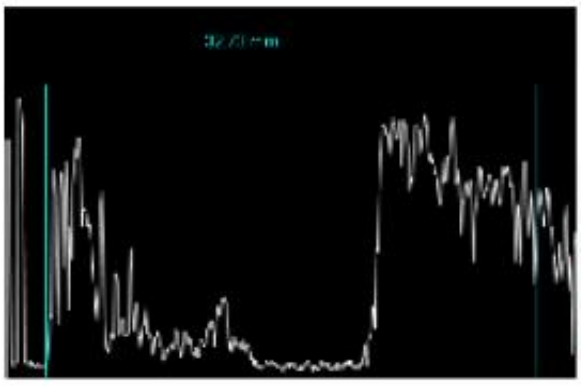

Choroidal melanoma:

Choroidal melanoma appears as a smooth, dome shaped or mushroom shaped solid mass. Melanomas may be associated with retinal detachments and vitreous haemorrhages.[39] They produce low to medium reflective, regularly structured spikes with medium to high sound attenuation.

E. SCLERAL DISEASES

Scleritis:

Posterior scleritis on USG presents a range of abnormalities including diffuse or nodular scleral thickening, diffuse fluid in the Tenon's space, and swelling of the optic disc, choroidal folds[7] and exudative retinal detachment. Eye wall thickness of greater than 2mm is considered abnormal.[51] When episcleral inflammation occurs in the peripapillary region it causes distention of the sub-Tenon's space, producing the "T-sign". [15] Thus USG is the most helpful ancillary test in the diagnosis of posterior scleritis.[7]

Uveal effusion syndrome

USG can demonstrate ciliochoroidal detachments, retinal detachments, thickening of sclera and retinochoroidal layer in cases of Uveal effusion syndrome.[59] USG is also helpful in determining the axial length in these cases as most of the eyes are shorter than normal.[64]

F. LEUKOCORIA : Ultrasound is an ideal tool in the investigation of children with leukocoria on account of its safety, ease of access, and ability to

be performed during examination under anaesthesia. Of lifesaving importance is the differentiation of retinoblastoma from other causes of leukocoria.[34] Examination can be carried out with the children under sedation or anaesthesia.

Retinoblastoma

Retinoblastoma is characterized by the presence of a solid mass, with an irregular configuration. Calcification within the lesion is a diagnostic feature, producing high internal reflectivity and shadowing effect. Calcification due to retinoblastoma is granular and within the tumor as opposed to the chronic degenerative calcification which is plaque-like and seen in the retina and choroid in phthisical eyes. Careful scanning of optic nerve and adjacent orbital fat is essential to exclude extraocular extension. Fellow eye also should be scanned to rule out bilateral disease.[3] The axial length is normal or slightly increased which is of major diagnostic significance.[34]

CT has advantage over USG in that it can detect extrascleral extension more accurately and is able to detect pinealoblastoma seen in hereditary cases of retinoblastoma.

Coat's disease

Coat's disease presents as an unilateral exudative retinal detachment with dense, mobile, subretinal deposits of cholesterol crystals.[3] The vitreous cavity remains clear and axial length is normal.[34]

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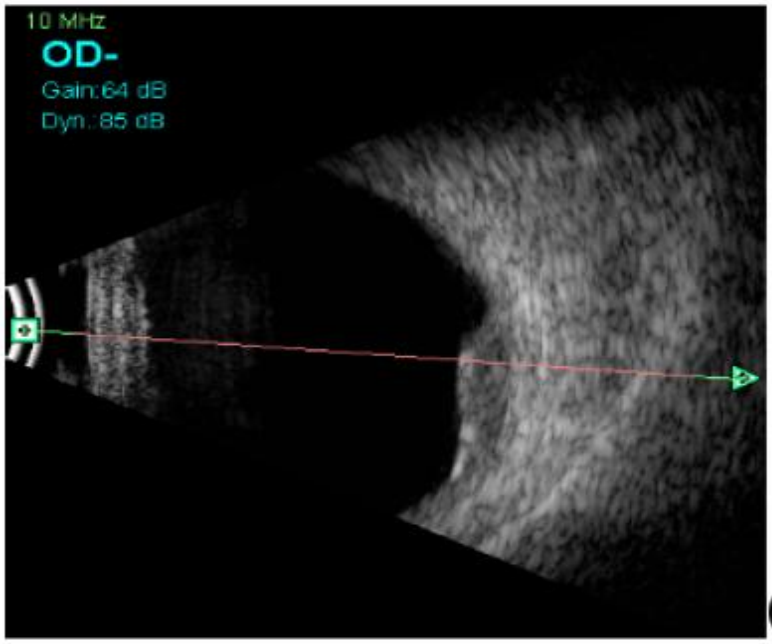
OTI SCAN REPORT

Patient Name : Biju **Date : 21-01-11**
Patient ID : 23675
Date of Birth : 3-11-2007
Diagnosis : Retinoblastoma



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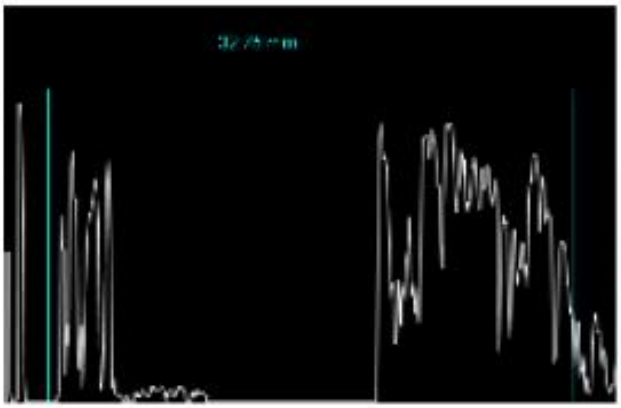

Congenital cataract

Congenital cataracts produce anterior and posterior lens capsule echoes followed by a clear vitreous space.[34]

Retinopathy of prematurity (ROP)

In ROP, USG is useful in the diagnosis, staging, treatment planning and follow up of patients. Axial length of the eyeball may be normal or shortened. In severe ROP, medium reflective retrolental echoes are seen representing retrolental fibroplasia. Various stages and configurations of retinal detachments with peripheral loops and cysts, subretinal opacities, choroidal thickening can be demonstrated. Pulido and coworkers reported that combination of A-scan and B-scan is helpful in evaluating advanced stages of ROP.[1,59]

Persistent hyperplastic primary vitreous (PHPV)

The eye has short axial length as compared to the fellow eye. A thin irregular band is seen extending from the posterior lens capsule to the optic nerve head. There may be irregularities of the posterior capsule.[1]

G. OCULAR TRAUMA

Ocular trauma is a common problem and can lead to several sight threatening complications. Clinical examination is difficult following trauma because of opacification of ocular media [19] or patient's inability to cooperate.[45] Ultrasound has revolutionized the management of traumatized eyes.[19] In a

severely injured eye, lid swelling and patient discomfort necessitate examination through closed lids. Whenever possible, open wounds should be repaired prior to echographic examination[15, 19] and sterility should be taken care of.

Determining the presence, location and nature of intraocular foreign body (IOFB) is of paramount importance in cases of ocular trauma.[12, 66] Much as a ship may use sonar to locate a submarine, the ultrasonographer can use the ultrasound machine to locate foreign bodies within the eye.[66] Foreign bodies that are radiolucent are detected as easily as those that are radiopaque using ultrasound.[12] The dynamic nature of ultrasound scores over other radiographic examination techniques.[66]

Small echoes in front of and behind the IOFB indicate an organized capsule surrounding it.[15]

When the IOFB has entered retinochoroidal scleral complex or in cases of significant refractive errors where the axial length departs from the mean, radiographic methods of IOFB localization become uncertain.[24] In these conditions USG is obviously more advantageous.

Even when a foreign body has been previously localized by computed tomography (CT), USG examination should still be performed for more precise localization and determination of extent of intraocular damage. If a

foreign body is located next to the scleral wall, CT scan will be unable to indicate whether it is just within or just outside the globe.[15]

Metallic foreign bodies.

On B-scan, metallic foreign bodies produce a very echodense signals which persist even at low gain settings. They cause marked, shadowing.

On A-scan, metallic foreign bodies produce high reflectivity regardless sound beam orientation.[15]

Orbital foreign bodies

Orbital foreign bodies are much more difficult to detect than intra ocular foreign bodies because the foreign body signal may be masked by the surrounding highly reflective orbital structures (bone, fat etc). [12, 15]

Role of ultrasound in the removal of foreign bodies

Ultrasound not only helps in the detection, localization but also in the removal of IOFB. It can be used to differentiate a magnetic IOFB from a non magnetic IOFB by demonstrating the movement of IOFB in a magnetic field.[24] Magnetic IOFB can be removed by using an electromagnet, which is least traumatic. The technique of extraction of non magnetic foreign bodies under ultrasound guidance was described by Bronson N.R.[13]

Along with the detection of IOFB, ultrasound also helps in detecting other effects of trauma-both in the anterior and posterior segment.[19] Apart from the pathologies already described, ultrasound can demonstrate scleral folds due to sudden decompression of the globe. Scleral folds are typically

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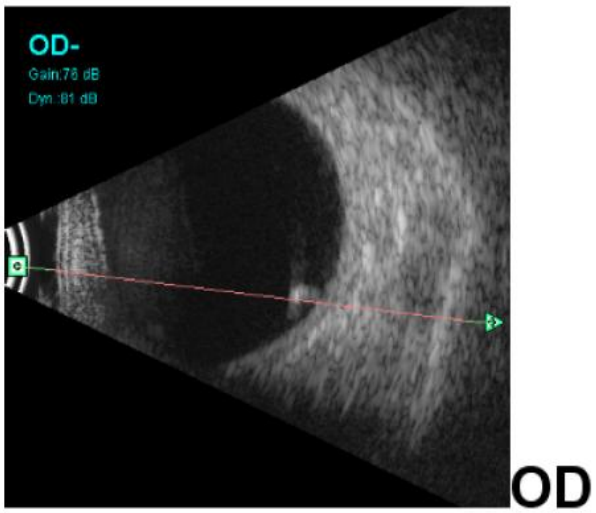
OTI SCAN REPORT

Patient Name : Ovian Nacha **Date : 11-3-2011**
Patient ID : 77842
Date of Birth : 10-12-1966
Diagnosis : Intraocular Foreign Body

Normal gain **Low gain**



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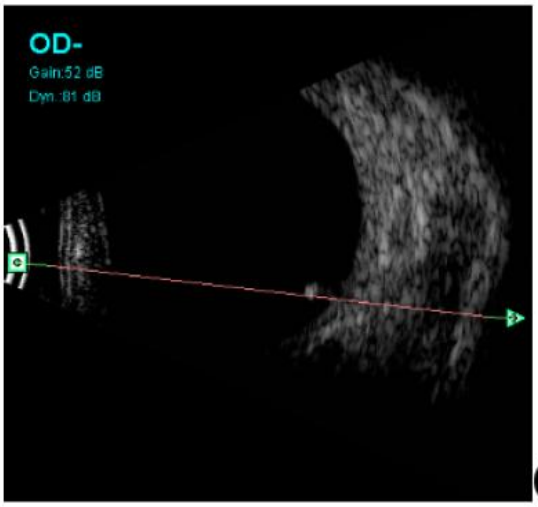

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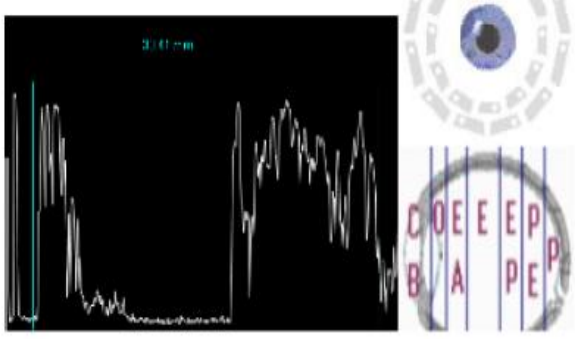
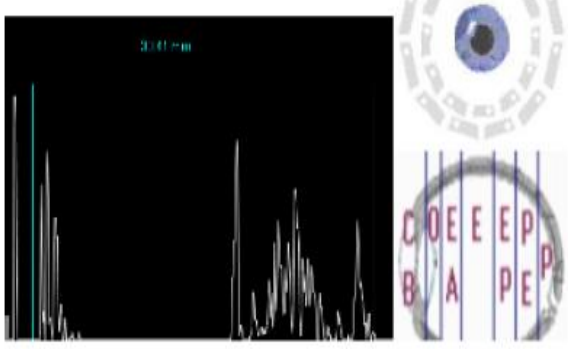




dome shaped with the apex of the dome being highly reflective, and can produce shadowing. Scleral folds may be mistaken for choroidal detachments, scleral buckle or foreign bodies.[15]

Whenever there has been a perforating injury careful search should be made for a haemorrhagic track and for retained I0FB.[19] Vitreous incarceration at the wound (entrance or exit) forms traction bands and the opposite side of globe should be evaluated to rule out tractional retinal detachments.[3] One potential pitfall of USG in the traumatized eye is the presence of artifacts. Presence of blood within the eye can mask the presence of IOFB. Presence of intraocular air can be mistaken for an IOFB.[66]

H. MISCELLANEOUS CONDITIONS

Myopia with posterior staphyloma

The axial length of the eyeball is longer and staphyloma presents as an outpouching of the thinned sclera, occurring earliest at the lateral margin of optic nerve head.[1]

Coloboma

On USG, irregularity of the contour of the globe is seen due to the absence of colobomatous tissue.[1]

Optic disc drusen

Highly reflective calcified nodule is seen lying over the optic nerve head.

Lens

A cataractous lens exhibits various degrees of echodensity. Subluxation, dislocation and rupture of lens capsule can be detected using ultrasound[15]. Macoul K.L. reported three cases of dislocated lens simulating retinal detachment on A-scan.[49]

Intraocular silicone oil:

The velocity of sound in silicone oil is 1010 meters / second and hence echograms of eyes filled with silicone oil appear larger than normal.[28]

ULTRASOUND FINDINGS IN ORBITAL DISEASES

Thyroid associated ophthalmopathy: [3]

Thyroid associated ophthalmopathy is typically a bilateral condition that affects multiple extraocular muscles. It may be very asymmetric. On B-scan, maximal muscle thickening is seen at the muscle belly, and tendon is spared. The internal structure is quite irregular, and reflectivity is medium to high. Other findings include swelling of orbital fat and lid tissues, thickening of periorbita and enlargement of lacrimal gland.

Orbital myositis: [3]

Orbital myositis can be unilateral or bilateral and can affect one or all extraocular muscles. The muscle is diffusely thickened, with involvement or both muscle belly and tendon. The internal reflectivity is low. USG also helps in monitoring the response to therapy.

Cavernous haemangioma: [3]

Cavernous haemangioma is frequently located within the muscle cone. Cavernous haemangioma appears as a large round or oval mass and can displace extraocular muscles and optic nerve or produce choroidal folds. Since it contains stagnant blood it produces highly reflective spikes, regular internal structure and moderate sound attenuation.

Orbital pseudotumour: [3]

On B-scan, orbital pseudotumour produces poorly outlined, infiltrative, dark mass lesion with irregular borders, very low reflectivity, regular internal structure, weak sound attenuation and no vascularity.

Rhabdomyosarcoma: [3]

Rhabdomyosarcoma on B-scan appears as a dark mass, with low reflective spikes and moderate sound attenuation. In advanced stages, bone defects may be detected.

ULTRASONOGRAPHIC ARTIFACTS [66]

Ultrasonographic artifacts are reflections or echoes that appear on the image but do not correspond in location or intensity to actual interfaces in the patient. The main types of artifacts are reverberation (multiple reflections) artifacts, ring down (comet-tail) an angle of incidence artifacts, shadowing artifacts, and refractive artifacts.[66]

INDICATIONS FOR INTRAOCULAR ULTRASOUND EXAMINATION [15]

1. Posterior segment evaluation in the presence of opaque ocular media due to:

- Corneal opacity
- Hyphema or hypopyon
- Cataract
- Pupillary or retrolenticular membrane
- Vitreous haemorrhage or inflammation

2. In the presence of clear ocular media

- Anterior segment : Iris lesions
  Ciliary body lesions
- Posterior segment : tumour
  - Choroidal detachment (serous versus haemorrhagic)
  - Retinal detachment (Rhegmatogenous versus exudative)
  - Optic disc abnormalities
  - Unexplained retinitis and choroiditis

3. Intraocular foreign body : Detection,
   Localization

INDICATIONS FOR ORBITAL ULTRASOUND EXAMINATION [15]

1. Unilateral or bilateral exophthalmos
2. Enophthalmos
3. Abnormal lid positions

ADDITIONAL INDICATIONS

Tissue differentiation of mass lesions

Clarification of CT and / or MRI findings

Assessment of blood flow within lesions

Follow up studies

An adequate evaluation of the eye depends on the ability of the echographer to think three dimensionally while examining the globe with the instruments that have only one or two dimensional display. By obtaining echograms from a variety of probe positions in a systematic fashion, examiner can construct a mental three dimensional picture.[15]

REVIEW OF LITERATURE

Gitter K.A. et al. (1968)[34] evaluated 25 patients with leukocoria under general anaesthesia using standardized echography. Ultrasound was found useful in determining clinically indiscernible microphthalmos which aids in the diagnosis of leukocoria.

Cowden J W and Runyan T F (1969)[29] evaluated fifty nine eyes suspected of having an IOFB independently by ultrasonic and radiographic localization techniques, and compared the results. They opined that ultrasound is a valuable aid in the diagnosis and management of IOFB but should not be substituted for an adequate radiographic evaluation.

Coleman D. J. (1972)[26] evaluated 100 ocular cases (76 with opaque media and 24 cases with suspected intraocular tumours and clear media) with ultrasonography. Patients were grouped into 5 categories (Retinal detachment, ocular trauma, intraocular tumours, vitreous haemorrage and miscellaneous). On confirming the ultrasound diagnosis by pathological studies and long term follow up, ultrasound was reliable in more than 90% of cases.

Coleman D.J. (1972)[27] performed 100 orbital ultrasonographies and proved that USG is a reliable, safe and atraumatic method of examining the orbit for tumour or inflammatory change, which gives the surgeon maximum information prior to surgical exploration.

Coleman D.J. et al., (1973)[21] after performing USG on 90 patients with various types of ocular trauma, highlighted the role of ultrasound as diagnostic tool and prognostic indicator.

McLeod D and Restori M (1979)[50] performed ultrasound on 154 consecutive patients with opaque ocular media due to severe diabetic eye disease and diagnosed various pathologies like epiretinal fibrosis, vitreous haemorrhage, vitreous detachment and retinal detachment.

Blumenkranz M.S. and Byrne S.F. (1982)[11] studied 35 consecutive patients with retinal detachment and clear media to determine the reliability and accuracy of ultrasound. They concluded that echography provides a highly reliable method for the detection and characterization of retinal detachment in patients with opaque media and also in clear media. Reliance on these techniques for the preoperative assessment and surgical planning of patient with retinal detachment and opaque ocular media appears to be well founded.

Bhatia I.M. et at., (1983)[9] subjected 100 cases of ocular trauma with hazy or opaque media to ultrasound examination. Among these 21 patients had various pathologies. USG not only helped in the detection but also in the localization of both radiopaque and radiolucent IOFB. This study highlights the usefulness of ultrasound in cases of ocular trauma.

Clemens S. et al., (1984)[20] performed postoperative A and B-scan USG in 55 patients with complicated retinal detachment who had undergone pars

plana vitrectomy with intravitreal silicone oil tamponade and show that the position of the retina could be demonstrated accurately.

Das T and Namperumalsamy P et al, (1987)[31] performed contact USG in 175 eyes, with opaque media due to recent or old trauma. Concluded that USG is highly valuable in the evaluation of traumatized eyes due to its cost effectiveness, noninvasive nature and safety. In addition to proper planning and execution of surgery, USG also helps in predicting the possible prognosis.

Atta H.R. (1988)[2] evaluated 31 eyes with choroidal folds unassociated with orbital tumours and described their findings. They opined that standardized echography is a highly sensitive, noninvasive and cost effective method for the detection of subtle ocular and orbital changes found in patients with choroidal folds.

Wilson R.G. et al., (1989)[65] measured medial rectus muscle width in 20 patients with Graves ophthalmopathy and 21 normal individuals using USG and CT. They proved that USG gives similar results to CT and hence is a valuable technique for prospective evaluation of Graves ophthalmopathy patients.

Chu T.G. et al., (1991)[16] conducted a clinical and echographic study of 18 patients with massive suprachoroidal haemorrhage with central retinal apposition and found echography to be useful in the diagnosis and

management. They concluded that ultrasound should be used as an adjunct to other imaging techniques in the evaluation of traumatized eyes.

Kokame G.T. (1995)[43] examined 47 eyes with macular hole and found 94% correlation between biomicroscopic and ultrasonographic findings, thus establishing the usefulness of ultrasound.

McNicholas M.M.J. et al, (1995)[53] prospectively examined 61 traumatized eyes and correlated their findings with clinical and surgical follow up and concluded that ultrasound accurately demonstrates the ocular damage in traumatized eyes and may also reveal clinically unsuspected problems. Their study also showed that ultrasound was superior to CT in the assessment of ocular damage produced by intraocular foreign bodies.

Haile M. and Mengistu Z. et al., (1996)[35] utilized USG in the evaluation of 318 eyes referred for various reasons. They explained the B- scan findings in detail. They concluded that in developing countries where other imaging modalities are neither widely available nor affordable, USG is a valuable method of evaluating the eye and orbit for any detectable abnormality and for planning the management.

Atta H.R. (l999) [5] retrospectively analyzed ultrasound records and case records of patients with vitreous haemorrhage and concluded that ultrasound is a useful modality in accurately diagnosing vitreous haemorrhage and in identifying the underlying cause.

Sabti K. et al., (2001)[62] examined 207 patients who had undergone cataract extraction, both clinically and echographically. Uveal effusion was documented echographically in 12 patients (5.8%), out of which only one was clinically evident.

Lal J.C. et al., (2003)[46] examined 77 eyes of 40 consecutive patients with B-scan, fluorescein angiography and optical coherence tomography. B-scan detected macular thickening with a high degree of sensitivity (91%) and specificity (96%), and correlated with biomicroscopy, FA and OCT findings. This study shows that B-scan is a potentially useful technique for assessing macular thickening when media opacity precludes other examination techniques.

Ingrid scot et al., (2004)[38] examined 154 eyes of 143 patients to investigate the usefulness and impact of echographic evaluation on management of patients with suspected posterior segment pathology. And concluded that echography confirmed 96% cases correctly which was confirmed by other tests and was impactful and pivotal in the management.

Ko.F et al (2011) [42] examined clinical case series of 15 patients with suspected orbital vascular lesions and concluded that orbital ultrasound provides reliable imaging parameter and can be used as a primary imaging modality when evaluating suspected orbital vascular lesion.

Roger Harries (2011)[60] after echographic study of 1000 patients over 16 months period ending in January 2009 opines that ultrasonography is an important diagnostic tool and has valuable place in clinical practice.[60]

AIMS AND OBJECTIVES

1. To evaluate the role of B-mode ultrasound as a diagnostic tool and prognostic indicator for posterior segment examination in eyes with opaque media (due to any cause) where other methods of examination fail to visualize the posterior segment.
2. To assess the usefulness of B-mode ultrasound in the detection and for topographic evaluation of intraocular tumours.
3. To assess the role of B-mode ultrasound in the evaluation of orbital lesions.

MATERIALS AND METHODS

This study was conducted in the Department of Ophthalmology, Government Rajaji Hospital, Madurai during the period July 2010 to June 2011.

The subjects for the study were selected from the following sources,

1. Out-patients attending the Department of Ophthalmology, Government Rajaji Hospital, Madurai.
2. In-patients of Department of Ophthalmology, Government Rajaji Hospital, Madurai.
3. Out-patients and in-patients of various other departments of Government Rajaji Hospital who were referred to the Department of Ophthalmology.

From the above sources, patients were selected using the following inclusion and exclusion criteria.

INCLUSION CRITERIA

1. Presence of opaque ocular media / hazy ocular media which precluded the use of other methods of posterior segment evaluation.
2. Patients with suspected intraocular tumours and suspected intraocular foreign bodies, even in the presence of clear media.
3. Patients with orbital lesions.

EXCLUSION CRITERIA

1. Patients with clear media in whom the posterior segment could be evaluated by other techniques, except patients with suspected intraocular tumours and suspected intraocular foreign bodies.
2. Patients with rupture globe.

After selecting the patients using the inclusion and exclusion criteria, 164 patients were selected for the present study by using the simple random sampling method.

METHODS

An informed consent was obtained. A proforma was prepared meeting the demands of the study. It was pretested. A detailed relevant clinical history was taken. The best corrected visual acuity and refractive status were recorded. Anterior segment biomicroscopic examination was performed. The intraocular pressure was recorded with the Goldmann applanation tonometer. Examination of the posterior segment was carried out using the direct ophthalmoscope, indirect ophthalmoscope and slit lamp biomicroscopy in patients orbital diseases. Exophthalmometry was carried out in patients with orbital diseases.

A provisional clinical diagnosis made.

ULTRA SOUND EXAMINATION

In the present study ultrasound examination was carried out by using "OTI scan 3000 Ultrascan imaging system", manufactured by OTI ophthalmic technologies Inc, Canada.

The instrument had the following specifications

1. Probe frequency - 10 MHz
2. Focal length - 23 mm
3. Operating mode - pulsed
4. PRF - 3840 Hz
5. Active diameter - 7 mm
6. Active surface - 154 mm^2
7. Axial resolution - 0.15 mm
8. Vertical resolution - 1020 points
9. Horizontal resolution - 256 lines
10. Linear resolution up to 14.6 µm

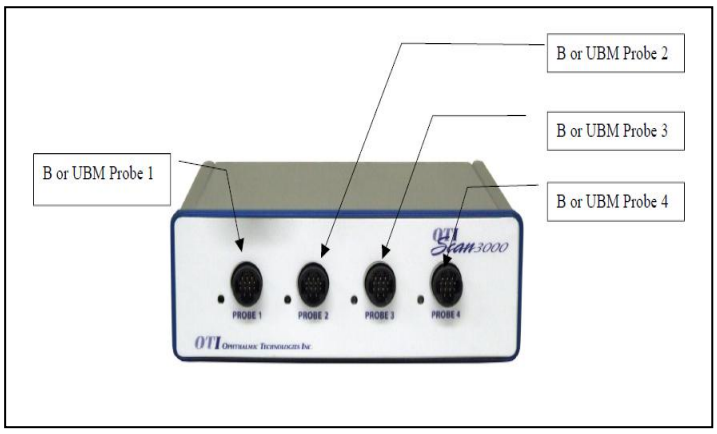
The procedure of ultrasound examination was explained to the patient. Intially ocular screening was carried out by eight overlapping transverse scans.

If no abnormality was detected no further examination was performed.

If an abnormality was detected during the initial screening examination then topographic evaluation, quantitative examination and kinetic echography were carried out for both ocular and orbital diseases.

An echographic diagnosis was made at the end of ultrasound examination. Other relevant investigations like plain x-ray of the orbit (PA and lateral view); CT scan and MRI of head including the orbit, thyroid profile and serum biochemistry were carried out.

OTI SCAN 3000
ULTRA SCAN IMAGING SYSTEM



MANAGEMENT

Patients were managed either medically or surgically. Patients who required additional management were referred to specialized hospitals and were followed up.

The final diagnosis was made following surgery or by ancillary investigations. This was compared with the echographic diagnosis that was made initially.

The data was analyzed by using the important statistical parameters like the mean, the standard deviation (S.D), standard error (S.E) and t-test. Sensitivity and specificity were also calculated.

Statistical Tools

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using **Epidemiological Information Package (EPI 2010)** developed by Centre for Disease Control, Atlanta.

Using this software range, frequencies, percentages, means, standard deviations, Sensitivity, Specificity and 'p' values were calculated. ‘t’ test was used to test the significance of difference between quantitative variables and Yate’s chi square test for qualitative variables.

A 'p' value less than 0.05 is taken to denote significant relationship.

RESULTS AND ANALYSIS

A total of 206 eyes of 164 patients were studied between July 2010 to June 2011. Out of these, 176 eyes of 144 patients had opaque / hazy media and 30 eyes of 20 patients had orbital diseases.

Age and Sex distribution of the subjects in the present study was as follows.

Table: 1

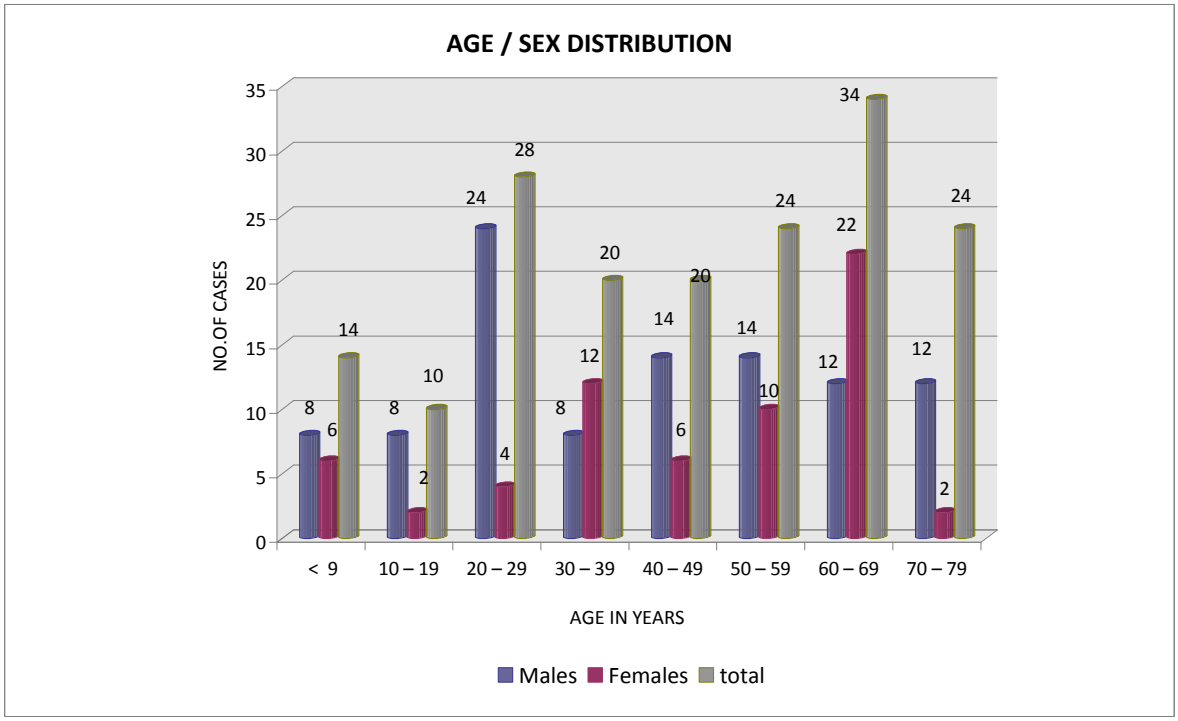
Age and Sex distribution of the study subjects

Age in years	Males	Females	Total	Percentage
< 9	8	6	14	8.5
10 – 19	8	2	10	6.1
20 – 29	24	4	28	17.1
30 – 39	8	12	20	12.2
40 – 49	14	6	20	12.2
50 – 59	14	10	24	14.6
60 – 69	12	22	34	20.8
70 – 79	12	2	14	8.5
Total	100	64	164	100

The youngest patient was a male child of one year and the oldest was a male aged 77 years.

A total of 100 male patients and 64 female patients were a part of the present study in the ratio of 1.6 : 1

The mean age of females was 46.1 years with a standard deviation of 20 years which was higher than the mean age of male patients which was 40.7 years with a standard deviation of 21.4 years.


AGE / SEX DISTRIBUTION
NO.OF CASES
35
30
25
20
15
10
5
0
8
6
14
8
2
10
24
4
28
8
12
20
14
6
20
14
10
24
12
22
34
12
2
24
< 9
10 – 19
20 – 29
30 – 39
40 – 49
50 – 59
60 – 69
70 – 79
AGE IN YEARS
Males
Females
total

Out of the 144 patients with opaque media, involvement of right eye alone, left eye alone and both eyes were observed in 68, 44 and 32 cases, respectively.

Among the 20 patients with orbital diseases, 4 had involvement of the right orbit only, 6 had involvement of the left orbit only and 10 cases had involvement of both the orbits.

Table – 2

Laterality of the lesions

Eyes involved	Patients with Opaque media				Patients with orbital diseases			
	No. of patients	%	No. of eyes	%	No. of patients	%	No. of eyes	%
Right eye alone	68	47.2	68	38.6	4	20.0	4	13.3
Left eye alone	44	30.6	44	25.0	6	30.0	6	20.0
Both eyes	32	22.2	64	36.4	10	50.0	20	66.6
Total	144	100	176	100	20	100	30	100

52 among the 144 patients had history of trauma. Of these, 32 patients had blunt trauma and 20 had penetrating trauma. None of the patients had perforating trauma.

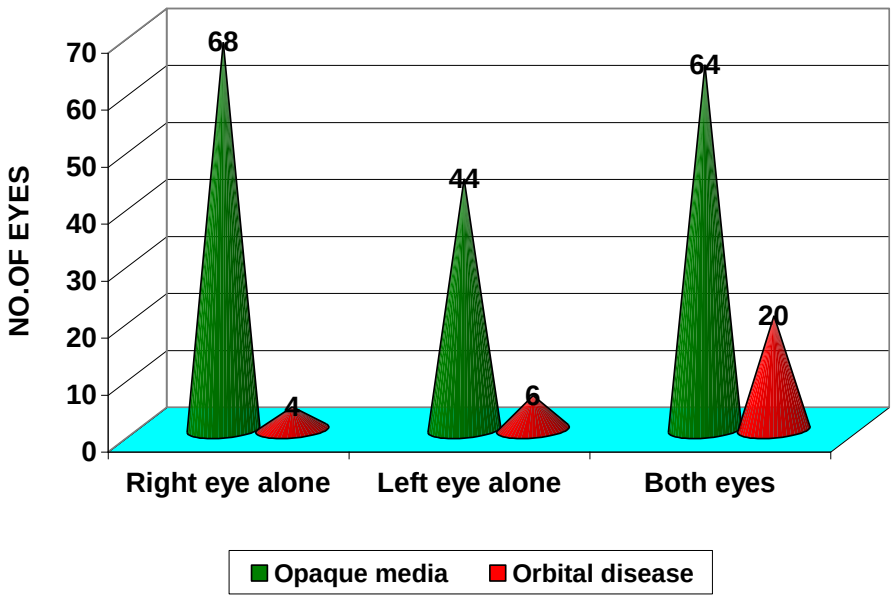
Table – 3

Nature of Trauma

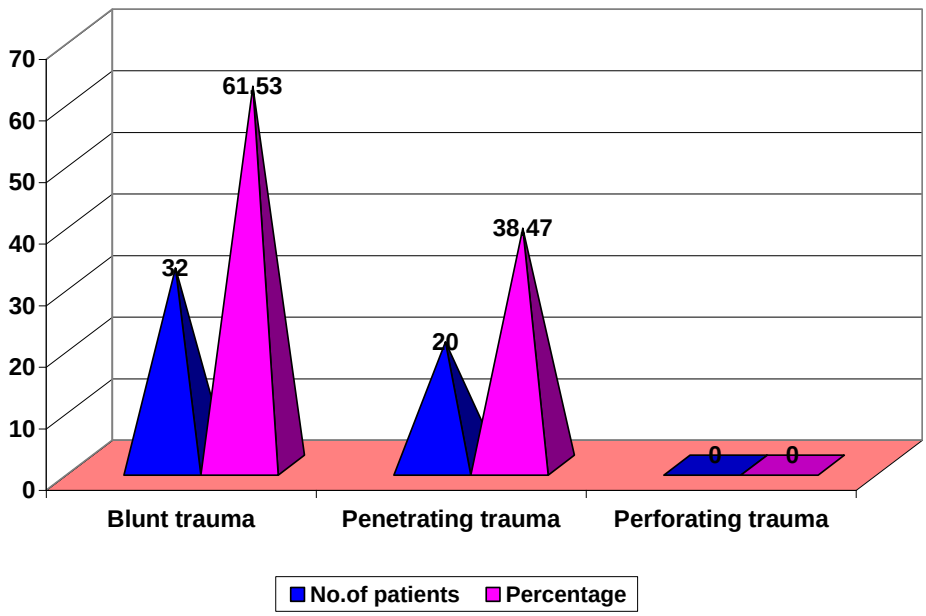
Nature of Trauma	No. of patients	Percentage
Blunt trauma	32	61.53
Penetrating trauma	20	38.47
Perforating trauma	0	0
Total	52	100

The number of patients with a history of blunt trauma was 1.6 times greater than those with penetrating trauma. The difference was statistically significant with the p value < 0.05.

LATERALITY OF THE LESIONS



NATURE OF TRAUMA



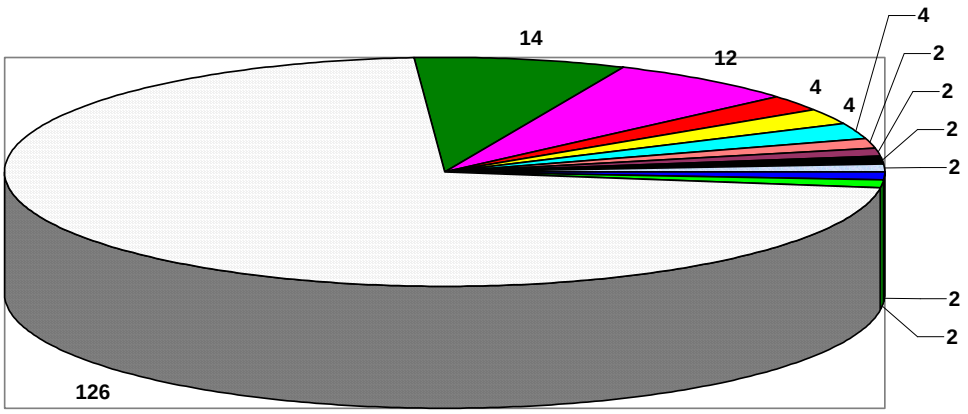
The various causes of opaque media in 176 eyes studied were as follows.

Table – 4

Causes of Opaque media

Causes of Opaque media	**No. of eyes**	**Percentage**
Cataractous lens (BE CL + CL)	126	71.6
Vitreous haemorrhage (BE VH +VH)	14	7.9
Total hyphaema	12	6.8
Corneal Oedema	4	2.3
Dense hypopyon + hypopyon	4	2.3
Tumour seedings into the vitreous	4	2.3
Vitreous inflammation	2	1.1
Pupillary exudative membrane	2	1.1
Dense hypopyon +Cataractous lens	2	1.1
Corneal oedema and papillary exudative membrane	2	1.1
Cataractous lens and Occlusio pupillae	2	1.1
Cataractous lens and vitreous haemorrhage	2	1.1
Total	176	100

CAUSES OF OPAQUE MEDIA



Cataractous lens	Vitreous haemorrhage
Total hyphaema	Corneal Oedema
Dense hypopyon + hypopyon	Tumour seedings into the vitreous
Vitreous inflammation	Pupillary exudative membrane
Dense hypopyon +Cataractous lens	Corneal oedema and papillary exudative membrane
Cataractous lens and occlusio pupillae	Cataractous lens and vitreous haemorrhage

Out of 52 eyes of trauma 2 eyes of 2 patients had clear media.

Table – 5

Causes of Opaque media in patients with history of trauma

Causes of Opaque media	No. of eyes	Percentage
Traumatic cataract	24	48
Traumatic hyphaema	12	24
Vitreous haemorrhage	6	12
Dense hypopyon	2	4
Vitreous inflammation	2	4
Corneal oedema and papillary exudative membrane	2	4
Dense hypopyon and cataractous lens	2	4
Total	50	100

Traumatic cataract was the major causes of opaque media in traumatized eyes, followed by traumatic hyphaema.

CAUSES OF OPAQUE MEDIA IN PATIENTS WITH HISTORY OF TRAUMA

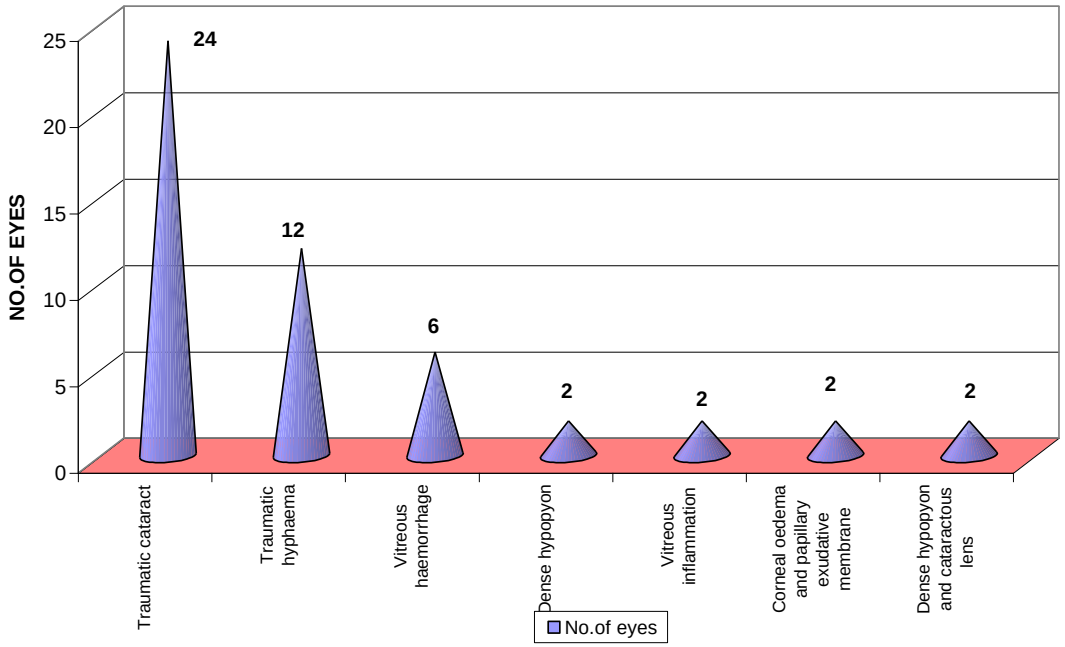


Table – 6

Echographic diagnosis in eyes with opaque media

Echographic Diagnosis	No. of eyes	Percentage
Normal posterior segment	36	20.45
Asteroid hyalosis	6	3.40
Fresh vitreous haemorrhage	6	3.40
Organized vitreous haemorrhage with membrane and PVD	20	11.36
Posterior hyphaema	2	1.14
Posterior vitreous detachment	22	12.5
Endophthalmitis	4	2.27
Rhegmatogenous retinal detachment	20	11.36
Vitreous haemorrhage with tractional retinal detachment	6	3.40
Endophthalmitis with tractional retinal detachment	4	2.27
PVD with retinal detachment	6	3.40
Posterior scleritis with exudative retinal detachment	4	2.27
Retinal detachment with intraocular silicone oil	2	1.14
Choroidal detachment	4	2.27
Choroidal thickening	2	1.14
Chorioretinal coloboma	8	4.54
Myopia with posterior staphyloma	4	2.27
IOFB	4	2.27
IOFB with vitreous haemorrhage	4	2.27
Retinoblastoma	6	3.40
Optic disc drusen	2	1.14
Dislocated lens into the vitreous	4	2.27
Total	176	100

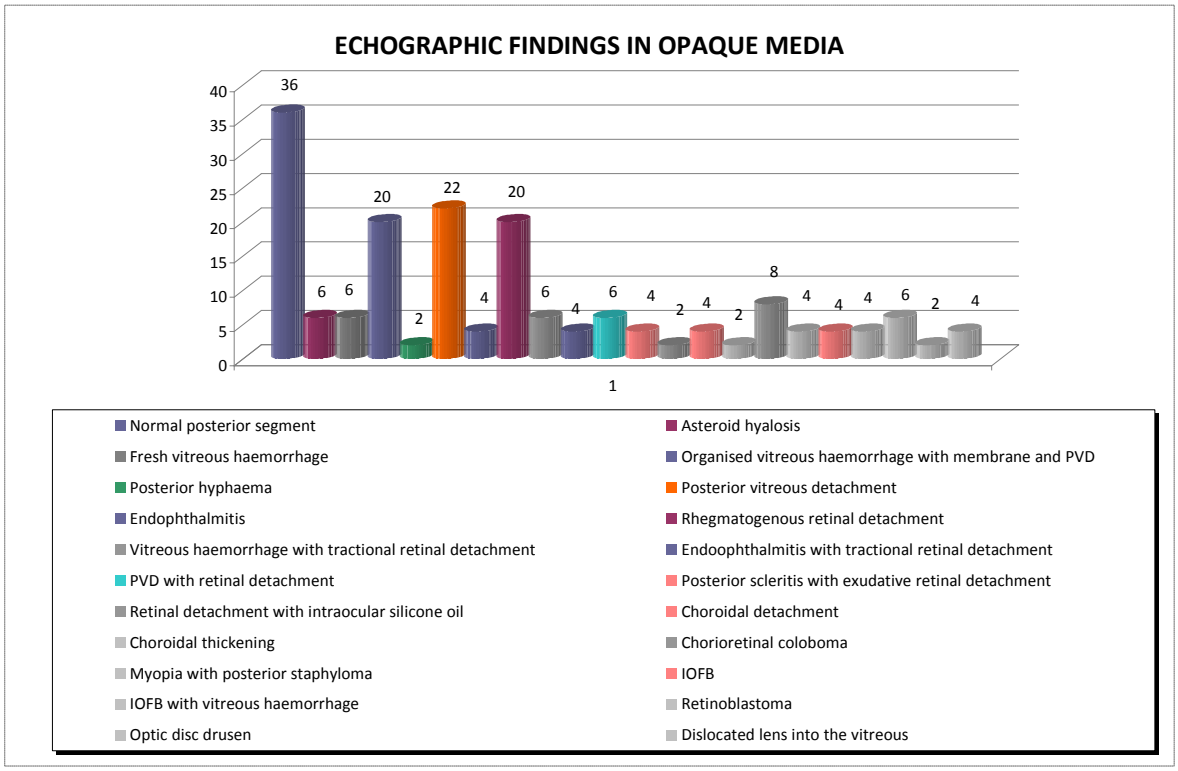

ECHOGRAPHIC FINDINGS IN OPAQUE MEDIA
40
35
30
25
20
15
10
5
0
36
6
6
20
2
22
4
20
6
4
6
4
2
4
2
8
4
4
4
6
2
4
1
Normal posterior segment
Asteroid hyalosis
Fresh vitreous haemorrhage
Organised vitreous haemorrhage with membrane and PVD
Posterior hyphaema
Posterior vitreous detachment
Endophthalmitis
Rhegmatogenous retinal detachment
Vitreous haemorrhage with tractional retinal detachment
Endoophthalmitis with tractional retinal detachment
PVD with retinal detachment
Posterior scleritis with exudative retinal detachment
Retinal detachment with intraocular silicone oil
Choroidal detachment
Choroidal thickening
Chorioretinal coloboma
Myopia with posterior staphyloma
IOFB
IOFB with vitreous haemorrhage
Retinoblastoma
Optic disc drusen
Dislocated lens into the vitreous

Table 7

Echographic Findings in traumatized eyes

Echographic Findings	Blunt Trauma		Penetrating trauma		Total	
	No. of patients	%	No. of patients	%	No. of patients	%
Normal posterior segment	2	6.66	0	0	2	4
Vitreous haemorrhage	4	13.33	0	0	4	8
Organized vitreous haemorrhage with membrane and PVD	2	6.66	2	10	4	8
Posterior vitreous detachment with retinal detachment	6	20	0	0	6	12
Vitreous haemorrhage with retinal detachment	2	6.66	0	0	2	4
Rhegmatogenous retinal detachment	10	33.33	0	0	10	20
Endophthalmitis	0	0	4	20	4	8
Endophthalmitis with tractional retinal detachment	0	0	4	20	4	8
Choroidal detachment	0	0	2	10	2	4
IOFB	0	0	4	20	4	8
Vitreous haemorrhage with IOFB	0	0	4	20	4	8
Dislocated lens into the vitreous	2	6.66	0	0	2	4
Retinal detachment with intraocular silicone oil	2	6.66	0	0	2	4
Total	30	100	20	100	50	100

24 diabetic patients were included in the study. The cause of opaque media was cataractous lens in all the eyes except in two with cataractous lens and vitreous haemorrhage.

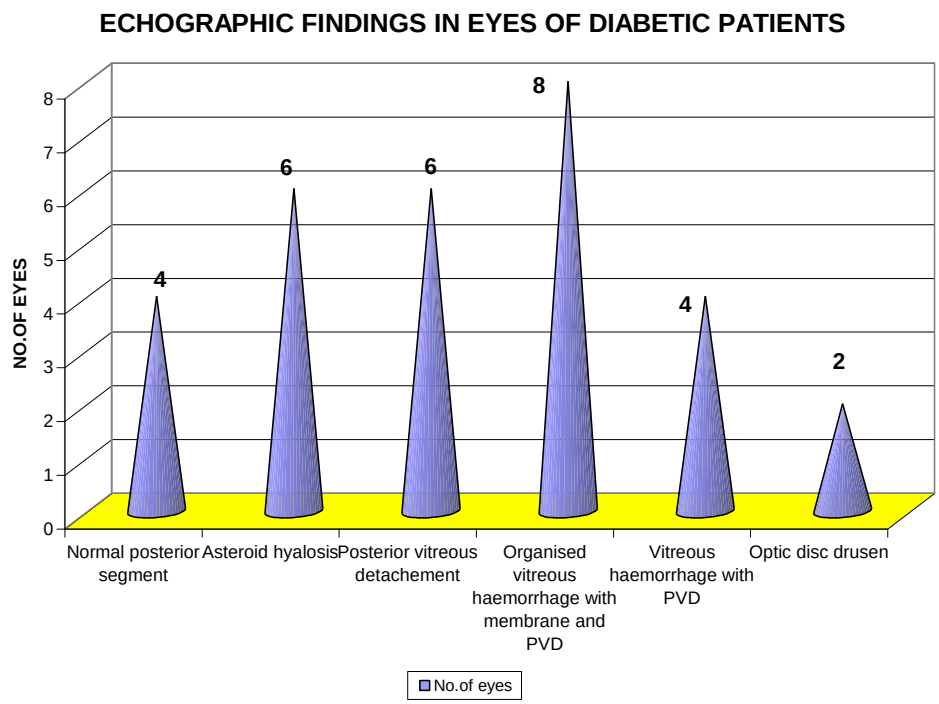
Table – 8 Echographic findings in eyes of diabetic patients

Echographic diagnosis	No. of eyes	Percentage
Normal posterior segment	4	13.33
Asteriod hyalosis	6	20.00
Posterior vitreous detachment	6	20.00
Organized vitreous haemorrhage with membrane and PVD	8	26.67
Vitreous haemorrhage with PVD	4	13.33
Optic disc drusen	2	6.67
Total	30	100

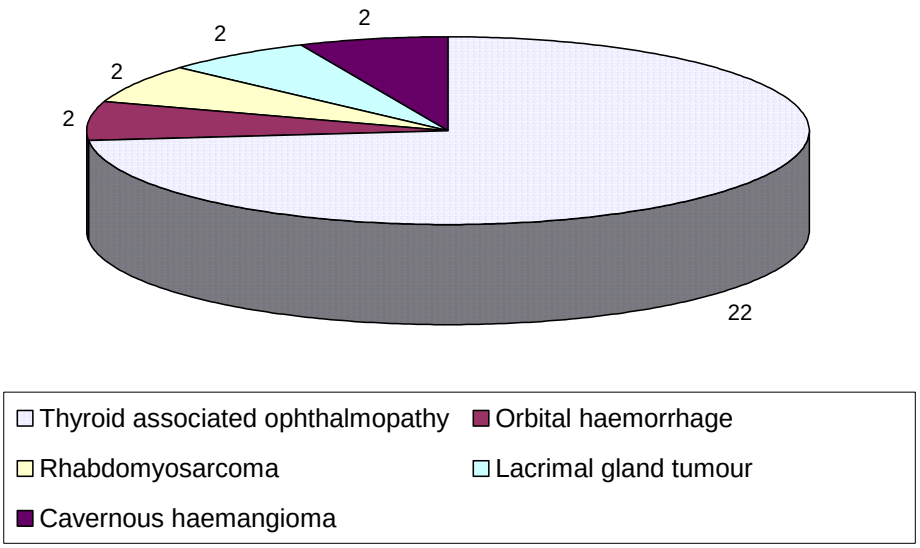
In the 30 orbits studied using B scan the various conditions detected were as follows.

Table – 9 Echographic Diagnosis in Orbital disease

Echographic diagnosis	No. of eyes	Percentage
Thyroid associated ophthalmopathy	22	73.2
Orbital haemorrhage	2	6.7
Rhabdomyosarcoma	2	6.7
Lacrimal gland tumour	2	6.7
Cavernous haemangioma	2	6.7
Total	30	100


ECHOGRAPHIC FINDINGS IN EYES OF DIABETIC PATIENTS
NO.OF EYES
0
1
2
3
4
5
6
7
8
4
6
6
8
4
2
Normal posterior segment
Asteroid hyalosis
Posterior vitreous detachement
Organised vitreous haemorrhage with membrane and PVD
Vitreous haemorrhage with PVD
Optic disc drusen
No.of eyes

ECHOGRAPHIC DIAGNOSIS IN ORBITAL DISEASES



Accuracy of ultrasound in the evaluation of opaque media

Out of 176 eyes with opaque media, which were included in the study and evaluated using ultrasound, 14patients (16 eyes) were lost for follow up and hence were not included in the estimation of accuracy (validity) indices.

Table – 10

Accuracy of B-mode USG in the diagnosis of Normal posterior segment

USG Diagnosis	Confirmed diagnosis		Total
	Normal posterior segment	Abnormal posterior segment	
Normal posterior segment	36	0	36
Abnormal posterior segment	0	124	124
Total	36	124	160

Sensitivity – 100 %, Specificity – 100%

All the 36 cases diagnosed as having normal posterior segment on ultrasound examination, were confirmed to have normal posterior segment following cataract extraction. No case which was diagnosed as having abnormal posterior segment on ultrasound examination was later found to have normal posterior segment. Thus ultrasound had 100% sensitivity and 100% specificity in the diagnosis of normal posterior segment.

Accuracy of B-mode Ultrasound in the diagnosis of PVD

Table 11

Accuracy of B-mode Ultrasound in the Diagnosis of PVD

USG Diagnosis	Confirmed Diagnosis		Total
	PVD	No PVD	
PVD	46	2	48
NO PVD	0	112	112
Total	46	114	160

Sensitivity – 100%, Specificity – 98.2 %

PVD was diagnosed on B scan in 48 cases. Of these 46 eyes were confirmed to have PVD. Two eyes which were diagnosed as having organized vitreous haemorrhage with membrane formation over detached posterior vitreous was found to have retinal detachment preoperatively. Thus on USG two cases of RD were wrongly diagnosed as PVD. All the 112 cases found to have no PVD on USG were confirmed subsequently. Thus the sensitivity of USG in the diagnosis of PVD was 100% and the specificity was 98.2%.

Accuracy of B-mode USG in the diagnosis of Vitreous haemorrhage

Table 12

Accuracy of B-mode USG in the Diagnosis of Vitreous haemorrhage

USG Diagnosis	Confirmed Diagnosis		Total
	Vitreous haemorrhage	No vitreous haemorrhage	
Vitreous haemorrrhage	38	0	38
No vitreous haemorrhage	2	120	122
Total	40	120	160

Sensitivity - 95 %, Specificity - 100%

The echographic diagnosis of vitreous haemorrhage in 38 eyes was confirmed. 122 eyes were found to have no vitreous haemorrhage on ultrasound examination. Out of these 2 eyes of a diabetic patient had mild vitreous haemorrhage which was missed on ultrasound examination. Thus in the diagnosis of vitreous haemorrhage ultrasound had 95% sensitivity and 100% specificity.

Accuracy of B-mode USG in the diagnosis of retinal detachment

Table 13

Accuracy of B-mode USG in the diagnosis of retinal detachment

USG Diagnosis	Confirmed Diagnosis		Total
	Retinal Detachment	No retinal detachment	
Retinal detachment	26	0	26
No retinal detachment	2	132	134
Total	28	132	160

Sensitivity - 92.9 %, Specificity - 100 %

Out of 28 confirmed cases of retinal detachment, 26 were correctly diagnosed on USG. Two cases of retinal detachment in a patient with vitreous haemorrhage were wrongly diagnosed as organized vitreous haemorrhage and thick membrane formation along the detached posterior vitreous. Thus the sensitivity of USG in diagnosing retinal detachment was 92.9%. All the cases found not to have retinal detachment on echography were confirmed later. Thus the specificity of USG in the diagnosis of retinal detachment was 100%.

Table 14

Accuracy of B-mode ultrasound in the diagnosis of retinoblastoma

USG Diagnosis	Confirmed Diagnosis		Total
	Retinoblastoma	No retinoblastoma	
Retinoblastoma	6	0	6
No Retinoblastoma	0	154	154
Total	6	154	160

Sensitivity - 100 %， Specificity - 100 %

USG had 100% sensitivity and 100% specificity in the diagnosis of retinoblastoma, correctly diagnosing 6 eyes with the condition and 154 eyes without.

Table 15

Accuracy B-mode USG in the diagnosis of IOFB

USG Diagnosis	Confirmed Diagnosis		Total
	IOFB	No IOFB	
IOFB	6	2	8
No IOFB	0	152	152
Total	6	154	160

Sensitivity - 100 %， Specificity - 98.7 %

Totally 8 eyes were diagnosed to have IOFB on B scan. 6 of these were confirmed by other radiological methods. Two eyes with the history of penetrating injury had intraocular air bubble which was mistaken for an IOFB on USG. Thus the sensitivity of USG in the diagnosis of IOFB was 100% and specificity was 98.7%.

Accuracy of B-mode USG in the diagnosis of Thyroid associated ophthalmopathy

Two cases of orbital disease were lost for follow up. Hence only 28 eyes were taken into account while estimating validity indices.

Table 16

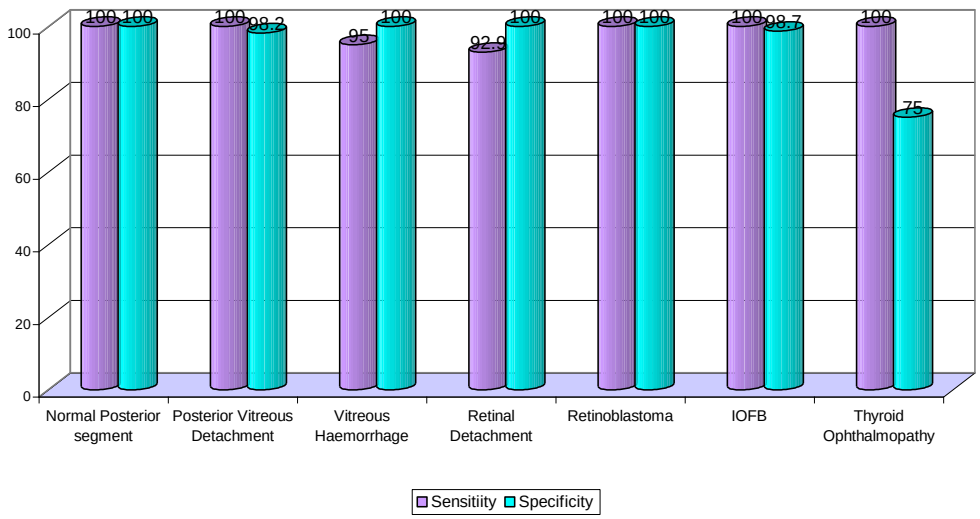
Accuracy of B-mode USG in the diagnosis of Thyroid associated ophthalmopathy

USG Diagnosis	Confirmed Diagnosis		Total
	Thyroid associated ophthalmopathy	No Thyroid associated ophthalmopathy	
Thyroid associated ophthalmopathy	20	2	22
Thyroid associated ophthalmopathy	0	6	6
Total	20	8	28

Sensitivity - 100 %, Specificity - 75 %

USG had 100% sensitivity and 75% specificity in the diagnosis of thyroid associated ophthalmopathy. Two cases of orbital myositis were wrongly diagnosed as thyroid associated ophthalmopathy on USG.

ACCURACY OF USG IN THE OPAQUE OCULAR MEDIA AND ORBITAL DISEASES



DISCUSSION

The present study conducted in the Department of Ophthalmology, Govt. Rajaji Hospital, Madurai between July 2010 and June 2011 included 206 eyes of 164 patients. Out of these 176 eyes of 144 patients were studied in order to evaluate the posterior segment in the presence of opaque media. Orbital lesions were studied in 30 eyes of 20 patients.

The highest number of patients were present in the 60-69 years of age group with 34 patients (20.8%), followed by the 20-29 years of age group with 28 patients (17.1%). This could be attributed to the increased incidence of age related cataract in the former and increased incidence of trauma in the latter group.

The present study had more number of male patients than female patients probably due to the fact that males were more prone to trauma (which was a major cause of opaque media).

Involvement of both the eyes was seen in 32 patients (22.22%) with opaque ocular media and 10 patients (50%) with orbital diseases. Thus, bilateral involvement was more common in orbital diseases especially in thyroid associated ophthalmopathy. Hence, subjecting both the orbits to echographic examination was of paramount importance, even in cases where clinically no involvement was suspected.

Causes of opaque media:

Cataract was the leading cause of opaque media being present in 126 (71.6%) of the 176 eyes included in the present study. Other major causes of opaque media were vitreous haemorrhage in 14 eyes (7.9%) and hyphaema in 12 eyes (6.9%) both attributable to the presence of trauma in these eyes.

Table – 18

Comparison of causes of opaque media in traumatized eyes in the present study with that of Das T. and Namperumalsamy P. (1987)

Causes of Opaque media	Das T. and Namperumalsamy P. (1987)	Present Study
Corneal oedema with papillary exudative membrane	0	2 (4%)
Dense hypopyon	0	2 (4%)
Total hyphaema	19 (10.9%)	12 (24%)
Dense hypopyon with cataractous lens	0	2 (4%)
Traumatic cataract	52 (29.7%)	24 (48%)
Vitreous haemorrhage	43 (24.6%)	6 (12%)
Vitreous inflammation	19 (10.9%)	2(4%)
Occlusio pupillae	6 (3.4%)	0
IOFB	22 (12.6%)	0
Globe rupture	14 (8.0%)	0
Total	175 (100%)	50 (100%)

The present study correlated well with that of Das T. and Namperumalsamy P. (1987) in that, traumatic cataract was the commonest cause of opaque media. The other important causes in the present study were total hyphaema and traumatic vitreous haemorrhage.

Echographic diagnosis in eyes with opaque media

The various echographic findings in eyes with opaque media in the present study correlated well with that of Haile M. and Mengistu Z. (1996).

Out of the 176 eyes studied, 36 eyes had normal posterior segment (20.46%). Which was the commonest echographic finding in eyes with opaque media, which correlated well with that of Roger P Harrie study where 27.9% of the patients with opaque media had normal posterior segment. Asteriod hyalosis was diagnosed in 6 eyes of 4 patients. Both the patients were found to be diabetic.

38 cases of vitreous haemorrhage were diagnosed by ultrasound. In 14 of these eyes vitreous haemorrhage was detected clinically which was later confirmed on ultrasound examination. In the remaining 24 eyes vitreous haemorrhage could not be detected on clinical examination.

Trauma (36.84%) was the commonest cause of vitreous haemorrhage followed by proliferative diabetic retinopathy (31.57%). This correlated with the study of Atta H.R. (1999) in which proliferative diabetic retinopathy accounted for 40% of the cases of vitreous haemorrhage.

Six eyes with mild, fresh vitreous haemorrhage and two with posterior hyphaema were observed without any surgical intervention. On follow up, there was spontaneous resolution of haemorrhage in these eyes. Dense, organized vitreous haemorrhage with thick membrane formation along with PVD was present in twenty cases. The presence of these reduces the visual prognosis and hence these cases were referred for surgical intervention. Thus USG helped not only in diagnosing vitreous haemorrhage but also in planning the management.

Another important role of B scan in eyes with vitreous haemorrhage was to rule out associated abnormalities, if any. In the present study, six eyes had tractional retinal detachment and four eyes had IOFB along with vitreous haemorrhage.

Retinal detachment was diagnosed on B scan in 42 cases. Of these twenty were rhegmatogenous retinal detachments. Tractional retinal detachment was diagnosed in eight eyes (in four eyes of vitreous haemorrhage and four eyes of endophthalmitis). Two patients had undergone retinal detachment surgery earlier for a traumatic retinal detachment. They showed the presence of intraocular silicone oil and there was non attachment of retina. They were advised resurgery. Four eyes had exudative retinal detachment secondary to posterior scleritis. The extent of retinal detachment could be precisely delineated in most of the cases.

Four eyes had choroidal detachment. USG was able to differentiate serous choroidal detachment seen in two eyes from the haemorrhagic detachment in the other two.

Endophthalmitis was diagnosed in eight eyes by USG, all of which had history of penetrating trauma. Four of these eyes had tractional retinal detachment, which was a bad prognostic indicator. This highlighted the role of USG as a prognostic indicator in endophthalmits patients.

In two patients with Vogt-Koyanagi–Harada syndrome, choroidal thickening was detected on B scan. Chorioretinal coloboma was detected on B scan in eight eyes and high myopia with posterior staphyloma in four eyes.

Clinical diagnosis of retinoblastoma was made in six cases of leukocoria included in this study. B-scan diagnosed the retinoblastoma. And diagnosis was confirmed by CT scan.

Stage II retinoblastoma was diagnosed in a two year old male child, who was clinically diagnosed as having hypopyon uveitis. Thus B scan not only helped in the diagnosis of eyes with leukocoria, but also in determining the extent of spread of retinoblastoma, and thus its accurate staging.

Considering the difficulties of examining children, the need for anaesthesia etc, the ease of repeatability of B scan was a real advantage. B scan could also be used to screen the fellow eye, to know the response to therapy and to rule out recurrences.

Eight cases of IOFB were detected on B scan. Four of these were magnetic in nature. Thus B scan not only helped in the detection of IOFB but also in determining its nature. Two cases of intraocular air bubble following a penetrating trauma was wrongly diagnosed as an IOFB. B Scan was also extremely useful and accurate in the localization of IOFB. Another advantage of B scan over other radiological methods was its easy repeatability owing to the relatively low cost and lack of radiation exposure. The real time nature of B scan, scored over other techniques in localization of IOFB. B scan could also assess the associated intraocular damage occurring as a result of trauma.

Echographic findings in traumatized eyes:

50 eyes with a history of trauma underwent ultrasound examination. The echographic findings in these eyes correlated well with the posterior segment abnormalities detected in traumatized eyes by Das T. and Namperumalsamy P. (1987) in their study.

Table – 20

Comparison of echographic findings in traumatized eyes in the present study with that of Das T. and Namperumalsamy P. (1987)

Echographic Findings	Das T and Namperumalsamy P. (1987)	Present study
Vitreous haemorrhage	40 (34.8%)	10 (20 %)
Dislocated lens	4 (3.5%)	2 (4 %)
IOFB	12 (10.4%	4 (8 %)
Vitreous haemorrhage with IOFB	5 (4.4%)	4 (8 %)
Retinal detachment	35 (30.4%)	20 (40 %)
Endophathalmitis	19 (16.5%)	8 (16%)
Normal posterior segment	0 (0%)	2 (4%)
Total	115 (100%)	50 (100%)

Echographic Diagnosis in diseases of the orbit:

Out of the 30 orbits scanned, 22 were diagnosed to be having thyroid associated ophthalmopahty. Of these, 20 cases were confirmed by CT scan. The remaining two cases, in which a clinical diagnosis of orbital myositis was made was wrongly diagnosed as TAO on B scan. CT of these patients showed orbital myositis.

Cavernous haemangioma of the orbit was diagnosed in two patients, which were incidentally lost for follow up.

Two cases each of rhabdomyosarcoma, lacrimal gland tumour, orbital haemorrhage was diagnosed which were later confirmed by CT Scan.

Accuracy of USG diagnosis in patients with opaque media

Out of the 176 cases with opaque media, 14 patients (16 eyes) were lost for follow up. In these eyes, a final diagnosis could not be established and hence the USG diagnosis could not be compared with the final diagnosis. Of the 160 eyes in which a final diagnosis was established, USG diagnosis was compared with the same.

Accuracy of USG in the diagnosis of normal posterior segment

Ultrasound was extremely accurate in the diagnosis of normal posterior segment, being 100% sensitive and 100% specific. This was of major clinical importance, as it helped in ensuring that the majority of abnormalities of posterior segment were diagnosed prior to cataract extraction. Thus USG combined with other preoperative evaluation methods, was of major use in ensuring the presence of normal posterior segment in eyes undergoing cataract surgery.

Accuracy of USG in the diagnosis of posterior vitreous detachment

B scan was very accurate in the diagnosis of PVD in eyes with opaque media with 100% sensitivity and 98.2% specificity.

In two diabetic patients with proliferative diabetic retinopathy, organized vitreous haemorrhage with tractional retinal detachment was wrongly diagnosed as PVD with thick membrane formation. This highlighted the difficulties of differentiating PVD with membrane formation from retinal

detachment. In such cases the echographer should carefully search for the insertion of membrane to the optic disc, which is suggestive of retinal detachment. Membranes on the other hand demonstrate thinning on tracing them superiorly. Also the spike height of membranes reduces on reducing the gain.

Table – 21

Comparison of correctness of USG diagnosis of PVD in the present study with that of McNicholas MM.J.et al., (1995)

USG Diagnosis	Correct diagnosis (no. of eyes and %	
	McNicholas MMJ et al (1995)	Present study
PVD	12 (100%)	46 (95.8%)

Accuracy of USG in the diagnosis of vitreous haemorrhage

Ultrasound had 95% sensitivity and 100% specificity in the diagnosis of vitreous haemorrhage. Two cases of vitreous haemorrhage in a diabetic patient could not be diagnosed by USG. Since fresh and mild vitreous haemorrhage is difficult to pick up on B scan, especially at low gain settings, it is important to increase the gain and scan the eye before the conclusion of examination.

Table – 22

Comparison of accuracy of USG diagnosis of vitreous haemorrhage in various studies

USG Diagnosis	Correct Diagnosis (No. of eyes and %)			Wrong Diagnosis (No. of eyes and %)		
	Coleman DJ (1972)	McNicholas MMJ et al (1995)	Present study	Coleman D.J. (1972)	McNicholas MMJ et al (1995)	Present study
Vitreous haemorrhage	11 (100%)	56 (100 %)	38 (100%)	0 (0%)	0 (0%)	0 (0%)
No vitreous haemorrhage	1 (100%)	Not mentioned	120 (98.4%)	0 (0%)	Not mentioned	2 (1.64%)

Accuracy of USG in the diagnosis of retinal detachment

In diagnosing retinal detachment, ultrasound was 92.9% sensitive and 100% specific.

Table – 23

Comparison of accuracy of USG diagnosis of retinal detachment in various studies

USG Diagnosis	Correct Diagnosis (No. of eyes and %)			Wrong Diagnosis (No. of eyes and %)		
	Coleman DJ (1972)	McNicholas MMJ et al (1995)	Present study	Coleman D.J. (1972)	McNicholas MMJ et al (1995)	Present study
Retinal Detachment	25 (100%)	17 (80.95 %)	26 (100%)	0 (0%)	4 (19.1%)	0 (0%)
No Retinal detachment	10 (100%)	Not mentioned	132 (98.5%)	0 (0%)	Not mentioned	2 (1.5%)

The accuracy of USG in the diagnosis of retinal detachment in the present study correlated well with the other studies.

Accuracy of USG in the diagnosis of retinoblastoma

USG was 100% sensitive and 100% specific in the diagnosis of retinoblastoma

Accuracy of USG in the diagnosis of IOFB

Eight cases of IOFB were detected on ultrasound of which six were confirmed by other radiological methods. In two cases, USG diagnosis was wrong. Thus B scan was 100% sensitive and 98.7% specific in diagnosing IOFB. Four foreign bodies were radiopaque and were diagnosed on plain X ray of the orbit. Two were glass pieces which were not diagnosed on X ray. The other two were intraocular air bubble which was wrongly diagnosed as an IOFB. USG not only helped in the detection of IOFB but also in accurate localization. USG detected associated vitreous haemorrhage in four cases.

Accuracy of USG in the diagnosis of thyroid associated ophthalmopahty

The accuracy of USG in the diagnosis of thyroid associated ophthalmopathy correlated well with the study of Coleman D.J. (1972)

Wilson R.G. and associates (1989) opined that both orbital CT and ultrasound are equally sensitive in the diagnosis of thyroid associated ophthalmopathy. However CT had some disadvantages; it involves radiation, is relatively time consuming and costly. Ultrasound was useful not only to diagnose orbital lesions, but also to monitor the response to therapy in inflammatory conditions.

SUMMARY

In the present study, 206 eyes of 164 patients were included. Of these, 176 eyes of 144 patients had opaque media and 30 eyes of 20 patients had orbital diseases. A provisional clinical diagnosis was made initially and then ultrasound examination was carried out. 16 patients were lost for follow up. In the remaining patients a final diagnosis was established either by other ancillary investigations or following surgery. This was then compared with the echographic diagnosis already made.

36 of 160 eyes had normal posterior segment on B-scan, which was confirmed after cataract surgery. Various posterior segment abnormalities were detected on B-scan in the remaining 124 eyes. Ultrasound diagnosis was found to be correct in 116 eyes and wrong in eight eyes.

Out of 20 patients with orbital diseases two were lost for follow up. Of the 28 eyes in which a final diagnosis was established, there was correlation with the ultrasound diagnosis in 26 eyes. In two eyes ultrasound diagnosis were wrong.

Thus, B-mode ultrasound was extremely accurate in the evaluation of eyes with opaque media. The nature, location and density of vitreous haemorrhage, was determined by ultrasound examination guiding the management of these cases. In cases of endophthalmitis, vitreous haemorrhage and other conditions, B-scan could detect associated abnormalities like PVD,

retinal detachment, etc. This not only helped in determining the prognosis of these cases, but also in deciding the management. Ultrasound was useful in monitoring the course of disease (e.g., spontaneous resolution of vitreous haemorrhage, liquefaction of blood in haemorrhagic choroidal detachment), and response to treatment (e.g., in endophthalmitis). In traumatized eyes where proper clinical examination is difficult due to media opacification,. lid oedema, and patient's non co-operation, USG was very useful.

In the detection of IOFB, B-mode USG had advantages as well as drawbacks. Combining the radiographic and ultrasonic approaches was of great benefit in overcoming the limitations of both.

Orbital diseases were accurately diagnosed using ultrasound, CT was also equally efficient. But the easy accessibility, relative low cost, repeatability and lack of radiation exposure offer B-scan a distinct place in the evaluation of orbital disorders. On the flip side were the fact that both orbits could not be imaged simultaneously.

B-mode USG was as reliable as optical techniques in demonstration of structural changes within the eye providing an acoustic section of the eye.

CONCLUSION

B mode ultrasound not only diagnosed intraocular pathologies with high sensitivity and specificity but also helped in planning management of traumatic eyes. Thus B mode ultrasound is an ideal diagnostic tool and useful prognostic indicator in the evaluation of eyes with opaque media where other methods of examination fail to visualise the posterior segment.

B mode ultrasound is extremely useful and accurate in the detection, differentiation and staging of intraocular tumours.

Though ultrasound has an important role in the evaluation of orbital lesions, it should be combined with other imaging modalities like CT Scan and MRI. CT scan and MRI are definitely better for orbital apex lesions.

Thus owing to its accuracy, cost effectiveness, safety, repeatability, absence of radiation exposure, excellent tissue differentiation and noninvasive nature, ultrasound is an indispensable tool in the evaluation of ocular and orbital diseases. This is more so in a developing country like India where other imaging modalities are neither widely available nor affordable.

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PROFORMA

Name : Age : yrs Sex : M/F

Occupation : Address :

OP / IP No. :

Date of Examination / Date of Admission :

Date of Surgery : Date of Discharge :

Chief complaints :

History of presenting complaint :

Diminution of vision : RE / LE / Both duration

Onset : Insidious / Sudden Progression : Gradual / Rapid

H/o	Pain	:	Y/N	RE/LE/Both	Duration
	Redness	:	Y/N	RE/LE/Both	Duration
	Floaters	:	Y/N	RE/LE/Both	Duration
	Flashes of light	:	Y/N	RE/LE/Both	Duration
	Watering	:	Y/N	RE/LE/Both	Duration
	Photophobia	:	Y/N	RE/LE/Both	Duration
	Discharge	:	Y/N	RE/LE/Both	Duration
	Trauma	:	Y/N	RE/LE/Both	Duration

Nature of Trauma : Blunt / penetrating / perforating / Others

Any other relevant history

Optical History : History of using spectacles / contact lenses Y/N

Duration

Medical history : H/o Diabetes : Y/N H/o Hypertension : Y/N

H/o Dysthyroid disease : Y/N

Past history : H/o Previous ocular surgery

Family history:

Personal history:

General physical examination:

Systemic examination : CVS RS

P/A CNS

OCULAR EXAMINATION

Head posture

Ocular posture

Extraocular movements Ductions

Versions

Vergences

	RIGHT EYE	LEFT EYE
Lids		
Conjunctiva		
Cornea	Clear / hazy / opaque	Clear / hazy / opaque
Sclera		
AC	Depth Abnormal contents	Depth Abnormal contents
Iris	Colour Pattern	Colour Pattern
Pupil	Size Shape	Size Shape
	Regular / Irregular	Regular / Irregular
	Reactions	Reactions
	Direct : Consensual	Direct : Consensual
	RAPD : Y/N	RAPD : Y/N
Lens		

Fundus	Media clear /hazy Disc : Vessels : Background retina : Macula :	Media clear /hazy Disc : Vessels : Background retina : Macula :
Best corrected visual acuity (BCVA)		
Refractive status		
Intraocular pressure (applanation tonometry)		
Exophthalmometry		

CLINICAL DIAGNOSIS:

ULTRASOUND EXAMINATION:

a. Ocular examination:

1. Screening

Transverse	12 0’ clock	Normal / Abnormal
Transverse	3 0’ clock	Normal / Abnormal
Transverse	6 0’ clock	Normal / Abnormal
Transverse	9 0’ clock	Normal / Abnormal
Transverse	1.30 0’ clock	Normal / Abnormal
Transverse	4.30 0’ clock	Normal / Abnormal
Transverse	7.30 0’ clock	Normal / Abnormal
Transverse	10.30 0’ clock	Normal / Abnormal

2. Topographic examination:

Shape

Location

Extension

3. Quantitative examination:

Reflectivity

Texture.

Sound attenuation

4. Kinetic examination:

Mobility

Aftermovement

Vascularity

b. Orbital examination:

1. Orbital screening:

Orbital fat Normal / Abnormal

Optic nerve Normal / Abnormal

Extraocular muscles Normal / Abnormal

Lacrimal gland Normal / Abnormal

Bony orbit Normal / Abnormal

2. Topographic examination:

Shape

Borders

Location

3. Quantitative echography:

Reflectivity

Internal structure or texture

Sound attenuation

4. Kinetic echography:

Consistency

Vascularity

Valsalva test

30^0 test

ECHOGRAPHIC DIAGNOSIS:

OTHER INVESTIGATIONS

FBS / PPBS

X-ray

CT Scan

MRI

MANAGEMENT:

FOLLOW UP:

FINAL DIAGNOSIS:

MASTER CHART

	name	age	sex	Ip/op no	Eyes affected	nature of trauma	bcva re	bcva le	causes of opaque media	provisional diagnosis	Echographic diagnosis	Final diagnosis(mode of diagnosis)
1	ponnusamy	70	M	25083	RE	NT	HMCF	6/6	CL	SMC	OVH+M+PVD	OVH+M+PVD(S)
2	PANDI	35	M	24365	RE	PT	PL+ve PRD	6/6	VI	Endophthalmitis	Endophthalmitis	Endophthalmitis
3	Parviz	20	M	23332	RE	BT	PL+ve PRD	6/6	CL	Traumatic cataract	RRD	RRD(S)
4	Chellapandi	60	M	25785	BE	NT	CF 1mt	PL+ve PRA	BE CL	BE SMC with NIDDM	BE asteroid hyalosis	BE asteroid hyalosis
5	Perumal	63	M	12976	BE	NT	CF 3mt	PL+ve PRA	BE CL	RE SIMC LE SMC	BE PS normal	BE PS normal
6	Papati	60	F	121986	LE	NT	CF 2mt	PL+ve PRA	Cl	SMC	Myopia with posterior staphyloma	Myopia with posterior staphyloma
7	Raju	21	M	334678	LE	BT	6/6	PL+ve PRD	CL	Traumatic cataract	Shallow RD	lost follow up
8	Sana	2	F	334737	LE	NT	Not asseessed	NO PL	CL	Retinoblastoma stage2	Total RD	Total RD
9	Murugan	63	M	113414	RE	NT	CF 2mt	6/36	CL	SIMC	PS normal	PS normal(S)
10	palanisamy	28	M	20905	RE	PT	HMCF	6/9	VH	Traumatic VH	VH+IOFB	VH+IOFB xray
11	sajida	35	F	25654	LE	NT	6/60	CF 1mt	CL	PSMC with IDDM	OVH+M+PVD	OVH+M+PVD(S)
12	Manoj	7	M	25459	BE	NT	PL+ve PRA	PL+vePRA	BE CL	BE congenital cararact with typical iris coloboma	BE chorioretinal coloboma	BE chorioetinal coloboma

13	thambi	22	M	25543	LE	PT	6/6	HMCF	Total hyphema	Traumatic total hyphema with OGI	VH+IOFB	Intraocular Air bubble with VH
14	Arun	30	m	25561	LE	BT	6/6	HMCF	VH	Traumatic VH	Fresh VH posterior	VH (F.U)
15	Ganesan	52	M	25592	LE	NT	6/60	CF 1mt	CL	SIMC with IDDM	OVH+M+PVD	OVH+M+PVD(S)
16	Alagupillai	72	F	25643	BE	NT	CF1mt	PL+ve PRA	BE CL	RE SIMC LE SMC	BE PS normal	BE PS normal
17	Venktesan	41	M	25432	RE	BT	PL+ve PRD	6/12	CL	Traumatic cataract	RRD	lost follow up
18	sonai	73	F	25540	LE	NT	6/60	PL+vePRA	CL	SMC with NIDDM	VH+TRD	VH+TRD (FU)
19	Selvaraj	42	M	25412	RE	NT	CF2mts	6/18	CL&Occlusio pupillae	panuveitis with cataract	Choroidal thickening	Choroidal thickening
20	Momd Basha	46	m	25437	BE	NT	HMCF	HMCF	BE CL	BE PSMC with IIDM	BE PS normal	BE PS normal
21	Panju	65	F	24435	BE	NT	CF 2mt	CF 1mt	BE CL	BE SIMC	BE PVD	BE PVD
22	pandiyappan	60	M	34567	LE	NT	6/60	HMCF	CL	Necrosing scleritis with complicated cataract	Posterior scleritis with exudative RD	Posterior scleritis with exudative RD (FU)
23	Chellayya	75	M	25521	BE	NT	PL +ve PRA	CF 2mt	BE CL	RE SIMC LE SMC	BE PVD	BE PVD (S)
24	kartik	13	M	25743	LE	NT	CF 3 mts	CF 2mt	CL	Posterior subcapsular cataract	Myopia with RRD	Patient lost for follow up
25	velu.p	4	M	121411	LE	NT	Not asseessed	No PL	TSV	Retinoblastoma stage2	Retinoblastoma with orbital extension	Retinoblastoma stage III (HPE)
26	balaji	25	M	25897	RE	NT	CF 1 ml	6/6	VH	Eales' disease with VH	OVH+M+PVD	OVH+M+PVD(S)

27	palaniyammal	68	F	121454	RE	NT	CF 1 ml	6/60	CL	SIMC	PS normal	PS normal(S)
28	palpandi	70	M	12765	LE	NT	6/60	HMCF	CL	SIMC with Es. HTN	Posterior hyphaema	Posterior hyphaema (S)
29	mangammal	65	F	24334	RE	NT	PL +ve PRA	CF 2mt	Corenal oedema	Post operative shallow AC	Kissing choroidal detachment	Kissing choroidal detachment (S)
30	saroja	22	F	24765	LE	PT	6/6	NO PL	CO & PE	Endophthalmitis	Endophthalmitis with TRD	Endophthalmitis with TRD (FU)
31	Mansur ali	55	M	24650	RE	NT	6/60	6/36	CL	SIMC with NIDDM	PVD	PVD (S)
32	vadivelu	60	M	26543	LE	NT	6/60	PL +ve PRD	CL	SMC with NIDDM	OVH + TRD	OVH + TRD (F.U)
33	manikandan	32	M	121980	RE	BT	HMCF	6/6	CL	Traumatic cataract	Fresh VH posterior	Fresh VH (Post) (S)
34	rasu	64	M	121300	RE	NT	HMCF	6/12	CL	SMC	PS normal	PS normal(S)
35	rajendran	27	M	24665	LE	BT	6/6	PL +ve PRA	Total hyphema	Traumatic total hyphaema	Funnel shaped RRD	Funnel shaped RRD (FU)
36	A chandrika	45	F	121388	RE	NT	6/60	6/24	CL	PSIC with IDDM	Optic disc drusen	Optic disc drusen(FU)
37	mani	2	M	23457	LE	NT	No PL	Not assessed	TSV	Retino blastoma stage II	Retinoblastoma stage II	Retinoblastoma stage III (HP)
38	sasikumar	26	M	25666	RE	NT	CF 1mt	6/6	VH	Eales's disease with VH	Fresh VH posterior	Fresh vVH (F.U)
39	rathinvel	39	M	121333	LE	BT	6/6	HMCF	Total hyphema	Traumatic total hyphaema	Dislocated lens into vitreous	Dislocated lens (F.U.)
40	Ammasi	55	F	121390	BE	NT	6/60	HMCF	BE CL	RE SIMC LE SMC with NIDDM	RE PVD LE OVH + M + PVD	RE PVD LE OVH + M + PVD(S)
41	Kannan	57	M	121558	BE	NT	CF 1mt	CF 3mts	BE CL	BE SIMC	BE PS normal	BE PS normal
42	Senthil	50	M	23564	LE	NT	6/60	CF 3 mts	CL	SIMC	Myopia with posterior staphyloma	Myopia with posterior staphyloma

43	Anandi	24	F	112989	BE	NT	PL +ve PRD	PL +ve PRD	BE CL	BE PSMC	BE funnel shaped RRD with PVR	lost follow up
44	Kamaluddin	44	M	121190	RE	BT	PL +ve PRA	6/6	Total hyphema	Traumatic hyphaema	PVD + RD	PVD + RD (FU)
45	Kallaiperumal	60	M	23689	RE	NT	PL +ve PRA	6/9	CL	SMC with NIDDM	Asteriod hyalosis	Asteroid hyalosis (S)
46	Vinoth	16	M	113334	LE	BT	6/6	PL +ve PRA	VH	Traumatic VH	VH + RD	VH+RD(FU)
47	Chellyam	72	M	23548	RE	NT	PL +ve PRA	CF 2mts	CL	SMC with NIDDM	PVD	PVD+VH(S)
48	Ramya	18	F	23421	RE	BT	PL +ve PRA	6/6	CL	Traumatic cataract	OVH + M + PVD	OVH + M + PVD (S)
49	Gunasekaran	27	M	112008	RE	PT	PL +ve PRD	6/6	Hypopyon + CL	Traumatic endophthalmitis	Endophthalmitis with TRD	Lost follow up
50	Suraj	5	F	23499	BE	NT	PL +ve PRD	PL +ve PRD	BE CL	BE Nystagmus with microphthalmia with congenital cataract and typical iris coloboma	BE chorioretinal coloboma	BE chorioetinal coloboma (F.U.)
51	Jesina begum	39	F	23222	RE	BT	PL +ve PRA	6/6	CL	Traumatic cataract	PS normal	PS normal(S)
52	Alagendran	21	M	112678	RE	BT	PL +ve PRD	6/6	CL	Traumatic cataract	Funnel shaped RD with intraocular silicone oil	Patient referred for surgery
53	Tangammal	55	F	112342	RE	NT	PL +ve PRA	6/60	CL + VH	SIMC with PDR with NIDDM	OVH+M+PVD	VH + TRD (S)
54	Balamurugan	55	M	113245	LE	BT	CF 3mts	PL +ve PRA	CL	Traumatic cataract	PVD + RD	PVD + RD (S)
55	Jepandi	24	M	23567	LE	PT	6/6	PL +ve PRA	Total hyphema	Traumatic hyphaema with OGI	OVH + M+ PVD	OVH + M + PVD (S)

56	Ramayee	62	F	23541	RE	NT	CF 3 mts	6/60	CL	SIMC	PVD	PVD (S)
57	Subbulakshmi	66	F	23909	BE	NT	PL +ve PRA	HMCF	BE CL	BE SMC	BE PS normal	BE PS normal (S)
58	Chitra	56	F	23905	RE	NT	PL +ve PRA	CF 1 mt	CL	BE PS Normal	BE PS normal	BE PS normal (S)
59	Rasu	2	M	23077	LE	NT	Not asseessed	PL +ve PRD	Hypopyon	Hypopyon uveitis	Retinoblastoma stage II	Retinoblastoma stage II (HPE)
60	Kamatchi	64	F	23666	RE	NT	PL +ve PRA	CF 3 mts	Exudative membrane	Severe post operative uveitis	Dislocated lens into vitreous	Dislocated lens in the vitreous FU
61	Mahalingam	58	M	24599	LE	NT	6/12	PL +ve PRA	CL	SMC	PVD	PVD (S)
62	Prakash	19	M	24577	BE	PT	PL +ve PRA	6/6	Total hyphema	Total hyphema with OGI	Haemorrhagic CD	Haemorrhagic CD (FU)
63	Armugam	26	M	24550	RE	BT	PL +ve PRD	6/6	CL	Traumatic cataract	Funnel shaped RRD	Lost for follow up
64	Pandiammal	57	F	24337	RE	NT	PL +ve PRA	6/36	Corenal oedema	Sclerokeratitis	Posterior scleritis with exudative RD	Posterior scleritis with exudative RD (FU)
65	Ovian nacha	45	M	77842	RE	PT	PL +ve PRA	6/6	CL	Traumatic cataract with OGI	IOFB (iron piece)	IOFB (X ray)
66	Mariammal	67	F	22330	BE	NT	CF1mt	CF 3 mts	BE CL	BE SIMC	BE PS Normal	BE PS normal (S)
67	Malaichamy	51	M	23477	RE	PT	PL +ve PRA	6/24	Dense hypopyon	Traumatic endophthalmitis with OGI	Endophthalmitis	Endophthalmitis (S)
68	Malayammal	64	F	22300	BE	NT	CF 2mt	CF 3 mts	BE CL	BE SIMC	BE PVD	BE PVD (S)
69	Karupayee	62	F	22345	RE	NT	PL +ve PRD	6/12	CL	SMC	Funnel shaped RD with PVR	Funnel shaped RD with PVR (FU)
70	Vasudevan	26	M	111340	BE	NT	HMCF	PL +ve PRA	BE VH	BE Eales' diseases with VH	BE OVH + M + PVD	BE OVH + M + PVD (S)

71	Muttukrishnan	42	M	122083	LE	BT	6/6	PL +ve PRA	CL	Traumatic cataract	PVD + RRD	PVD + RRD (S)
72	Virumandi	45	M	121333	RE	PT	CF 2mt	6/6	CL	Traumatic cataract	IOFB glass piece	IOFB glass piece (S)
73	Alagar	15	M	23990	LE	BT	6/6	6/6	Media clear	Orbital haemorrhage	Orbital haemorrhage	Orbital haemorrhage (CT)
74	Kalyani	32	F	23144	BE	NT	6/6	6/6	BE media clear	BE thyroid ophthalmopathy	BE thyroid ophthalmopathy	BE Thyroid opthalmopathy CT
75	Sugandhi	45	F	121558	RE	NT	6/6	6/6	Media clear	Orbital myotitis	Thyroid ophthalmopahty	Orbital myositis CT
76	Sheik abdulla	85	M	123111	LE	NT	CF2mts	HMCF	CL	Cavernous haemangioma	Cavernous haemangioma	Lost for follow up
77	Kaliammal	39	F	23358	BE	NT	6/6	6/6	BE media clear	RE thyroid ophthalmopahty LE clinically normal	BE thyroid ophthalmopathy	BE Thyroid opthalmopathy CT
78	Sundarammal	52	F	23677	RE	NT	6/6	6/6	Media clear	Lacrimal gland tumour	Lacrimal gland tumour	Lacrimal gland tumour CT
79	Zaherabanu	49	F	121124	BE	NT	6/6	6/6	BE media clear	BE thyroid ophthalmopathy	BE thyroid ophthalmopathy	BE Thyroid opthalmopathy CT
80	Ramalakshmi	32	F	132111	BE	NT	6/36	6/6	BE media clear	BE thyroid ophthalmopathy	RE thyroid ophthalmopathy with optic nerve compression LE Thyroid ophthalmopathy	RE thyroid ophthalmopathy with optic nerve compression (LE) Thyroid ophthalmopathy (CT)
81	Ranjini	30	F	111870	BE	NT	6/6	6/6	Media clear	BE thyroid ophthalmopathy	BE thyroid ophthalmopathy	BE thyroid ophthalmopathy CT
82	Ramyapriya	3	F	122334	RE	NT	Not asseessed	Not assessed	Media clear	Orbital cellulitis	Rhabdomyosarcoma	Rhabdomyosarcoma
83	Ramayyathevar	70	M	24536	RE	NT	HMCF	6/6	CL	SMC	OVH+M+PVD	OVH+M+PVD(S)

84	Mani	35	M	24777	RE	PT	PL+ve PRD	6/6	VI	Endophthalmitis	Endophthalmitis	Endophthalmitis
85	Palanikumar	20	M	23559	RE	BT	PL+ve PRD	6/6	CL	Traumatic cataract	RRD	RRD(S)
86	Mookan	60	M	112878	BE	NT	CF 1mt	PL+ve PRA	BE CL	BE SMC with NIDDM	BE asteroid hyalosis	BE asteroid hyalosis
87	Machathevar	63	M	23222	BE	NT	CF 3mt	PL+ve PRA	BE CL	RE SIMC LE SMC	BE PS normal	BE PS normal
88	Sallammal	60	F	23459	LE	NT	CF 2mt	PL+ve PRA	Cl	SMC	Myopia with posterior staphyloma	Myopia with posterior staphyloma
89	Ramakrishnan	21	M	22543	LE	BT	6/6	PL+ve PRD	CL	Traumatic cataract	Shallow RD	lost follow up
90	Vidhya	2	F	111678	LE	NT	Not asseessed	NO PL	CL	Retinoblastoma stage2	Total RD	Total RD
91	Jayakodi	63	M	23377	RE	NT	CF 2mt	6/24	CL	SIMC	PS normal	PS normal(S)
92	chinnakannan	28	M	121209	RE	PT	HMCF	6/12	VH	Traumatic VH	VH+IOFB	VH+IOFB xray
93	Geetha	35	F	123998	LE	NT	6/24	CF 1mt	CL	PSMC with IDDM	OVH+M+PVD	OVH+M+PVD(S)
94	Rakesh	7	M	121444	BE	NT	PL+ve PRA	PL+vePRA	BE CL	BE congenital cararact with typical iris coloboma	BE chorioretinal coloboma	BE chorioetinal coloboma
95	Ram mohan	22	M	23448	LE	PT	6/ 12	HMCF	Total hyphema	Traumatic total hyphema with OGI	VH+IOFB	Intraocular Air bubble with VH
96	Jegannathan	30	m	121560	LE	BT	6/6	HMCF	VH	Traumatic VH	Fresh VH posterior	VH (F.U)
97	Muthusami	52	M	23257	LE	NT	6/18	CF 1mt	CL	SIMC with IDDM	OVH+M+PVD	OVH+M+PVD(S)
98	Rukkammal	72	F	23654	BE	NT	CF1mt	PL+ve PRA	BE CL	RE SIMC LE SMC	BE PS normal	BE PS normal
99	Balu	41	M	23544	RE	BT	PL+ve PRD	6/9	CL	Traumatic cataract	RRD	lost follow up

100	Chinnammal	73	F	121226	LE	NT	6/24	PL+vePRA	CL	SMC with NIDDM	VH+TRD	VH+TRD (FU)
101	Saravanan	42	M	121777	RE	NT	CF2mts	6/12	CL&Occlusio pupillae	panuveitis with cataract	Choroidal thickening	Choroidal thickening
102	Sankar	46	m	121098	BE	NT	HMCF	HMCF	BE CL	BE PSMC with IIDM	BE PS normal	BE PS normal
103	Pappu	65	F	121334	BE	NT	CF 2mt	CF 1mt	BE CL	BE SIMC	BE PVD	BE PVD
104	Ahilan	60	M	121098	LE	NT	6/60	HMCF	CL	Necrosing scleritis with complicated cataract	Posterior scleritis with exudative RD	Posterior scleritis with exudative RD (FU)
105	Ponraj	75	M	121897	BE	NT	PL +ve PRA	CF 2mt	BE CL	RE SIMC LE SMC	BE PVD	BE PVD (S)
106	Nagraj	13	M	23255	LE	NT	CF 3 mts	CF 2mt	CL	Posterior subcapsular cataract	Myopia with RRD	Patient lost for follow up
107	Biju	3	M	23675	RE	NT	Not asseessed	No PL	TSV	Retinoblastoma stage2	Retinoblastoma with orbital extension	Retinoblastoma stage III (HPE)
108	Natarajan	25	M	23444	RE	NT	CF 1 ml	6/6	VH	Eales' disease with VH	OVH+M+PVD	OVH+M+PVD(S)
109	Mariam.	68	F	23499	RE	NT	CF 1 ml	6/60	CL	SIMC	PS normal	PS normal(S)
110	Uchavuthevar	70	M	23778	LE	NT	6/60	HMCF	CL	SIMC with Es. HTN	Posterior hyphaema	Posterior hyphaema (S)
111	Velammal	65	F	23784	RE	NT	PL +ve PRA	CF 2mt	Corenal oedema	Post operative shallow AC	Kissing choroidal detachment	Kissing choroidal detachment (S)
112	Sriranjini	22	F	121360	LE	PT	6/6	NO PL	CO & PE	Endophthalmitis	Endophthalmitis with TRD	Endophthalmitis with TRD (FU)
113	Tamilmuttu	55	M	23756	RE	NT	6/60	6/36	CL	SIMC with NIDDM	PVD	PVD (S)

114	Tangaraj	60	M	23712	LE	NT	6/60	PL +ve PRD	CL	SMC with NIDDM	OVH + TRD	OVH + TRD (F.U)
115	Chellam	32	M	497632	RE	BT	HMCF	6/6	CL	Traumatic cataract	Fresh VH posterior	Fresh VH (Post) (S)
116	Santhanam	64	M	498760	RE	NT	HMCF	6/12	CL	SMC	PS normal	PS normal(S)
117	Venat	27	M	23732	LE	BT	6/6	PL +ve PRA	Total hyphema	Traumatic total hyphaema	Funnel shaped RRD	Funnel shaped RRD (FU)
118	Devaki	45	F	25639	RE	NT	6/60	6/24	CL	PSIC with IDDM	Optic disc drusen	Optic disc drusen
119	Muttu	1	M	23723	RE	NT	No PL	Not assessed	TSV	Retino blastoma stage II	Retinoblastoma stage II	Retinoblastoma stage III (HP)
120	Farooq	26	M	23736	RE	NT	CF 1mt	6/6	VH	Eales's disease with VH	Fresh VH posterior	Fresh vVH (F.U)
121	Muniyandi k	39	M	23748	LE	BT	6/6	HMCF	Total hyphema	Traumatic total hyphaema	Dislocated lens into vitreous	Dislocated lens (F.U.)
122	Rajathy	55	F	23757	BE	NT	6/60	HMCF	BE CL	RE SIMC LE SMC with NIDDM	RE PVD LE OVH + M + PVD	RE PVD LE OVH + M + PVD(S)
123	Muniyandi	57	M	23769	BE	NT	CF 1mt	CF 3mts	BE CL	BE SIMC	BE PS normal	BE PS normal
124	Raja	50	M	23778	LE	NT	6/60	CF 3 mts	CL	SIMC	Myopia with posterior staphyloma	Myopia with posterior staphyloma
125	Sarada	24	F	23782	BE	NT	PL +ve PRD	PL +ve PRD	BE CL	BE PSMC	BE funnel shaped RRD with PVR	lost follow up
126	Murugesan	44	M	23793	RE	BT	PL +ve PRA	6/6	Total hyphema	Traumatic hyphaema	PVD + RD	PVD + RD (FU)
127	A ganeshan	60	M	26578	RE	NT	PL +ve PRA	6/9	CL	SMC with NIDDM	Asteriod hyalosis	Asteroid hyalosis (S)
128	Rajpandi	16	M	121776	LE	BT	6/6	PL +ve PRA	VH	Traumatic VH	VH + RD	VH+RD(FU)
129	Ochathevar	72	M	23795	RE	NT	PL +ve PRA	CF 2mts	CL	SMC with NIDDM	PVD	PVD+VH(S)

130	Rajeswari	18	F	121488	RE	BT	PL +ve PRA	6/6	CL	Traumatic cataract	OVH + M + PVD	OVH + M + PVD (S)
131	Kadiresan	27	M	121543	RE	PT	PL +ve PRD	6/6	Hypopyon + CL	Traumatic endophthalmitis	Endophthalmitis with TRD	Lost follow up
132	Shanti	5	F	121679	BE	NT	PL +ve PRD	PL +ve PRD	BE CL	BE Nystagmus with microphthalmia with congenital cataract and typical iris coloboma	BE chorioretinal coloboma	BE chorioetinal coloboma (F.U.)
133	Nagammal	39	F	121761	RE	BT	PL +ve PRA	6/6	CL	Traumatic cataract	PS normal	PS normal(S)
134	Anandarajan	21	M	121422	RE	BT	PL +ve PRD	6/6	CL	Traumatic cataract	Funnel shaped RD with intraocular silicone oil	Patient referred for surgery
135	Arputham	55	F	23823	RE	NT	PL +ve PRA	6/60	CL + VH	SIMC with PDR with NIDDM	OVH+M+PVD	VH + TRD (S)
136	Marimuttu	55	M	23826	LE	BT	CF 3mts	PL +ve PRA	CL	Traumatic cataract	PVD + RD	PVD + RD (S)
137	Ganesh	24	M	23836	LE	PT	6/6	PL +ve PRA	Total hyphema	Traumatic hyphaema with OGI	OVH + M+ PVD	OVH + M + PVD (S)
138	Ponnuthayi	62	F	23841	RE	NT	CF 3 mts	6/60	CL	SIMC	PVD	PVD (S)
139	Papatiammal	66	F	23857	BE	NT	PL +ve PRA	HMCF	BE CL	BE SMC	BE PS normal	BE PS normal (S)
140	Natchiammal	56	F	23863	RE	NT	PL +ve PRA	CF 1 mt	CL	BE PS Normal	BE PS normal	BE PS normal (S)
141	Kavitha	3	M	23843	LE	NT	Not asseessed	PL +ve PRD	Hypopyon	Hypopyon uveitis	Retinoblastoma stage II	Retinoblastoma stage II (HPE)
142	Nallammal	64	F	23852	RE	NT	PL +ve PRA	CF 3 mts	Exudative membrane	Severe post operative uveitis	Dislocated lens into vitreous	Dislocated lens in the vitreous FU

143	Kadiravan	58	M	23867	LE	NT	6/12	PL +ve PRA	CL	SMC	PVD	PVD (S)
144	Moses	19	M	23874	BE	PT	PL +ve PRA	6/6	Total hyphema	Total hyphema with OGI	Haemorrhagic CD	Haemorrhagic CD (FU)
145	K Kannan	26	M	23883	RE	BT	PL +ve PRD	6/6	CL	Traumatic cataract	Funnel shaped RRD	Lost for follow up
146	Rathinam	57	F	23892	RE	NT	PL +ve PRA	6/36	Corenal oedema	Sclerokeratitis	Posterior scleritis with exudative RD	Posterior scleritis with exudative RD (FU)
147	Muniyandi	45	M	121888	RE	PT	6/6	PL +ve PRA	CL	Traumatic cataract with OGI	IOFB (iron piece)	IOFB (X ray)
148	Muruglakshmi	67	F	23911	BE	NT	CF1mt	CF 3 mts	BE CL	BE SIMC	BE PS Normal	BE PS normal (S)
149	Anbu	51	M	23921	RE	PT	PL +ve PRA	6/24	Dense hypopyon	Traumatic endophthalmitis with OGI	Endophthalmitis	Endophthalmitis (S)
150	Sarswati	64	F	23935	BE	NT	CF 2mt	CF 3 mts	BE CL	BE SIMC	BE PVD	BE PVD (S)
151	Karupammal	62	F	23944	RE	NT	PL +ve PRD	6/12	CL	SMC	Funnel shaped RD with PVR	Funnel shaped RD with PVR (FU)
152	Kartikkumar	26	M	23953	BE	NT	HMCF	PL +ve PRA	BE VH	BE Eales' diseases with VH	BE OVH + M + PVD	BE OVH + M + PVD (S)
153	Satishkumar	42	M	23961	LE	BT	6/6	PL +ve PRA	CL	Traumatic cataract	PVD + RRD	PVD + RRD (S)
154	Danielraja	45	M	23972	RE	PT	CF 2mt	6/6	CL	Traumatic cataract	IOFB glass piece	IOFB glass piece (S)
155	Manoj	15	M	23984	LE	BT	6/6	6/6	Media clear	Orbital haemorrhage	Orbital haemorrhage	Orbital haemorrhage (CT)
156	Radika	32	F	23992	BE	NT	6/6	6/6	BE media clear	BE thyroid ophthalmopathy	BE thyroid ophthalmopathy	BE Thyroid opthalmopathy CT

157	Chitradevi	45	F	121455	RE	NT	6/6	6/6	Media clear	Orbital myotitis	Thyroid ophthalmopahty	Orbital myositis CT
158	Mohd nazir	85	M	121566	LE	NT	CF2mts	HMCF	CL	Cavernous haemangioma	Cavernous haemangioma	Lost for follow up
159	Parvati.	39	F	121654	BE	NT	6/6	6/6	BE media clear	RE thyroid ophthalmopahty LE clinically normal	BE thyroid ophthalmopathy	BE Thyroid opthalmopathy CT
160	Mayakkal	52	F	121740	RE	NT	6/6	6/6	Media clear	Lacrimal gland tumour	Lacrimal gland tumour	Lacrimal gland tumour CT
161	Umadevi	49	F	121882	BE	NT	6/6	6/6	BE media clear	BE thyroid ophthalmopathy	BE thyroid ophthalmopathy	BE Thyroid opthalmopathy CT
162	Kanimuli	32	F	121921	BE	NT	6/36	6/6	BE media clear	BE thyroid ophthalmopathy	RE thyroid ophthalmopathy with optic nerve compression LE Thyroid ophthalmopathy	RE thyroid ophthalmopathy with optic nerve compression (LE) Thyroid ophthalmopathy (CT)
163	Kalpana	30	F	121923	BE	NT	6/6	6/6	Media clear	BE thyroid ophthalmopathy	BE thyroid ophthalmopathy	BE thyroid ophthalmopathy CT
164	Anjali	3	F	121099	RE	NT	Not asseessed	Not assessed	Media clear	Orbital cellulitis	Rhabdomyosarcoma	Rhabdomyosarcoma

KEY TO MASTER CHART

BCVA	-	Best corrected visual acuity
BE	-	Both eyes
BT	-	Blunt trauma
CD	-	Choroidal detachment
CF	-	Counting fingers at
CL	-	Cataractous lens
CO + PE	-	Corneal oedema and pupillary exudative membrane
Ess. HTN	-	Essential hypertension
F.U.	-	Follow up
HMCF	-	Hand movements close to face
l.P. I O.P. No.-		In-patient / Out-patient number
IDDM	-	Insulin dependent diabetes mellitus
IOFB	-	Intraocular foreign body
LE	-	Left eye
NIDDM	-	Non-insulin dependent diabetes mellitus
NT	-	No trauma
OGI	-	Open globe injury
OVH + M + PVD	-	Organised vitreous haemorrhage with membrane and posterior vitreous detachment.
PL +ve	-	Perception of light present
PRA	-	Projection of rays accurate

PRD	-	Projection of rays defective
PS	-	Posterior segment
PSIMC	-	Presenile immature cataract
PSMC	-	Presenile mature cataract
PT	-	Penetrating trauma
PVD	-	Posterior vitreous detachment
PVR	-	Proliferative vitreoretinopathy
RD	-	Retinal detachment
RE	-	Right eye
RRD	-	Rhegmatogenous retinal detachment
S	-	Conformed by surgery
SIMC	-	Senile immature cataract
Sl. No.	-	Serial Number
SMC	-	Senile mature cataract
TAO	-	Thyroid associated ophthalmopathy
TRD	-	Tractional retinal detachment
TSV	-	Tumour seedings into the vitreous
VH	-	Vitreous haemorrhage
VI	-	Vitreous inflammation
VKH syndrome	-	Vogt-Koyanagi-Harada syndrome
Yrs	-	Years

ABBREVIATION

A - Scan	-	Amplitude mode scan
B - Scan	-	Brightness mode scan
CRVO	-	Central retinal vein occlusion
CT	-	Computed Tomography
IOFB	-	Intraocular foreign body
MRI	-	Magnetic resonance imaging
PVD	-	Posterior vitreous detachment
RD	-	Retinal detachment
ROP	-	Retinopathy of prematurity
TAO	-	Thyroid associated ophthalmopathy
TGC	-	Time gain compensation
USG	-	Ultrasonography