INTRODUCTION

- B SCAN – Brightness scan
- Non invasive
- Provide qualitative and quantitative assessment of the globe and the orbit
- Image is formed by reflected sound signals from different tissues

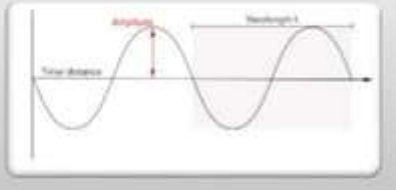
ULTRASOUND –PAST AND PRESENT

- 1880-Curie brothers first demonstrated that difference in electric potential could be created by mechanically rubbing tourmaline crystals …this is called as piezoelectric effect .

- This was first applied in World war 2 for underwater sonar system .

- 1949-Ludwig used ultrasound to detect gallstones.
- 1956 –Hughes and Mundt – first ophthalmological use –A scan.
- Baum and Greenwood – two dimensional B mode imaging.

WHAT IS ULTRASOUND



- Longitudinal sound waves
- Greater than the upper limit of human hearing that is 20,000Hz
- Alternate compressions and rarefactions.
- Just like sound waves – reflected and refracted.

PHYSICS

- Frequency of the wave is inversely proportional to its wavelength.
- Wavelength is directly proportional to its penetration.
- So larger the frequency ,less is the penetration and more is the resolution of the resultant echograph

Abdominal USG	1–5 MHz
Ophthalmic USG (BSCAN)	**8–10 MHz**
Ultrasound Biomicroscopy(UBM)	20–50 MHz

PULSE ECHO SYSTEM

- Ophthalmic USG uses high frequency sound waves generated by piezoelectric effect
- Transmitted from probe to the eye
- Strike the intraocular structure
- get reflected back to the probe
- Converted into electric signals
- Display on the monitior

VELOCITY

- Depends on medium.
- More denser is the media, faster is the velocity of sound transmission.

By Carl Ossoing

Medium	Velocity(m/sec)
water	1480
Aqueous/Vitreous	1532
Soft tissue	1550
Crystalline lens/Cornea	1641
Bone	3500

REFLECTIVITY

- When sound travels from one medium to another medium of different density, part of the sound wave is reflected from the interface between those media, back into the probe.
- This is known as Echo .
- Greater the difference in the density at that interface ,the stronger the echo or the higher the reflectivity.

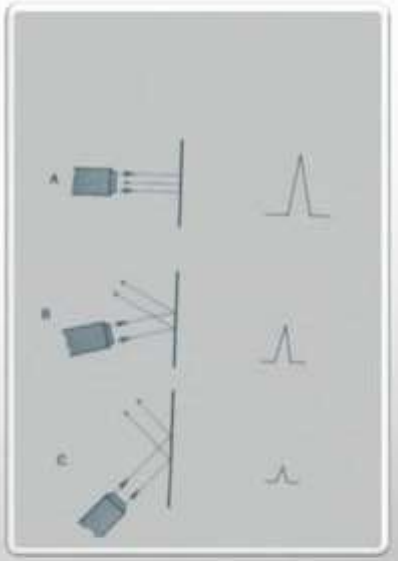
- In A SCAN ultrasonography, a thin sound beam is emitted, which passes through the eye and images one small axis of the tissue, the echoes of which are represented as spikes arising from the baseline. The stronger the echo, higher the spike.

- In BSCAN ultrasonography , an oscillating sound beam is emitted, passing through the eye and imaging a slice of tissue, the echoes of which are represented as multitude of dots that together form an image on the screen.
- Stronger the echo, brighter the dot.
- Example: the dots that form the posterior vitreous hyaloid membrane are not as bright as the dots that form the retina .Thus , we can differentiate between posterior vitreous detachment and retinal detachment.

ANGLE OF INCIDENCE

- When the probe tip is held perpendicular to the field of interest, more of the echo is reflected back to the probe tip and sent to the display screen.
- When the probe tip is held obliquely to the field of interest, some of the echo is reflected away from the probe tip, sending back less of it to the display screen.

- Thus , more obliquely the probe held to the area of interest, more compromised would be the display image.
- On ASCAN, perpendicular the probe, more steeply rising spike and higher the spike.
- On BSCAN, perpendicular the probe, brighter the dots on the surface of interest.



ABSORPTION

- Ultrasound is absorbed by every media through which it passes.
- Higher the density of the media, more is the absorption.
- That's why the density of solid lid structure compromises the image of posterior segment imaging as it absorbs a part of the sound wave.

- Likewise, while performing an ultrasound on eye with denser cataract, more of the sound wave is absorbed, and lesser is able to pass through next media, thereby compromising the spike and the image formed on ASCAN and BSCAN .
- For this reason, the best image would be produced when the probe is in contact with the sclera rather than the cornea, as it would bypass the crystalline lens and intraocular lens.

RESOLUTION

- The ability to distinguish between adjacent echoes-both axial and lateral.

- This is enhanced by use of focused sound beam.

- Axial resolution is related to frequency, piezoelectric crystal shape and dampening material attached to crystal.
- Shorter the pulse better the axial resolution.
- The concave shape of the crystal focuses the sound. The focused sound increases axial as well as lateral resolution.

AMPLIFICATION

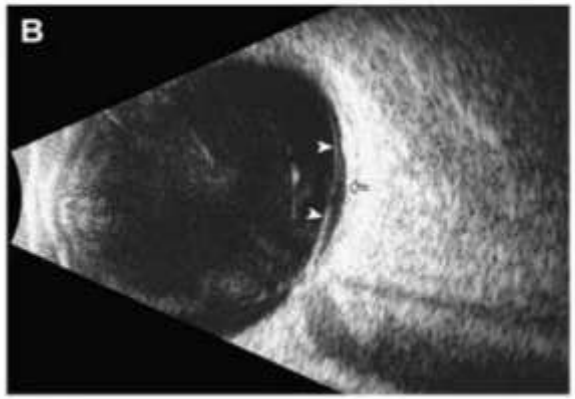
- This is the important part of signal processing that occurs before the sound wave reached the display monitor.
- Three types

1. Linear: limited range of echo densities, but can show minor difference within this range
2. Logarithmic: wider range of echo densities ,but does not show minor difference between the echo intensity.
3. S Curve: combine benefit of both the above .

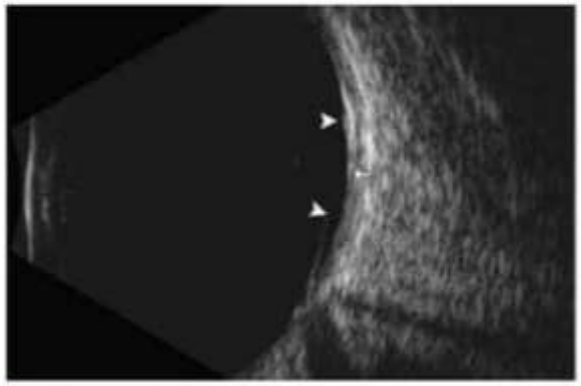
GAIN

- It is used for increasing or decreasing the amplitude of echoes that are displayed on the screen.
- Measured in decibels.
- Does not change the frequency or velocity of the sound .
- Changes the sensitivity of the instrument's display screen .

- Higher gain display weaker echoes like vitreous opacities.
- Lower gain displays stronger echoes like retina and sclera
- Better resolution.
- Typically all examination begin with highest gain, so that no weaker signal is missed ,and then the gain is reduced as necessary for good resolution of stronger signals.

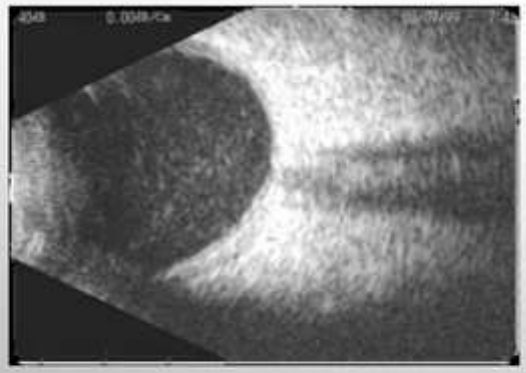


PVD at high gain (90dB)
PVD (arrowheads) and retina (arrow)

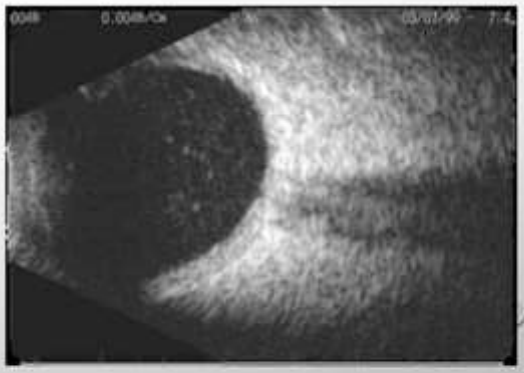


PVD at low gain (39 dB)

As the gain is reduced, the PVD (arrowheads) disappears in contrast to the retina (arrow), which remains visible even at low gain settings



High gain



Low gain

TIME GAIN COMPENSATION

- This technique is used to enhance the echoes returning from deeper structures by reducing those from the structures closer to the surface, which is typically utilized in studying the orbit.

DISPLAY OF SIGNALS

- The ultrasound signal that is received can be displayed in three ways : A mode , B mode or a combination of the above.

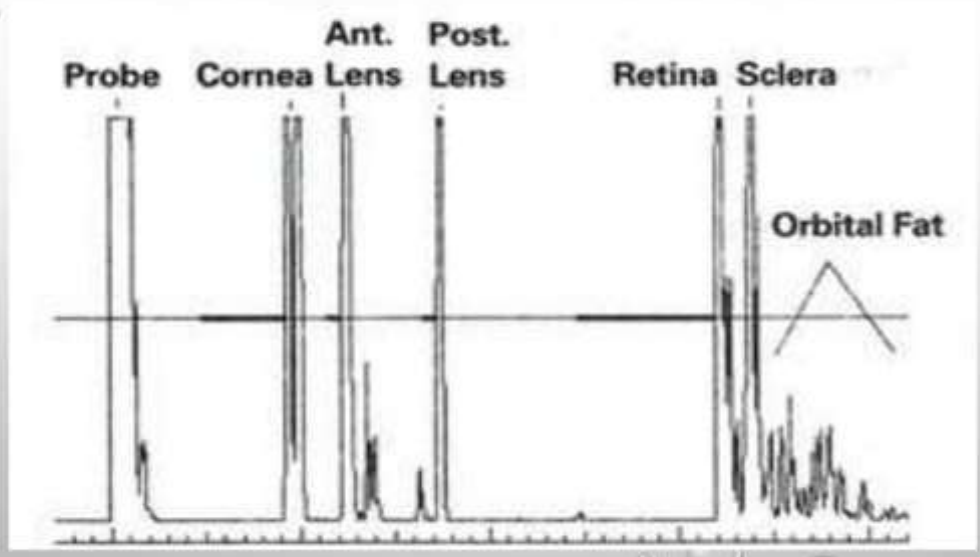
Other modification includes

- three dimensional ultrasound
- a combination of colour doppler with the BSCAN.

A SCAN

- One dimensional time - amplitude display .
- The echoes represented by spikes from the baseline.
- Linear amplification.
- 10-12MHz
- Used for axial biometry.

- Designed to scale acoustic density of retina -100 percent when sound is perpendicular
- Sclera and choroid also produce 100 percent.
- Allow tumour cells to be identified and differentiated.
- In combination with B scan, helps to differentiation of vitreo-retinal membranes


Probe
Cornea
Ant. Lens
Post. Lens
Retina
Sclera
Orbital Fat

PATIENT PREPARATION

- Ideally reclined position.
- Display and patient's head should be parallel and in close proximity
- topical anaesthesia
- methylcellulose-based gel as coupling agent
- both eyes should be opened and gaze in the direction being imaged.
- B-scans through closed eyelids
    1. Ultrasound waves are attenuated due to the soft eyelid
    2. Difficult to determine the exact position of the probe on eye.

B SCAN PROBE

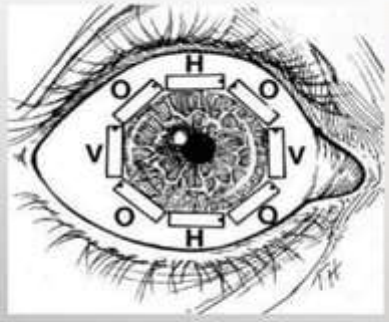
- Thick with a mark.
- It as a transducer that moves rapidly back and forth.
- Emits a focused sound beam at frequency 10 MHz.
- Methylcellulose is used as a coupling agent.
- Can be placed over conjunctiva/cornea/lid.
- Area towards which the mark is directed appear at the top of the display screen.

B SCAN PROBE ORIENTATION

- Transverse
- Longitudinal
- Axial

TRANSVERSE

- Mark is kept parallel to the limbus
- Movement of transducer parallel to the limbus .
- Probe shifted from the limbus to the fornix and sideways.
- Produce a circumferential slice through several meridian.
- To detect lateral extent of lesion.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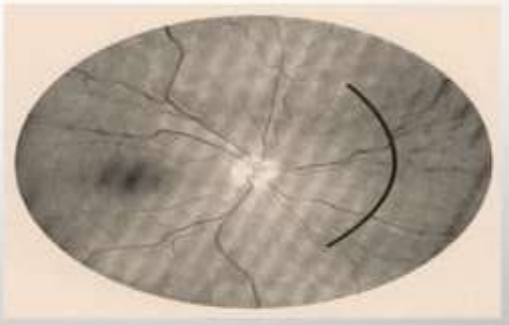
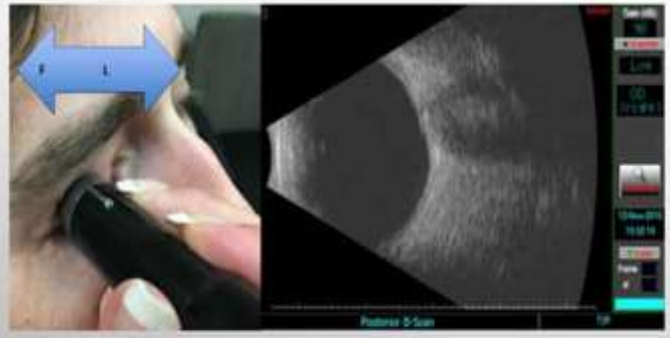


TRANSVERSE VIEW T 3 – QUADRANT CENTERED AT 3 O CLOCK

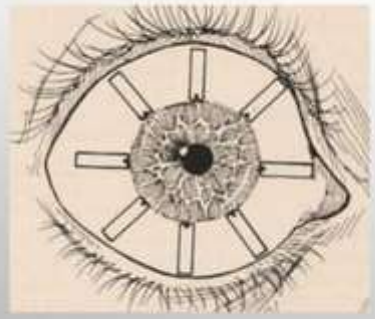


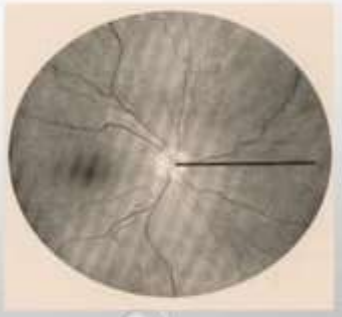
Remember, to scan the medial and lateral quadrants of the eye, the probe marker should point superiorly. For the T3 quadrant of the patient's right eye, instruct the patient to look left. Place the probe on the temporal limbus (L). After obtaining an image of the retina and optic nerve, gently sweep the probe to the fornix (F) to complete evaluation of this quadrant. To view the T3 quadrant of the left eye, the patient should still gaze to the left, but the probe will be placed at the medial limbus, with the marker oriented superiorly.

LONGITUDINAL SECTION

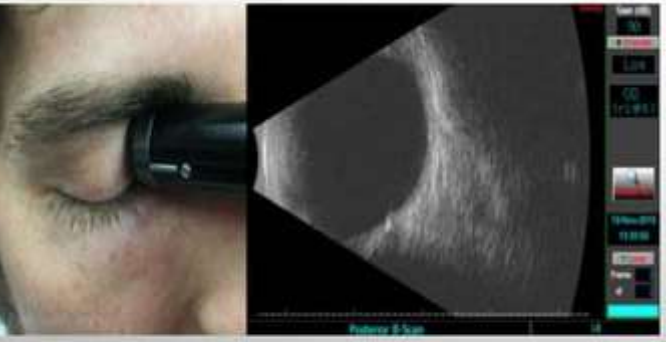
- Transducer kept perpendicular to the limbus.
- Probe marker kept towards the centre of cornea.
- Determine the anteroposterior limit of the lesion.
- Optic disc –lower part of the display screen.

- Best – demonstration of insertion of the membrane to the optic disc.





LONGITUDINAL MACULA VIEW(LMAC)

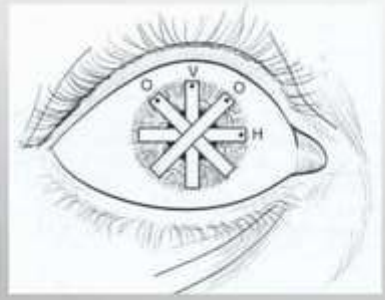


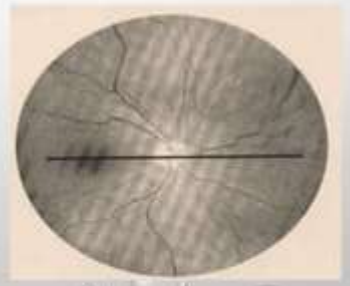
The LMAC view allows for proper visualization of the macula and optic nerve. Gently place the probe on the nasal aspect of the eye with the patient's gaze directed temporally. Note: For this position, the marker of the probe should be directed **toward the pupil**, instead of superiorly. A longitudinal scan is the only scan where this occurs! In this view, the optic nerve will be below the macula. Maneuver the probe to bring the macula into the center of the image to obtain the best resolution.

AXIAL

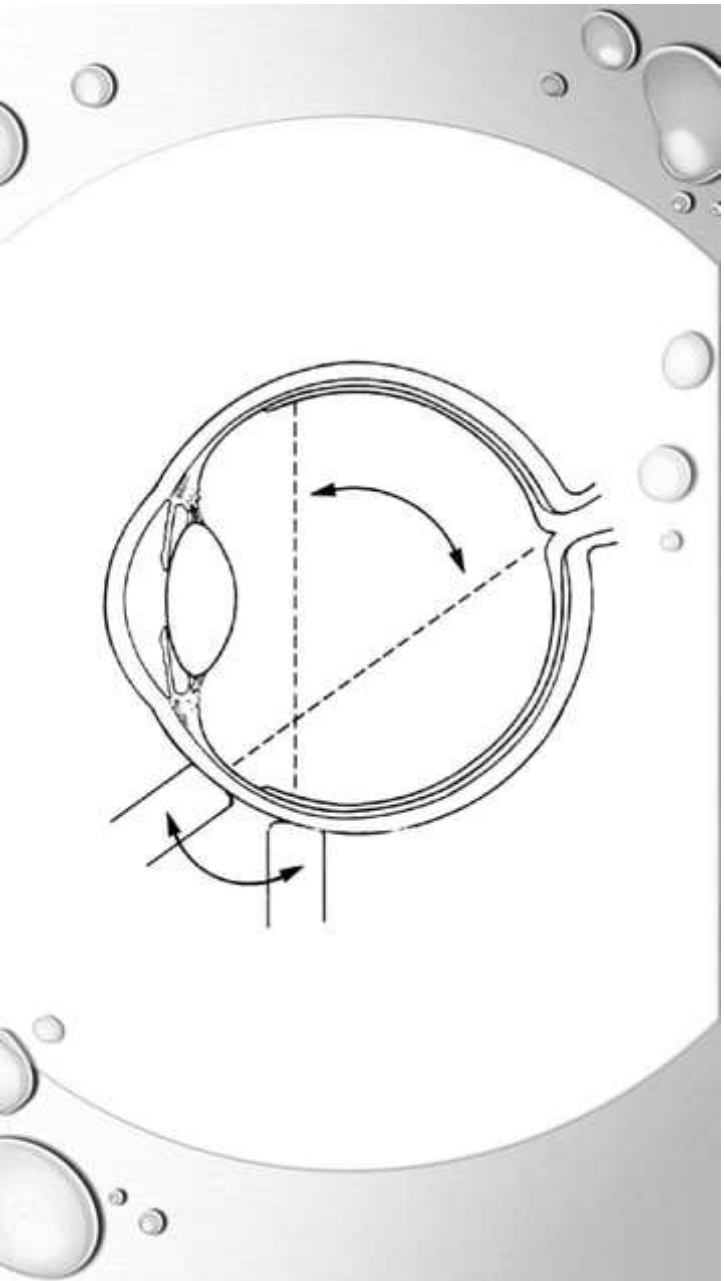
- Patient fixates in primary gaze , probe is placed on the globe directly and directed axially.
- Easiest to understand as it display lens and optic nerve .
- Documentation of lesion and membrane in relation to the optic nerve.
- Hinder resolution of posterior portion of the globe (sound attenuation and refraction) due to crystalline lens and intraocular lens.

- Depending on the clock hour location of the marker, axial horizontal , axial vertical and axial oblique pictures are obtained

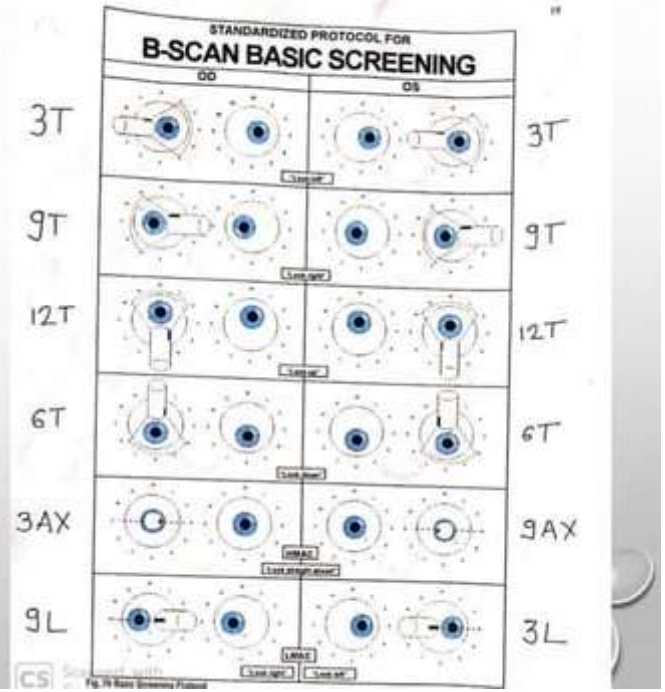




Clock position	Area screened
3-limbus	9-posterior
3-equator	9-equator
3-fornix	9-anterior
6-limbus	12-posterior
6-equator	12-equator
6-fornix	12-anterior



• Six scan screening - four transverse ,one axial and one longitudinal B-scan – the entire posterior segment can be well imaged.



INDICATIONS OF BSCAN

Media opacity

- Corneal opacity
- Hyphaema
- Small pupil
- Pupillary membrane
- Dense cataract
- Dense vitreous hemorrhage
- Dense vitreous exudates

- Differentiation of solid from cystic and homogenous from heterogeneous masses.
- Examination of retrobulbar soft tissue masses and normally present orbital structures (to differentiate proptosis from exophthalmos).
- Identification, localization of foreign bodies.
- Assessment of collateral damage in trauma cases.

EVALUATION

- Vitreous
- Retina
- Choroid
- Optic nerve

DIFFERENTIATION OF OCULAR LESIONS

TOPOGRAPHIC	QUANTITATIVE	KINETIC
Location	Reflectivity	Mobility
Shape	Internal structure	Vascularity
Extent	Sound attenuation	Convection Movement

TOPOGRAPIC ULTRASONOGRAPHY

Transverse Scan for lateral extent.

Longitudinal Scan for anteroposterior extent.

Axial scan useful to establish the lesion's location in relationship to the optic nerve.

QUANTITATIVE ULTRASONOGRAPHY

Reflectivity is graded by the height of the spike on A-Scan.

Internal Structure-

Homogeneous cell architecture- Little variation in spikes.
Heterogeneous cell architecture- Marked variation.

Sound attenuation or acoustic shadowing refers to the diminished or extinguished echo pattern resulting from a strongly reflective or attenuating structure.

Calcification of lesions, foreign bodies and bones are among the structures that cause sound attenuation.

KINETIC ULTRASONOGRAPHY

Mobility- Movement of a membrane or opacity following a change in gaze.

Vascularity-

Fast, low-amplitude flickering — Blood flow within an intraocular solid lesion.

Convection Movement-

Slow, continuous movement of blood, layered inflammatory cells, or cholesterol debris.

Occurs secondary to convection currents.

Seen in eyes with long-standing vitreous haemorrhage.

COLOUR DOPPLER ULTRASONOGRAPHY

- Simultaneously allows Bscan and evaluation of blood flow.
- The red end of the spectrum-blood moving towards the, transducer. The blue end of the spectrum – flow is moving away.
- Effective in detecting ocular and orbital tumour vasculature, carotid disease, central retinal artery and vein occlusion neuropathy .

3D ULTRASONOGRAPHY

- Multiple consecutive Bscan are utilized to create 3 D block.
- The transducer rotates.
- Useful in evaluating volume of intraocular lesions and for evaluation of retrobulbar optic nerve.

BSCAN IMMERSION TECHNIQUE

Done using the B-Scan Probe with an immersion scleral shell or a small water filled balloon.

Contact B-scan is of little use in evaluating anterior eye structures because there is a 5-mm area directly in front of the probe known as the “dead zone”

Patient is asked to fixate in primary gaze when doing axial scan.

It allows display of cornea, anterior chamber, iris, lens and retrolental space along the visual axis.

Using scleral shell

Latex glove

ULTRASOUND BIOMICRSCOPY

- 35-100 MHZ
- Anatomy of anterior segment, as well as associated pathologies, including angle closure glaucoma, ciliary body cysts, cyclodialysis, foreign bodies in angle neoplasm and angle trauma.

VITREOUS

VITREOUS HAEMORRHAGE

- Most common causes

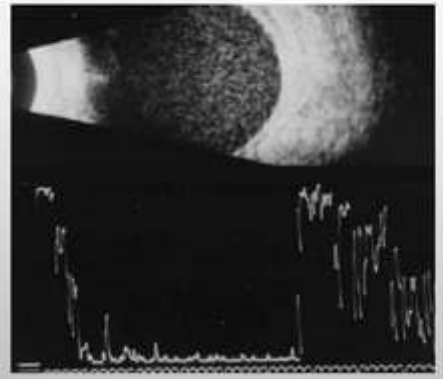
I. posterior vitreous detachment with or without retinal tear

II. proliferative diabetic retinopathy

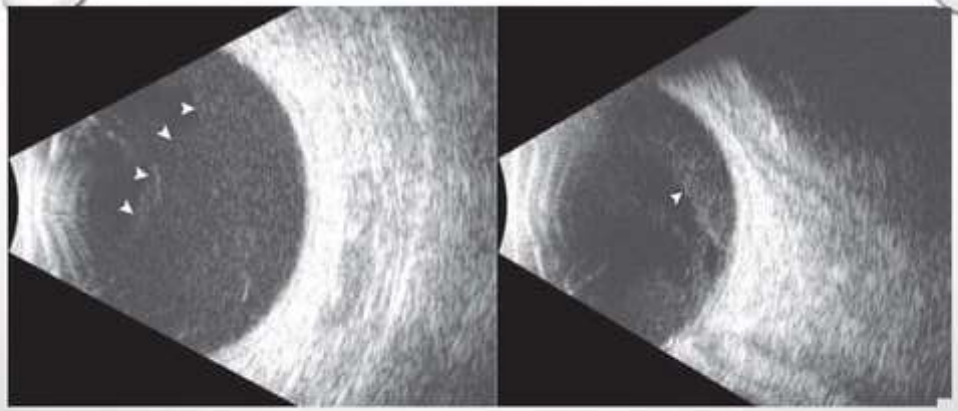
III. ocular trauma

IV. neovascularisation secondary to retinal vein occlusion.

- Fresh vitreous h'age appears as diffuse opacities of medium to low reflectivity, with low intensity spikes on A scan

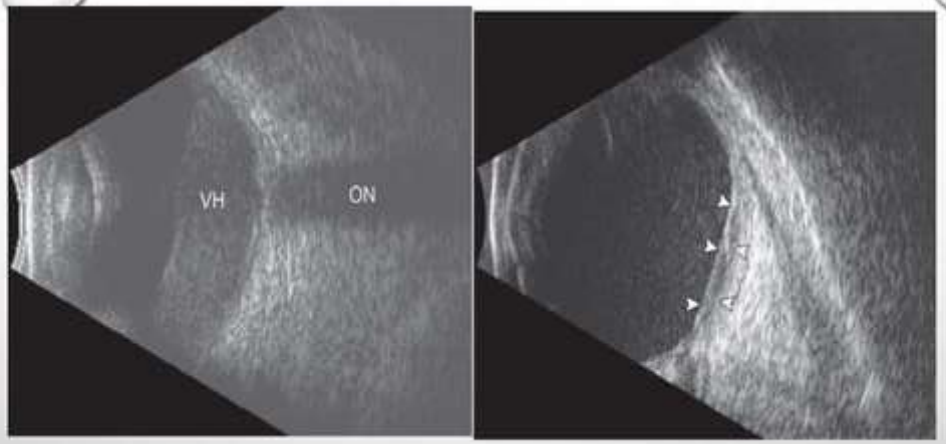


As the blood organises, it forms a pseudomembranous surface on B scan ,corresponding to slightly higher intensity spike of A scan .



Fresh vitreous hemorrhage showing diffuse low to medium echoes

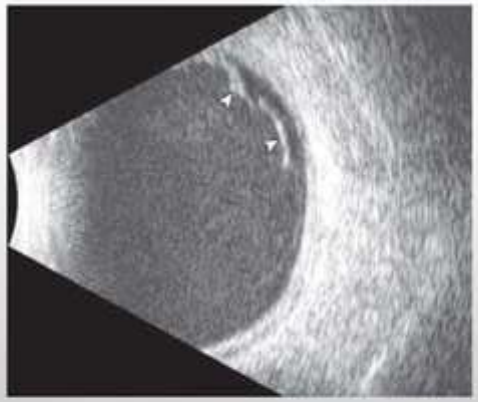
Pseudomembrane representing the organization of blood moderately dense vitreous hemorrhage



Subhyaloid hemorrhage

Layered vitreous hemorrhage mimics retinal detachment

In vitrectomised eye, blood remains in liquefied state and often requires use of high gain setting.

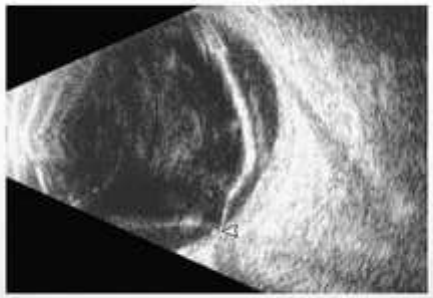


Vitreous hemorrhage in a vitrectomized eye in high gain

MIMICKING CONDITIONS

- Asteroid hylosis- echoluscent gap between echoes and posterior globe wall.
- Inflammatory echoes- other signs present such as retinochoroidal thickening, exudative RD, optic disc elevation or Tenons space widening seen.

POSTERIOR VITREOUS DETACHMENT

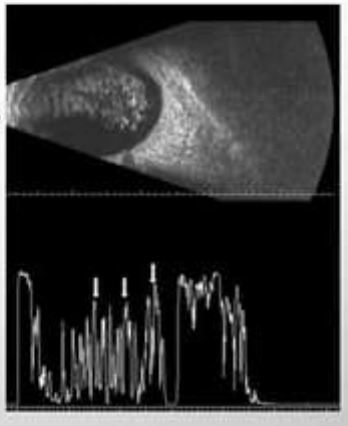


- PVD appears as a thin, smooth membrane that may retain its attachment to the retina at sites of retinal tears, areas of neovascularisation, the optic disc, or the vitreous base.
- PVD demonstrates significant movement and aftermovements on dynamic B-scan.

Feature	Posterior vitreous detachment	Retinal detachment
Echogenicity	Low–medium echogenicity	High echogenicity
Change with gain (dB)	Disappears with low gain	Visible with low gain
Mobility	High mobility	Low mobility
Optic disc attachment	Present or absent	Always present

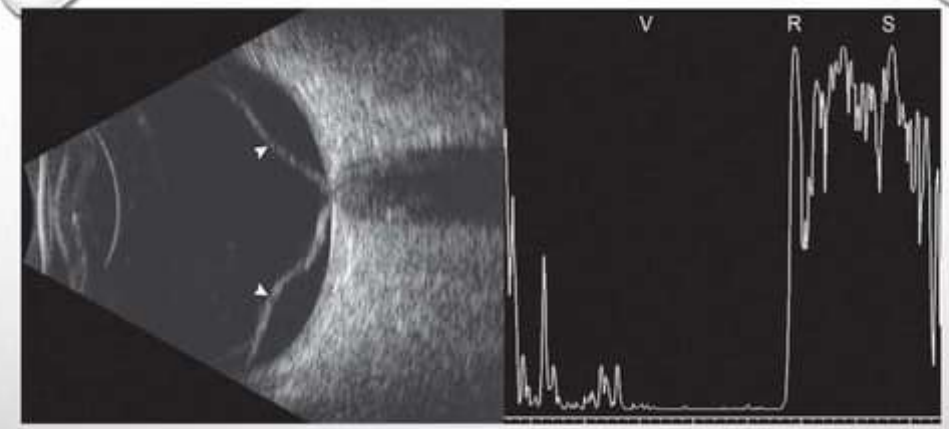
ASTEROID HYALOSIS

- Multiple small spheres of calcium and phospholipid suspended in the vitreous framework and act as distinctive sound reflectors.



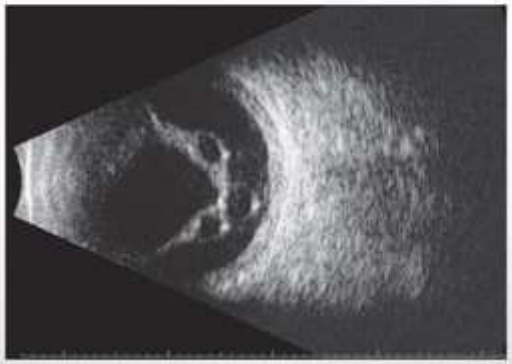
- B scan – diffuse and focal points of high reflective sources with a clear vitreous between asteroid bodies and retina

RETINA

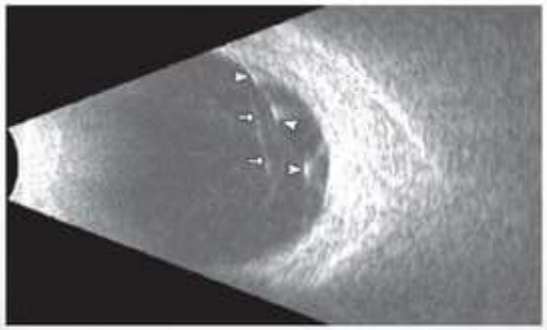


Total open funnel RD. B-scan at low gain shows open funnel configuration and optic disc attachment. A-scan shows 100% peak corresponding to the RD S – sclera, V – vitreous, R – retina.

- Retinal echoe-100% spike on A scan.
- Reflectivity remain equal in all part of membrane as long as the probe is perpendicular to it.
- Restricted after movements.
- In case of PVR ,retina loses its mobility and assumes triangular or funnel shaped configuration which can range from open to tightly closed.



Multiple intraretinal macrocysts in a chronic retinal detachment.



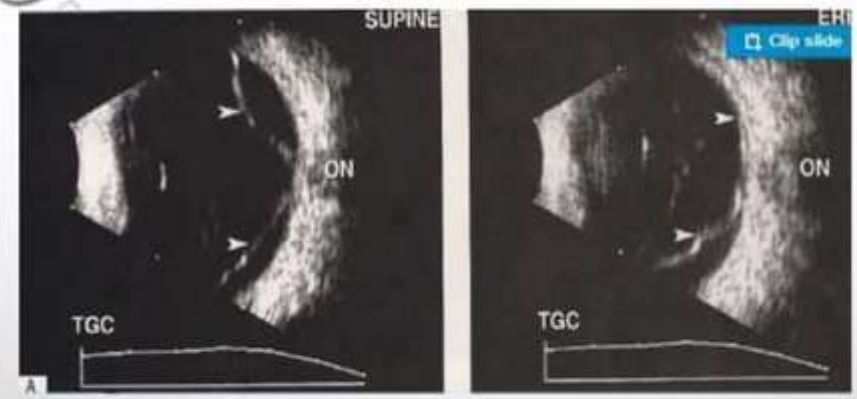
Arrow shows thin posterior PVD adherent to tent like tractional RD (arrow head).

TRD has a tent like configuration that does not extend to ora serrata.

Also it exhibits less mobility as compared to RRD due to traction on retina.

- Diabetic TRD – along disc and vascular arcades.

- Vascular TRD – equator or anterior to equator.



Exudative RD –Smooth , convex surface

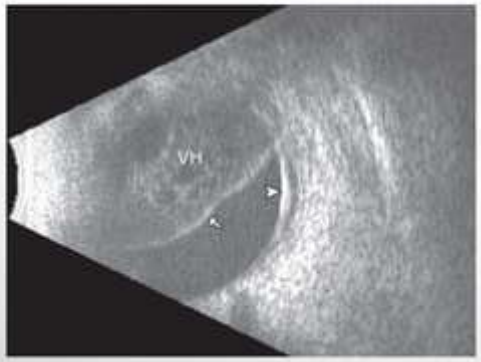
Shifting SRF in dependent part .

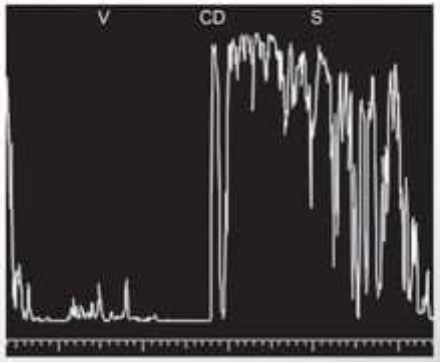
- In exudative RD caused by photocoagulation – peripheral detachment or isolated pockets, choroidal detachment may also be present.

- Inflammatory etiology – retinochoroidal thickening

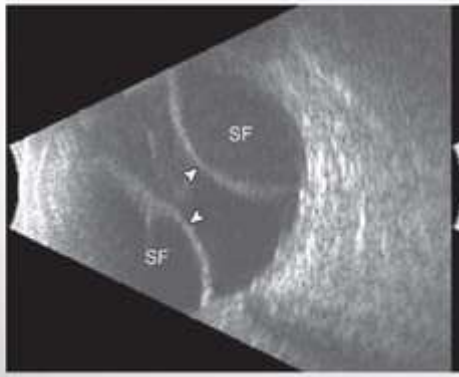
- Look for tumour mass or granuloma.

FEATURES	CHOROID DETACHMENT	RETINAL DETACHMENT	PVD
SHAPE	DOME	LINEAR	-
LOCATION	PERIPHERY	VARIABLE	VARIABLE
ATTACHMENT TO ONH	NO	YES	VARIABLE
OTHER FINDINGS	KISSING CHOROIDALS	FOLDS,BREAKS, PVR CHANGES	PROMINENT INFERIORLY
A SCAN SPIKE %	90-100	80-100	40-90
MOBILITY	MINIMAL	MODERATE	MARKED
AFTER MOVEMENT	-	MINIMAL	MARKED

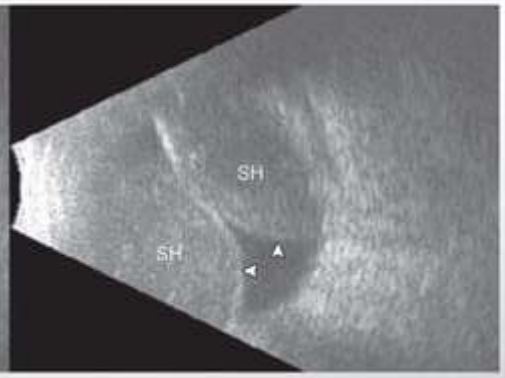




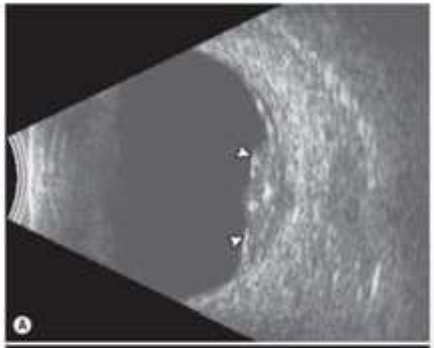
B-scan shows PVD (arrow), choroidal detachment (arrowhead), and vitreous hemorrhage (VH). A-scan shows the characteristic double peak on initial spike The probe must be perpendicular to see the double peak

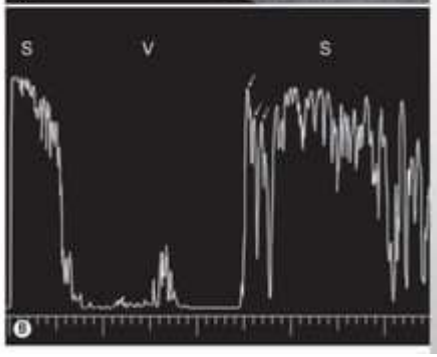


Serous choroidal detachment. Two choroidal detachments with echolucent subchoroidal serous fluid (SF).



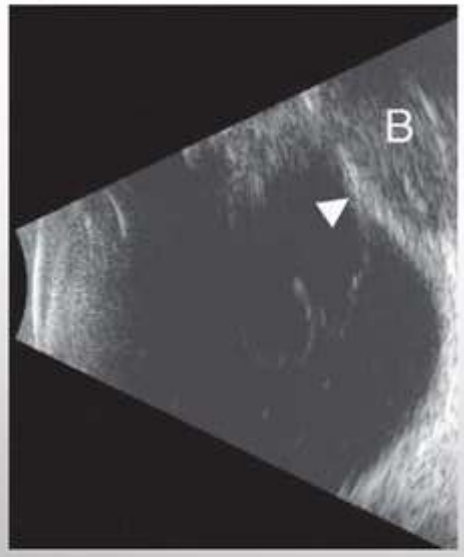
Hemorrhagic choroidal detachment. "kissing" choroidal detachment with dense opacities in the suprachoroidal space indicative of hemorrhage (SH).



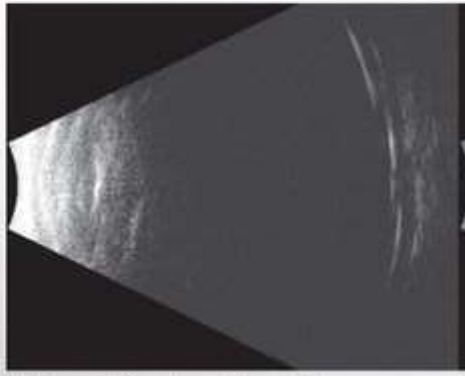


Retinoschisis-
B scan- thin ,dome shaped membrane
A scan –thin 100 % spike seen just anterior to retina

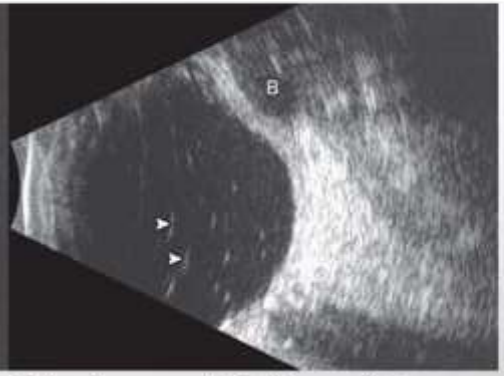
POST SURGICAL CHANGES



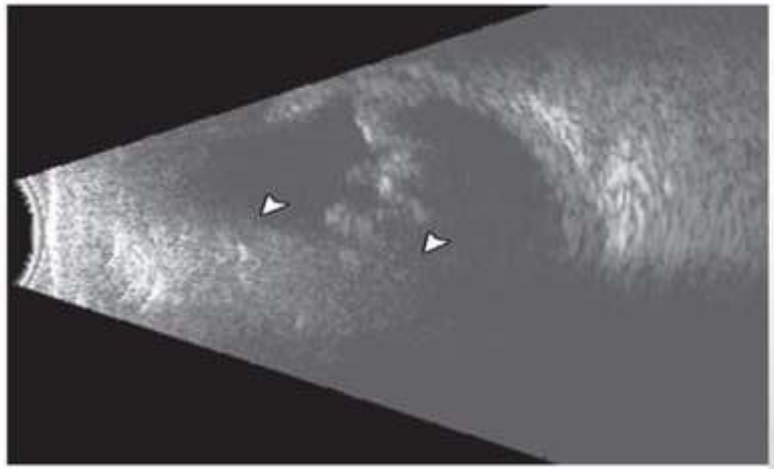
Scleral buckle-
Bscan showing
scleral indentation.
Produce convex
indentation of
ocular wall and
strong sound
attenuation due to
extremely high
reflectivity of
buckling material.



Echographic elongation of the vitreous cavity by silicone oil and limited visibility of posterior ocular structures – acoustic elongation



Following removal of silicone oil. few droplets of oil that remain in the eye are visible as highly reflective surfaces (arrowheads) B – scleral buckle



BSCAN-arrow head shows probable meniscus of gas. No structures are seen behind the bubble due to extensive shadowing.

INTRAOCULAR TUMOURS

Retinoblastoma

- Solid tumor arising from the retinal layer obliterating the vitreous cavity.
- Calcification within the tumor mass is typical of retinoblastoma
- shadowing effect behind the lesion in the orbital mass.
- Concomitant RD may be present.
- A scan- high reflectivity, vascularity and absence of after movements

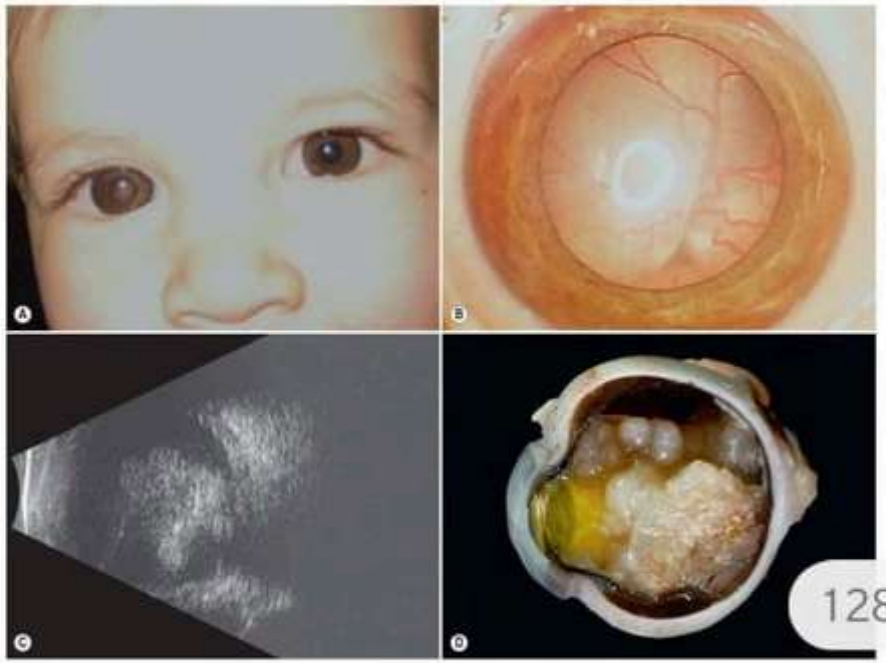


Figure 11.1 Classic presentation of retinoblastoma. External photograph showing right-sided leukocoria (A), slit lamp photograph (B), B-scan revealing an intraocular calcified mass (C), gross photograph of globe with retinoblastoma (D).

Differential diagnosis of white reflex

Condition	Age of presentation	Risk factors	Laterality	Axial length	USG
Retinoblastoma	90% <3 years old	Family history	Unilateral or bilateral	Normal	Intraretinal/subretinal mass with calcification
ROP	Days to months after birth	Prematurity; oxygen supplementation	Bilateral	Short	RD with retinal bands
PFV	Days to weeks after birth		Unilateral	Short	Vitreous band from lens to optic nerve
Coats' disease	4–10 years of age	Male gender	Unilateral	Normal	Exudative RD Subretinal hyper-reflective particles
Toxocariasis	Variable	Contact with dogs	Unilateral	Normal	Peripheral mass, vitreoretinal band, traction RD
Medulloepithelioma	First decade of life		Unilateral	Normal	Ciliary body mass with cyst

USG: ultrasonography, ROP: retinopathy of prematurity, RD: retinal detachment, PFV: persistent fetal vasculature

Box 11.1 Conditions associated with intraocular calcification

Retinal and retinal pigment epithelium (RPE) lesions

- Retinoblastoma
- Astrocytic hamartoma
- Chronic retinal detachment
- RPE metaplasia
- Cysticercosis

Choroidal lesions

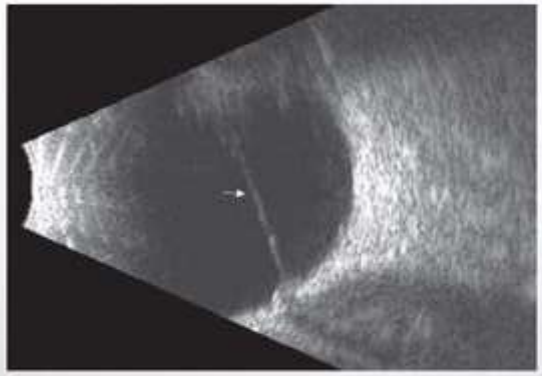
- Choroidal osteoma
- Sclerochoroidal calcification
- Choroidal granuloma

Others

- Optic nerve head drusen
- Scleral calcification (Cogan's plaque)
- Phthisis bulbi

PERSISTENT FETAL VASCULATURE

- First few weeks of life
- Unilateral
- Associated ocular anomalies - microphthalmos, shallow AC, axial length shortening
- Retrolental fibrovascular mass that cause ciliary body process to rotate inwards
- But unlike retinoblastoma, no discrete mass visualised.

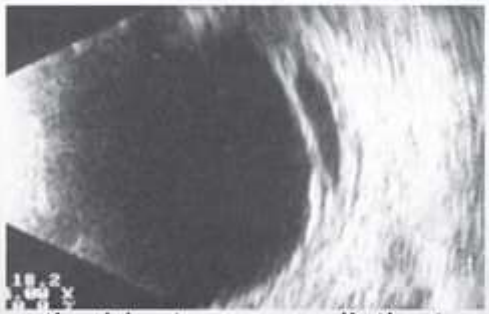


Persistent fetal vasculature (PFV). Taut, thickened vitreous band adherent to the slightly elevated optic disc

COAT'S DISEASE

- Young males
- 4-10 years of age
- Early stage- localised focal retinal detachments
- Advanced stage-total exudative retinal detachment.
- Yellow cholesterol deposition in subretinal space - xanthocoria, much less reflective than calcium crystals .

COAT'S DISEASE



Unlike retinoblastoma ,no distinct mass seen below the retinal detachment.

UVEAL MELANOMA

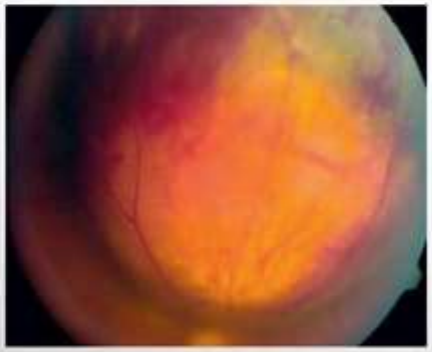
Box 11.2 Ultrasonographic features of uveal melanoma

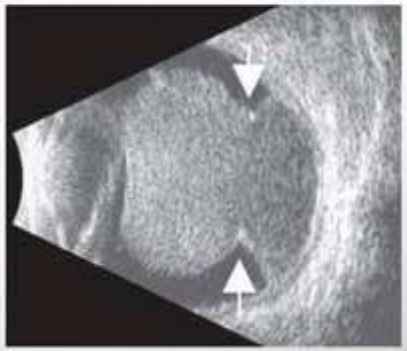
A-scan

- Low to medium reflectivity
- Sound attenuation
- Fast, spontaneous, low amplitude flicker

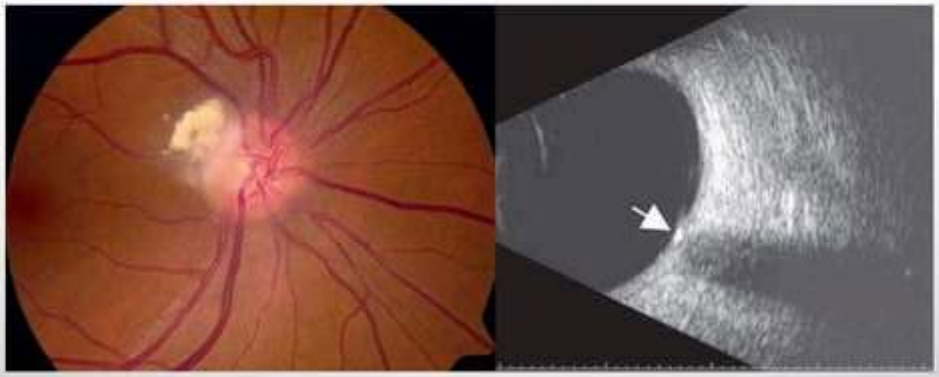
B-scan

- Collar button/dome shape
- Solid consistency
- Acoustic quiet zone
- Choroidal excavation
- Intrinsic vascular pulsations



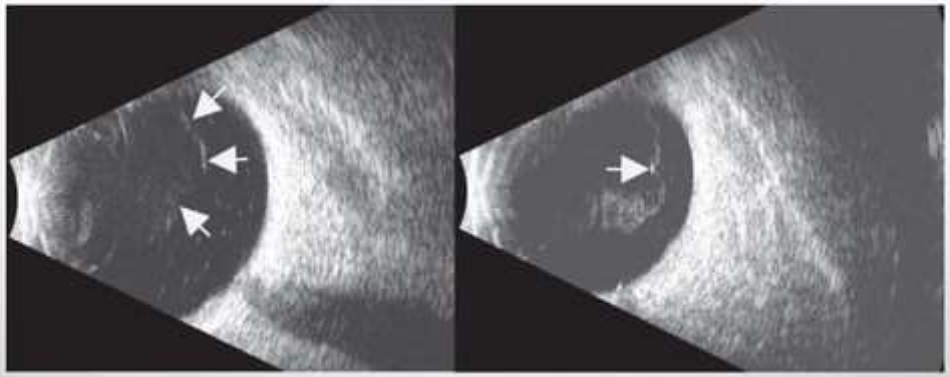


Choroidal melanoma. Clinical photograph showing large, partially amelanotic dome-shaped choroidal mass. B-scan reveals a mushroom-shaped choroidal mass that has broken through Bruch's membrane (arrows) touching the posterior surface of the lens

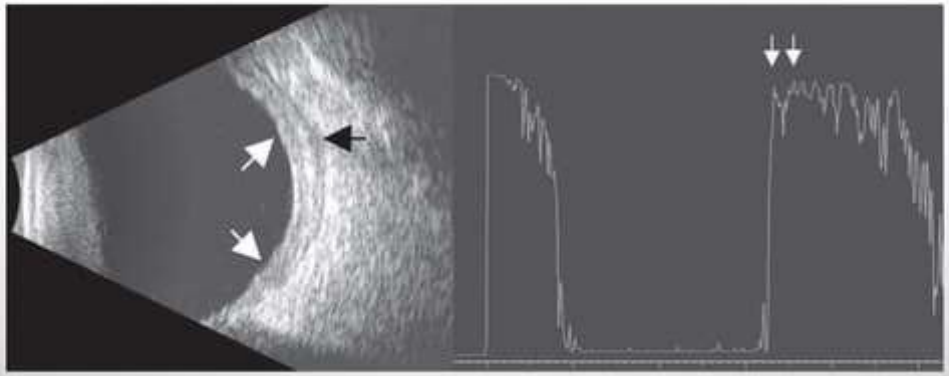


Astrocytic hamartoma. Clinical photograph of peripapillary calcified astrocytic hamartoma. B-scan demonstrating calcification near optic disc (arrow).

Ocular Inflammatory Diseases

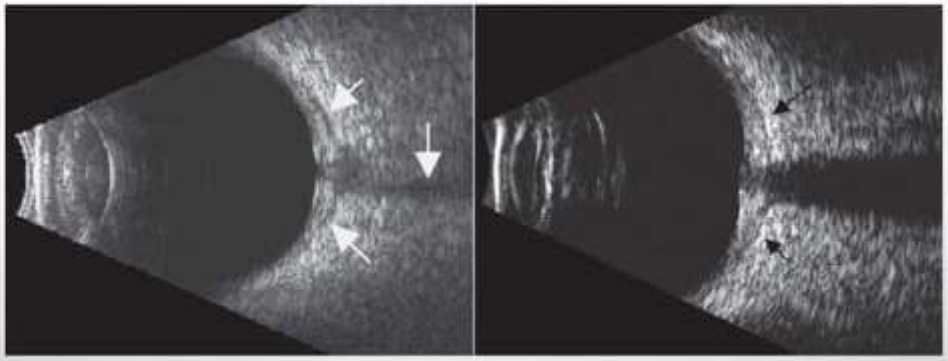


Ant. Vitritis - Mild to moderately dense vitreous opacities anterior to the posterior vitreous detachment (arrows) and very mild subhyaloid opacities



B-scan demonstrating marked, diffuse thickening of the posterior fundus and sclera (arrows) with a thin band of low reflectivity in Tenon's space (black arrows) indicative of posterior scleritis.

Diagnostic A-scan showing highly reflective thickening of the posterior fundus and sclera



"T-sign" in posterior scleritis. Axial B-scan shows posterior scleral thickening and low reflective infiltrate behind the peripapillary sclera and optic nerve creating the classical "T-sign" (arrows). Axial B-scan showing marked thickening of the sclera with only a very thin band of low reflectivity behind the peripapillary sclera (arrows).

OCULAR TOXOCARIASIS

- Characteristic pseudocystic degeneration of peripheral vitreous.
- Mild to moderately elevated granulomatous lesions, that can be calcified.
- Vitreous membrane extending from granulomatous lesion to posterior pole.
- Posterior tractional retinal detachment .

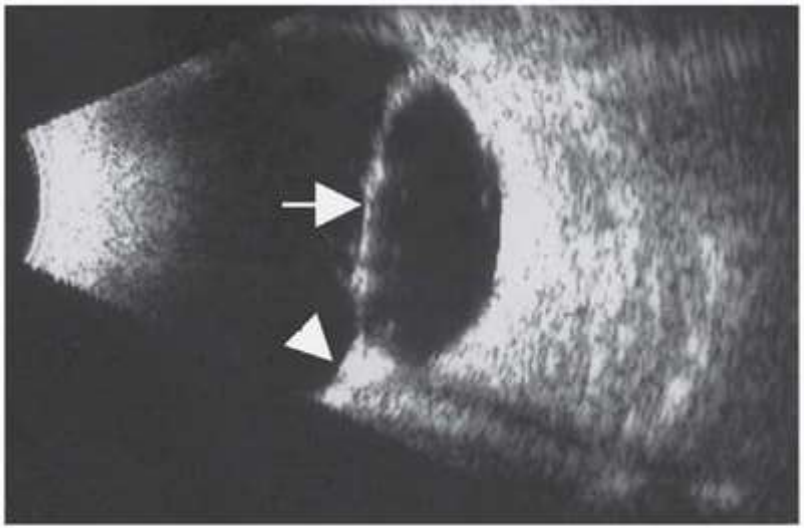
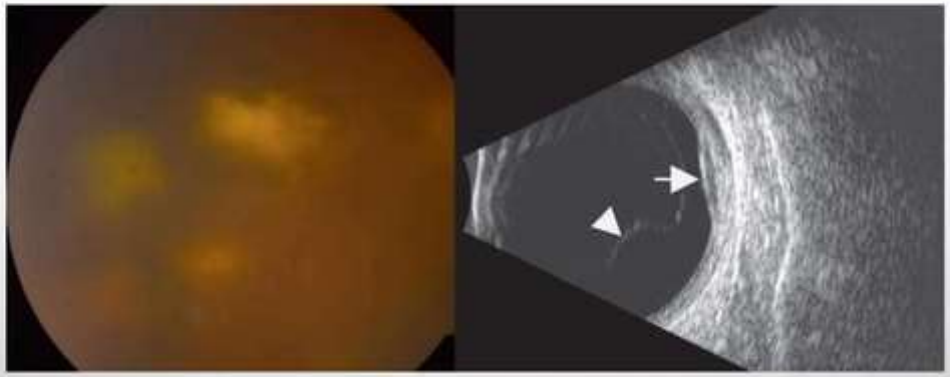


Figure 12.8 Toxocariasis. Transverse B-scan demonstrating a taut membrane (arrow) extending across the vitreous and adherent to an irregularly shaped, highly reflective granuloma that is causing shadowing of the orbit (arrowhead). Reproduced with permission from Ventura ACM, Hayden BC

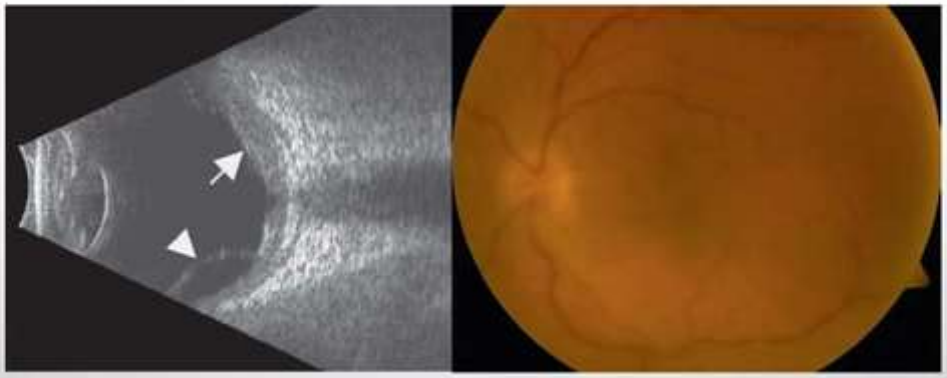
OCULAR TOXOPLASMOSIS

- Intravitreal punctiform echoes.
- Thickening of posterior hyloid.
- Partial or total PVD.
- Focal retinochoroidal thickening.

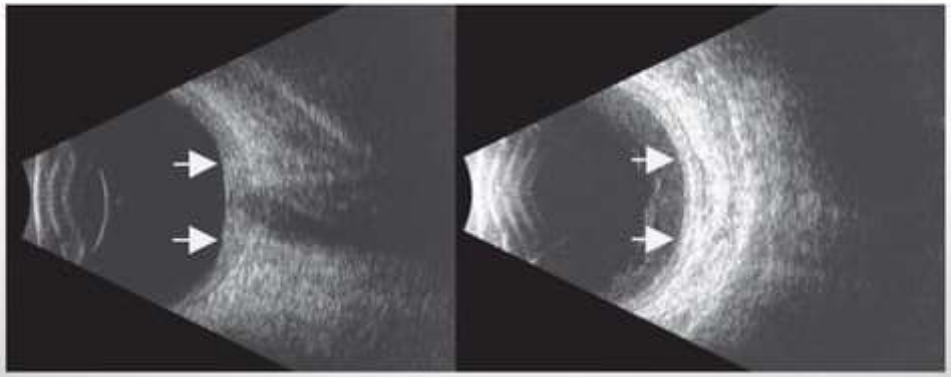


Toxoplasmosis.

Marked vitreous haze with toxoplasmosis lesions of the fundus. B- scan at a low gain demonstrating a posterior vitreous detachment (arrowhead) and a dome-shaped, elevated lesion of the fundus (arrow).



Vogt–Koyanagi–Harada syndrome.
Axial B-scan showing marked choroidal thickening (arrow) and a serous retinal detachment (arrowhead).

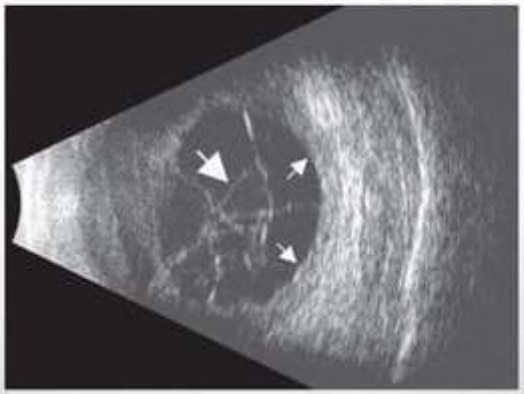


Axial B-scan at a low gain showing marked thickening of the posterior fundus (arrows).

Transverse B-scan at a high gain showing dense, clumped vitreous opacities adjacent to the thickened choroid (arrows)

ENDOPHTHALMITIS

- Low reflective vitreous echoes- dot or cobweb shaped.
- More severe cases- thick membrane like echoes.
- PVD may or may not be present.
- As PVD develops in eye with endophthalmitis, TRD like picture may develop - this is due to thickened inflamed posterior hyaloid.



Endophthalmitis.

Transverse B-scan showing marked membrane formation (arrow) throughout the vitreous space and marked, irregular fundus thickening (small arrows)

Optic Nerve Diseases

NORMAL RETROBULBAR OPTIC NERVE MEASUREMENTS

- Measured in two locations
  - 3 mm posterior to the nerve head and
  - as close as possible to the orbital apex
- Normal - 2.2 to 3.3 mm in diameter - variation can occur
- A difference of ≥0.5 mm between two eyes may indicate an abnormal thickness in one eye.

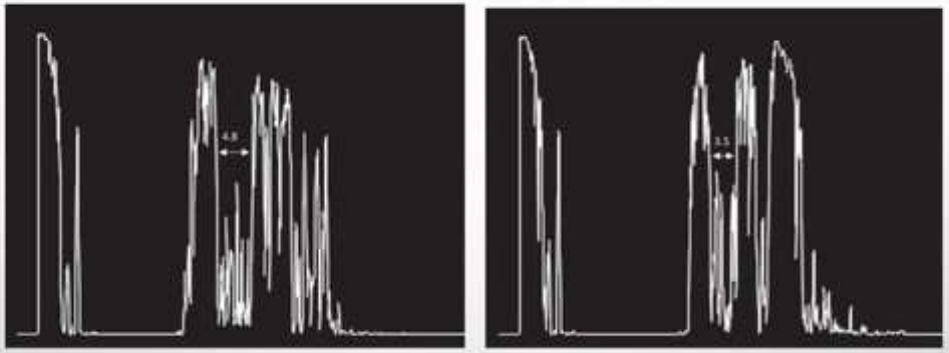
30° test

- Increased subarachnoid fluid can be differentiated from thickening of the parenchyma or perineural sheaths

- Optic nerve perineural sheaths measured anteriorly and posteriorly
    - In primary gaze
    - 30° lateral gaze

- When eye fixates laterally, the optic nerve sheath are stretched and subarachnoid fluid is spread over larger area.

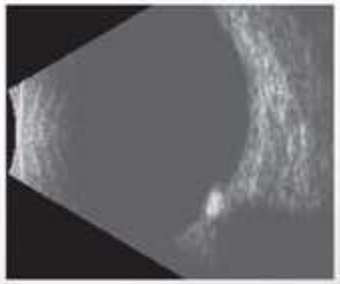
- A decrease in diameter of >10% in lateral gaze is a positive 30° test which is due to increased subarachnoid fluid.



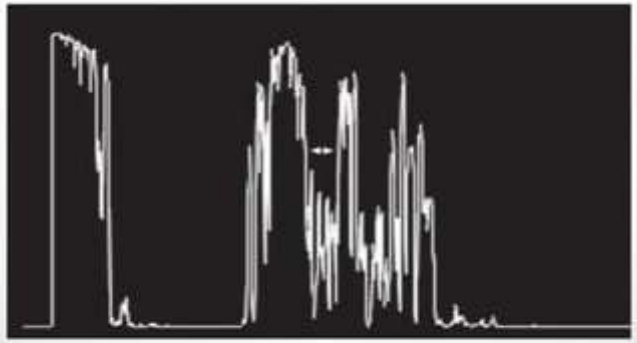
Positive 30° test with diagnostic

A-scan while the eye is in primary gaze with an enlarged retrobulbar optic nerve (4.8 mm) When the eye is fixated 30° laterally, a marked decrease in the size of the retrobulbar optic nerve (3.5 mm)

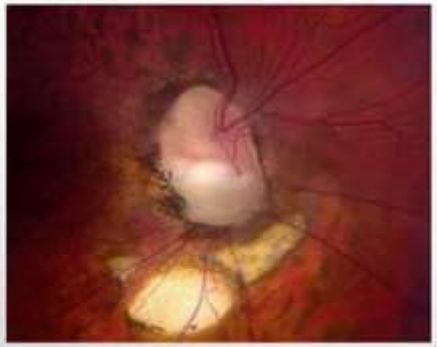
Pseudopapilledema

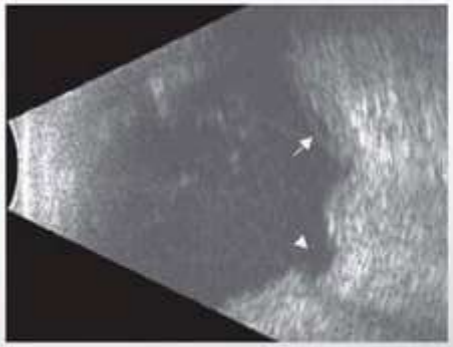


- Buried optic nerve head drusen.
- Fundus photograph shows optic nerve head elevation and absence of optic cup mimicking papilledema.
- B-scan shows highly calcified, round drusen at the with shadowing.



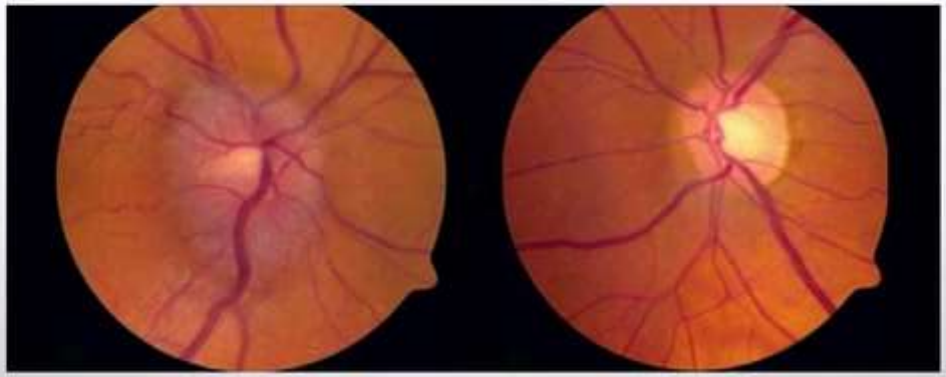
Diagnostic A - scan shows normal retrobulbar optic nerve diameter measuring 3.2 mm



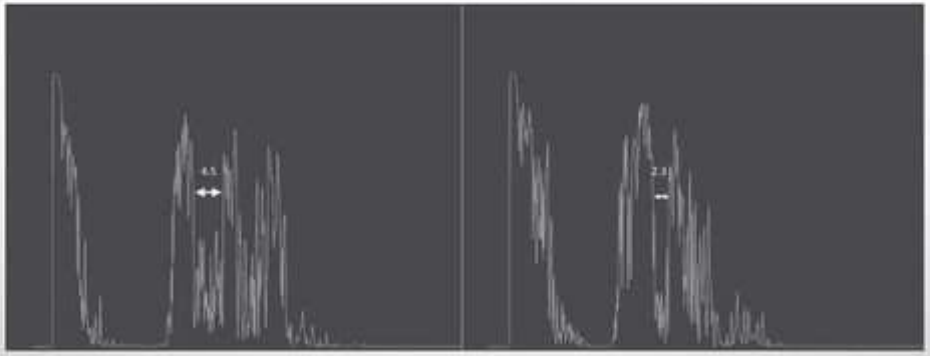


Optic disc coloboma.

Fundus photograph and Longitudinal B-scan. Note vitreous hemorrhage, a shallow retinal detachment (arrow) and coloboma at the inferior portion of the optic nerve head (arrowhead)



Fundus photograph showing congestion and elevation of the right optic disc
Normal contralateral left optic disc



Diagnostic A-scan shows thickening of right optic nerve with retrobulbar diameter of 4.50 mm. 30° test was negative for subarachnoid fluid

A-scan of normal left optic nerve with retrobulbar diameter of 2.32 mm

THANK YOU