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B-SCAN EVALUATION OF OCULAR PATHOLOGIES IN PATIENTS OF A TERTIARY CARE HOSPITAL IN GARHWAL

Radiodiagnosis

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ABSTRACT

B-scan ultrasonography (USG) of the eye is a simple, noninvasive diagnostic tool used for diagnosing lesions of posterior segment of the eyeball like cataract, vitreous degeneration, retinal detachment, ocular trauma, vitreous hemorrhage, posterior vitreous detachment and others including ocular tumors. It is cost-effective tool which is an important consideration in remotely located setup like ours situated in Garhwal mountain ranges. It is easily available and the results are easily reproducible. The present retrospective hospital based study shows effectiveness of ultrasound in form of B-scan in diagnosing various spectra of ocular pathologies in patients of the hilly regions, wherein 50 patients were studied in a period of 3 years from April 2016 to March 2019.

KEYWORDS

B-scan, ocular pathologies, retinal detachment, vitreous degeneration, posterior vitreous detachment

INTRODUCTION

When fundoscopy is not possible on account of opacification of the transparent media as in vitreous hemorrhage or mature cataract, ultrasound can guide clinicians in diagnosing posterior segment ocular abnormalities and helps in choosing treatment[1-4]. So also dynamic ultrasound study helps in distinguishing various conditions that would be otherwise difficult to differentiate like posterior vitreous detachment, retinal detachment and choroidal detachment which have typical, unique and characteristic b-scan features on dynamic scanning[18]. B-scan of eyeball is also a good technique to diagnose diverse conditions like lens subluxation or dislocation, vitreous hemorrhage, asteroid hyalosis, optic disc drusen, posterior staphyloma and different ocular tumors. It helps in identifying any foreign bodies in eyeballs like metallic particles especially when MRI is contraindicated. Thus it helps in primary assessment of ocular pathologies as it is cheaper, easily available and easily reproducible study[1-4]. Patient compliance is better and it is good option when cost is the issue[1-4]. USG helps in intraocular and periocular inflammatory diseases and produces rapid images in real-time and can obtain images in different planes as in other ocular diseases, it does not cause biological hazards like X-rays. The only disadvantage of B scan is that it is solely operator dependant and there is need of direct placement of probe over globe or lid which makes it impossible to scan in acute pain.

MATERIALS AND METHODOLOGY:

The present retrospective hospital based study was done in department of Radiodiagnosis in HNB Base government teaching hospital situated in Srinagar Garhwal, Uttarakhand on Badrinath highway about 110 kms interior to Rishikesh. The study period was between April 2016 to March 2019; for a total of three years done on patients referred for B-scan. Scanning was done using Toshiba Nemio SSA 510A color Doppler machine (Toshiba Inc Corporation, Tokyo, Japan) using 7.5 MHz linear probe with the contact method. The probe was placed over the closed eyelid after application of intervening coupling gel. Out of 8575 ultrasound cases done in the study period, about 50 B-scan cases were performed in patients of all age groups in both sexes.

Cystic nature of the eyeball makes it ideal for ultrasound study. For better results gel is applied abundantly to allow better contact between the transducer and the eyeball. The probe is gently placed and eye is scanned in neutral position and also during gentle eye movements and patient is thus instructed beforehand.

Data thus obtained was entered in pre-designed proforma which included all vital details of scanned patient like name, age, sex, presenting complaints, region, past history, details of surgery in past, any occupational history, present USG study findings and relevant laboratory tests results. Data was retrieved on Microsoft Excel sheet and analyzed in detail for tabulating results using percentage methods.

Results based on B-scan study:-

Out of 8575 ultrasound cases 50 B-scan cases were done, forming about 0.58% cases of all ultrasound studies done over study period of three years. The male female ratio was 37: 23.

The age groups of patients referred for B-scan are represented belows;

1) < 10 years - 11
2) 11- 20 years - 06
3) 21- 30 years - 08
4) 31- 40 years -07
5) >41 years – 18

50 cases of B-scan done in a period of three years showed many various disease conditions of eyes including posterior vitreous detachment, retinal detachment, vitreous hemorrhage, retinochoroidal thickening, cataractous lens, vitreous degeneration, lens and IOL related issues, posterior scleritis and some other miscellaneous conditions.

The B-scan findings in such ocular conditions are described in discussion part and along the images of sonography produced for better understanding in the legends accompanying the images, almost 21- 22 in number.

Various ocular pathological conditions found in the present B-scan USG study (n=50)

1) Posterior vitreous detachment (PVD) - 10 (20%)
2) Retinal detachment -10(20%)
3) Vitreous detachment – 10 (20%)
4) Retinochoroidal thickening - 7(15%)
5) Cataractous lens- 17(34%)
6) IOL related issues - 02(4%)
7) Vitreous degeneration - 06(12%)
8) Preseptal lesions -03(6%)
9) Endophthalmitis -01(2%)
10) Shallow anterior chamber -01(2%)
11) Posterior scleritis – 01(2%)
12) Myopic eyeballs -01(2%)
13) Posterior staphyloma – 01(2%)
14) Lens fracture /subluxation -02(4%)
15) Optic nerve head drusen -01(2%)
16) Phthisis bulbi -01(2%)
17) PHPV -01(2%)
18) Metallic foreign particle in vitreous -01(2%)

Commonest condition found was cataractous lens seen in 17 cases, followed by posterior vitreous detachment (10 cases), retinal detachment (10 cases), vitreous hemorrhage (10 cases) and retinochoroidal thickening (7 cases). Many conditions are associated with other conditions and so the case study appears bigger in numbers.

Ocular trauma lead to lens fracture in two cases, IOL subluxation with fracture in two cases and one young male who worked in foundry had two metallic tiny particles embedded in posterior segment.

Total ten cases of retinal detachment are seen with case details seen as given below.

Retinal detachment:-

a) Total RD- 5 cases

1) 23/ M- RD left eye with Vitreous hemorrhage (organizing) and cataract [**Figure 11]**
2) 19/M - RD right eye with vitreous degeneration and organized vitreous hemorrhage as well as cataract **[Figure 13**]
3) 25/— Left eye RD and cataract with right eye pseudophakia and PVD
4) 22/ M-RD left eye and vitreous hemorrhage fresh and cataract
5) 19/F- RD left eye with cataract and right eye posterior staphyloma and vitreous degeneration.[**Figure 14]**

b) Partial RD- 5 cases

1) 31/F- Left eye RD with myopic eye and PVD and bilateral vitreous degeneration
2) 75/ M- Right eye RD with PVD
3) 29/— Right eye RD [**Figure 8]**
4) 20/F- left eye RD and IOL. [**Figure 9]**
5) 28/ F- Traumatic left eye RD with cataract and lens fracture.

Lens related issues were seen in many cases details of which are given below:

i) Mature cataract - 03
ii) Immature cataract - 14
iii) Lens subluxation - 01
iv) Lens fracture - 01
v) Pseudophakia - 05
vi) IOL subluxation / fracture - 02
vii) Aphakia - 01.

Retinochoroidal thickening was seen in 7 cases in which the thickness of this layer on B-scan is increased, usually more than 1.5 mm. Normal thickness ranges from 1 mm to 1.5 mm. [**Figure 10]**

A case of PHPV associated with RD was seen in one young patient with leukocoria in right eye. **[Figure 15]**

A case having phthisis bulbi and posterior staphyloma each was also detected**.[Figure 16]**

DISCUSSION:

We will discuss normal sonography of eye ball and orbit followed by the relevant ocular pathologies.

Normal B-scan anatomy of eye ball[1-4,5,18]: - [Figure 1]

The human eye with its superficial location and its fluid filled cystic structure is ideally suited for examination by ultrasound like other superficially located structures, using high frequency probe for better structural and morphological details[1-5]. USG is the only practical method for obtaining clear images of the posterior segment of the eyeball when the light conducting media are opaque like lens, cornea and conjunctiva as well as vitreous humour. It is the most useful investigation prior to vitrectomy[1-5].

The eyeball has a transparent anterior segment and an opaque posterior segment containing the echofree vitreous humour[1-5]. The iris diaphragm which is pigmented divides the anterior segment which is filled by echolucent aqueous humour into two chambers[1-5]. The globe has three protective coats, the sclera, the choroid and the retina. The light conducting lens is a transparent, biconvex structure situated behind the iris[1-5]. Normal clear vitreous is seen in the posterior segment with the echo of posterior lens capsule anteriorly. The axial length of a normal adult eyeball is about 22 - 24 mm[18].

The optic nerve can be seen as hypoechoic tubular structure passing through the retrobulbar fat[1-5]. The retrobulbar fat is echogenic and the optic nerve is seen extending from the posterior pole of the eyeball towards the orbital apex[1-5]. The extraocular muscles can be seen especially the medial and lateral rectus muscle[1-5].

Various ocular conditions / pathological conditions relevant to our B-scan study:-

Ocular pathologies can be divided according to regions involved like[20];

1) Ocular globe size and shape - posterior staphyloma, phthisis bulbi, microphthalmia, highly myopic eyes[20].
2) Lens- cataract, dislocation and fracture[20].
3) Vitreous humour - Asteroid hyalosis, PHPV, PVD, Vitreous hemorrhage, Vitreous degeneration[18,20].
4) Retina - RD, Proliferative diabetic retinopathy, retinochoroidal thickening, Retinoblastoma[18,20].
5) Choroid - Choroidal detachment, choroidal tumors[18,20],
6) Optic nerve and head - Drusen, optic glioma, optic neuritis, optic nerve meningioma[20]
7) Post-surgical conditions - Pseudophakia, scleral buckle, silicone oil, intraocular air, PFC liquid[20].

a) Highly myopic eyes are usually not spherical and have staphyloma and B-scan helps to localize macula accurately for refractory correction[1-5]. Axial length of such myopic eyes ranges between 25.2 and 33.2 mm[1-5]. [**Figure 14** shows highly myopic eye with posterior staphyloma in a young female]

b) Posterior staphyloma is a condition that can be present in highly myopic eyes with long axial lengths caused by elongation of globe due to thinning and bulging of sclera and results in an irregular configuration of the retina at the posterior pole[1-5]. [**Figure 14**]

c) Cataract[1-3, 18] is degenerative disease of lens usually age related but can be secondary to trauma, galactossemia, infection and ischemia. The lens becomes opaque due to deposition of reflective material in lens substance usually beneath lens capsule which on B-scan are seen as thickening of posterior capsular echo or as scattered opacities in lens substance separated by clear zones as in immature cataract. In mature cataract, the eye lens shows completely opaque cortex with increased density. Our study shows B-scan features of both mature and immature cataract. **[Figures 2 & 6]**

d)Intraocular lens (IOL)[20] in situ is called as Pseudophakia and such prosthetic lens shows posterior reverberation artifacts due to scattering of sound waves by artificial material in such lens which obscure details of posterior segment and retina on sonography [1-5, 18]. Sometimes on traumatic incidence of eye ball, IOL can get subluxated or dislocated and can get fragmented with spillage of echogenic particles in vitreous[3]. Native lens material can get subluxated or dislocated or fractured on trauma[3]. **[Figures 4, 5, 9 & 10**]

e) Vitreous degeneration [18]

Also termed as 'vitreous floaters', term indicates liquefied vitreous having cholesterol crystals that move in eye ball, on eye movements and show dynamic after movements[2, 4, 18]. They are seen as multiple hyperechoic foci within vitreous chamber on B-scan[2, 18]. The condition is termed as 'synchysis scintillans'[2, 18]. It can be unilateral or bilateral. It can also occur secondary to longstanding uveitis or may follow vitreous hemorrhage[2, 4, 18]. There is no obvious reduction in visual acuity[1-5,8]. [**Figure 3, 13 & 17]**

f) Asteroid hyalosis[20] is a degenerative conduit eye in which small hyperechoic echoes with comet tail artifacts are seen floating in posterior segment of eye and these represent fatty calcium soap deposits in the vitreous body. It can obscure the examiner's view of fundus[20]. It is age related and is more common in patients with diabetes, hypertension and gout[20].

g) Vitreous hemorrhage[18, 20] may occur in vasoproliferative diseases resulting from various causes like tearing due to vitreoretinal traction like diabetic retinopathy, retinal tear, PVD, retinal macroaneurysms, vasculitis, subarachnoid hemorrhage, age related macular degeneration and ocular trauma[1-5, 18, 20]. Patient complains of black rain and dimness of vision[20]. On B-scan, low level echoes are seen vitreous which later on get organized to produce linear membranes. These echoes show marked after movements on dynamic scanning.

h) Posterior vitreous detachment [18,20]

Endstage of vitreous degeneration is posterior vitreous detachment which is an age related phenomenon in which the posterior vitreous capsule or hyaloid detaches from the underlying retina[18]. It is seen usually in elderly individuals, resulting from vitreous gel liquefaction and collection of fluid in the subvitreal space leading to detachment of vitreous from retina[1-5]. It is usually associated with cataractous lens[1-5, 18]. It can be seen incidentally. B-scan is diagnostic which shows reduced volume of vitreous gel with marked mobility and elasticity of detached vitreous showing mirror image configuration when the eye is deviated to one side and then to the other[1-5, 18]. Vitreoretinal adhesions can cause retinal or avulsion of a peripheral blood vessel leading to vitreous hemorrhage or retrohyaloid hemorrhage[20]. [**Figures 18 &19]**

i) Retinal detachment [1-5,18,20]

Retinal detachment (RD) is a common ocular condition which occurs due to a break or tears in the retina or can be caused by vitreoretinal traction due to contracting membranes[1-5, 18]. Thus retinal detachment is classified into three types, 1) rhegmatogenous RD - resulting from a retinal tear 2) tractional RD - from vitreoretinal traction due to contracting membranes 3) exudative RD-due to blood, exudates or a lesion in subretinal space. It can also be classified into total, partial and focal RD[18,20].

Partial RD has a membrane representing detached retina which is attached to optic disc but does not cross it. The detached retina is usually attached anteriorly to the firm anchorage points of the ora serrata and the optic nerve head posteriorly[2, 10, 18]. Thus a complete or total RD is seen like a shape of funnel or V shaped[18]. Fresh RD shows undulating motion of thin flimsy detached retina, whereas an old RD shows thick organized immobile membranes[18, 20]. Fresh RD can be treated surgically by laser or cryotherapy. Chronic RD forms a rigid triangle sign[20]. Eventually in such cases cysts form within the retinal leaves[20]. Chronic RD is not amenable to surgery[20].

The main advantage of B-scan is that with its help it is possible to diagnose RD early so that reparative vitreoretinal surgeries can be carried out to seal the retinal tear and save the impending loss of vision by laser or cryotherapy[18,20]. Our study 5 cases of total RD, out of which two were fresh RDs and could be treated surgically. Rest 3 cases of total were chronic RD not amenable to treatment. All cases of partial RD were fresh and are treatable by vitreoretinal surgery.

RD is sometimes associated with persistent hyperplastic primary vitreous (PHPV) covering the persistent central hyaloid artery forming a thick retrolental membrane with fibrovascular tissue extending from lens to posterior pole of eye ball (optic disc)[2, 10, 18]. PHPV is serious unilateral disease of childhood presenting as leukocoria and occurs due to failure of regression of primary vitreous[2,10,18]. Our case of PHPV in a young girl had organized thick RD and had clinically blind eye not amenable to therapy. **[Figure 15]**

j) Choroidal detachment[1-5,18]

Rarely RD is seen associated with choroidal detachment which on B-scan shows fluid in the suprachoroidal space. The choroid is attached to the ciliary body anteriorly at scleral spur and posteriorly at the exit foramina of the vortex veins[18]. Choroidal detachment occurs secondary to trauma or surgery or it might occur spontaneously[18]. Sometimes detached choroidal membranes form half domes on each side creating a B-scan appearance of kissing choroids[1-5, 18]. We had no such case of choroidal detachment.

k) Proliferative diabetic retinopathy[20] occurs in diabetic patient with poor glycemic control. There are progressive changes in the eye microvasculature leading to opacification of the transparent media by vitreous hemorrhage, retrohyaloid hemorrhage and occasional focal thickening of macular area due to subretinal hemorrhage or diabetic macular edema. In later stage, preretinal membranes form which contract and lead to RD leading to loss of vision.

l) Endophthalmitis[1-5] is a severe purulent inflammation of tissues inside the eye (vitreous and aqueous humour) occurring due to infection by bacteria and fungi, resulting into a condition called as progressive vitritis. Regular eye examination followed by B-scan to visualize inner ear structures such as vitreous and retina helps in early diagnosis. There is increased haze of posterior segment with loss of clarity of vitreous chamber[1-5]. We found single case on Bscan with hazy vitreous in right eye in young male.

m) The differential diagnosis of leukocoria are 1) Coats disease 2) Retrolental fibroplasia 3) Toxocariasis 4) PHPV 5) Retinoblastoma[18].

Common globe lesions in children causing leukocoria[1-5]**:-**

1) Retinoblastoma[1-3,6,7,18]

It is malignant neoplasm of retina and most common tumor of eye globe in children presenting as leukocoria (white pupil reflex). 75% cases are unilateral whereas 25% cases are bilateral. Trilateral retinoblastoma indicates bilateral globe tumors with a pineal gland tumor, whereas quadrilateral retinoblastoma indicates trilateral along with suprasellar lesion.

2) Persistent hyperplastic primary vitreous (PHPV) [1-5, 10,16,18]**-** PHPV results from persistent embryonic vascularity within the vitreous resulting into vitreous hemorrhage, cataract and retinal detachment with characteristic microphthalmia and increased density in vitreous in a full term infant.

B-scan of eyeball reveals echogenic band extending from optic disc to posterior aspect of the lens with color Doppler showing vascular flow in the persistent hyaloid artery in a microphthalmic eye[2, 10, 18]. There is coexisting retinal detachment seen organized along the fibrovascular retrolental tissue[2, 10, 18]. The anterior chamber is shallow and frequently glaucoma develops. Very rarely condition can be bilateral[10,16]. The treatment consists of visual rehabilitation by various surgeries including cataract surgery, IOL placement, treating glaucoma, vitrectomy and removal of embryonic remnants in posterior segment[10,16].

3) Coats disease[1-5,15,18]

It occurs in young males and shows characteristic subretinal exudates, retinal detachment and vascular anomalies of retina. Globe size is normal and there is lack of calcification.

4) Retinopathy of prematurity (ROP) [1-5,15,18]

It is called also as 'retrolental fibroplasia'; results from sequelae of prolonged oxygen therapy in premature infants leading to abnormal vascular development and hemorrhage in microphthalmic eyes bilaterally. Calcification can occur in advanced cases. It is a bilateral condition that is associated with premature birth and oxygen therapy in neonatal period. Fibrotic changes are seen in retrolental area in anterior vitreous which is seen as retrolental mass on B-scan (in a child presenting with leukocoria). We did not find any case of ROP.

5) Toxocariasis[1-3,15,18]

Ocular toxocariasis results from hypersensitivity to larval form of Toxocara cani worm seen in dogs and cats, resulting in unilateral visual disturbances. Globe size is normal and there is no calcification and there is positive history of contact with cats and dogs.

n) Ocular and orbital tumors/ Neoplasm:- Though we did not find any ocular tumors or any orbital tumor except for an elderly woman [**figure 7**]with benign upper lid tumor, still we discuss tumors as this is a relevant to this topic as Bscan helps in primary screening of tumors followed by assessment by CT and MRI. Articles no 7 and 8 by same author in bibliography shows relevance of Bscan assessment of common ocular tumors – choroidal melanoma and retinoblastoma in the previous institute in Ahmednagar, Maharashtra]

I) Orbital neoplasms:-

Orbital cavernous hemangiomas[15] are the most common orbital tumors, which are benign and present with proptosis and orbital pain. Mostly they are intraconal and retrobulbar and show calcifications within in some cases.

Orbital lymphangiomas[15] are benign hamartomatous malformations occurring in young age, involving extraconal compartment and present with proptosis. They are cystic and multilocular showing fluid-fluid levels due to hemorrhages within.

Orbital meningiomas[15] occur in middle aged adults and in children with NF2, with extraconal involvement from a sphenoid wing meningioma. Cavernous sinus meningiomas also can spread to orbit. Optic nerve sheath meningiomas are the intraconal lesions which do not spread intracranially like optic gliomas. They can show calcifications and hyperostosis and like hemangiomas, lymphangiomas and gliomas are best investigated by CT and MRI[15].

Orbital metastasis [15]account for about 10% of all orbital tumors and can involve bony orbits, globe, intraconal and extraconal compartment. Ca Breast and Ca Lung, followed by GI malignancies, Urinary tract malignancies, childhood neuroblastomas, leukemia and Wilm's tumor spread to orbits[15].

Non-Hodgkin Lymphoma[15] can involve orbits causing painless swelling with proptosis, commonly involving lacrimal glands and superior aspect of the orbits.

ii) Ocular tumors are basically divided into two groups, tumors in infants and children and tumors of adulthood[6,7,8,15,18].

1)Retinoblastoma occurs in children of age less than five years, seen involving posterior segment of eye ball with calcifications in tumor in

50% cases[6, 7, 8, 15, 18]. USG is important in retinoblastoma 1) to measure axial length of globe as only in retinoblastoma axial length is normal or increased 2) it is an excellent and cheap tool for follow up of treatment cases of retinoblastoma as chemotherapy is mainstay of treatment in lesions less than 10 mm size[6]. Enucleation is done as a last resort[6].

White pupillary reflex is also called as amaurotic cat's eye reflex[7]. B-scan in retinoblastoma helps to assess extrascleral spread as well as to detect optic nerve invasion[7]. If left untreated, retinoblastoma progresses through the same stages as in choroidal melanoma like, a) quiescent stage - from 6 months to a year b) glaucomatous stage c) extraocular spread of tumor d) metastatic stage[7].

2) Choroidal melanoma and choroidal metastasis[6, 7, 8, 15, 18] both occur in adulthood out of metastasis are more common in India[6]. Ca Breast in women and Ca prostate in men metastasizes to choroid[6]. Malignant melanoma of eye arises from choroid (85%) and from ciliary body (15%)[8]. A typical choroidal melanoma is a primary ocular tumor seen in adulthood showing bilobed, mushroom configuration arising from choroid and protruding into vitreous and revealing a waist in its midportion due to restricted growth by Bruch's membrane[8, 18]. The shape of tumor is also called as collar button shape, with some amount of choroidal excavation[8, 18]. Color Doppler study on B-scan reveals vascularity of the tumor. B-scan like in retinoblastoma helps to localize tumor and assess extraocular spread of tumor and involvement of optic nerve[7,8,18].

3) Choroidal hemangiomas[6] with presence of calcified phleboliths are seen as a dome shaped lesion in choroid usually associated with vitreous hemorrhage[6].

N.B.:- B-scan is first imaging modality of choice in suspected ocular tumors. CT and MRI help in further diagnosis and staging of tumors, and for decision of resectability and chemotherapy[6, 7, 8, 15, 18].

o) Other orbital and miscellaneous lesions:-

Orbital pseudotumor[15]

It is the most common cause of a painful orbit in adults, and is an idiopathic inflammatory disease involving any part of orbit, like extraocular muscles including myotendinous junctions. There can be lacrimal gland swelling and also involvement of retrobulbar fat. Tolosa Hunt syndrome indicates intracavernous spread of orbital pseudotumor. 25% cases of sarcoidosis show involvement of orbit in form of lacrimal gland, optic nerve, and extraocular muscles involvement. They present with acute uveitis, chronic dacroadenitis[15]. **[Figure 20]** Representative coronal CT cut in a patient shows classical orbital pseudotumor.

Tolosa Hunt syndrome is an idiopathic inflammatory disease of cavernous sinus and pathologically related to orbital pseudotumor, characterized by recurrent painful ophthalmoplegia with involvement of oculomotor nerve in superior orbital fissure[15].

Sarcoidosis is an idiopathic systemic Granulomatous disease causing infiltration of perineural tissues with compressive effects when it involves CNS[15].

Posterior scleritis is an inflammatory condition of sclera and shows thickening of posterior eye walls, sclera and choroid associated with edema in tenons space in retrobulbar space seen as T-shirt sign on B-scan[1-5]. It presents as acute loss of vision and is usually associated with anterior scleritis and uveitis. Clinically it presents with painful eye with redness and tenderness, photophobia and decreased visual acuity[1-5]. We found one case of posterior scleritis in a young male with dimness of vision with classical T sign on B-scan.

p) Ocular trauma[1-5,18]

It results from blunt trauma or penetrating injuries that can lead to vitreous hemorrhage, lens subluxation or dislocation and even lens fracture[1-5]. There may be loss of vitreous leading to rupture and shrinkage of globe with or without distortion of globe. PVD may result along with vitreous hemorrhage[1-5]. Sometimes penetrating foreign bodies like a wooden piece or a metallic rod may be seen crossing the eyeball[18]. Metallic foreign particles can be localized by B-scan and such particles show posterior reverberation artifacts. **Orbital blowout fracture**[15] result from direct blow to globe with fracture along inferior thin wall of orbit with trapdoor appearance and can involve inferior rectus muscle. Tripod and Le fort fracture can lead to orbital and globe injuries[15]. B-scan helps in identifying presence of retained intraocular foreign bodies (hidden location, small particles) as they lead to persistent uveitis if left undetected, especially in poor patient cooperation and opaque media.

Phthisis bulbi is an end stage ocular condition following ocular trauma and hemorrhage[18]. The eyeball is clinically blind, small, deformed and nonfunctional with extensive calcification[18].

q) Carotico-cavernous fistula are communications between the cavernous segment of the internal carotid artery and cavernous venous spaces, resulting from trauma or aneurysmal rupture, presenting with headaches, exophthalmos, ophthalmoplegia and vascular bruit[9, 11, 17]. Young men being more prone to trauma have high incidence of such fistulas. If left untreated it can lead to loss of vision. B-scan reveals dilated superior ophthalmic vein with arterial flow pattern with high velocities[9,11,17]. CT and MR study give better details. There is proptosis with glaucoma and presence of vascular bruit over eyeballs with prominence of episcleral veins[9,11]. High arterialized blood flow is seen in superior ophthalmic vein on color Doppler. MR angiography is diagnostic so also a color Doppler assisted B-scan[9, 11]. CT and MR demonstrate the enlarged cavernous sinus as well as dilated and tortuous superior ophthalmic vein. The treatment can be done by catheter angiography followed by embolisation of CCF by coiling[9, 11]. Article 9 & 10 in bibliography by same author shows a case of CCF in a young engineering student who developed symptoms of CCF after one year of a bike accident (RTA) and was detected on MR angiography and Bscan followed by successful treatment by embolisation with coiling in a IR setup in Pune. Bscan helped in primary diagnosis aided by Doppler.

r)Canalicular dacryolithiasis is stone formation in lacrimal system (lacrimal sac, nasolacrimal duct and canaliculus) occurring as sequelae of chronic infection of lacrimal sac[13]. It can be diagnosed by B-scan or CT scan. B-scan can be used as primary screening modality of choice being noninvasive, in addition to eliciting proper history and performing local examination[13].

s) Thyroid - associated orbitopathy (TAO)[15,19]

Swelling of extraocular muscles in both orbits due to deposition of mucopolysaccharides secondary to hyperthyroidism is termed as TAO or thyroid ophthalmopathy. The disease process involves only muscle bellies instead of myotendinous junctions leading to bilateral proptosis in women having usually Graves's disease, which reduces on steroid therapy. In TAO about 90 % cases are clinically hyperthyroid whereas rest are euthyroid. The condition is best diagnosed on CT but B-scan can help in primary assessment of condition.

t)Wilson disease is a rare autosomal recessive disorder characterized by degenerative changes due to deposition of copper in liver and brain (hepatolenticular degeneration) due to lysosomal defects in liver cells and associated with Kayser Fleischer ring(KF ring) in descemet layer of cornea[12]. KF ring is best seen on slit lamp examination[12]. B-scan as such has no role in diagnosis.

u) Optic nerve lesions:-

Optic nerve head drusen[1-5] are hyaline bodies (globules of mucoproteins and mucopolysaccharides) that progressively calcify in the optic disc. They are remnants of the axonal transport system of degenerated retinal ganglion cells. They cause blurring of optic disc margins on fundoscopy[1-5]. We found two cases of optic disc drusen one of which was bilateral.

Optic neuritis[15]

It occurs secondary to demyelination due to viral or autoimmune process, or may be part of multiple sclerosis. Other causes include ocular infection, toxic or metabolic degeneration, ischemia and meningoencephalitis. They present with ipsilateral orbital pain with eye movement and dimness of vision. Chronically it leads to optic atrophy which is best assessed by MRI but Bscan can help in primary assessment by measuring the optic nerve thickness of intraconal course.

Optic nerve gliomas[1-5,15]

They are low grade neoplasms (histologically juvenile pilocytic astrocytoma) occurring in young age group of 5 to 15 years and presenting with vision loss with or without proptosis. They typically cause elongation, enlargement and buckling of optic nerves with

enlargement of optic canal in some[15]. It may extend intracranially along optic pathway involving chiasm, optic tracts and optic radiations[15]. Bilateral tumors are seen in association with NF1. Hypothalamus can be involved in some cases[15]. [**Figure 21**]Axial CT image (borrowed) shows right optic glioma in young child.

Optic nerve sheath meningiomas arise from arachnoid rests in the meningeal coverings of optic nerves[15]. It presents in females usually in fourth decade with progressive loss of vision, typically showing tram track enhancement on post contrast CT study[1-5, 15]. In all gliomas and optic nerve lesions CT and MRI are more useful as compared to B-scan[15].

v) Retinochoroidal thickening is seen following intraocular infection, choroidal hyperemia, phthisis bulbi, endophthalmitis, nanophthamitis and trauma[1-5]. In the macular region, the normal retinochoroidal thickness is 1.7 mm; any values greater than 1.7 mm are abnormal. In regions other than macula, 1.2 mm thickness in cut-off limit. We found such 7 cases**. [Figure 10**]

CONCLUSION:-

Our present study highlights the efficacy of the B-scan in diagnosing and assessing the ocular pathologies with the help of a 7.5 MHz frequency probe in absence of small part convex probes with high frequency, especially in remotely situated tertiary setup like ours. The various spectrum of ocular pathologies presented in this study shows the reliability and usefulness of B-scan in performing real-time excellent quality imaging of eyes and orbits. It shows utility of ultrasound in presence of opaque media when fundoscopy is difficult. It helps in preoperative planning of various conditions like retinal detachment, cataractous lens, ocular trauma, tumours etc. It is a cost effective and feasible option in absence of other diagnostic modalities like CT and MRI scan. It is a preferred screening modality in extraocular lesions like preseptal lesions, retrobulbar lesions, etc. Ocular trauma can be assessed primarily by B-scan as MRI is contraindicated in situations like metallic foreign particles in eyes which can aggravate ocular trauma in MR gantry due to paramagnetic effect of MR magnet. The usefulness of B-scan in retinal detachment for treatment planning is already explained in relevant title in preceding pages. B-scan worldwide is accepted as a reliable, safe, cheap and rapid investigation.

Figure 1) Normal anatomy: B-scan reveals a normal eyeball with optic nerve passing through the retrobulbar fat. Posterior segment containing echolucent vitreous humour is seen. Posterior capsular echo of normal eye lens is seen anterior to clear posterior segment.

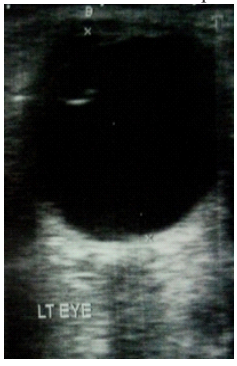

Figure 2) Cataract: B-scan reveals reflective material in lens substance and opaque lens with marked posterior capsular echo. This is a mature cataract.

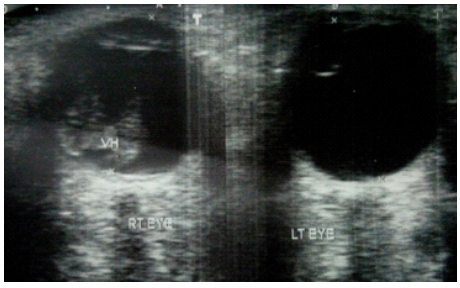

Figure 3) Organized vitreous hemorrhage in right eye seen on B-scan in a 65 years female having diabetes and hypertension , seen as heterogeneous echoes in vitreous with dynamic after movements. Normal left eye is shown for comparison.

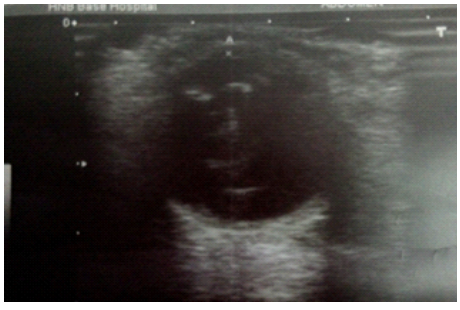

Figure 4) B-scan image showing a case of Pseudophakia with typical posterior reverberation artifacts from an intraocular lens (IOL).

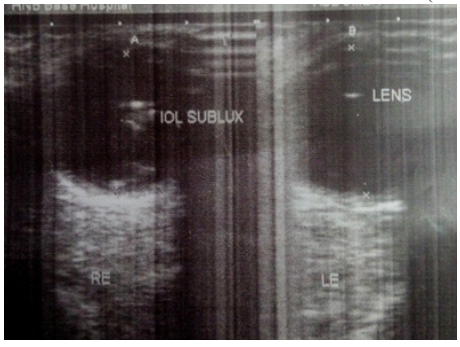

Figure 5) Traumatic fracture of IOL in a 48 year old man showing echogenic fragments of subluxated intraocular lens scattered in vitreous humour. Normal left eye is shown for comparison.

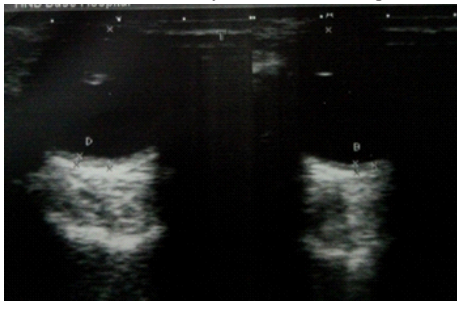

Figure 6) Immature cataract on right side with midsubstance echoes in lens and clear vitreous seen on B-scan with normal lens showing normal posterior capsular echo on left side for comparison in same patient.

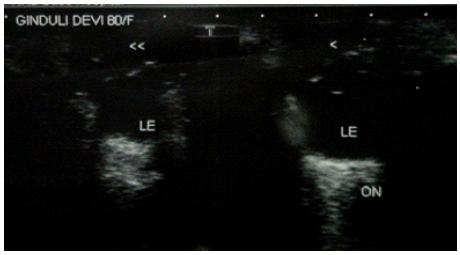

Figure 7) B-scan in a 80 year old lady having echopoor left preseptal lid swelling indenting on globe without any ocular invasion.

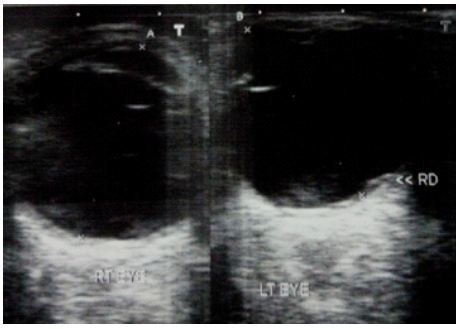

Figure 8) B-scan in a 28 year male patient showing partial retinal detachment in left eye along posterior pole on temporal aspect with detached retina of length of 18 mm. Normal right eye is seen.

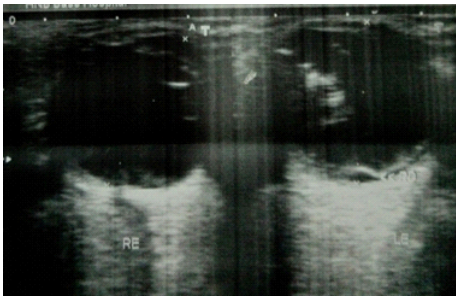

Figure 9) Another case of partial RD in left eye with IOL in situ showing posterior reverberation artifacts and detached retina posteriorly. Normal right eye is seen.

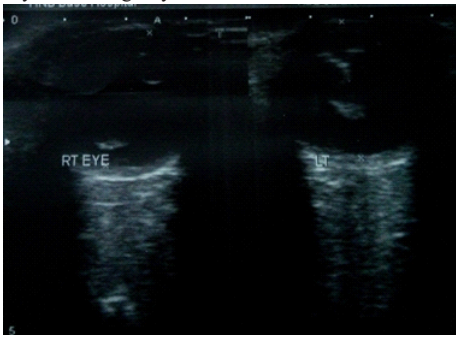

Figure 10) Bilateral retinochoroidal thickening on B scan seen in both eyes with posterior vitreous detachment in left eye. Organized vitreous hemorrhage on right side noted.

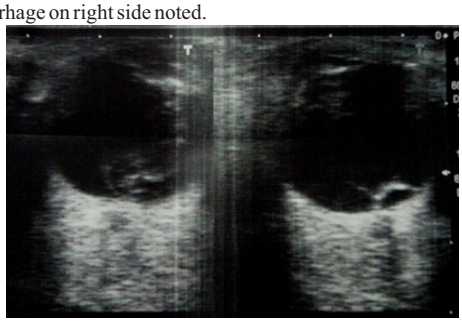

Figure11) Partial RD seen on B-scan as a posterior dome shaped linear structure with a limb attached to optic nerve head. Internal echoes with linear density are seen in vitreous due to organized hemorrhage with IOL seen in situ.

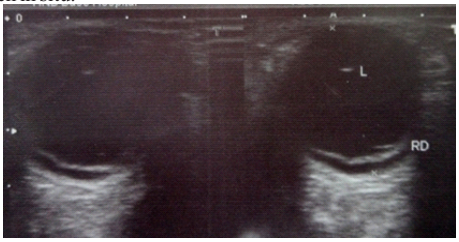

Figure 12) Partial RD prominently seen as detached membrane along posterior half of eyeball, it was inferotemporal in location.

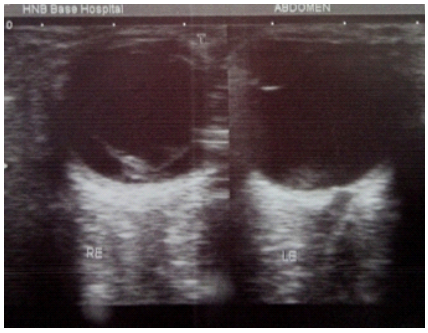

Figure 13) Total RD in 19 years male in right eye showing typical sonographic features of funnel shaped detached retina. In addition vitreous floaters and cataractous right eye lens was seen in other sections.

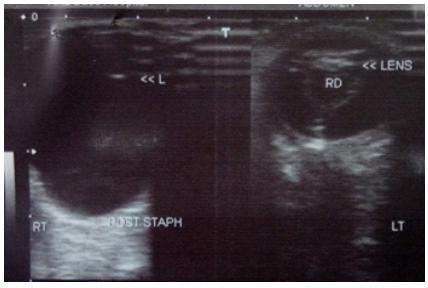

Figure 14) Interesting case on B-scan of 19 year female having small left eye, dense calcified left eye lens, thick organized total RD seen as thick funnel like membrane and associated optic nerve head drusen. Right eye showed increased axial length (26.1 mm as opposed to 17 mm on left) with posterior staphyloma, early Cataractous lens, vitreous floaters, and slightly thick Retinochoroidal layer. Optic nerve head drusen was also seen.

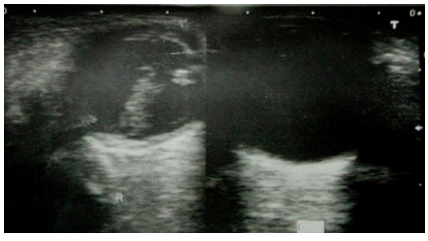

Figure 15) PHPV is seen on B-scan of young patient with thick retrolental membrane with organized RD extending upto posterior pole of right eye which is microphthalmic. Right eye is myopic and shows clear vitreous and lens.

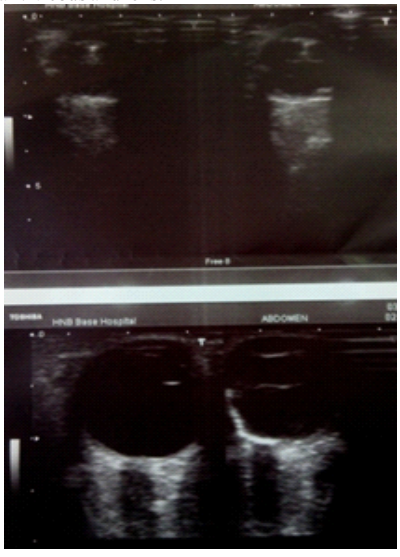

Figure 16) Normal right eye on B-scan, but on left side, there is aphakia with reduced axial length of globe and partial scleral calcification going into Phthisis bulbi formation, may represent sequelae of ocular infection.

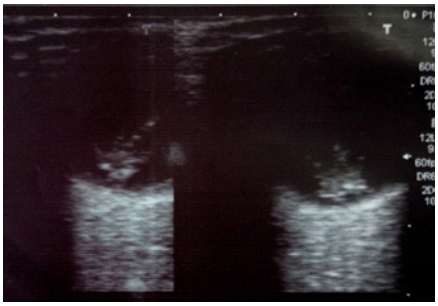

Figure 17) Vitreous hemorrhage (organized) seen on B-scan of 63 year male.

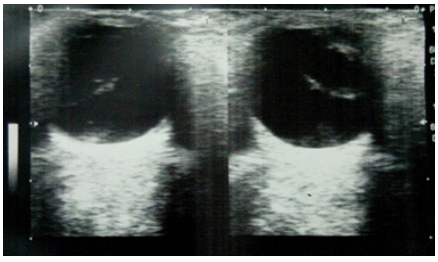

Figure 18) Classic features of Posterior vitreous detachment (PVD) seen in elderly male showing mirror image configuration of detached coagulated vitreous when eyeball is moved to one side and towards opposite side.

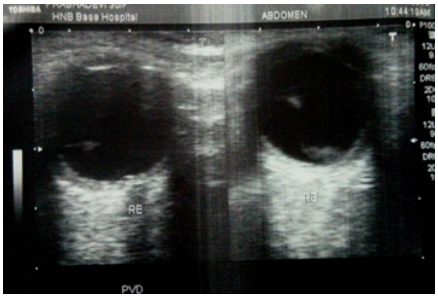

Figure 19) Another case of PVD in right eye in a thirty year female on B-scan.

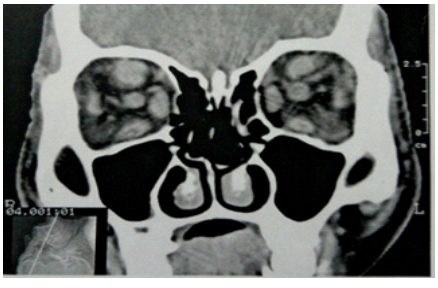

Figure 20) Coronal CT image (borrowed image from my collection from my previous institution) of both orbit showing thick extraocular muscles with haze in retrobulbar fat bilaterally, suggesting orbital pseudotumor, close differential is orbital cellulitis.

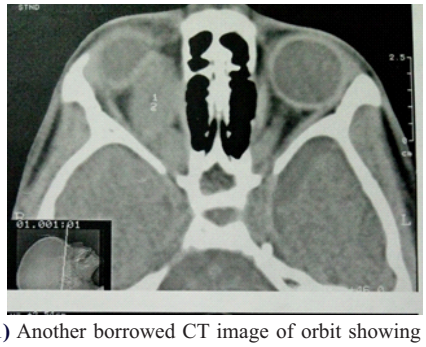

Figure 21) Another borrowed CT image of orbit showing a typical optic nerve glioma on right side with enlarged, elongated and buckled right optic nerve, normal optic nerve is seen on left side. This was axial CT image of a child.

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