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Evaluation of Orbital and Ocular Lesions on Sonography

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Abstract: *Loss of sight ranks second or third in people's perceptions after the most feared conditions of cognitive loss or cancer, hence importance for early diagnosis and treatment is required in which radiology plays important role.Ultrasonography is a simple and cost effective tool in investigating eye symptoms. It provides a detailed cross sectional anatomy of the entire globe. It is a rapid, non ionizing, cost effective imaging modality and provides real time display of the moving organ. It can be performed on outdoor patient without any use of anaesthetics or sedative therapy.*

I. Introduction

The superficial location of the eye and its cystic composition make ultrasound ideal for imaging the eye. It is a simple, non ionizing, cost effective, real time imaging modality providing detailed cross sectional anatomy of the entire globe[1]. It can be safely performed in outdoor patient without any use of anaesthetics or sedative therapy. It is non hazardous, atraumatic and invaluable in the evaluation of orbito- ocular lesions, especially in the presence of opaque media. Vitreoretinal diseases, ocular inflammatory diseases and intraocular masses can be effectively diagnosed using sonography .Ultrasound is also of great help in the assessment of the orbit, outside the globe[2]. Ultrasound contributes more to tissue diagnosis due to its high spatial and temporal resolution compared to CT or MRI[3]. Ultrasonography helps us to establish kinetic properties of the tumours such as its consistency and vascularity (with the help of colour Doppler). Colour Doppler flow imaging (CDFI) helps in the diagnosis and follow up of space occupying lesions of the orbit.[4]

Aims And Objectives: To evaluate the Sonographic findings in suspected orbital and ocular lesions and to Correlate with advanced imaging modalities (CT / MRI) and surgery were done as necessary

II. Materials And Methods

A prospective correlation study was conducted in a tertiary care centre,MEERUT over a period of two years 59 eyes of 52 patients with symptoms related to eye and orbit. Patients with clinically suspected orbital and ocular lesions with positive Sonographic findings and Ocular trauma were included in the study. Patients presenting with ocular complaints with absent findings on sonography and all the patients lost to follow up were excluded from the study using ACCUVIX SAMSONITE ultrasound system using linear high frequency probe (5 to 17 MHz). The patient was positioned supine with head slightly turned to the opposite side. The eye was kept closed during the examination and adequate amount of gel was applied on the closed eyelid Static scans were performed in transverse and sagittal planes and dynamic scans during eye movements after instructing

the patient . Higher imaging modalities (CT) were employed where necessary and findings were correlated with Surgery andhistopathologicallywhereas few patients were followed up conservatively. Final diagnosis was made based on these findings and compared with the ultrasonographic diagnosis.

III. Results

In our study most of the patients were in5th decade (36.6%)withmale predominance With predilection for involvement of right eye (46.2%)was noted with13.5% of cases having bilateralinvolvement. The presenting complaints were predominantly diminished vision(21%) followedby trauma(14%). Our cases are predominantly of intraocular (86.5%) pathology compared to extraocular lesion. The most common etiology being trauma(23%) followed by degenerative lesion(17%). Inflammatory lesions are 7 out of 52 and neoplasm was noted in 3 extraocular pathology and 1intraocular pathology. Common estocular pathology in our study wasretinaldetachment (26.7%) followedbycataract(20.0%). Out of 7 extraocular cases, 3 were extraocular cysticercosis in our study.The distinction between ocular and extraocular pathologies was made in 100% of cases. Out of 52 cases, 50 cases were diagnosed correctly on USG.The overall sensitivity, specificity, PPV, NPV and accuracy ofultrasound for the diagnosis of ocular pathologies were 95.5%, 100%, 100%, 77.8% and 96.2 % .

The distinction between ocular and extraocularpathologies was made in 100% of cases.

IV. Discussion

OCULAR PATHOLOGIES:

Cataract: of the 9 cases of cataract , all cases were correctly diagnosed by ultrasound which showed echoes in the anterior and posterior cortex of lens. The sensitivity and specificity being 100% and 93% respectively with an accuracy of 94.2%.

Vitreous haemorrhage: all the three cases were diagnosed on ultrasound . Ultrasound was 100 % sensitive, 89.8 % specific and 90.3 % accurate in diagnosing VH. OP Sharma found ultrasound to be 97 % sensitive for diagnosing VH[5]

Retinal detachment: Retinal detachment was the commonest diagnosis in our study. Ultrasound was found to be quite accurate in diagnosing almost all cases (10 out of 11) of RD in our study. It also formed an important tool in following up these cases. The sensitivity & specificity in our study are 90.9% & 95.1% respectively with a diagnostic accuracy of 94.2%. Jemeld B et al., found US to be 78 % accurate whereas Rabinowitz R et al., found US to be 100 % accurate in diagnosing RD.[6,7]

Posterior Vitreous Detachment and Vitreous Floaters: All 5 cases of Vitreous Detachment and 3cases of VF were correctly diagnosed by ultrasound. Rashmi et al found PHPV to be 100% specific and sensitive on usg.[8]

Retinoblastoma: one case of RB was in the first decade in our study and were correctly diagnosed by ultrasound.Zilelioglu G et al., in his study found US to be accurate in diagnosing 87.12% of retinoblastoma[9]

Panophthalmitis: one case of panophthalmitis was correctly diagnosed ultrasonically which showed heterogeneous echoes in vitreous cavity with scleral thickening andincreased colour flow signal, in patients presenting with pain, loss of vision and fever.

Phthisis Bulbi: 1 case of Phthisis bulbiwere correctly diagnosed by ultrasound which showed deformed collapsed globe with curvilinear calcification of the wall of globe.

EXTRAOCULAR PATHOLOGIES:

Hemangioma: one case of cavernous hemangioma were noted in our study in second decade. Ultrasound was 100 % sensitive, 100 % specific and 100 % accurate in diagnosing haemangioma in our study. Rashmi et al concluded hemangioma to be 75.9% sensitive and 99.5% specific.[8]

ExtraocularCysticercosis: 2 cases presented with localized swelling in periocular region, ultrasound revealed solitary cystic lesion with eccentric echogenic scolex in one of the extraocular muscle. Ultrasound was able to diagnose both the cases correctly with a sensitivity of 100%. In the study conducted by rashmi et al, she concluded extraocularcysticercosis to be 100% sensitive and specific on usg.[8]

Lacrimal gland pleomorphic adenoma: 1 male patient, presented with a local swelling in the supero-lateral aspect of orbit and proptosis. Ultrasound showed these lesions to be acoustically "solid" involving the lacrimal gland and showing signal on colour Doppler.In the study conducted by rashmi et al, she concluded LGPA to be 100% sensitive and specific on usg.[8]

Squamous cell carcinoma: An elderly male patient presented with painless swelling in upper eyelid. Ultrasound showed a solid well defined irregular swelling in upper eyelid showing internal vascularity. Location and ultrasonographic features favoured diagnosis.

Pre-septal cellulitis with lid abscess: A 3 year old male patient presented with diffuse swelling involving upper eyelid associated with severe pain. Ultrasound revealed an irregular heterogeneous collection in the upper eyelid with internal echoes and adjacent inflammatory edema.

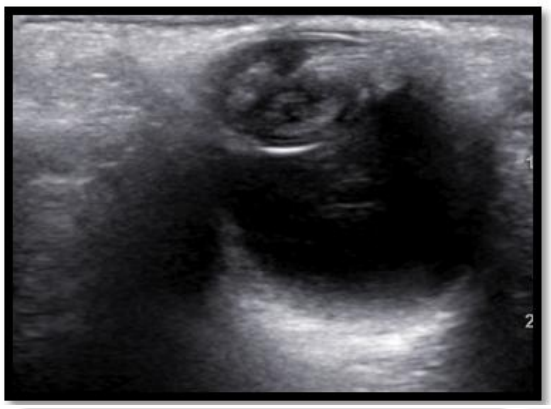

FIG 1: Catract: Echogenic foci in anterior and posterior cortex of the lens parenchyma

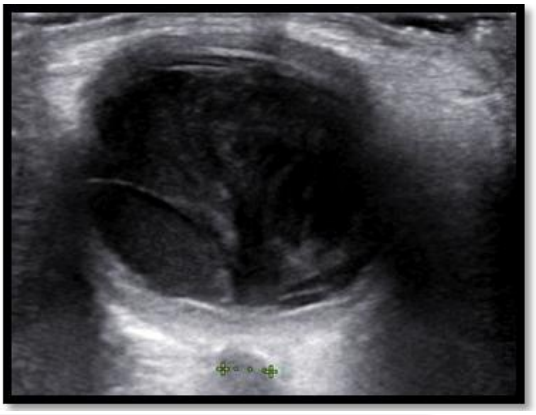

FIG11: Choroidal detachment: echogenic dome shaped membrane seen lifting the choroidal laver

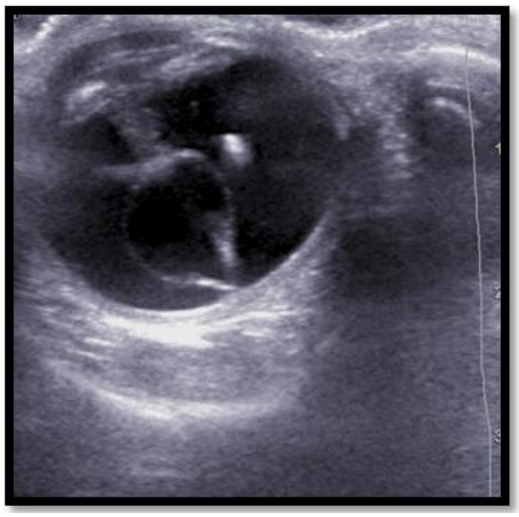

FIG2: A&B: Dislocated lens in the vitreous cavity.

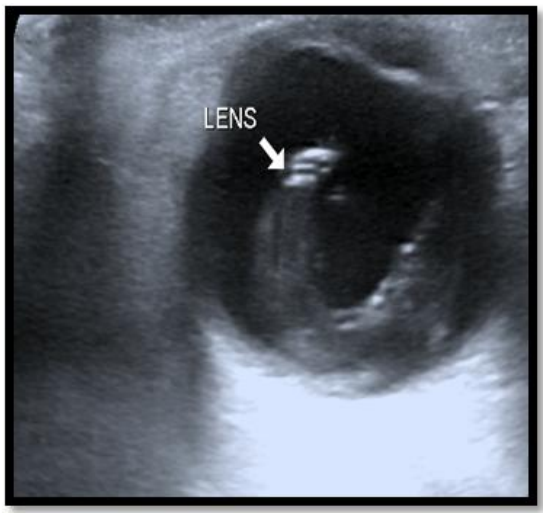

FIG 3: *foreign body in the vitreous cavity with reverberation artifact*

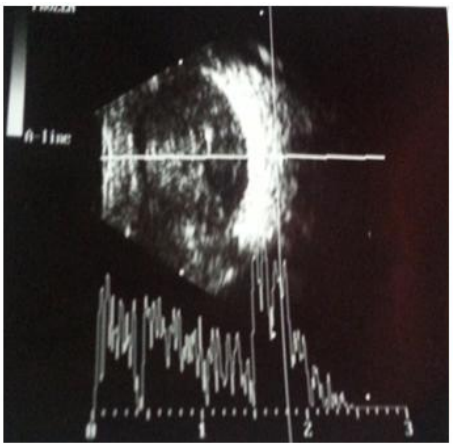

FIG 5: A Scan Showing Peak In The Vitreous Cavity in PHPV

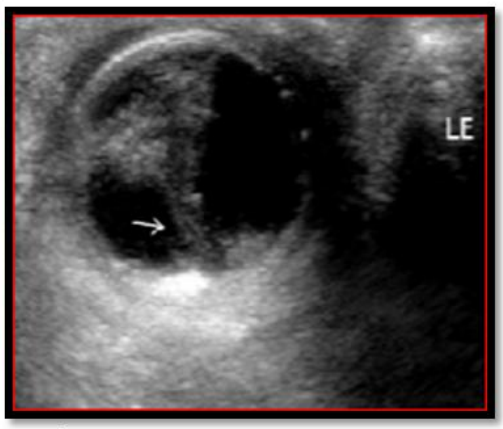

FIG6: Persistent Hyperplastic Primary Vitreous: Irregular Echogenic Structure Extending From The Optic Disc To Posterior Surface Of Lens With Doppler Signal From Posterior Hyaloid Artery With In.

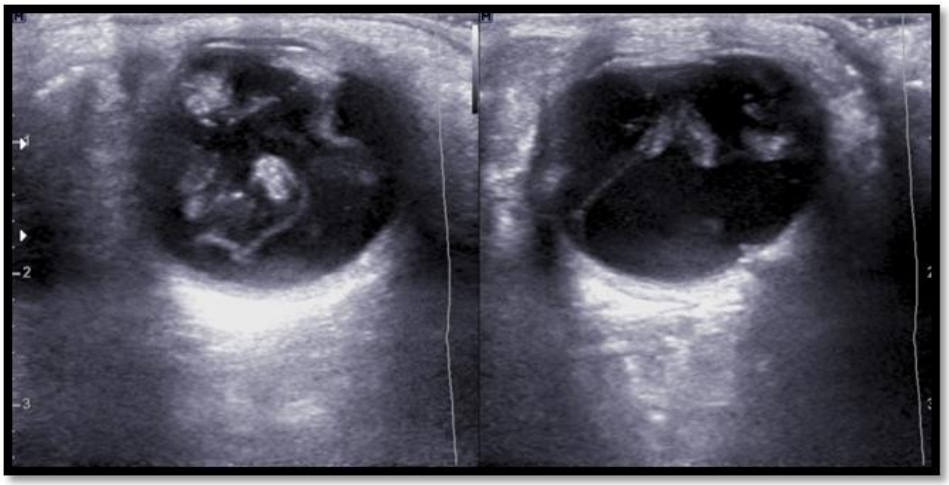

FIG 8: Vitreous hemorrhage-echogenic floating membranes.

FIG9: Retinal detachment: well defined thick echogenic v-shaped retinal folds attached to optic disc and oraserrata

FIG 10: T2WI reveals retinal detachment: well defined thick hypointense v-shaped retinal folds attached to optic disc and oraserrata

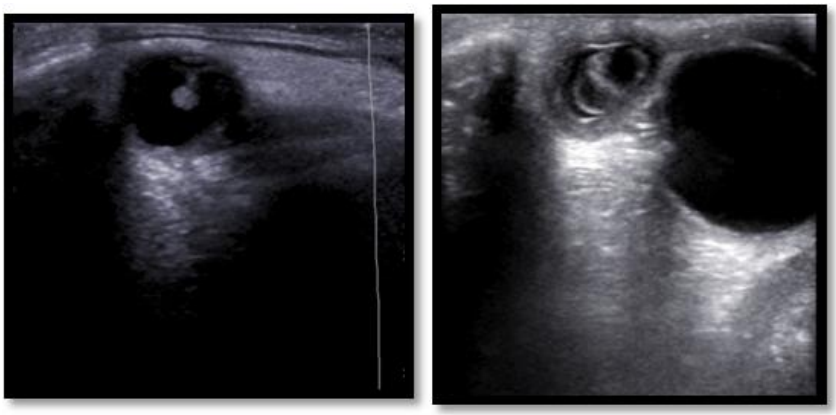

FIG 13A&B: Cysticercosis Well Defined Cystic Lesions With Ecenteric Echogenic Nodule Representing Scolex, In The Extra Ocular Muscles.

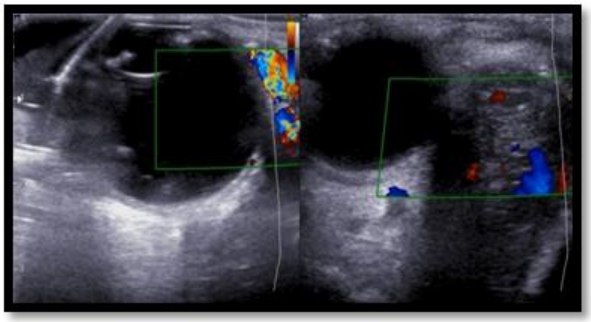

FIG 14 A&B: Hemangioma: fairly defined hypoechoic lesion involving extraconal and intraconal space of orbit with high vascularity within

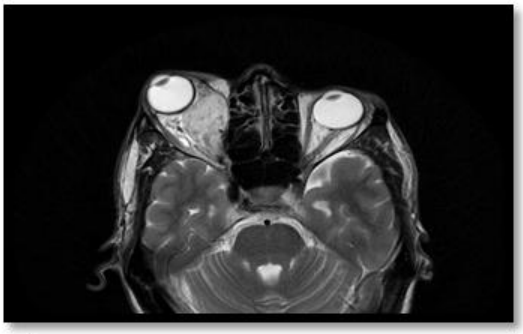

FIG 15: T2WI image showing well defined heterogeneously enhancing lesion.

Distribution Of Primary Diseases:

Table 1: Distribution of primary disease condition among patients in the study. (N = 52)

Primary Disease Condition		Number	Percentage in group
Intra-ocular disease conditions (N = 45)	Retinal Detachment	12	26.7 %
	Cataract	9	20.0 %
	Vitreous Detachment	5	11.1 %
	Foreign Body	3	6.7 %
	Posterior Vitreous Detachment	3	6.7 %
	Vitreous Hemorhage	3	6.7 %
	Choroidal Detachment	2	4.4 %
	Dislocated Lens	2	4.4 %
	Vitreous Degeneration	2	4.4 %
	Posterior Capsule Rupture	1	2.2 %
	Phthisis Bulbi	1	2.2 %
	Retinoblastoma	1	2.2 %
	Retinopathy of Prematurity	1	2.2 %
Extra-ocular disease conditions (N = 7)	Cysticercosis	2	28.6 %
	Cellulitis	1	14.3 %
	Conjunctival Cyst	1	14.3 %
	Hemangioma	1	14.3 %
	Pleomorphic Lacrimal Gland Adenoma	1	14.3 %
	Squamous Cell Carcinoma	1	14.3 %

Table 2: Sensitivity, specificity and accuracy of USG according to Primary Diagnosis. (N = 52)

Primary Diagnosis	**USG findings**		
	Sensitivity	**Specificity**	**Accuracy**
Cataract	100.0%	93.0%	94.2%
Cellulitis	100.0%	98.0%	98.1%
Choroidal Detachment	100.0%	100.0%	100.0%
Choroidal Tuberculoma	0.0%	100.0%	98.1%
Conjuctival Cyst	100.0%	100.0%	100.0%
Cysticercosis	100.0%	100.0%	100.0%
Dislocated Lens	100.0%	100.0%	100.0%
Foreign Body	100.0%	100.0%	100.0%
Haemangioma	100.0%	100.0%	100.0%
PCR	100.0%	100.0%	100.0%
PLGA	100.0%	100.0%	100.0%
PVD	100.0%	97.9%	98.1%
Phthisis Bulbi	100.0%	100.0%	100.0%
Retinal Detachment	90.9%	95.1%	94.2%
Retinoblastoma	100.0%	100.0%	100.0%
ROP	100.0%	100.0%	100.0%
SCC	0.0%	100.0%	98.1%
Vitreous Detachment	100.0%	89.4%	90.3%
Vitreous Degeneration	100.0%	84.0%	84.6%
Vitreous Haemorrhage	100.0%	89.8%	90.3%

PCR=PosteriorCapsular Rupture, PLGA = Pleomorphic Lacrimal Gland Adenoma, PVD Posterior Vitreous Detachment, ROP = Retinopathy of Prematurity, SCC = Squamous Cell Carcinoma

Table 3: Showing sensitivity (%),specificity(%), PPV(%) and NPV(%) of sonological diagnosis.

PARAMETER	**SONOLOGICAL DIAGNOSIS**
SENSITIVITY	95.5%
SPECIFICITY	100%
PPV	100%
NPV	77.8%
ACCURACY	96.2%
P-VALUE	1

Comparison With Other Studies

In OP Sharma's study[5]**,** it was documented thatUltrasound was 100 % effective in differentiating intra and extraocularpathologies with 97 % accuracy for diagnosing VH, 99 % for RD

and 100% for lacrimal gland and optic nerve tumours**.** Rashmi et al[8]noted the overall sensitivity, specificity, PPV, NPV and accuracy of ultrasound for the diagnosis of ocular pathologies as 94.2 %, 98.8 %, 99.1 %, 92.2 % and 94.9 % (p- value < 0.0001) respectively compared to 62.5 %, 98.8 %, 98.7 %, 64.8 % and 62.7 % for ophthalmoscopic examination.Nzeh DA et al[10]in their study found RD to be the commonest intraocularpathology and retinoblastoma formed the commonest intraocular neoplasm.Ultrasound was 93 % sensitive and 99 % specific in diagnosing oculo-orbital lesions.There was 88.6 % agreement between clinical and ultrasonographic diagnosis.

Scott IU et al., found 96% correlation between final clinical or pathological diagnosis and ultrasonographic diagnosis in their study .Zhang w et al[11]., examined 288 cases with orbital diseases by using the technique of CDI ultrasound and concluded that CDI can provide the information of colour blood flow in orbital diseases, especially the tumours with rich vascular tissue and orbital vascular diseases, in combination with B-mode ultrasound, CT or MRI .Hafiz MA et al[12], studied 50 cases with B-scan and found it to be significantly accurate in diagnosing orbital masses including neoplastic and inflammatory conditions. ParchandS et al[13]., studied 130 patients and found ultrasound to have overall sensitivity and specificity of 92.31% and 98.31% for identification localising and characterising orbital pathologies. Further evaluation with higher cross sectional imaging modalities (CT) were indicated in certain cases; for evaluation of bony involvement, extension to adjacent structures and intracranial extensions. Surgery and histopathology (as applicable) formed gold standard for the diagnosis in few cases. Ultrasound diagnosis correlated very well with the final diagnosis established by higher modalities and histopathology. It thus formed a major basis for management decisions in significant number of cases.Glasier CM et al[14]., examined 26 infants and children with orbital and ocular pathology with ultrasound and concluded that high resolution US examination of the eye and periorbital tissues is readily performed using widely available equipment and often delineates subtle structural abnormalities not shown by CT or MRI . JA Fielding[15] in their study found ultrasound to be 92% sensitive in diagnosing intraocular pathologies .Itani KM et al[16]., found ultrasound to be 100% successful in diagnosing orbital mass . Ferrer E et al[17]., studied 79 ocular diseases in 52 patients and concluded ophthalmic ultrasonography as an important adjuvant for the clinical assessment of various ocular and orbital diseases .

LIMITATIONS OF ULTRASOUND: The major limitation of USG is its high operator dependence, requiring skills and knowledge of trained personnel. There can be difficulty in performance in cases with gross proptosis. US is also less sensitive for identification of calcification, bony involvement, extension to adjacent structures and brain.

V. Summary And Conclusion:

The distinction between ocular and extraocular pathologies was made in 100% of cases in the present study, highlighting the efficacy of high frequency ultrasound in localizing orbital lesions. Ultrasonography had overall high diagnostic validity and accuracy in localising and characterising orbital pathologies. Further evaluation with higher cross sectional imaging modalities (CT) were indicated in certain cases; for evaluation of bony involvement, extension to adjacent structures and intracranial extensions. Surgery and histopathology (as applicable) formed gold standard for the diagnosis in few cases. Ultrasound diagnosis correlated very well with the final diagnosis established by higher modalities and histopathology. It thus formed a major basis for management decisions in significant number of cases.

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