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Role of B scan ultrasonography in evaluating orbital pathology

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Abstract
Introduction*:Ophthalmic ultrasound is performed when opaque media prevent direct visualisation of the ocular fundus opthalmoscopically. Intraocular and extraocular structures are to be visualized or to measure the axial length before cataract surgery. The present study was undertaken to evaluate the role of B-scan in evaluation and characterization of orbital diseases.*
Methodology: *We performed a cross-sectioned study of all patients who presented with suspected orbital diseases in Department of Ophthalmology and were referred for ultrasonography to Department of Radiodiagnosis, Dr.Rajendra Prasad Government Medical College, Kangra at Tanda. Himachal Pradesh from May 2016 till April 2017. Ultrasonographic diagnosis was made with general purpose ultrasound machine (GE Logiq P5) using linear high frequency probe (7.5 to 10 MHz) in conjunction with clinical and historical data.*
Results:*In the present study 69 patients were included. The three most common orbital pathologies found were retinal detachment , vitreous disorders and cataract . Among vitreous disorders, vitreous haemorrhage was the most common, showing dot like echoes, membranes or both on B scan. All retinal detachment patients showed funnel shaped membrane attached to optic disc posteriorly and oraserrata anteriorly on B scan. In cataractpatientstraumatic, senile andcongenitaletiology was seen. In the miscellaneous group optic nerve head drusens, choroidal detachment, fibro vascular lesions ,endophthalmitis, orbital cysticercosis and anterior chamber edema including iritis and ciliary muscle hypertrophy was visualized on B scan.*
Conclusions: *Despite the increased use of cross-sectional imaging for orbital diseases. B-scan ultrasonography still has a valuable role because of its ease, portability and economic feasibility.*
Keywords:*diagnosis, orbit, ultrasonography,vitreal disorders*

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I. Introduction

Despite recent improvements in ophthalmologic examination techniques, evaluation of vitreoretinal disease often presents a diagnostic difficulty for ophthalmologists. Opthalmic ultrasound is performed when opaque media prevent direct view of the ocular fundus and periphery, intraocular and extraocular structures are to be visualized or to measure axial length before cataract surgery.[1]The superficial location of eye, its cystic composition makes sonography ideal for imaging the eye. Additionally eye can be examined dynamically during eye movements, which has significant value in localizing abnormalities. It is also useful for outpatient clinical and preoperative evaluation of vitreous opacities including asteroid hyalosis, synchysisscintillans, inflammatory debris, membranes such as seen in retinitis proliferans and vitreoretinal traction, foreign bodies, and organized blood. Ocular trauma, particularly that resulting from lacerating or penetrating injuries, usually results in immediate opacification of the ocular media. Ultrasonography helps in detection and in the localization of both radio-opaque and non radio-opaque intraocular foreign bodies. In addition ultrasonography can be used for evaluation of ocular coats and for assessment of the associated soft tissue damage, such as vitreous hemorrhage or retinal detachment.

B-mode (brightness mode) is 2-dimensional imaging, which is used to characterize ocular structures. Changes in tissue medium reflect sound and generate gray-scale images.[2]

B-scan USG is cost-effective, which is an important consideration in the rural setting. In addition, it is non-invasive and easily available and the results are reproducible.[3]The present study was undertaken to evaluate the role of B-scan in evaluation and characterization of orbital diseases.

II. Methodology

Study Design and Setting

We performed a cross-sectioned study of all patients who presented with suspected orbital diseases in Department of Ophthalmology and were referred for ultrasonography to Department of Radiodiagnosis, Dr.Rajendra Prasad Government Medical College, Kangra at Tanda. Himachal Pradesh from May 2016 till April 2017. The study was carried out after approval of institutional protocol review committee, institutional ethics committee and after informed written consent from patient.

Sample population

We included all patients with clinical suspicion of orbital lesions and presented clinically with pain, trauma, mass, complete loss of vision and diminished vision. We excluded patients with active ocular discharge, not willing to participate in the study and therefore refused consent.

Data Collection and Data Analysis

After obtaining informed written consent of the patient, we collected patient related historical and clinical information from the patient and the clinical records of the patient. We recorded the information using a predesigned semi-structured proforma. Ultrasonography of the orbit was performed with general purpose ultrasound machine (GE Logiq P5) using linear high frequency probe (7.5 to 10 MHz). The patient was positioned supine with head slightly turned to the opposite side. The eyes were kept closed during the examination and adequate amount of sterile gel was applied on the closed eyelid. Scans were performed in transverse and sagittal planes and dynamic scans during eye movements after instructing the patient when indicated. Examinations were performed in a consistent manner by ensuring thorough and accurate observation of all parts of the globe and orbit.Basic screening was performed initially at high gain setting (i.e., 80 dB) to detect weaker echoes followed by examination under lower sensitivity. The contralateral normal eye was used as control to provide optimal grey scale information.Ultrasonographic diagnosis was made based on various sonological features including (location, acoustic characteristics, kinetic properties and Doppler flow dynamics), studied in conjunction with clinical data. Collected information was codified in Microsoft excel and analysed in EPI Info statistical software. We described the data using frequency tables.

III. Results

In the present study 69 patients were included. There were 48 males and 21 female. The age of the patients ranged from 5 months to 85 years. The maximum number of patients 29 were in the age group 21-40 years (Table 1). Right eye was involved in 32 and left eye was involved in 32 patients and bi-lateral eyes were involved in 5 patients. The three most common orbital pathologies found were cataract, retinal detachment and vitreous disorders (Table 2). Six patients did not demonstrate any orbital pathology on b-scan. Among the patients with vitreous disorders, two most common finding were vitreous haemorrhage, followed by vitreous degeneration and vitreous detachment. Three patients showed dot like echoes, five showed membranes and two showed combination of above two findings.Half of all patients with retinal detachment had tractional retinal detachment, and other half showed exudative retinal detachment. B-Scan findings common to all retinal detachment patients were funnel shaped membrane attached to optic disc posteriorly and oraserrata anteriorly and was seen in all 14 patients . We combined Dynamic scan with B-Scan in all patients. No movements on dynamic scan were seen in three patients and movements were seen on dynamic scan in six patients. Additional findings of sub retinal collection was seen in four patients and one patient showed cyst formation within the detached retinal membranes. Choroidal melanoma, hemangioma and other tumor like condition was seen in one patient each.Out of 15 patients with cataract 8 patients had traumatic cataract, 6 patients had senile cataract and one had congenital cataract. The most common pathology in patients placed under miscellaneous group were optic nerve head drusens (28%) followed by choroidal detachment, fibro vascular lesions and endophthalmitis (18 % each), then orbital cysticercosis and anterior chamber edema including iritis and ciliary muscle hypertrophy (11.1%). B scan findings of patients with cataract and those placed in miscellaneous group are explained in Table 2.

IV. Discussion

Clinical examination and ophthalmoscopy forms the basis of diagnosis in majority of patients with eye disease. However, in many cases ultrasound becomes an important tool, especially when clinical examination of the ocular fundus is difficult. In addition to its specific role in certain conditions, ultrasound is a safe, cheaper and more affordable imaging modality as compared to other imaging techniques. Ultrasonography does not involve the contraindications such as presence of metallic items, claustrophobia that may make us use other expensive and difficult to access imaging techniques. With a good indication and using a proper technique it is possible to gather information which is otherwise not possible with clinical examination alone. In addition to the

A-mode technique, the B scan provides a good anatomical background.[4] While the A-mode technique can be used for intraocular lens measurements and for differential diagnosis in suspected melanoma, B scan is the most used technique because of its higher sensitivity and specificity. Moreover, B scan is helpful when the vitreous chamber and the retina are not visible orwhen better visualization of the posterior segment of the eye is required.

Ultrasound is frequently used to differentiate malignant from benign lesions, as the consistency of lesions helps to determine that. While most of the choroidal pigmented lesions are benign nevi, some of these may undergo malignant degeneration and become melanomas.[5] Furthermore, flat nevi and elevated pigmented choroidal lesions are most likely benign, however, there is a concern of it evolving into a malignant melanoma. In such cases, serial ultrasound is helpful and to see if there is any growth over time. In general, melanocytic lesions thicker than 2.5 to 3.0 mm are highly suspicious for being neoplastic.[6] The resolution of ultrasound, therefore makes it a preferred modality for assessingsuch ocular lesions over computed tomography (CT) or magnetic resonance(MR) imaging. Furthermore, for visualizing optic nerve and orbit, ultrasound has certain advantages over CT and MR imaging. This is in particular true when assessing the optic nerve for calcification (as seen with optic nerve drusen), as ultrasound is more sensitive in visualizing buried optic nerve drusen.[7] Although CT scans may detect optic drusen, it can be missed between the cuts. Moreover, superimposed papilledema may make it difficult to ascertain drusen.[8]Because sound does not penetrate into the orbits deep enough, CT and MR imaging are in general superior to visualize orbits as compared to ultrasound. These modalities are also better choices when assessing for an orbital mass or extension to adjacent sinuses.

V. Conclusion

Ultrasonography is an important imaging tool which can be used to diagnose a variety of conditions affecting the globe and orbit. It requires familiarity of ocular anatomy and techniques. Vitreous disorders and retinal detachments were among the commonest pathological conditions encountered during B scan. Dynamic B-Scanultrasonography is a special feature which can be useful in detecting retinal detachment in setting of vitreous hemorrhage.Despite the increased use of cross-sectional imaging like CT and MRI for orbitaldiseases, B scan ultrasonography still has a valuable role because of its ease, portability and economic feasibility. Further research is required with larger sample size to support the results of our study.

Table 1. Demographic profile of the patients (n=69)

Age distribution	
Less than 20 years	11
21-40 years	29
41-60 years	13
More than 60 years	16
Gender distribution	
Males	48
Females	21
Side of eye involved	
Right	32
Left	32
Both	5

Table 2. Ultrasound B scan findings of various orbital pathology in our patient population

Pathology	**N**	**B scan findings**	**N**
Vitreous disorders (n=14)			
Vitreous hemorrhage	10	Dot Like Echoes	3
Vitreous degeneration	3	Membranes	5
Vitreous detachment	1	Combination Of Above	2
Retinal detachment (n=14)			
Tractional retinal detachment	7	Funnel shaped membrane attached to optic disc posteriorly and oraserrata anteriorly	14
Exudative retinal detachment	7		
Tumor or tumor like conditions (n=3)			
Choroidal melanoma	1	Nodular dome shaped lesion protruding into vitreous with internal vascularity on color Doppler	1
Hemangioma	1	Heterogeneous mass superior and lateral causing mild compression on eye	1

Other tumor like condition	1	ball with vascularity seen on color Doppler Isoechioc lesion with calcifications seen in vitreous (non specific)with additional choroidal detachment	1
Foreign body (n=6)			
Intraocular Extraocular	2 4	High reflective focus with dense acoustic shadow (metallic foreign body) Reflective focus without acoustic shadow (non-metallic foreign body)	2 4
Cataract with lens dislocation (n=15)			
Congenital Cataract	1	Hyperechoic lens	1
Senile Cataract	6	Hyperechoic lens	6
Traumatic Cataract	8	Hyperechoic lens post trauma	8
Miscellaneous (n=11)			
Endophthalmitis with exudates	2	Vitreous opacification due to diffuse vitereal echoes and membranes with thickened and ill defined RCS complex	2
Choroidal detachments	2	Echogenic membranes in vitreous cavity approaching the midline and sparing the optic nerve head posteriorly and extending beyond ora-serrata anteriorly	2
Orbital cysticercosis	1	Hypoechoic foci in medial rectus muscle with central hyper echoic foci no vascularity on Color Doppler seen	1
Optic nerve head drusen	3	Calcification in the optic nerve head	3
Fibro vascular lesions	2	Heterogeneous lesion predominantly hypoechoic	2
Anterior chamber edema	1	Opacified anterior chamber, thickened iris and hypertrophied ciliary muscles.	1

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