

Evaluation of Posterior Segment Pathology of Eyes by Non-dedicated Ultrasonography in a Rural Medical College

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Abstract: Ultrasonography has become a valuable diagnostic imaging device in the field of ophthalmology. The present cross-sectional study involving B-scan ultrasonography among 124 patients (248 eyes) highlighted the advantages of ocular ultra sonography (B-mode) in the evaluation of posterior segment disorders. Sonography of the eye is a rapid, cheap, safe and reliable investigation for the eye. The sensitivity and specificity of this modality in detecting posterior segment pathologies has been recorded as extremely high and is of great value to the eye surgeon for a preoperative assessment of the posterior segment when funduscopy is not possible due to opaque ocular media from various causes.

Key Words: Ultrasonography, Eye, Posterior segment pathology

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I. Introduction

B-scan ultrasonography (USG) has played a key role as a valuable diagnostic imaging device in the field of ophthalmology. Ultrasonic imaging of ocular structures has unique acoustical advantages of the cyst like globe and the dimensions of the important ocular tissues. Routine ocular scanning is performed with B-scan using 7.5 MHz- 12 MHz transducers. This modality is of great value to the eye surgeon for a preoperative assessment of the posterior segment when particularly funduscopy is not possible due to opaque ocular media from various causes.

It gives instantaneous information of lesion in eyes with opaque ocular media. It is an important adjunct in the differentiation of intraocular tumors, even when the media are clear.^[1] The orbit and the eyeball can be involved in variety of pathologies. Manytimes, it is difficult to judge the exact nature of the ocular and orbital lesions merely on clinical examination. B-scan USG has increased our ability to detect and differentiate many intraocular and intra-orbital disorders. The superficial location of eye with its fluid composition and the advent of high frequency ultrasound make USG ideal for imaging the eye. Imaging provides information about the presence, location, configuration, and their extent.^[2] Ocular USG uses high frequency sound waves, routinely 7.5–10 MHz, which is transmitted from the probe into the eye.^[3] The B-scan presents echoes as dots rather than spikes. Intensity of dots relates to the intensity of reflection. It produces a two-dimensional cross-sectional display of the globe and the orbit.^[4] The present study evaluates characteristic USG features of ophthalmic lesions, defines the anatomical location, and classifies them according to location and etiology. Ocular USG, being a relatively inexpensive, quick, painless, and noninvasive imaging modality, helps in accurate diagnosis leading to a better visual assurance to the patients, especially in rural area where the study is being conducted. Use of ultrasound in the investigation of the ocular and orbital diseases dated back to 1950s.^[5] Presence of opaque media prevents adequate ophthalmoscopic visualization of the posterior portion of the globe. Direct visualization of the retro bulbar pathologic lesions with ophthalmoscope is also not possible even with clear media. It is therefore imperative to use alternative imaging modalities for better definition of anatomy and characterization of lesions in these areas. Radiography, USG, computed tomography, and magnetic resonance imaging have been used in this respect. Of these, USG has the advantage of being easily available and affordable, devoid of ionizing radiation and has a good spatial resolution. It could also be performed at the patient's bedside; dynamic study is also possible with real time ultrasound system. In addition ocular biometry for calculation of optical power of artificial lens implants is another advantage of ocular ultrasound.^[5]

II. Material And Methods

Study Design and Study Setting: An institution based, observational, analytic study was conducted which was cross-sectional nature among the patients of any age irrespective of sex those had clinical suspicion of intraocular and orbital pathology and were referred to the Radiodiagnosis Department of the Midnapore Medical College and Hospital, Paschim Medinipur.

Study Period: The study was conducted from January 2017 to March 2018 (for a period of 15 months).

Study Participants: The present study considered all the referred cases from the Ophthalmology department, Midnapore Medical College and Hospital, Paschim Medinipur, West Bengal with clinical suspicion of intraocular and orbital pathology for B-scan ultrasonographic evaluation of the posterior segment of the eyes to the department of Radiodiagnosis of the same institute as the study participants.

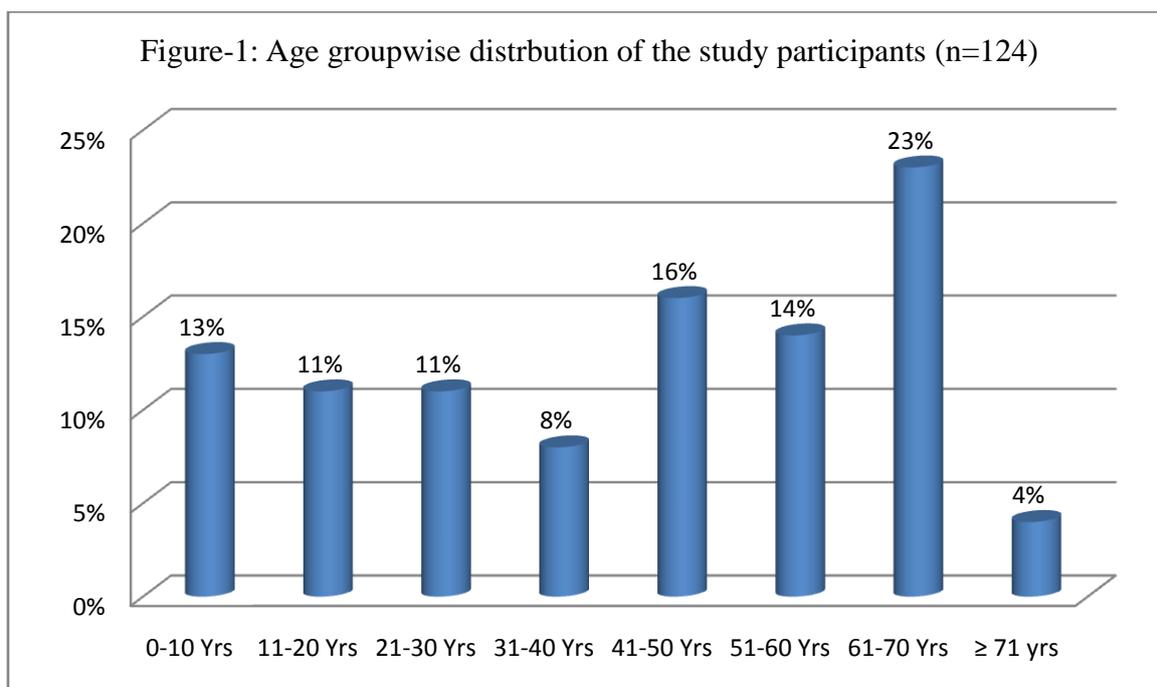
Sample size and Sampling Technique: The present study included all the voluntarily willing patients those attended the Radiodiagnosis department of the Midnapore Medical College, Pashim Medinipur for the USG evaluation of the posterior segment of their eyes as study participants. In the present study, during the data collection period, a total 124 patients (248 eyes) were evaluated which form the study sample.

Ethical Issues: The study was approved by the 'Institutional Ethics Committee' of the Midnapore Medical College, Paschim Medinipur, West Bengal, India. Informed written consent was obtained from either each of the study participants in case of adult patients or from responsible family members in case of minors after explained the purpose and expected outcome of the study.

Methods of Data Collection: A pre-tested and pre-designed questionnaire was used for data collection. Basic socio-demographic information were collected. A total 124 patients (248 eyes) irrespective of age and sex with a clinical suspicion of intraocular and orbital pathology were taken up for ultrasonographic study with a 7.5-12MHz transducer sector probe coupled to a conventional ultrasonography equipment, HP AGILENT. Patients in whom fundoscopy could not be carried out due to opaque ocular media, patients with blunt trauma to eye, and patients presenting with proptosis formed the main selection group for ultra sonogrpahic scan at our center. The examination was performed with patient in supine position, using a coupling jelly and the transducer head held over a closed eyelid. The cornea was not anaesthetized. Few children had to be sedated prior to the procedure. Both eyes were scanned serially in transverse and sagittal planes. The patient was instructed to move the eye ball upwards, downwards, nasal side and temporal side for delineating better anatomy of the eye ball and mobility of intra-ocular lesions.

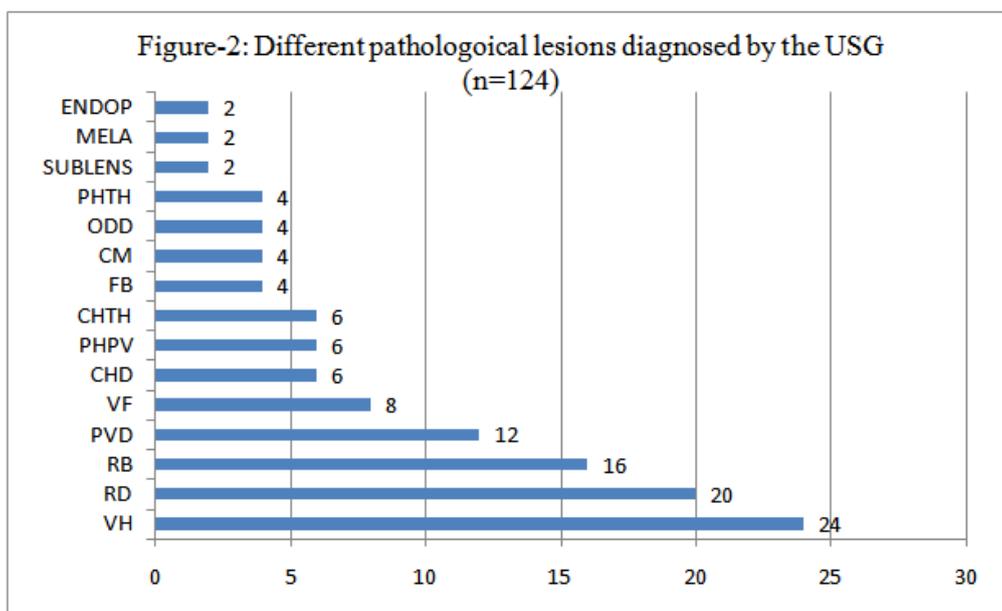
III. Result

A total of 124 patients (248 eyes) were evaluated by the help of the B-scan ultrasonography for evaluation of the posterior segment of their eyes. The mean age of the study participants was 48.7 ± 9.4 years. Among the study participants, 68 (54.8%) were found male and remaining 56 (45.2%) were female. Among the study participants, 36 (29.1%) were found elderly (age ≥ 60 years) population. The age group wise distribution of the study participants were shown in Figure-1. It was evident that majority of the study participants belonged to the age group of the 4th to 6th decade. [Figure-1]



The pathological lesions detected after the ultrasonographic scanning of the posterior segment of the eyes of the study participants were illustrated in Figure-2.

In the present study, the commonest pathological lesion of the posterior segment of the eyes among the study participants was found vitreous haemorrhage (VH: 19.4%; 24 out of 124). The other common pathological lesions were found retinal detachment (RD: 16.2%; 20 out of 124), retinoblastoma (RB: 12.9%; 16 out of 124), posterior vitreous detachment (PVD: 9.7%; 12 out of 124) and vitreous floaters (6.5%; 8 out of 124). The other less common lesions were persistent hyperplastic primary vitreous, foreign body, choroidal metastasis, choroidal melanoma, choroidal osteoma etc. (Figure-2)



VH: Vitreous haemorrhage, RD: Retinal detachment, RB: Retinoblastoma, PVD: Posterior vitreous detachment, VF: Vitreous floaters, CHD: Choroidal detachment, PHPV: Persistent hyperplastic primary vitreous, CHTH: Choroidal thickening, FB: Foreign body, CM: Choroidal metastasis, ODD: Optic disc drusen, MELA: Melanoma, SUBLENS: Subluxation of lens, ENDOP: Endophthalmitis

In the present study, the following posterior segment pathologies were encountered:

- ✓ **VITREOUS HEMORRHAGE (VH):** The commonest ocular pathology in our study. 24 cases (19.4%) were diagnosed. Fresh VH is very low reflective. In old vitreous hemorrhage, the dot-like echoes organize to form membranes of varying reflectivity, most dense inferiorly due to gravity.
- ✓ **RETINAL DETACHMENT (RD):** From the ophthalmology department, total 22 cases of clinically suspected retinal detachment cases were referred for the USG evaluation. By the help of our existing USG, we were able to diagnosed 20 cases (90.6%) of retinal detachment cases. Ophthalmology dedicated high resolution USG may solve the problem. USG became an important tool in following up these cases. It may be rhegmatogenous, tractional, combined traction-rhegmatogenous or exudative. It appears as thin, continuous, V- shaped membrane separated from globe wall with attachment points at the nasal and temporal ora serrata and at the optic nerve.
- ✓ **POSTERIOR VITREOUS DETACHMENT (PVD) AND VITREOUS FLOATERS (VF):** All 12 cases of PVD diagnosed by ultrasound. PVD is seen as a freely mobile membranous echo with variable attachments to the optic nerve head or retina. The mobility of the PVD is more than that of RD. Vitreous floaters (8 cases identified) appear as discrete mobile point like bright echoes with a clear space between the particles and the posterior globe wall.
- ✓ **RETINOBLASTOMA (RB):** 16 cases of RB (12.9%) were there in our study, all of them in first decade. They formed the most common ocular neoplasm and the commonest ocular pathology to cause proptosis (7%) and leukokoria in our study. All were correctly diagnosed by ultrasound. It may appear as single or multiple mass lesions in the vitreous cavity arising from the retina with high internal reflectivity. Presence of calcium, seen as high reflective specks or clumps within the lesion, causing orbital shadowing. Calcification seen in 50% of cases. When calcification are seen it is diagnostic of retinoblastoma. It is sometimes associated with retinal detachment.
- ✓ **PERSISTENT HYPERPLASTIC PRIMARY VITREOUS (PHPV):** All 6 cases of PHPV were in first decade and were correctly diagnosed with ultrasound, especially with color Doppler which demonstrated

flow in posterior hyaloid artery. PHPV appears as vitreous band of variable reflectivity extends from the lens to the optic disc. Doppler signal from posterior hyaloid artery may be seen within.

- ✓ **CHOROIDAL MELANOMA (CH MELA)** : 2 cases of choroidal melanoma was noted in our study in 5th decade. It classically appears as homogenous solid mass showing internal vascularity. Choroidal excavation produced by the contrast between the normal high reflective choroid surrounding the tumor and the low reflectivity of the densely homogenous tumor mass. Features to be noted in ocular tumours: Number, shape, surface, location & layer involved, presence, extent & location of RD, reflectivity of lesion compared to sclera, measurements-base-vertical and horizontal, height, presence of extrascleral extension, optic nerve extension & orbital soft tissue involvement, presence of tumor vascularity and associated inflammatory signs.
- ✓ **CHOROIDAL METASTASIS (CM)**: In our study, total 4 cases (3.2%) with primary carcinoma of thyroid presented with gradual loss of vision. Lenticular echogenic lesions arising from choroid showing internal vascularity were noted in both cases. It appears as irregular solid mass at the posterior pole with or without internal blood flow.
- ✓ **CHOROIDAL OSTEOMA (CHO)**: Total 2 cases (1.6%) of CHO were detected in our study. Young male patient presented with bilateral diminution of vision. Ultrasound showed curvilinear calcification involving posterior aspect of choroid bilaterally.
- ✓ **DISLOCATION/SUBLUXATION OF LENS (SUB LEN)**: Total 2 cases of have been identified. Dislocated Lens, a dislocation or malposition of the lens, is largely caused by ocular trauma, but it is also seen in collagen disorders such as Marfan and Ehlers-Danlos syndromes. There are two major types of dislocation: partial (subluxation) and complete. In partial dislocation, the lens remains partially attached to the ciliary body. In a complete dislocation, the lens sinks in the vitreous body, lying over the retina, though it does move during dynamic examination. A traumatic dislocation may be associated with a traumatic cataract and vitreous haemorrhage.
- ✓ **CHOROIDAL DETACHMENT (CHD)**: Total 6 cases (4.8%) of the CHD detected in our study. Choroidal detachment also known as uveal effusion, is less common than retinal detachment, and is caused by the accumulation of fluid in the potential space located between the choroid and the sclera. It may result from trauma, surgery for glaucoma, lens extraction for cataracts, or hypotony of any cause. At US, the choroid balloons into the eye and protrudes convexly into the vitreous. The bands visible in the choroidal detachment are typically thick and rigid; they end at the level of the exit foramina of the vortex veins and do not extend to the optic disc. Arterial flow can be seen in these thick membranes. Subchoroidal haemorrhage may be associated. In these cases, low or medium level echoes can be seen between the choroid and the sclera.
- ✓ **CHOROIDAL THICKENING (CHT)** : Total 6 cases (4.8%) of choroidal thickening detected. Diffusely thickened choroid was detected ultrasonically in various conditions, including: following intraocular surgery , trauma, phthisis bulbi , endophthalmitis, and nanophthalmos.
- ✓ **ENDOPHTHALMITIS (ENDOP)**: Total 2 cases (1.6%) of endophthalmitis were detected in our study. The findings of the endophthalmitis found in our study were i) dispersed vitreous opacities with vitritis and ii) Chorioretinal thickening.
- ✓ **OPTIC DISC DRUSEN (ODD)**: Total 4 cases (3.2%) have been identified in our study by B scan USG. In USG, it shows ultrasonography: optic nerve head with ODD is elevated and highly reflective. When decreasing the gain setting, calcified drusen maintain high signal.
- ✓ **PHTHISIS BULBI (PHTH)**: A total 4 cases (3.2%) of the phthisis bulbi cases were identified by the USG. In USG, it shows small, deformed eye.

Some of the USG findings of the present study were given in Figure-3 and Figure-4.

FIGURE 3: Few USG findings of the present study.

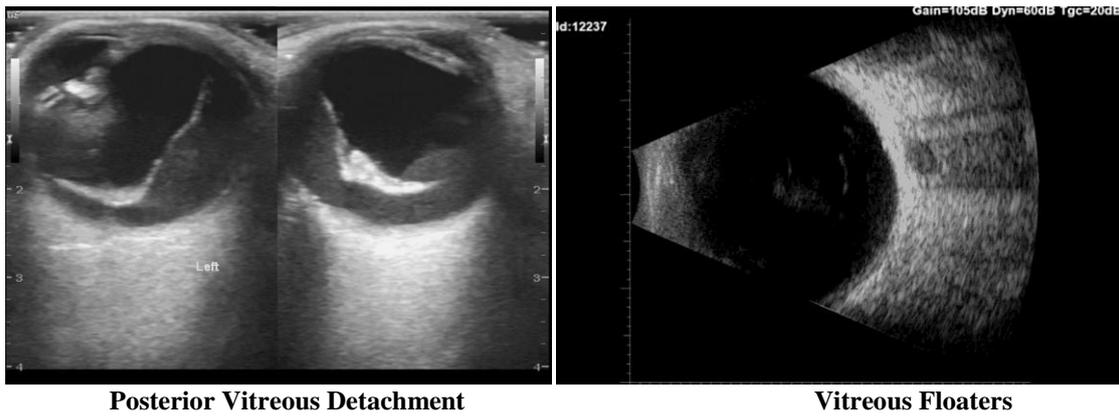
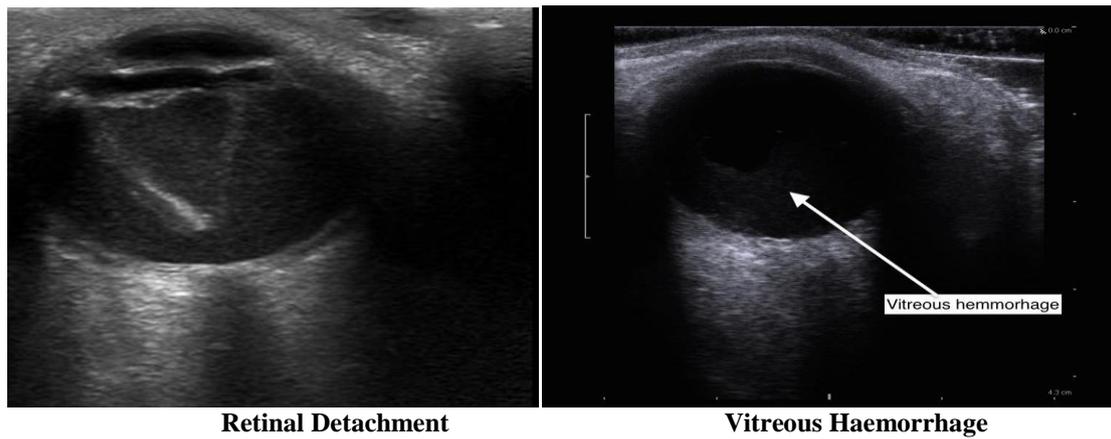
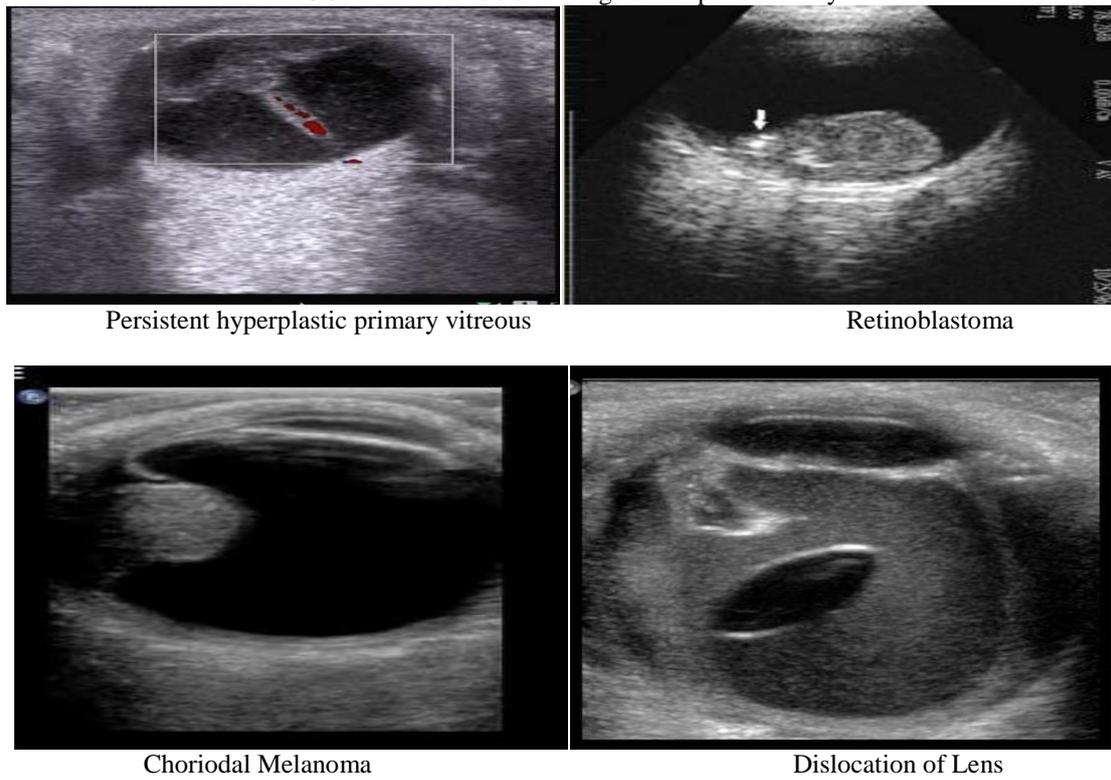
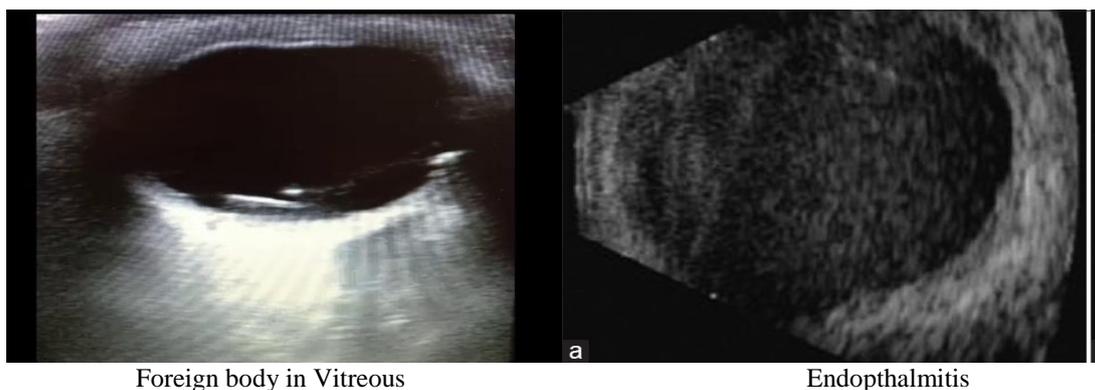


FIGURE 4: Few USG findings of the present study.





Foreign body in Vitreous

Endophthalmitis

IV. Discussion

Several studies reported better accuracy in diagnosis of pathological lesions of the posterior segment of eyes by means of the B-scan USG than other modes of investigation. OP Sharma et al. conducted a study on 122 cases, the clinical and USG diagnosis were correlated with final diagnosis to infer the accuracy, sensitivity and specificity.^[5] Commonest intraocular pathology was vitreous hemorrhage. Retinal detachment showed diagnostic accuracy of 99% but specificity was slight less (98.6%). Ultrasonographic findings well correlated with clinical, operative & histological observation. Nzeh DA et al. conducted a retrospective review of 202 eye patients for ultrasonography over a 5-year period using two non-dedicated general purpose US scanners. 179 (88.6%) had agreement between clinical and ultrasound diagnosis. They concluded that in experienced hands, there is a high correlation of findings on US and clinic-pathological diagnosis even in the absence of a dedicated eye scanner.^[6] Ejaz A J et al. conducted B-Scan on 463 eyes and concluded that B-scan was a valuable diagnostic modality in opaque media and had remarkable prognostic importance.^[7]

J A Fielding performed 200 consecutive scans on 184 patients through-the-lid with general ultrasound equipment. The examination was simple to perform with production of good images. It was sensitive (92%) and specific (99%) in the detection and exclusion of intra-ocular disease.^[8]

Roger P et al. in a study addressed the impact of echography on the evaluation and management of posterior segment disorders. This study presents the diagnostic findings of 1,000 consecutive patients referred to an ophthalmic echographic specialty practice over a 16-month period. Ophthalmic echography provided essential information about the anterior and posterior segments in eyes.^[9]

Fisher Y L et al.^[15] (1991) investigated the status of the posterior vitreous in 70 eyes to evaluate the diagnostic value of kinetic contact ultrasonography, which provided an extremely accurate method for evaluating the posterior vitreoretinal interface in 69 of the 70 eyes in this study, when compared with all conventional clinical means of examination including slit-lamp biomicroscopy with the Goldmann contact lens and fundus photography with the El Bayadi-Kajiura lens.^[10]

Zafar D et al. performed 320 B-scans and concluded that ultrasonography proved to be very helpful method for medical diagnosis in Ophthalmology. Opacities in the vitreous were the commonest problems followed by retinal detachment for which ultrasound was advised.^[11]

Scott IU et al. conducted a retrospective, non-comparative, consecutive case series study on 154 eyes of 143 patients, to investigate the impact on patient management of posterior segment echographic evaluation. The final clinical or pathologic diagnosis confirmed the echographic diagnosis in 148 eyes (96%).^[12]

Ahmed J et al. conducted a study 73 eyes of 68 patients with vitreous opacities and concluded that B-scan was very useful in detection and evaluation of vitreo-retinal pathologies.^[13]

Jemeld B et al. examined 93 diabetics (168 eyes) with opaque ocular media and low visual acuity by ultrasonography. The ultrasonic accuracy was checked in 49 eyes at vitrectomy. It was 78% for retinal detachments and 67% for prepapillary and pre retinal proliferations.^[14]

R Rabinowitz et al. correctly diagnosed all cases of retinal detachment, but less than 50% of retinal tears with ultrasound. A total of 18.9% of the eyes were falsely diagnosed as having retinal detachment.^[15]

Verbeek AM et al. analyzed the data on echographic diagnosis of intraocular tumors, using the final diagnosis either from pathology after enucleation or from the confirmed clinical diagnosis. The material consisted of melanomas (n=325), metastases (n=44), hemangiomas (n = 19) and other intraocular tumors (n=16). The best set of echographic parameters in descending order of significance was: reflectivity (A-mode), choroidal excavation (B-mode), shape (B-mode), and regularity (A/B mode). The clinical echographic classification for these cases was 89%, 93% and 99.5%, respectively. The simultaneous differentiation between the three classes was found to yield a correct fraction of 85% by computer statistics and 95% by routine echography.^[16]

Byrne SF et al. conducted a study to describe the methods used by the 'Collaborative Ocular Melanoma Study (COMS) Echography Center' for grading tumor echograms and to assess reliability of the grading system. The level of agreement (after adjusting for chance agreement) ranged from 'moderate' to 'almost perfect.' Grading for 'confidence of tumor measurement' differed between the original grading and the regrading but there was little difference in the tumor measurements. The COMS Echography Center has demonstrated that its grading protocol is consistent over time. ^[17]

Collaborative Ocular Melanoma Study Group conducted a study to compare pre-enucleation clinical and echographic measurements with postenucleation histopathological measurements of choroidal melanoma of a size and in a location suitable for iodine 125 brachytherapy. The results suggest that tumor measurements made according to COMS protocol were highly reliable in planning radioactive plaque therapy and monitoring changes in tumor size after such treatment. ^[18]

Boldt HC et al. conducted a retrospective study on 2320 patients to report baseline echographic characteristics of tumors in patients enrolled in the COMS randomized trials, to determine how often these characteristics matched specified criteria for choroidal melanoma. 88 % of the tumors in the COMS exhibited features characteristic for melanoma: low to medium reflectivity, the classic mushroom shape, or both. Using additional preset criteria, 96% of tumors exhibited baseline echographic characteristics consistent with the diagnosis of melanoma. Echography graders were able to detect extrascleral nodules ≥ 1.5 mm in elevation but not minimally elevated extraocular tumor extension. Clinicians and echographers can use these data to improve their understanding of the echographic features of untreated uveal melanomas. ^[19]

Varene B et al. performed echography on 38 eyes enucleated for suspected retinoblastoma. No errors in diagnosis were made on the 25 eyes considered to be cases of retinoblastoma by echographic criteria. ^[20]

Roth DB et al. concluded that echography is a useful adjunct to indirect ophthalmoscopy in establishing the diagnosis of retinoblastoma, permits monitoring of treatment response and may aid in detecting recurrent tumor growth or failure to respond to treatment. ^[21]

Mackeen LD et al. concluded stating High-frequency ultrasound can be reliably used to distinguish characteristic features of PHPV. Furthermore, the presence of a thickened adherent anterior hyaloid face may help explain the well-recognized complications of peripheral retinal tears and retinal detachments during and after surgical intervention. ^[22]

V. Conclusion

To conclude, ultrasonography is a readily available, non-invasive, non-ionizing, highly accurate and cost effective modality which offers real time scanning with option of color Doppler. It is particularly well suited in cases of opaque conducting media when direct ophthalmoscopy is not possible. US is a highly sensitive modality and it can reliably differentiate various ocular detachments, vitreoretinal disorders and neoplastic lesions.

VI. Study Limitations

Ultrasonography is operator dependent and requires the knowledge and expertise of a well-trained and skilled operator to obtain accurate, repeatable, high-quality images. It has relatively lower sensitivity in the detection of calcification compared to CT scan. Ultrasonographic scan of eyes may be difficult to perform in cases with external eye injuries

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