Original Article

Role of B-Scan Ultrasonography for Posterior Segment Lesions

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ABSTRACT

OBJECTIVE: To determine the usefulness of B-scan ultrasonography and to observe the relative frequency of conditions for which ultrasound B-scan examination was requested in Ophthalmology.
DESIGN: A descriptive study.
SETTING: Department of Ophthalmology, Ziauddin Medical University and Dr Akil Bin Abdul Kadir Welfare Eye Hospital Karachi, Sindh - Pakistan, from February 2002 to March 2005.
METHODS: We performed 320 B-scans over a period of 3 years. Patients were selected from out patient department. We used "SONOMED" and ALCON ultrasound machines.
RESULTS: In the total 320 ultrasounds performed, 102 did not demonstrate any pathology on B-scan ultrasonography. Vitreous disorders were present in 98 patients, 58 showed retinal detachment, 16 showed intraocular tumors and tumor like conditions, 9 patients showed optic nerve lesions and 6 patients showed intraocular foreign bodies. The remaining 31 patients had different types of miscellaneous lesions.
CONCLUSION: Diagnostic ultrasonography has 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. It is also important to correlate B-scan findings to the clinical condition of patient.

KEY WORDS: B – Scan. Opacity. Diagnosis. Tumor. Retinal Detachment. Vitreous disorders.

INTRODUCTION

In 1880, Curie brothers who were French scientists and were active in ultrasound research, described the "Piezoelectric Phenomenon" upon which the current diagnostic ultrasound is based.[1] The first diagnostic use of ultrasound in medicine was reported in 1953 for visualization of heart valves. Mundt and Hughes first reported the use of ultrasound in ophthalmic diagnosis in 1956.[2] They utilized A-scan mode. Two years later, Baum and Greenwood described B-scan ophthalmic ultrasonography.[3] B-Scan ultrasonography is now widely used in Ophthalmology for investigation of posterior segment lesions. Ultrasound has become an important part of ophthalmic diagnosis because of its ability to detect, outline and characterize the nature of soft tissue of eyeball and orbit, regardless the degree of ocular media transparency. The definition of ocular structure is better understood with ultrasound than with M.R.I. or C.T. scan.[4] In ophthalmic ultrasonic examination, frequencies used lie mostly in the range from 5 MHz to 20 MHz.[5] B-scan presents two dimensional cross section of the eye. Here 'B' stands for **"**BRIGHTNESS**".** Strong echoes are white whereas weaker echoes are shades of gray, depending upon their strength.[6] There are two techniques of B-scan ultrasonography. With direct contact method, contact probe is used. The anterior segment details are not visible with this method. Lesions of the eye in this segment can not be studied.[7,8] With water bath technique, we can visualize quite accurately a variety of pathological conditions of cornea, anterior chamber, iris, lens and ciliary body. Objectives of this study were to determine the usefulness of B-scan in the detection of posterior segment pathology in the presence of opaque media, usefulness of this diagnostic procedure in the management of patient concerned, the frequency of conditions investigated and the limitations of B-scan ultrasonography.

SUBJECTS AND METHODS

For this study, we performed 320 ultrasonograms from February 2002 to March 2005. Patients were selected from the Out-patient Department. It also included those cases, which were referred from other Ophthalmic Centres in the city of Karachi. Most of these patients had media opacities so that clear fundus view was not possible. Some eyes with clear media were

also scanned, for the purpose of correlation of ultrasonogram with clinical examination. Patients were briefly told about the procedure. This facilitated his/her co-operation. A printed performa containing patient's history, ocular examination and provisional diagnosis was properly filled up prior to performing ultrasonography. History and clinical examination are important because ultrasound findings alone may be confusing at times. Initial examination was perfomed at a maximum sensitivity (maximum gain i.e. 80 dB). After completing the examination under maximum sensitivity, the examination was repeated under lower sensitivity.

RESULTS

In this study, a total of 320 ultrasonograms were performed, 174 patients (54.37%) were male and 146 (45.63%) females. The age of the patients ranged from 6 months to 92 years. In total, 320 ultrasounds were performed and 102 patients did not demonstrate any pathology on B-scan echography. Most of these patients had opaque media. Cataract was present in 74 eyes, corneal opacities were present in 11 eyes. In 5 eyes, both cataract and corneal opacities were present. One eye had hyphema. In 11 eyes, media was clear. These were referred for suspected posterior segment pathology, being doubtful on clinical examination. Of the remaining 218 ultrasonograms performed in this study, 98(44.95%) showed vitreous disorder, 58(26.60%) retinal detachment while 16(7.34%) showed intra ocular tumors or tumors-like conditions. Six (2.75%) patients were sent to us for ultrasonograms for suspected intra-ocular foreign bodies. Nine (4.14%) patients were sent for optic nerve disorder. In 31(14.22%) patients ultrasonographic findings were placed in miscellaneous group. In this series of patients, vitreous problems (98 cases) were the most common indications for which diagnostic ophthalmic ultrasonogram was requested. (**Table I**) Among this group vitreous haemorrhage (35 cases) topped the list, followed by posterior vitreous detachment (19 cases). Nine cases were of endophthalmitis. The second largest group of patients was those having retinal detachment (58 cases). (**Table II**) In this group total retinal detachment (32 cases) and partial or localized retinal detachment (14 cases) were the dominant findings. This was followed by tractional retinal detachment (11 cases). One case of exudative retinal detachment was also scanned. The third largest group included many heterogeneous conditions and all were placed under the heading of miscellaneous disorder (31cases). (**Table III**) It included 7 cases of posterior staphyloma, 9 cases of different orbital pathology, 4 cases of phthisis bulbi and 6 cases of dislocated crystalline lens or fragments of nucleus into vitreous and two cases of dislocated IOL into vitreous. The fourth group of 16 cases comprised of intraocular tumors and tumor like conditions. (**Table IV**). Important subgroups were retinoblastoma (5 cases), disciform macular degeneration (2 cases) and total choroidal detachment (4 cases). The fifth main group of 9 cases was that of optic nerve disorders. (**Table V**) Its subgroups were deep glaucomatous cupping (3 cases), optic disc swelling (4 cases), optic disc drusen (1 case) and optic disc coloboma (1 case). The sixth group comprised of those patients having intraocular foreign bodies (6 cases). The two important subgroups were single foreign body (4 cases) and multiple foreign bodies 2 cases. **(Table VI)**

TABLE I:
FREQUENCY OF VITREOUS DISORDERS (n = 98)

Diagnosis	Cases	Percentage
Vitreous haemorrhage	35	35.82%
Vitreous floaters	11	11.22%
Vitreous bands and membranes	13	13.37%
Posterior vitreous detachment with vitreous haemorrhage	10	10.20%
Posterior vitreous detachment	9	9.08%
Endophthalmitis	9	9.08%
Asteroid hyalosis	5	5.11%
Vitritis	6	6.12%
TOTAL	98	100%

TABLE II:
RETINAL DETACHMENT (n= 58)

Diagnosis	Cases	Percentage
Total retinal detachment	32	55.17%
Localized retinal detachment	14	24.14%
Tractional retinal detachment	11	18.96%
Exudative retinal detachment	1	01.73%
TOTAL	58	100%

TABLE III:
MISCELLANEOUS GROUP (n=31)

Diagnosis	Cases	Percentage
Elongated globe and posterior staphyloma	7	22.60%
Dislocated crystalline lens in vitreous	6	19.36%
Dislocated IOL in vitreous	2	6.45%
Phthisis bulb	4	12.90%
Posterior scleritis	1	3.23%
Chorioretinal thickening	2	6.46%
Orbital pathology	9	32.20%
TOTAL	31	100%

TABLE IV:
INTRA OCULAR TUMORS AND TUMOR LIKE CONDITIONS (n=16)

Diagnosis	Cases	Percentage
Choroidal melanoma	1	6.25%
Disciform macular scar	2	12.50%
Localized choroidal detachment	2	12.50%
Total choroidal detachment	4	25.00%
Retinoblastoma	5	31.25%
Persistent hyperplastic primary vitreous	1	6.25%
Retrolental fibroplasias	1	6.25%
TOTAL	16	100%

TABLE V:
OPTIC NERVE DISORDERS (n=9)

Diagnosis	Cases	Percentage
Glaucomatous Cupping	3	33.33%
Optic Disc Swelling	4	44.45%
Optic Disc Coloboma	1	11.11%
Optic Disc Drusen	1	11.11%
TOTAL	9	100%

TABLE VI:
INTRA OCULAR FOREIGN BODIES (n=6)

Diagnosis	Cases	Percentage
Single Foreign Body	4	66.67%
Multiple Foreign Body	2	33.33%
TOTAL	6	100%

DISCUSSION

Over the last 30 years, ultrasonography has greatly advanced and this has enabled us to study posterior segment of eye even in the presence of opaque media. Although, it can also be used to detect the pathology in the anterior segment and in the orbit, but its most common use is to study the abnormalities in the posterior segment. Most common vitreous problem in this series of patients was vitreous haemorrhage. Out of 35 patients of vitreous haemorrhage, 21 patients were diagnosed ophthalmoscopically whereas in 14 cases, hyphema or cataract was present which obscured the fundal view. Ultrasonography was performed in each case to study the state of vitreous and retina, as well as to rule out any underlying pathology.
Fresh unclotted blood cannot be visualized by ultrasonography. As cells aggregate, they produce dot like echogenic shadows in the vitreous cavity. These echogenic opacities are highly mobile. These echoes disappear from the screen by reducing the sensitivity from 80 dB to 70 dB. Organization of the haemorrhage is seen as sheets or clumps of echoes, which do not have regularity of retinal detachment, when scanned in three dimensions. (**Figure I**) Out of 35 cases with vitreous haemorrhage, 12 had history of trauma, 9 patients had diabetic eye disease, one had central retinal vein occlusion, 2 were hypertensive, 3 had retinal tear and one had disciform macular haemorrhage. In 7 cases the cause was undetermined. In 12 patients, the haemorrhage was fresh with low reflectivity while remaining 23 eyes showed dense organized membranes in the vitreous. Eleven patients with clear media showed vitreous floaters. There were one or few echogenic shadows in the vitreous cavity. These showed distinct after movements. These vitreous floaters were because of condensation of vitreous fibrils. These were of no clinical significance. Senile vitreous degeneration and myopic vitreous degeneration were the cause in most conditions.
Five patients were diagnosed as cases of asteroid hyalosis. Out of these five patients, three had sufficient clear media that asteroid hyalosis was visible on ophthalmoscopy. Two patients had dense cataract but the appearance was typical. All had very intense echoes in the mid vitreal cavity, persist up to 50 dB, high

mobility and were separated from chorioretinal layer by a clear zone. All these cases were confirmed ophthalmoscopicaly after cataract extraction. Out of 19 cases of posterior vitreous detachment, ten were associated with vitreous haemorrhage. Posterior vitreous detachment appears as a single echogenic line in posterior half of vitreous cavity, parallel to the posterior wall, but usually with no attachment to optic nerve head. (**Figure II**) In this series, a total of 58 patients were diagnosed as having retinal detachments of different types. Out of 32 patients of total retinal detachment, three were aphakic (intracapsular cataract extraction with vitreous loss), six had a history of trauma, seven were pseudophakic and four were highly myopic. In the remaining patients, the cause was undetermined. Out of 14 localized retinal detachment cases, 12 had retinal detachment in supero temporal quadrant. Out of 11 cases of tractional retinal detachment, 6 were due to diabetic eye disease. Two patients with silicone oil were also examined. There were lots of artifacts seen and status of retina, although detached was not clearly visible. MRI is helpful in the presence of silicone oil inside the eye.[9] Another study shows characteristic echographic appearance in the presence of intraocular gas. Gas fluid (vitreous) and gas tissue (lens) interface are highly reflective and no structure within or behind the bubble is visible.[10] Total retinal detachment is typically funnel shaped biconvex or biconcave membranous pattern extending from optic disc to ora serrata. (**Figure III**) Because the retinal tissue is strong reflector of sound, it persists with reduction of sensitivity control to 60 dB. In long standing retinal detachment, cystic changes within the membrane are noted. Sub retinal space is usually echo free. There is limited motility, characterized by slight after movement. This is demonstrated with probe held stationary and asking the patient to move the eye. It causes the retina to undulate. Undulations continue for short period after the motion of the globe ceases. Partial retinal detachment usually is attached to the optic disc. (**Figure IV**) In exudative retinal detachment small echogenic opacities are present in subretinal space, representing exudates or red blood cells. In exudative retinal detachment shifting fluid can be noted. Probe is held stationary while changing the position of patient's head with respect to gravity. In this way detachment can be seen to shift in the position. In tractional retinal detachment retina shows tent-like elevation and usually involves a small area. (**Figure V**) Retina does not demonstrate any mobility. Multiple vitreous bands are attached to the anterior surface of the retina. Out of 218 cases with some pathology, 6 eyes had intraocular foreign bodies. Two of these had multiple foreign bodies. Four out of 6 foreign bodies were associated with vitreous haemorrhage. In one eye, retina was also detached. Vitreous haemorrhage appeared as multiple small echogenic dots like opacities of mild intensity. Intraocular foreign bodies were very dense acoustically. At lower sensitivity echoes from vitreous haemorrhage disappeared while foreign body echoes remained visible. In every case actual localization of foreign body in relation to quadrant involved was done and distance measurement was taken from optic disc and retina. Exact localization is helpful in determining the best surgical approach for removal of the foreign body.[11] Four cases of phthisis bulbi were also scanned. Phthisis bulbi was diagnosed clinically in each case and B-scan was done to study the echograpic findings in phthisis and to determine any associated pathology. In all cases, there was axial shortening of the globe with severe disorganization. It may not be possible to detect individual abnormalities. Five young children were referred to us with leukocoria and suspected retinoblastoma for B-scan examination. In all 5 cases, echogenic mass was seen arising from retina and filling the vitreous cavity. Highly echogenic areas of suspected calcifications were also found in the mass in 4 patients. In 2 patients optic nerve was also involved. C.T scan also confirmed our finding in one patient. The retina cannot be identified in the involved area. Concomitant retinal detachment is often present. Nine patients with vitreous cells and membranes were diagnosed as endophthalmitis. Four of these patients developed endophthalmitis post-operatively. In endophthalmitis, opacities are exactly similar to the opacities of dispersed vitreous haemorrhage. Follow up is necessary as organization and membrane formation is faster than seen in vitreous haemorrhage. In case of dislocated lens in vitreous B-scan shows a spherical mass floating in the vitreous. The mass is highly mobile and shifts with the change of head position. In total choroidal detachment, choroid is elevated in multiple areas. A "KISSING CHOROIDALS" shape is characteristic of total choroidal detachment. Two opposite echogenic convex lines extend into the vitreous cavity. (**Figure VI**) The echogenic lines do not involve the optic nerve head. Choroidal Melanoma shows characteristic features of sound attenuation in the deeper layers, acoustic quiet zone, choroidal excavation at the base of the tumor and shadowing of orbital fat. Disciform macular degeneration appears as an echogenic sub retinal mass located in the macular area. Its shape is round or flat. Sound attenuation is weak. Echographic appearance of solid chorio-retinal elevation is characterized by a bumpy, lobulated surface with indistinct peripheral margins.[12] B-Scan ultrasonography is very useful for detection of macular thickening.[13] When biomicroscopy and FFA are impossible because of opaque media, detection of pres-

ence of macular edema prior to cataract extraction or in uveitis patient greatly change the management plan. Optic disc was scanned for cupping in 3 glaucoma patients. All these patients had advanced optic disc cupping. Optic disc cupping is not as reliable as ophthalmoscopic examination but is helpful in opaque media. To display the optic nerve echographically, the lamina cribrosa and rim of the optic cup must be exposed to a relatively perpendicular sound beam. The reliability of echographic appearance of optic cup may be improved by comparing the result with those of the fellow eye when its cup is ophthalmoscopically visible.[14] Optic nerve head swelling was identified in 4 cases. In gross pappiloedema, the disc protrudes into the vitreous cavity. It appears as a white elevation into echolucent vitreous. An optic nerve shadow behind the sclera is enlarged. There is doubling of meningeal shadow due to cerebro-spinal fluid filling the subarachnoid space. One case of posterior scleritis was scanned. The ultrasonogram had typical 'T' sign.[15] B-scan ultrasonography is widely used for the diagnosis of different ocular and orbital lesions. It is mostly used in opaque media but in the presence of clear media, ultrasonography provides an additional dimension of visible intraocular lesions, complimenting the diagnostic technique. Opacities in the vitreous were the commonest problem followed by retinal detachment for which B-scan was advised. Similar results were also found in another study published in Pakistan.[16] It is difficult to differentiate red blood cells from inflammatory cells and some times between thick membrane and retinal detachment. In most instances, clinical history and examination assist in differentiation process. A full knowledge of ocular pathology is necessary if B-scans are to be correctly interpreted. In certain situations, where CT scan or MRI are more useful than B-scan ultrasonography, it is still valuable because of its economical feasibility.

FIGURE I: VITREOUS HEMORRHAGE

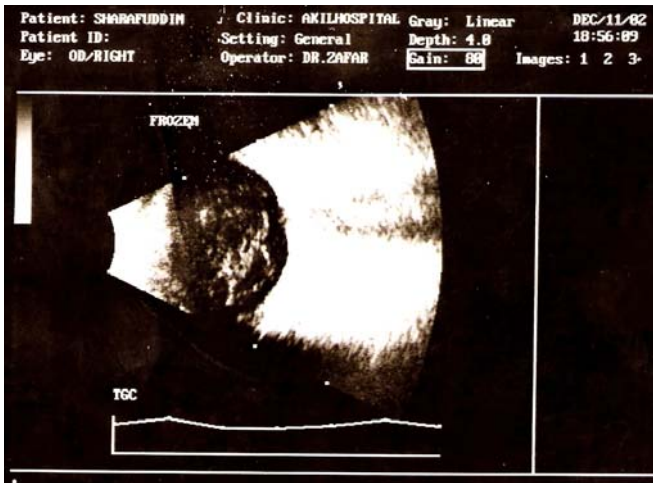


FIGURE II: POSTERIOR VITREOUS DETACHMENT

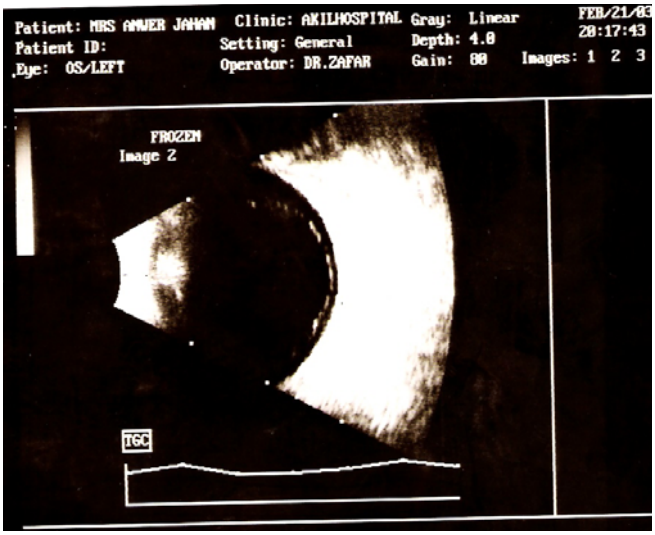


FIGURE III: TOTAL RETINAL DETACHMENT

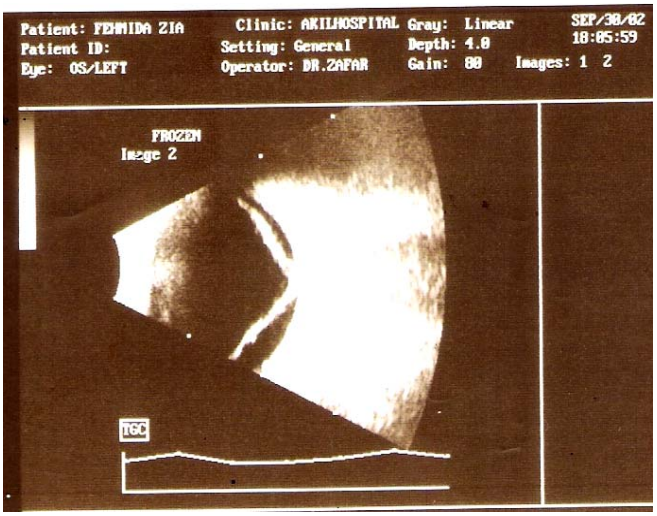


FIGURE IV: PARTIAL RETINAL DETACHMENT

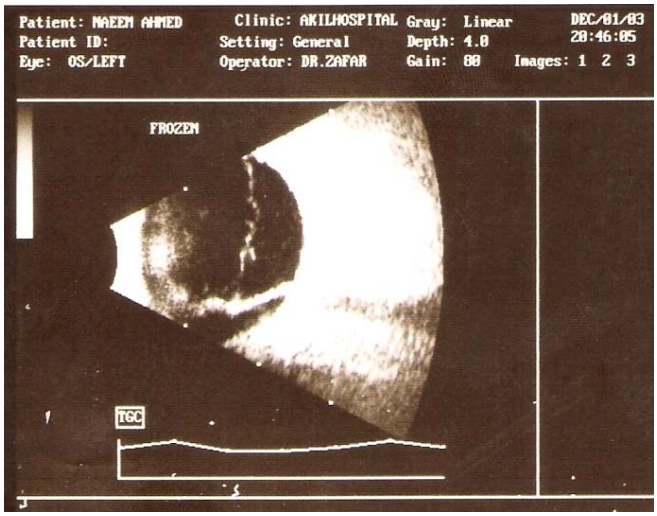


FIGURE V: TRACTIONAL RETINAL DETACHMENT

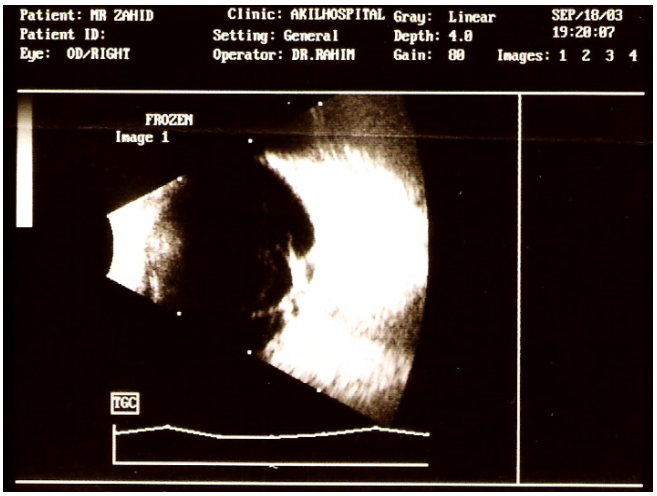
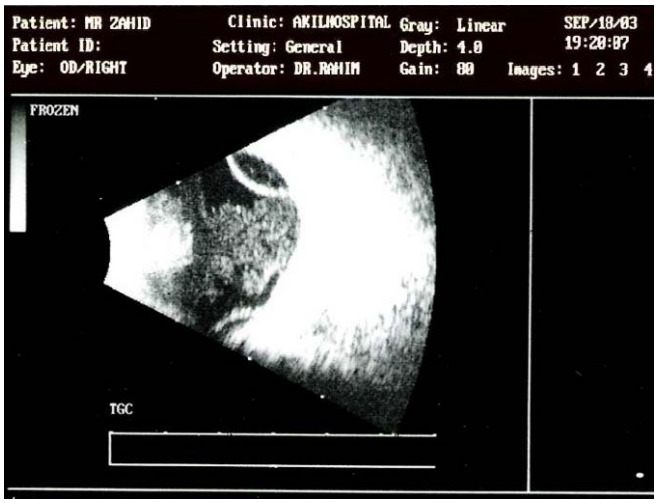


FIGURE VI: TOTAL CHOROIDAL DETACHMENT



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