Role of Sonography in Ocular Disease

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Abstract: A prospective study was conducted to assess the role of sonography in ocular diagnosis. Theirty six (36) patients with suspected ocular disease were examined using non-dedicated ultrasound scanners by small part probe. Sonographic (US) findings were correlated with clinical course of disease, surgical or histopathological findings. Amongst 29 patients with opaque media, US diagnosis was correct in 27 and partially correct in 2 patients. In 7 patients with clear media, US diagnosis was correct in 6, partially correct in one patient, and gave additional information in 2 patients. It is concluded that ocular contact B-scan sonography is a simple, safe, inexpensive, and accurate procedure and can be used as the diagnostic method of choice in ocular lesions.

Key words : *Sonography, ocular*

Introduction

The spectrum of lesions that can occur in the eye and orbit is vast and complex[1]. Advances in radiologic imaging in the past 20 yrs. have played an important role in practice of ophthalmology. Ultrasonography was first introduced as a diagnostic tool in the field of ophthalmology in the 1950s[2]. In spite of this, most radiologists are unfamiliar with the anatomy of the eye as depicted sonographically, largely because ophthalmic sonography has principally been the domain of ophthalmologists[3]. Due to its superficial location and cystic nature, the globe is an ideal structure for examination by US[4]. The study was undertaken to assess the role of sonography in the diagnosis of ocular disease.

Material and Methods

The study was conducted in all inpatients and outpatients with suspected ocular lesions, referred by the Ophthalmology Department; a total of thirty six cases were examined.

Ultrasound scanning was done using a non dedicated Philips P 700/Esaote Biomedica scanner with a small parts high frequency 7.5-10.0 MHZ linear array transducer. Scanning was done with the patient lying supine, when the pull of gravity is exerted in the direction of the optic axis. Procedure of scanning was explained to the patient in detail. The patient was instructed to close the eyelids throughout the examination. Both eyes were examined in all patients. The entire eye was scanned in both transaxial and longitudinal planes. In some cases, oblique scanning was used to avoid artifacts from a dense cataract. Gain settings were adjusted to increase near field amplication of echoes for the assessment of vitreous and then to decrease near-field amplication for evaluation of the retina. The eye was observed as its moved from side to side and up and down to identify membranous structures. The site, nature, echotexture and size/extent of the lesion were studied. Attempt was made to evaluate the optic nerve head. Patients with open globe injury were not taken up for ultrasonography. In case of ocular trauma or recent ocular surgery, care was taken that pressure is not applied to the globe, **as it may came** expulsion of intraocular contents from an occult ruptured globe. Sonographic findings were confirmed by clinical course, surgicalfindings, or histopathological results.

Results

A total of 36 patients with ocular lesions with age range from newborn to 75 years equal male:female distribution were examined. Most common symptom was diminution of vision; common indication for US examination was posterior segment evaluation for opaque media. Amongst 36 patients' media was opaque in 29(80.5%) and clear in 7 patients (19.4%). Most common cause of opacity of media was vitreous haze in 21 patients, (58.3%), followed by cataract in 15 (41.6%); other causes were corneal opacity, anterior segment exudates or hyphema, and leucocoria; many patients had multiple causes for opacity of media. The most common abnormality in ptients with vitreous haze was hemorrhage, present in 13 cases; abnormalities like retinal detachment, vitreous detachment, vitreous hemorrhage, and choroidal detachment were detected in 15 patients with cataract; these abnormalities were not suspected clinically. Retinal detachment was seen in 15 cases, partial in 2 cases, total in 10 cases, and was associated with ocular mass in 3 cases; intraocular foreign body was detected in 3 cases. US was able to make a correct diagnosis of ocular mass in 4 cases, i.e. retinoblastoma in 3 and choroidal mass in one case.

In 7 cases with clear media, ultrasound was done to confirm the clinical diagnosis and to detect any associated abnormality. US diagnosed total retinal detachment in 3 cases, partial in 2 cases, 1 case each of bilateral fundal coloboma and choroidal hemangioma.

In 29 cases with opaque media, US diagnosis was correct in 27 cases, and partially correct in 2 cases. In 7 cases with clear media, US diagnosis was correct in 6 partially correct in one case, and gave additional information in 2 cases (Table 1).

Discussion

Congenital Lesions :

Three (3) cases with congenital ocular lesions were diagnosed. One case of congenital cataract was seen. Normal lens appears as a linear echogenic structure; echoes being caused by the posterior capsule. Cataractous lens appears as an oval hyperechoic structure[5]. Increased anteroposterior diameter of eyeball was noted in a case of buphthalmos. A case of bilateral fundal coloboma was diagnosed (Fig.1 (a) & (b)). Coloboma is a condition resulting from incomplete closure of the fetal fissure. It may involve the lens, iris, chorioretina or optic disc. US shows a funnel shaped excavation[5].

Status of the Vitreous (Table 2)

Vitreous hemorrhage : Most common abnormality seen in patients

Table 1 : comparison of us and final diagnosis.

S. No.		No.of Case3	%	US Diagnosis	No. of Cases	%	Final Diagnosis	No. of Cases	%
	Ocular Lesions								
1.	Opaque Media								
	i) Cataract	15	41.6	a) At. with total R.D.	6	16.6	a) Cat. with total R.D.	6	16.6
				b) Cat. with V.H.	2	5.5	b) Cat with V.H.	2	5.5
				c) Cat. with C.D.	2	5.5	c) Cat. with C.D.	2	5.5
				d) Cat with VH & RD	1	2.8	d) Cat. with VH & RD	1	2.8
				e) Cat. with V. Membrances	1	2.8	e) Cat. with V. Membrances	1	2.8
				f) Cat. with PVD	1	2.8	f) Cat. with PVD	1	2.8
				g) Congenital Cataract	1	2.8	g) Congenital Cataract	1	2.8
	ii) AC haze	2	5.5	a) V exudates	1	2.8	a) Endophthalmits	1	2.8
				b) Thick eyeball coats (Uveitis)	1	2.8	b) Uveitis	1	2.8
	iii) Corneal Opacity	3	8.3	a) PVD with VH	1	2.8	a) PVD with VH	1	2.8
				b) V. exudates	1	2.8	b) Endophthalmitis	1	2.8
				c) Buphthalmos	1	2.8	c) Buphthalmos	1	2.8
	iv) Vitreous haze	21	58.3	a) V.H.	5	13.9	a) V.H.	5	13.9
				b) V.H. with R.D.	1	2.8	b) V.H. with R.D.	1	2.8
				c) V. exudates	5	13.9	c) Endophthalmitis	5	13.9
				d) Phthisis bulbi	1	2.8	d) Phthisisbulbi	1	2.8
				e) VH with PVD	3	8.3	e) VH with PVD	3	8.3
				f) V. membranes	3	8.3	f) V. membranes	3	8.3
				g) i) V.H. with FB vitreous ii) V.H. with FB chorioretina	2	5.5	g) V.H. wi th FB chorioretina extending into vitreous	3	8.3
				h) V.H. with scleral tear	1	2.8	h) V.H. with Scleral tear with # med.	1	2.8

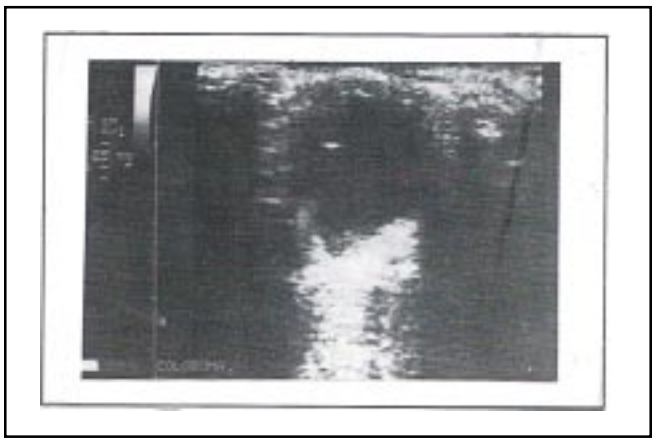

Fig. 1 Coloboma. US shows a funnel shaped depression in the fundus of both eyes.

Table 2 : Status of Vitreous.

Status of Vitreous	No.	(%)
Vitreous Hemorrhage	13	36.1
Vitreous Exudates	5	13.9
Vitreous Membranes	4	11.1
Intra-Vitreal foreign body	3	8.3
Intra-Vitreal Mass	3	8.3
Vitreous Detachment	4	11.1

with vitreous haze was hemorrhage, which was seen in thirteenc cases. Most common cause or hemorrhage in this study was trauma, present in 9 cases. A fresh vitreous hemorrhage is completely dispersed throughout the vitreous gel and gives little or no echoes, because there are no acoustic interfaces between hemorrhage and vitreous[6]. Hemorrhage may get organized to form fibrous bands, indicating long standing hemorrhage. Such fibrous bands may mimic retinal detachment. However, membranes cannot be traced to optic nerve head and reducing the gain of ultrasound can eliminte its echoes[7].

Vitreous exudates : Out of 21 cases of vitreous haze, 7 were due to inflammation. In 3 cases, exudates were organized and did not show any movement on dynamic scanning. In 4 cases, low level internal echoes were seen which showed movement on dynamic scanning and were indistinguishable from vitreous hemorrhage. Clinical correlation was required to make accurate diagnosis. Dacey et al[8] studied 136 patients with infectious endophthalmitis; eye findings were associated with poor final vision; these were dense vitreous opacities, vitreous membranes, presence of retinal or choroid detachment and extent of retinal detachment.

Posterior vitreous detachment : This may be focal or extensive. The posterior hyaloid may separate completely from the posterior pole or it may remain attached to the optic disc. A posterior vitreous detachment is usually smooth and it may be thick especially posteriorly and inferiorly, when blood is layered along its surface[9]. The reflectiveity of a posterior vitreous detachment can vary from extremely low, as in a normal eye to extremely high, as in dense hemorrhage[5]. Posterior vitreous detachment was seen as an undulating membrane, which showed considerable aftermovement on dynamic scanning and was not attached to the optic nerve head vitreom detachment is frequently accompanied by a partial ciliary body detachment. This event reduces aqueous production and tends to perpetuate the hypotonous condition[11].

Choroidal detachment is generally seen in the postoperative period following vitreous loss. It is classically seen on US as a dome shaped membrane not attached to the optic disc. When it progresses, both membranes may touch each other, producing the

classical 'kissing choroid' sign[5]. Three cases with choroidal detachment were diagnosed in the present study. It was seen as a biconvex echogenic membrane in the posterior segment, which was not attached to the optic nerve head and showed minimal to no movement on dynamic scanning. Suprachoroidal echoes suggestive of hemorrhage were seen as a cause of detachment (Fig. 2).

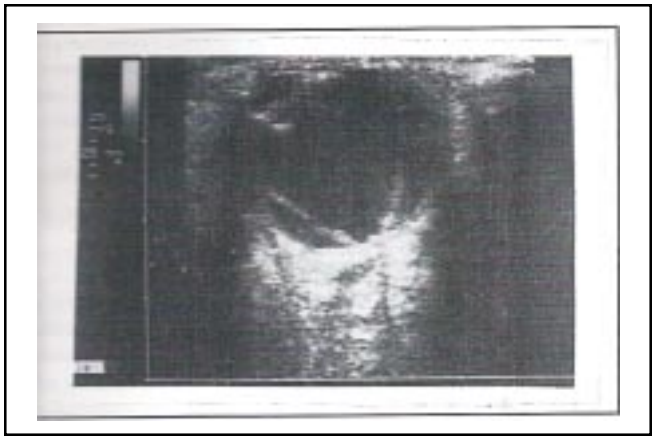

Fig. 2 Choroidal detachment with suprachoroidal hemorrhage. Biconvex membrane is seen in the posterior segment with echoes deep to it. No attachment to the optic nerve head is present. Blood-fluid level is also observed.

Intraocular foreign body : Intraocular foreign body was detected in three cases. The echographic findings for most metallic bodies are generally similar. They are irregular in shape and produce bright signal that perists at low gain settings[5]. Nicholas et al[12] examined the value of real time sonography and CT in evaluation of intra-ocular foreign body. They concluded that ultrasonography is superior to plain radiography in demonstration of intra-ocular foreign bodies including non-opaque foreign bodies. CT was, however, superior to ultrasound in demonstration or precise location and its relation to sclera and lens. However, resolution of intra-ocular structures and their damage was much more detailed on US. All 3 foreign bodies identified in our study were metallic and were seen on plain X-rays. On US, they appeared as high amplitude signals with distal acoustic shadowing, which persisted on reduced gain settings. However, accurate location of foreign body was correctly diagnosed only in two cases. Associated ocular damage was well depicted on US in the form of location and extent of vitreous hemorrhage.

Ocular mass : (4) cases of ocular mass were examined. Clinical presentation was leucocoria in one case, proptosis in 2 cases, and gradual loss of vision in one case. On US, a diagnosis of *retinoblastoma* was made in three cases. Retinoblastoma is the most common malignant intra-ocular tumor in childhood[13]. The common growth patterns are endophytic, exophytic and diffuse type. The spread occurs along the optic nerve with subarachnoid extension or choroidal invasion. Distant secondary deposits of bone marrow, liver and lymph nodes may be present[5]. Small tumors are smooth and dome shaped. However large tumors are highly irregular and heterogenous in texture. Usually, it comes out from one side or retina and fills the posterior segment. Calcification is a typical feature of retinoblastoma and is accompanied with acoustic shadowing[14]. In our study, retinoblastoma appeared as an irregular, heterogeneous mass arising from the retina and growing into the posterior segment. Calcification was observed in 2 cases. US also excluded extraocular extension of mass into the retrobulbar space. US findings were confirmed on surgery.

One case was diagnosed as *choroidal hemangioma.* It appeared as a uniformly echogenic dome-shaped mass in the macular region. Associated serous retinal detachment was also observed (Fig.3). Choroidal hemangoimas are characteristically singular masses found at the posterior pole of the globe.

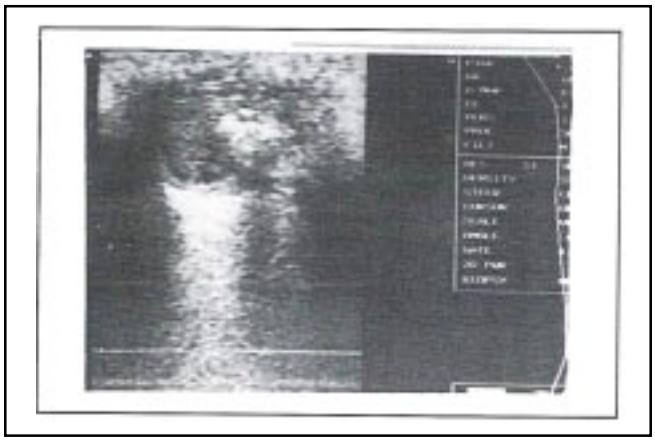

Fig.3 Choroidal hemangioma. US shows a uniformly hyperechoic dome shaped well defined mass in the macular region. Associated partial retinal detachment is observed.

Status of Retina and Choroid : (Table 3)

Retinal detachment : In 36 cases with ocular disease, retinal detachment was seen in 15 cases. Retinal detachment may also be classified according to the pathogenetic mechanism responsible. The most common form is *rhegmatogenous retinal detachment*, which occurs as the result of a full thickness retinl break. The second category, *tractional retinal detachment,* occurs when vitreoretinal adhesions mechanically pull the retina off the underlying retinal pigment epithelium. The third type of detachment involves a *combined rhegmatogenous and tractional mechanism*. A fourth category, *exudative (serous) retinal etachment*, is secondary to an associated process, such as a tumor or inflammation, which results in accumulation of subretinal fluid[10].

Table 3 : Status of Retina and Choroid

Chorioretinal Status	No.	(%)
Total R.D.	5	13.9
Partial R.D.	2	5.5
R.D. with Ocular Mass	3	8.3
R.D. with Retinal Cysts	3	8.3
R.D. with Sub-Retinal Echoes	2	5.5
Choroidal Detachment	3	8.3
Thick Chorio-retinal Layers	3	8.3
FB Embedded in Chorio-retinal Layers	2	5.5
Not Visualized Adequately	2	5.5
Coloboma	2	5.5
Disrupted	1	2.8

In our study, total retinal detachment was seen in 7 cases which appeared as a uniform echogenic membrane extending from the optic nerve head to the ora serrata, taking a V or funnel shape (Fig.4). Long standing retinal detachment was seen a Y or closed funnel shaped membrane due to formation of adhesions between the opposing retinal layers (Fig.5). Degenerative retinal cysts

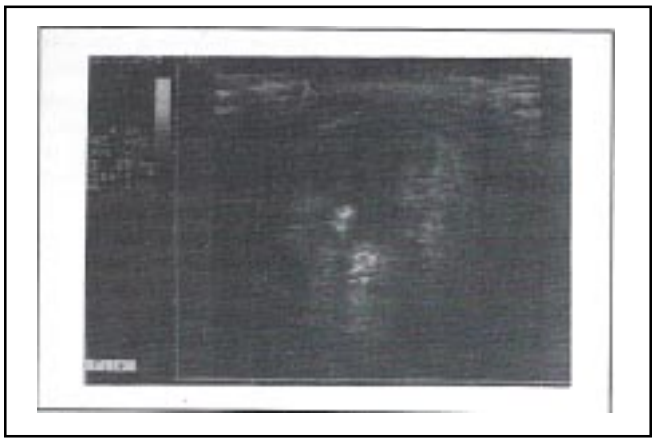

Fig. 4 Total retinal detachment. US shows an echogenic membrane attached to the optic nerve head and extending anteriorly till the ora serrata.

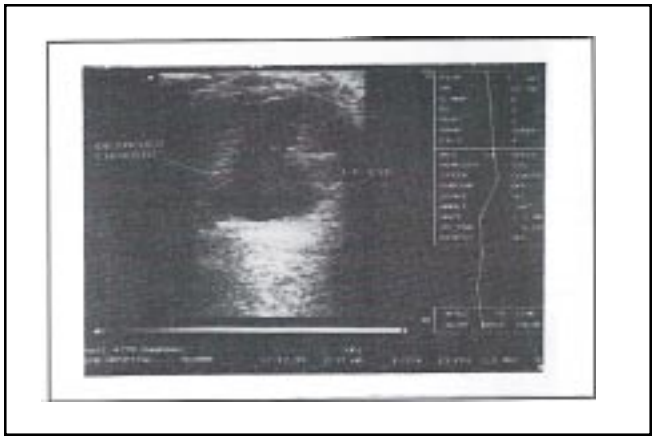

Fig. 5 Old retinal detachment is seen as a Y shaped membrane attached to the optic nerve head.

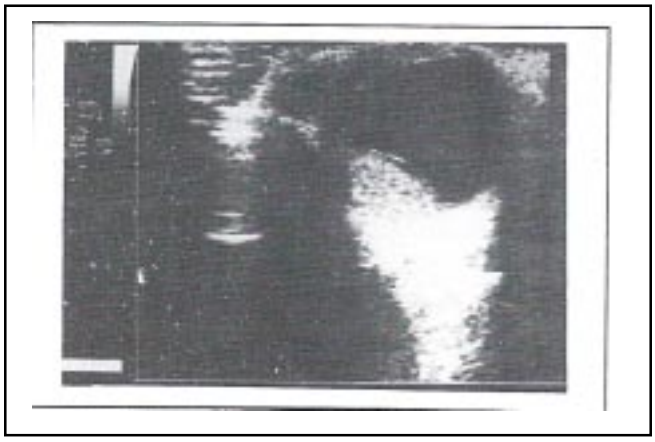

Fig. 6 Long standing retinal detachment with complete apposition of retinal leaves and degenerative retinal cysts.

were also seen three of the old detachments (Fig.6). In two cases, retinal detachment was associated with retinoblastoma.

Choroidal detachment : Choroidal detachment is caused by hypotony. Low intra-ocular pressure favours transudation from the blood vessels into the potential space between the choroid and sclera, whcih results in choroidal detachment. Choroidal secondary changes include exudative, retinal detachment, cystic degeneration and pigment epithelial mottling of the overlying retina. A useful clinical sign is blanching of the lesion with pressure on the globe[15].

Ocular lesions with clear media :

Out of 7 patients with clear media in our study, clinical diagnosis of retinal detachment was made in 6 cases by fundus examination. On sonography, 6 cases were found to have retinal detachment. Three had total detachment, 2 had partial detachment, while one case had partial retinal detachment with choroidal hemangioma. Clinical examination failed to detect subretinal pathology, i.e. subretinal hemorrhage in one case and subretinal mass in another.

Conclusion

Ultrasonography is quick, safe, non-invasive method of imaging the eye, especially when light conducting media is opaque, rendering ophthalmoscopy difficult. US is the only diagnostic tool that may be applied in preopeative evaluation of posterior segment inpatients of cataract. In clear media, it provides supplementary information to that obtained by optical and clinical methods. An accuracy of 85% to 95% correct diagnosis is expected in ophthalmic sonography and the results in theabove study are well within this range[16,17]. It can be concluded that ultrasound is an ideal diagnostic modality for the diagnosis of ocular lesions.

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