Practical Aspects of Ophthalmic Ultrasound in Ibadan

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SUMMARY

Objective: **To highlight the clinical usefulness and the practical aspects of ophthalmic ultrasonography.**

Materials and Methods: **We have described the practical aspects of ophthalmic ultrasonography and reviewed the results of over 200 ophthalmic ultrasounds in our hands.**

Result: **Using ultrasonography, the normal eye is globular and measure 18-24mm in anterior posterior view. The vitreous chamber is clear of reflection. Various intraocular lesions like cataracts, debris, vitreous haemorrhage, retinal detachment, panophthalmitis and foreign bodies as well as retro-ocular masses were diagnosable using ophthalmic ultrasonography.**

Conclusion: **Ophthalmic ultrasonography is recommended as an adjunct to the diagnosis of eye diseases as it is painless, in-expensive and gives accurate results.** *Niger Med J* 1995; 29(1): 25-27.

KEYWORDS: *Ultrasonography; Eye diseases; Diagnostic value*

INTRODUCTION

The unique position of the eye as a superficial, easily accessible organ makes it readily available for inspection. However, in certain circumstances, particularly where there is cataract formation, the posterior segment is obscured from view using the ophthalmoscope. In addition to intraocular lesions, most extra-ocular lesions are not accessible for study and assessment by the ophthalmologist. Ultrasound offers a unique opportunity to inspect the lens, the posterior segment, the wall of the eye and also the extra-ocular areas to determine the nature, position, site and size of palpable and unseen pathology. In situations where facilities exist, ultrasound is usually a preliminary test to be backed up by CT and MRI scans. The absence of MRI and the scarcity of CT in Nigeria and other developing countries means that ultrasound is the final diagnostic tool before intervention in most patients. Where all imaging facilities are available, ultrasound is still used for follow-up of confirmed lesions. Ultrasound has been reported to be superior to MRI in defining thin intra-ocular membrane in an eye with dense cataract. The location of these is critical in differentiating retinal detachments from intravitreal membranes or posterior vitreous detachments. A reasonable knowledge of ultrasound findings in the eye is essential for those who seek to offer ultrasound reports on the subject. This paper reviews the ultrasound experience in one clinic.

MATERIALS AND METHOD

In Ibadan, over 200 ophthalmic ultrasounds were performed by a single ultrasound unit for various ocular and orbital lesions. Theoretically, high frequency transducers of the order of 7.5 to 10MHz are used primarily because of their high resolution. The practical disadvantage is that the higher the frequency, the shorter the focus. This is converted to advantage when scanning small and superficial structures like the eye. Where a high frequency transducer is not available, a 5MHz or even a 3.5MHz transducer may be used provided the eye is brought into the focal length of the transducer which is usually 3-7 cm from the transducer. This can be done by separating the eye from the transducer by inserting a stand off pad or a water bath. A suitable water bath will be an unopened bag of IV fluids placed over the closed eye.

In the supine position, the patient is instructed that the test is painless and informed of the need to keep the eyes closed and the head straight while executing the various eye moment on request. Because ultrasound does not penetrate through air easily, a small amount of ultrasound gel is applied to the closed eye lid and the surfaces of the stand off pad and the transducer. Where the gel is unavailable, liquid paraffin, vaseline or any other mineral oil may be used taking care to keep the oil out of the eye. If the eye is severely infected or if there is ecchymosis and the mucosa of the eye lid is showing, then scanning is awkward. In this case, a sheet of celophane or a celophane glove lightly lubricated with gel can be placed over the eye to prevent contamination of the transducer.

Great care must be taken during application of the transducer to prevent undue trauma. In some circumstances, particularly in small children, the person applying the transducer to the eye cannot at the same time read the screen because the irritated child may sustain an eye injury. In this case, a second party will read the screen and freeze suitable frames while the sonologist concentrates on good and safe application of the transducer to the eye. In all cases the transducer is applied in the transverse plane to the eye and the eye is swept medio-laterally while observations are made of the lens, the contents of the vitreous humour, membranes in the vitreous, the state of the retina, the shape of the eye and the antero-posterior diameter of the eye measured from the transducer to the

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Abbreviations: AP, Anterior-posterior; CT, computerised tomography; MHZ, Megahertz; MRI, Magnetic resonance imaging.

posterior wall. The transducer is then applied to any extra-ocular lesion that is palpated to determine its nature, size, site, shape and perhaps its origin. Asking the patient to move the eye into 4 cardinal positions and also randomly will confirm the location and mobility of intraocular lesions be the foreign bodies, membranes, debris or haemorrhage. Occasionally, the patient may require to sit in the head down position, to determine the mobility of a foreign body. If there is no mass, the retro-ocular space is inspected carefully, sometimes with removal of the stand-off pad to improve access to deeper structures. During the examination, the gain facility and the magnification may require repeated adjustment to obtain the best views. It is important to note that there are four eyes available for comparison in case of difficulty and interpretation. The patient has two eyes, hopefully only one of which may be affected and the observer also has two eyes which he can readily scan to confirm persistent artifacts which may be mistaken for lesions if one is not cautious.

It is essential to photograph all lesions for the benefit of the ophthalmologist and for medico-legal purposes.

FINDINGS AND COMMENTS

The Normal Eye: In our experience, the normal eye measures 18-24 mm AP. The eye is globular, the lens is represented by

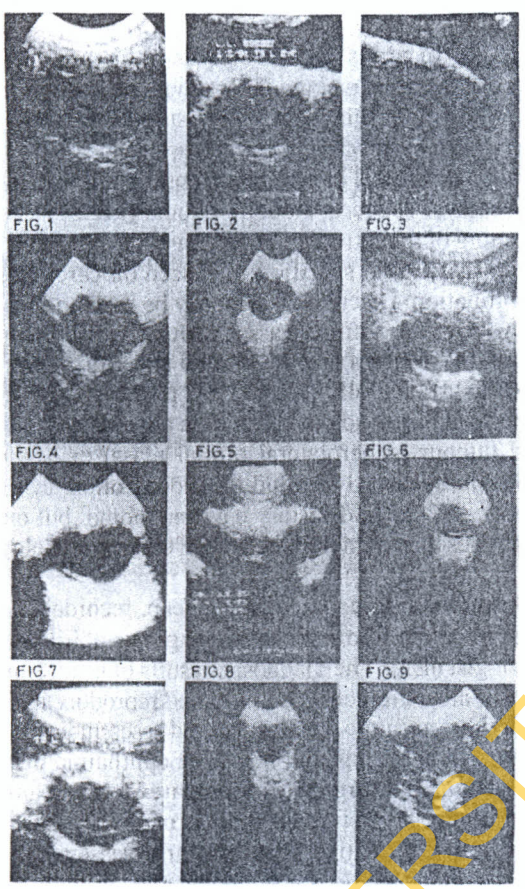

Fig. 1 – *Normal eye: absence of echoes in the vitreous space.*
Fig. 2 – *Cataract: increased echoes in the anterior segment.*
Fig. 3 – *Infected eye: fine echoes in the vitreous space and a collapsed eye.*
Fig. 4 – *Debris in vitreous: high echoes within the posterior.*
Fig. 5 – *Vitreous Haemorrhage (mild): fine echoes in posterior vitreous.*
Fig. 6 – *Vitreous Haemorrhage: high echoes within vitreous space.*
Fig. 7 – *Vitreous Haemorrhage plus Retinal Detachment: echoes outlining the retina detached from posterior part of eyeball.*
Fig. 8 – *Bilateral Retinal detachment: echoes outlining the retina in both eyes, detached.*
Fig. 9 – *Retinal detachment: echoes outlining the retina detached from posterior part of eyeball.*
Fig. 10 – *Panophthalmitis: high echoes within vitreous space.*
Fig. 11 – *Retinal thickening – oedema post trauma: echoes showing swelling of retina. Note that there is no space between retina and choroid.*
Fig. 12 – *Penetrating injury of eye with irregular collapsed vitreous humour and debris: outline of the eye is interrupted posteriorly with fine echoes within the vitreous.*

Fig. 13 – *Foreign body: Solitary high echo within vitreous on retina at 5 o'clock.*
Fig. 14 – *Retino blastoma) very high echo within vitre-*
Fig. 15 – *Retino blastoma) ous space, due to calcification of tumour.*
Fig. 16 – *Choroidopathy – ? Melanoma: echoes outlining mass in posterior part of the eye.*
Fig. 17 – *Fibrosis following retinal detachment surgery: echoes in anterior vitreous in mass at 9 o'clock.*
Fig. 18 – *Mass anterior to eye: echoes within orbit outlining a mass in front of the eye i.e conjunctival or eyelid mass.*
Fig. 19 – *Mass Medial to eye: mass, well outlined on the medial aspect of the orbit.*
Fig. 20 – *Mucoele: echoes outline a mass with an empty/fluid filled interior, next to the eyeball.*
Fig. 21 – *Mass in retro-ocular space: echoes outline a mass, bigger than the eye, posterior in the orbit.*
Fig. 22 – *Mass in supra orbital space: echoes outline a mass above the eyeball.*
Fig. 23 – *Mass postero-medial to eye: echoes outline a solid mass in postero-medial aspect of the orbit.*
Fig. 24 – *Mass lateral to eye: echoes outline a solid mass lateral to the eyeball in the orbit.*

the elliptical line of reflection of sound from its posterior wall (Fig 1). The vitreous chamber is clear of reflection but sometimes if gain valves are high then some reverberation artifacts may be present. Reducing the gain will sometimes eliminate the artifacts. However, excessive gain reduction can eliminate normal reflectivity from an intra-ocular lesion thus masking a lesion. The gain requires constant manipulation in order to confirm and eliminate suspected pathology. The optic nerve head can often be seen as a depression in the retina. The membranes are usually very thin and represented only by the wall of the eye.

Intra-ocular lesions: The lens, vitreous and retina are available for study.

Cataract: This is represented by an oval area of increased echogenicity anteriorly. It is especially obvious during eye movement (Fig 2). However, as this is seen by the naked eye it is the condition of the retrolental area that is of importance in determining whether cataract surgery will be of benefit to the patient. For example a retinal detachment will detract from the value of surgery if retinal surgery facilities are not available.

Debris: In the vitreous humour, some freely floating speckled structures usually represent cellular debris from previous intra-ocular infections or inflammation (Fig 3). Debris may sometimes be quite solid (Fig 4). Eye movement enhances the visualization of debris that may have settled on the membranes.

Vitreous haemorrhage: Flimsy, very thin membranes often arising from the posterior part of the eye, floating with the movement of the eye with some low echoes contained within the membranes usually represent vitreous haemorrhage (Fig 5,6). The vitreous haemorrhage may be quite echogenic (Fig 7).

Retinal detachment: The membrane is usually thicker than that of a haemorrhage and more easily discernible without any contained echoes. It appears to arise from the wall of the eye with the intervening membrane very mobile and floating in the vitreous (Fig 8,9). It is not always possible to distinguish between a retinal detachment and a large vitreous haemorrhage. A longstanding retinal detachment shows up on ultrasound as a very rigid membrane, sometimes funneling on the optic nerve head.

Panophthalmitis: The vitreous humour is reduced in volume. There is thickening of the membranes with echogenic irregular walls and speckling, representing debris in the vitreous. The eye ball may be reduced in size (Fig.10).

Blunt eye injury: After a punch or slap, the eye will keep its shape. There may be retinal detachment or retinal thickening suggesting focal oedema or haemorrhage or haematoma formation (Fig 11).

Penetrating eye injury: The eye is shrunken in size in proportion due to loss of vitreous humour and becomes irregular in shape (Fig.12). The membranes may be thickened, irregular and echogenic.

Foreign body: Depending on the extent of trauma and the duration of injury, the eye may appear normal in outline or collapsed. The usual trauma is from metalic objects from welding but sometimes broom sticks, wood or glass can also be responsible. Metalic objects are very echogenic and can be located precisely especially if they are intra-ocular (Fig.13). Extraocular foreign bodies are more difficult to locate. It is useful to determine if the object is mobile. This can be done by asking the patient to sit up and bend the head down with the transducer still in contact with the eye. The foreign body may be seen floating towards the lens or static against the membranes.

Retinoblastoma: This appears in young children as a small spot of variable echogenicity on the retina if early. The mass will be bigger in later stages until in extensive diseases it may fill the eye which is not usually distorted (Fig.14,15). The tumour mass is sometimes highly echogenic due to calcific areas following necrosis of the tumour especially in large tumours (Fig.15). The vitreous will be reduced proportionally. It is important to examine the other eye and the liver to exclude secondaries.

Miscellaneous: In adults, growths on the retina may be identified as choroidopathy, melanoma or other neoplastic process (Fig.16). Following retinal detachment surgery thickening of the posterior vitreous occurs due to fibrosis (Fig.17).

Rectro-ocular masses: Thickening of optic nerve which initially may be oval suggests an optic glioma (Fig.21). A diffuse thickening of the retro-ocular content due to oedema may cause proptosis with no specific lesion seen on careful retro-ocular examination. Discrete masses may be seen and located specifically as well as diffuse masses with poorly defined borders (Fig.18-24). Masses may be located superiorly (Fig.22), medially (Fig.23), laterally (Fig.24) or posteriorly (Fig.21). The diagnosis may be indicated from the position e.g. a lacrimal gland tumour (superolateral orbital mass) or a glioma (retro-ocular mass directly behind the globe, often cylindrical), or from the age and history e.g. lymphoma, but only a mucocoele gives the characteristic lack of echoes. Histology is essential.

Ultrasound offers a relatively cheap, recordable, non invasive, painless addition to the investigative ability of the ophthalmologist (1,2). The diagnostic results of ultrasound in ocular disease are extremely good (3,4) and reproduceable (5). It allows for more accurate localization and assessment of various eye and orbital lesions and helps the ophthalmologist to plan management and surgery (5). Compared to CT scanning and MRI scanning, it is simpler to perform, a lot less expensive and just as informative about ocular diseases (6). We, therefore, recommend the use of ocular and orbital ultrasound as an adjunct to the diagnosis of ophthalmic diseases and have laid out practical ways of achieving good results.

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