Original Article

Ultrasonographic Evaluation of Ophthalmic Diseases at Delta State University Teaching Hospital, Oghara, Delta State, Nigeria

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Abstract

Background: Ultrasonography (US) is one of the first-line imaging modalities of choice for evaluating ocular pathologies after clinical examination. The human lens being radiosensitive requires imaging modalities that do not utilize ionizing radiation. **Aim:** This study determined the indications for ocular ultrasound and the pattern of ocular pathologies in patients imaged with B-mode ocular US at the radiology department of a teaching hospital over a seven-year period. This study also determined the correlation between the provisional diagnosis of the referring ophthalmologist and the sonographic diagnosis. **Materials and Methods:** This was a retrospective descriptive study of the patients referred for ocular ultrasound scans from January 2012 to December 2018. **Results:** The records of 125 patients comprising 72 males (57.6%) and 53 females (42.4%) with a mean age of 32.9 (±23.12) years that fulfilled the inclusion criteria were reviewed. The most common indication was loss of vision/deterioration in vision. The most common provisional diagnosis was cataract seen in 20 (16%) patients, while the most common sonographic finding was retinal detachment seen in 44 (35.2%) patients. For the trauma cases, cataract, lens dislocation, retinal detachment, vitreous haemorrhage, and intraocular foreign body were diagnosed by US. **Conclusion:** Cataract was the most common clinical diagnosis, but retinal detachment was the most common sonographic diagnosis. This study highlights the use of US as a valuable tool in diagnosing and confirming clinical diagnosis, particularly valuable when the posterior segment cannot be adequately visualized as a result of opacities in the visual axis.

Keywords: B-mode ultrasonography, Delta State, ocular pathology, ocular trauma, posterior eye segment

Introduction

Ultrasonography (US) is one of the first-line imaging modalities of choice among the imaging techniques employed in evaluating ocular pathologies. Its use in Ophthalmology dates back to 1956 when it was first used by the American Ophthalmologists, Mundt and Hughes.[1] US is easily accessible and affordable in comparison to computed tomography and magnetic resonance imaging (MRI).[2-5] The human lens being radiosensitive requires imaging modalities that do not utilize ionizing radiation such as US and MRI.[6] US is ideal for depicting ocular anatomy and pathologies due to the location and cystic nature of the eyes.[6] It is specifically ideal for structures of the posterior segment which are difficult to view with an ophthalmoscope when the media are opaque.[3,7,8] With the application of proper sonographic techniques, pathological intraocular structures can be recognized to clinch a radiological diagnosis.[6-9]

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The patterns of ocular morbidities differ in the developed and developing world.[10-12] The use of US to evaluate ocular pathologies has been reported in other climes and centers in Nigeria,[13-16] but none has been reported in this study center.

This study was done to determine the indications for ocular US and the pattern of ocular pathologies in patients imaged with B-mode ocular US and to determine the correlation between the provisional diagnosis of the referring ophthalmologist and the sonographic diagnosis.

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Materials and Methods

This was a retrospective descriptive study in which the records of patients referred to the radiology department for ocular US between January 2012 and December 2018 were reviewed. Approval from the Health Research Ethics Committee of the Hospital (EREC/PAN/2020/048/0388) was sought before the commencement of the study. The radiological request forms and ultrasound scan reports of all the consecutive patients referred for ocular ultrasound scans during the period of review archived in the Picture Archiving and Communication System (PACS) unit of the department were retrieved and studied. The hospital has standardized radiology request forms, which are designed to capture information such as bio data, presenting complaints, clinical questions to be answered, provisional diagnosis, and details of the referring doctor. The hospital is also equipped with the Radiology Information System, in which all the radiology request forms and imaging reports of patients are archived. The information extracted was the patient's bio data, clinical history, provisional diagnosis, sonographic findings, and radiological diagnosis.

Inclusion criteria for the study are adequately filled radiological request forms and complete reports of sonographic examination (ocular scan) carried out/supervised by the consultant radiologist. Adequately filled radiological request forms that fulfilled the inclusion criteria for the study were those that contained patient's names, age, hospital number, gender, ward/clinic, address, imaging modality requested, clinical information, provisional diagnosis, radiology number, consultant in charge, and doctor's name and signature.

Inadequately filled or incomplete radiological request forms and ultrasound reports with inconclusive findings/radiological diagnosis were excluded from the study. The study was conducted following the principles of Helsinki declaration (Helsinki, 2013).

The degree of agreement between clinical diagnosis and US diagnosis was determined based on the degree of similarity between the results of ultrasound report and clinical diagnosis using Cohen's kappa. This was graded as "total agreement" when clinical and ultrasound diagnosis were same; "partial agreement" when there are one or two dissimilarities; and no agreement when the diagnosis were "totally different."

Toshiba Viamo® ultrasound scan machine (Model SSA-640A, Toshiba Medical Systems Corp, Japan, 2009) coupled with a probe frequency of 7.5–10 MHz was used for scanning all the patients. Sonographic technique of the orbito-ocular scans was longitudinal and transverse planes, while the patient was lying supine with the eyes closed. Both eyes were scanned except when contraindicated in cases of ruptured globe, profuse bleeding from the eye, and history of recent eye surgery.

The obtained data were then entered into an Excel structured data spreadsheet and analysed with IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as proportions, frequencies, and percentages. Where appropriate, Chi-square, and Student's *t*-test were used, and a statistical significance was placed at $P < 0.05$.

Results

Within the seven-year period, a total of 141 patients had orbito-ocular ultrasound scans, but 15 (10.6%) were discarded on account of incomplete records. A total of 125 patients with complete records comprised 72 males (57.6%) and 53 females (42.4%), with a male-to-female ratio of 1.36:1. There was no statistically significant difference between the sex distribution ($P = 0.47$). The mean age was 32.9 (±23.12) years and the range was 1–83 years. A total of 38 (30.4%) were in the paediatric age group (0–17 years). Eighty-three (66.4%) of the study participants were in the 0–40 years of age group. Table 1 shows the demographic characteristics of the patients who had ocular ultrasound scans.

Table 2 shows the provisional clinical diagnosis of the patients who had orbito-ocular US scans during the period under review.

The most common provisional diagnosis was senile cataract 20 (16.0%), followed by retinal detachment 14 (11.2%), traumatic lens dislocation 11 (8.8%), and vitreous haemorrhage 8 (6.4%). Within the paediatric age group, the most common provisional diagnosis was traumatic cataract (9, 23.6%), followed by orbital cellulitis (5, 13.5%) and vitreous haemorrhage and retinal detachment (3, 7.8%), each respectively.

The most common indication for ocular ultrasound was loss of vision/deterioration in vision comprising 68 (54.4%) patients, followed by trauma to the eye in 45 (36.0%) and flashes/floaters in 25 (20.0%) patients. In the paediatric age group, the most common indication for ocular ultrasound was ocular trauma (12, (1.5%), followed by orbital cellulitis (5, 13.5%). The left eye (51, 40.8%) was most commonly requested for ultrasound scan.

Of the 125 patients who had US, 112 (89.6%) had ocular pathologies, while 13 (10.4%) had normal findings.

Table 1: Demographic characteristics of patients who had orbito-ocular ultrasound scans

Variables			Frequency (100%)
Age	Male	Female	
1-10	19	9	28 (22.4)
11-20	11	8	19 (15.2)
21-30	9	7	16 (12.8)
31-40	15	5	20 (16.0)
41-50	6	4	10 (8.0)
51-60	2	7	9 (7.2)
61-70	5	8	13 (10.4)
71-80	5	3	8 (6.4)
81-90	0	2	2 (1.6)
Total	72	53	125 (100)

The most common sonographic findings [Table 3] were retinal detachment (44, 35.2%) [Figures 1 and 2], vitreous haemorrhage (39, 31.2%) [Figure 3], and cataract (38, 30.4%) [Figure 4]. In the paediatric age group, the most common sonographic findings were cataract (13, 34.2%), followed by vitreous haemorrhage (7, 18.4%), retinal detachment (6, 15.7%), and retinoblastoma (4, 10.5%). Increasing age was significantly associated with sonographic diagnosis of cataract ($P < 0.016$) and retinal detachment ($P < 0.012$). The vitreous detachment was found more in males ($P < 0.015$).

Table 2: The clinical diagnosis of the patients referred for orbito-ocular ultrasonography

Clinical diagnosis	Frequency (%)
Cataract	20 (16)
Retinal detachment	14 (11.2)
Traumatic lens dislocation	11 (8.8)
Vitreous haemorrhage	8 (6.4)
Corneoscleral laceration	7 (5.6)
Congenital ocular anomaly	6 (4.8)
Intraocular tumor	6 (4.8)
Orbital cellulitis	5 (4.0)
Posterior uveitis	5 (4.0)
Hyphema	4 (3.2)
Glaucoma	4 (3.2)
Inflammation/infection	4 (3.2)
Pseudophakia	4 (3.2)
Traumatic mydriasis	2 (1.6)
Corneal scarring	2 (1.6)
Refractive error	2 (1.6)
*Others	21 (16.8)

*Posterior synechiae, vitreous opacities, phthisis bulbi, ocular hypotony, buphthalmos, retinopathy, vitreous detachment, drusen, age-related maculopathy

Table 3: The distribution of sonographic diagnosis

Sonographic findings#	Frequency (100%)
Retinal detachment	44 (35.2)
Vitreous haemorrhage	39 (31.2)
Cataract	38 (30.4)
Normal ultrasound finding	13 (10.4)
Choroidal detachment	7 (5.6)
Posterior vitreous detachment	6 (4.8)
Intraocular foreign body	5 (4.0)
Retinoblastoma	4 (3.2)
Anterior dislocation of the lens	3 (2.4)
Buphthalmos with aphakia	3 (2.4)
Contracted globe	2 (1.6)
Hyphema	2 (1.6)
Retinopathy	2 (1.6)
Phthisis bulbi	2 (1.6)
Others**	9 (7.2)

#Some eyes had multiple pathologies, **Ruptured globe, dacryoadenitis, choroidal detachment with phthisis bulbi, eye abscess, choroidal detachment with orbital cellulitis, eyelid swelling, choroidal swelling, optic nerve atrophy, hypoplastic left globe, choroidal thickening

A total of 45 (36%) patients who had ocular ultrasound scans based on a history of trauma had trauma-related findings.

Figure 1: Retinal detachment seen as a V-shaped hyperechoic wavy membrane with the limbs attached to the ora serrata anteriorly and the optic nerve head posteriorly

Figure 2: Retinal detachment with retro-retinal haemorrhage

Figure 3: Vitreous haemorrhage seen as extensive echogenic structures within the vitreous

Males (29, 64.4%) had more trauma-related pathologies than females (16, 35.5%). The mean age was 19 years.

The left eye was most commonly affected while the trauma-related pathologies diagnosed by US were traumatic cataract/lens dislocation, retinal detachment, vitreous haemorrhage, and intraocular foreign body. A total of 44 (97.8%) patients with ocular trauma had retinal detachment, 38 (84.4%) had cataracts, 30 (66.7%) had vitreous haemorrhage, while 5 (11%) had intraocular foreign body. Ocular trauma was significantly associated with male gender ($P < 0.000$), decreasing age ($P < 0.034$), cataract ($P < 0.009$), retinal detachment ($P < 0.000$), vitreous haemorrhage ($P < 0.000$), and foreign body in the eye ($P < 0.001$). Table 4 shows the age distribution of those with trauma-related ultrasound diagnosis of retinal detachment and cataracts.

Table 5 shows the degree of agreement between clinical diagnosis and sonographic diagnosis using Cohen's kappa. The ultrasound and clinical diagnosis were same in 66 (52%) of the patients and discordant in 29 (23.2%) of the patients. There was a partial agreement between the clinical and sonographic diagnosis in 30 (24%) of the patients.

Discussion

This study sought to highlight the role of ultrasound scans in the management of ocular pathologies in Delta State University Teaching Hospital, Oghara, Nigeria. The demographic analysis showed that more males were referred for ultrasound scans compared with females, which is similar to studies done in Ife, Enugu, Ibadan, Benin City, Jos, and Sagamu.[8,14-18] Females are more likely to be blind and have visual impairment from eye diseases but are less likely to access eye care services, which may be responsible for a male preponderance in this study.[19] It also may seem that males are more likely to have ocular pathologies due to ocular trauma as a result of their high-risk behaviour, thereby requiring US to make a diagnosis. The study showed that 36% of the patients who had ocular ultrasound had a history of ocular trauma and 64.4% of these patients were males. These observations have also been documented by other researchers.[13,20-22]

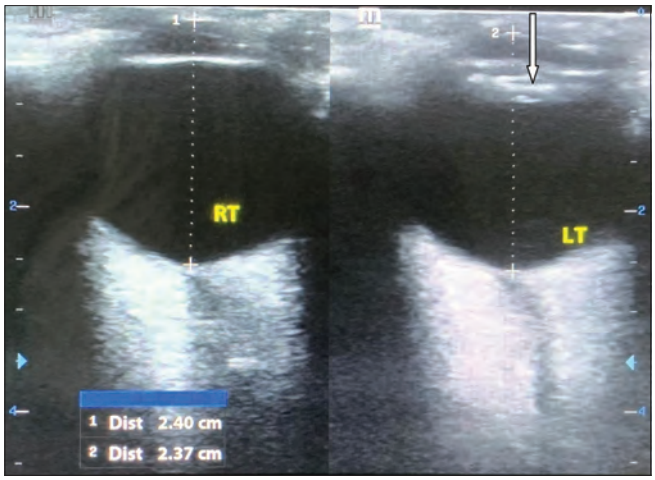

Figure 4: LT eye cataract. The LT lens (thick down arrow) is thickened and shows perilenticular echogenic strands. RT: Right; LT: Left

More than two-thirds of the patients who had ocular ultrasound scans were <40 years; this points to the implication that most of the ocular pathologies occurred at the most productive stages of life which could affect the socioeconomic status of the individuals. A significant proportion of the patients within this age group also had ocular trauma which is a known cause of unilateral blindness worldwide.[23-25]

The most common indications for requesting ultrasound scan were deteriorating vision, ocular trauma, and flashes and floaters. These symptoms are related to the symptoms of cataract/lens dislocation, vitreous haemorrhage, and retinal detachment, which were the most common clinical and sonographic diagnosis.

Cataract was the most common clinical diagnosis, but retinal detachment was the most common sonographic diagnosis; this could be as a result of patients with cataract being requested to do orbito-ocular US when the posterior segment could not be visualized to determine the state of the retina, especially in the presence of poor pupillary response or light projection. Retinal detachment was also the most common finding in similar studies done in Enugu, Ibadan, Benin City, and Sagamu.[14-18] Conversely, cataract was the most common sonographic diagnosis in an Indian study[3] and in Ife, Nigeria.[8] Vitreous haemorrhage and posterior vitreous detachment were the other common pathologies that were similarly documented in the studies in Enugu, Ibadan, Benin City, and Sagamu, though in varying frequencies.[14-18] The indications for B-mode US and varying aetiologies etiologies may be responsible for the variation.

Table 4: Age distribution of those with trauma-related retinal detachment and cataract/lens dislocation

Age (years)	Retinal detachment (%)	Cataract (%)
1-10	8 (18.18)	7 (18.42)
11-20	2 (4.55)	6 (15.79)
21-30	6 (13.64)	4 (10.53)
31-40	13 (29.55)	8 (21.05)
41-50	1 (2.23)	3 (7.89)
51-60	3 (6.82)	0 (0.0)
61-70	5 (11.36)	5 (13.16)
71-80	6 (13.64)	5 (13.16)
81-90	0	0
Total	44 (100.0)	38 (100.0)

Table 5: Degree of agreement between clinical diagnosis and sonographic diagnosis

Degree of agreement	Frequency (%)
Total agreement	66 (52)
Partial agreement	30 (24)
No agreement	29 (23.2)

This study revealed an increase in the frequency of the sonographic diagnosis of certain ocular pathologies after clinical diagnosis has been made: 16% of cases of cataract diagnosed clinically increased to 30.4% of cases with sonographic diagnosis, while retinal detachment increased from 11.2% to 35.2% and vitreous haemorrhage increased from 6.4% to 31.2%.

This shows that B-mode US is a valuable tool in diagnosing and confirming the clinical diagnosis and this is particularly valuable when the posterior segment cannot be adequately visualized as a result of opacities in the visual axis such as corneal opacities, cataract, vitreous haemorrhage, or vitreous opacities. This study also exposed the fact that critical posterior segment lesions could have been missed in a significant proportion of patients which would have adversely affected treatment outcomes.

A major proportion of the patients who had US gave a history of trauma. US has proven to be useful in diagnosing the extent of ocular involvement, especially when a posterior segment or intraocular foreign body is suspected. US can therefore be used to determine the prognosis of an ocular injury and is helpful in medicolegal documentation.[21] Retinal detachment, vitreous haemorrhage, and cataracts were significantly associated with ocular trauma. Similar findings were found in Ilorin, Kebbi, Benin City, and Enugu.[12,20-22] Ocular trauma has also been noted to be commoner in younger males with a consequent impact on quality of life and socioeconomic implications. Ocular trauma is a significant cause of blindness and visual impairment and the leading cause of monocular blindness in Nigeria and worldwide.[23-26]

A clinical and ultrasonographic total agreement of 52% was revealed in this study. Studies done in Enugu, Ibadan, Benin City, and Kebbi documented a varying degree of agreement or concordance.[14-17] A number of factors could be responsible ranging from sample size, etiological indications for US, diagnostic accuracy of the equipment, and study focus.

This study has provided a dataset that will be useful in the planning and formulating of ocular health policies, and provision of better eye care services including imaging, for which it has highlighted the role of US in the management of ocular disease in poor-resource areas, especially where other imaging modalities may not be accessible or affordable.[4]

An important limitation of this retrospective study is some missing vital data such as the duration of presentation to the hospital and presenting visual acuity of the patients. This information was not documented in the PACS archives, and retrieval of a significant number of the patients' case notes could not be done due to software failure in the medical records department at the time of this research. There was also difficulty in accessing the information on the definitive management of the patients.

Conclusion

This study has highlighted the importance of B-mode US in confirming the clinical diagnosis and also detecting orbito-ocular diagnosis that may have been undetected by the ophthalmologist as a result of opacities in the visual axis. Furthermore, this study has shown the importance of collaboration between the ophthalmologist and radiologist in achieving better treatment outcomes in patients with ocular diseases.

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Conflicts of interest

There are no conflicts of interest.

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