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A 5-YEAR REVIEW OF ULTRASONOGRAPHIC EVALUATION OF OCULAR DISEASES AT THE UNIVERSITY COLLEGE HOSPITAL IBADAN, SOUTH-WEST, NIGERIA

A.J. Adekanmi[1], O.A. Ogun[2], A.T. Adeniji-Sofoluwe[1] and M.O. Obajimi[1]

1. Department of Radiology, College of Medicine, University of Ibadan and University College Hospital, Ibadan, Nigeria.
2. Department of Ophthalmology, College of Medicine, University of Ibadan and University College Hospital, Ibadan, Nigeria.

Correspondence:
Dr. O.A. Ogun
Department of Ophthalmology,
College of Medicine,
University of Ibadan,
Ibadan.
Email: olufunmiogun@gmail.com

ABSTRACT

Background: **Orbito-ocular diseases are a major public health issue, often causing visual impairment with serious socioeconomic implications on individual lives. Ocular ultrasonography is an invaluable diagnostic tool when clinical examination of the ocular fundus is difficult.**

Objectives: **To describe the indications, sonographic findings, and contribution of orbito-ocular ultrasonography to the management of orbito-ocular diseases in the University College Hospital, Ibadan.**

Materials and Methods: **A retrospective review of B-mode ocular ultrasound findings and hospital data of all patients referred to the Radiology department of the University College Hospital, Ibadan for ocular Ultrasound between January 2014 - December 2018.**

Results: **There were 142 patients, aged 1-85 years, (median age =28 years). 72 (50.7%) patients were under 30 years of age, and 50 (35.2%) were pediatric cases. Male to female ratio was 1.84:1. The commonest presenting complaint was blurred vision in 97 (68.3%) cases, followed by eye trauma in 54 (38.0%). B-mode Ultrasound, demonstrated cataract in 63 (44.4%,) cases, vitreous hemorrhage in 42 (29.6%), retinal detachment in 27 (19.0%), vitreous detachment in 19 (13.4%), normal findings in 17 (12%) and orbital tumors in 13 (9.2%) patients.**

B-mode ultrasound scan and clinical diagnosis demonstrated good agreement in 91 /142 cases (64.1%), partial agreement in 23/142 (16.2%) cases, and no agreement in 28 (19.7%). Kappa agreement scores, K were 74.3% and 70.9%, for ruptured globe and cataract respectively.

Conclusion: **Orbito-ocular ultrasonography contributes significantly to the diagnosis of orbito-ocular disease and shows good correlation with clinical diagnoses. However, a future study with larger numbers is required.**

Keywords: Ocular disease, Retinal detachment, Vitreous hemorrhage, Ultrasound.

INTRODUCTION

Orbito-ocular diseases are major public health issues, often causing visual impairment with serious socioeconomic implications on individuals' lives.[1,2] According to WHO[3], an estimated 1.3 billion people globally live with some form of visual impairment.[1] In Nigeria, an estimated 4.25 million adults have moderate to severe visual impairment or blindness in the better eye, according to the Nigerian national blindness survey in 2009[4], and this number was projected to increase by over 40% by 2019 [4]. Lifestyle modifications was advocated to forestall this trend as 80% of all causes of visual impairment and blindness are known to be preventable or curable [4]. However, this is yet to be achieved globally, with avoidable or treatable vision loss anticipated to increase [5]. Diagnostic imaging, particularly ocular ultrasound, has become a proven tool that improves the accuracy of clinical diagnoses, with the potential to improve early detection, improve care, and treatment.[6]

Although, clinical examination is the mainstay of diagnosis in most patients with eye disease, ocular ultrasound scan is an invaluable tool for detecting and outlining soft-tissue abnormalities of the eye and orbit. Ocular Ultrasound is particularly useful when fundus examination is equivocal or impaired by media opacification.[7,8] The superficial location of the eye and its cystic composition provides a suitable window for imaging.[9] Compared with other imaging techniques such as X-rays, computed tomography (CT) scanning, and Magnetic resonance imaging (MRI), ultrasonography is simple, does not utilize ionizing radiation, is

non-invasive, affordable, safe, repeatable, and a real-time imaging modality which provides detailed cross-sectional anatomy of the entire eye globe.[10]

Previous studies, in other climes, have demonstrated the reliability of ocular ultrasound for the investigation of ocular pathologies such as cataract, lens dislocation, choroidal dislocation, retinal tears, vitreous and retinal detachments, vitreous hemorrhage, subretinal hemorrhage[8,11,12]; evaluation and diagnosis of ocular tumours[7,13-16]; localizing foreign bodies within the globe and to evaluate the extent of damage in ocular trauma.[12] However, there is paucity of data on the clinico-ultrasonographic orbito-ocular disease evaluation in our environment. In this study, which represents a mini-audit of interdisciplinary collabora-tion between radiologists and ophthalmologists at the UCH, Ibadan, we evaluated the hospital presentation time of patients, correlated ultrasonographic features with clinical diagnosis. We provided evidence of the current trend of ultrasound use in our institution's clinical management of orbito-ocular diseases.

MATERIALS AND METHODS

This retrospective descriptive study was conducted in both the Departments of Ophthalmology and Radiology of the University College Hospital, Ibadan, Oyo State, South-Western Nigeria. The study included case notes and radiology reports of all patients referred for ocular sonography between January 2013 and December 2018. Two ultrasound scanners were used for the evaluations of the patients, namely the General Electric, Logic P5 ultrasound unit, and Ultrasonix SP ultrasound scanner. Ultrasonographic images were acquired using a 7.5 10MHz linear transducer. Ultrasound of all the patients was performed in the supine position, with the transducer applied gently to the globe over the closed eyelid, after coupling gel was applied, using the B-scan ultrasound mode. Scanning of both globes was done in orthogonal planes with gentle movement of the eyeballs during the examination as one examines the intraorbital and intrabulbar structures. Orbital pathologies were documented in a radiology report for each patient. The authors retrieved and reviewed the radiology reports and clinical data of all patients who had performed ocular ultrasound scans during the study period. Data were extracted and entered into a structured spreadsheet in Excel and analysed using SPSS, version 22 (IBM). This research was conducted following the principles of the Helsinki declaration (Helsinki, 1978). Continuous variables were reported using frequencies and proportions, while Chi-square tests were used to analyse associations between categorical variables.

RESULTS

A total of 142 subjects were studied. Patients' ages ranged from 1-85 years, with a median age of 28 years. Fifty (35.2%) were in the pediatric age group. The male to female ratio was 1.84:1, and about half (50.7%) were below the age of 30 years.

Duration of symptoms before presentation was greater than three months in 68 (47.9%) patients, while 42 (29.5%) presented within a week of symptoms. Eighty-one (57.0%) patients had severe visual impairment at presentation, 32 (22.5%) were blind, and mild visual impairment recorded in 9 (6.3%) patients. Visual acuity was documented in all but 5 cases. Table 1 describes the demographic characteristics of patients and their time of presentation.

Presenting complaints and time of presentation of the study population

Ninety-seven (68.3%) patients had blurred vision followed by trauma/injury and headache/eye ache/pain in 54(38.0%) and 45(31.7%) patients respectively. More than half, 29 (53.7%) of the patients with trauma/injury presented within a week. Also, most patients with headache and eye pain and redness of

Table 1: Demographic, time before clinical presentation and visual acuity of the study population

Variables	Frequency	Percentage
Gender		
Male	92	64.8
Female	50	35.2
Age		
1 – 9 years	28	19.7
10 – 19 years	22	15.5
20 – 29 years	22	15.5
30 – 49 years	38	26.8
50 – 64 years	19	13.4
65 years and above	13	9.2
Duration to clinical presentation	8	5.6
Sub-acute (less than 24 hours)	34	23.9
Acute (within one week)	32	22.5
Moderate (>1wk to 3 months)	31	21.8
Chronic (>3 months to 1 year)	37	26.1
Prolonged (>1 year)		
Visual acuity		
Good visual acuity	4	2.8
Mild visual impairment	9	6.3
Moderate visual impairment	11	7.7
Severe visual impairment	81	57.0
Blindness	32	22.5
Not reported	5	3.5

***Key**: Good visual acuity= ≥6/6; Mild visual impairment = 6/9-6/12; moderate visual impairment= 6/18-6/60; severe visual impairment= <6/60-3/60 and blindness= <3/60 According to WHO classification of visual impairment based on Snellen acuity (ICD-10)* [37]

Table 2: Presenting complaints versus time of presentation at the hospital.

Presenting complaints	Duration to presentation					
	Less than 24 hours	1 to 7 days	>1wk to 3 months	>3months to 1 years	> 1 year	Total (%)
Blurred vision (%)	4 (4.1)	17 (17.5)	21 (21.6)	24 (24.7)	31 (32.0)	97 (68.3)
Trauma/ Eye Injury (%)	3 (5.6)	26 (48.1)	14 (25.9)	7 (13.0)	4 (7.4)	54 (38.0)
Headache associated with eye pain (%)	4 (8.9)	14 (31.1)	11 (24.4)	8 (17.8)	8 (17.8)	45 (31.7)
Redness of the eye (%)	2 (5.0)	14 (35.0)	10 (25.0)	9 (22.5)	5 (12.5)	40 (28.2)
Watery discharge from the eye (%)	0(0.0)	11 (37.9)	9 (31.0)	6 (20.7)	3 (10.3)	29 (20.4)
Eye discomfort to light (%)	2 (10.0)	5 (25.0)	6 (30.0)	4 (20.0)	3 (15.0)	20 (14.1)
White spot (%)	0 (0.0)	0 (0.0)	3 (27.3)	4 (36.4)	4 (36.4)	11 (7.7)
Purulent eye discharge (%)	0(0.0)	1 (14.3)	2 (28.6)	1 (14.3)	2 (28.6)	7 (4.9)
Eye protrusion (%)	0(0.0)	0(0.0)	2(28.6)	4(57.1)	1(14.3)	7(4.9)
Itching of the eyes	0(0.0)	2(33.3)	2(33.3)	1(16.7)	1(16.7)	6(4.2)
Floaters/flash light (%)	1(25.0)	0(0.0)	0(0.0)	1(25.0)	2(50.0)	4(2.8)
Post-surgery (%)	0(0.0)	1(50.0)	0 (0.0)	1 (50.0)	0 (0.0)	2 (1.4)
Chemical injury to the eye (%)	1(100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.7)
Others (%)	1 (10.0)	1 (10.0)	2 (20.0)	4 (40.0)	3 (30.0)	10 (7.0)

Others: Orbital swelling, defect in medial aspect of the eye, gritty sensation, eye discomfort, eyelid drooping, feeling of a mass in the corner of the eye and excessive tears.

the eyes presented at the Hospital within one week of their complaint. Those with Ophthalmic infections commonly presented after a week of the infection. In contrast, more than half of patients with a white spot in the eye 8 (72.4%) or blurred vision 55 (56.7%) patients presented more than three months after. The only case of chemical injury, however, presented in less than 24 hours at the Hospital.

On clinical evaluation, cataract was reported in 51(35.9%) patients in addition to other ocular pathologies, followed by vitreous hemorrhage 37 (26.1%) cases and retinal detachment in 29 (20.4%), lens subluxation was the least diagnosis in 3 cases (2.1%) as shown in Table 3.

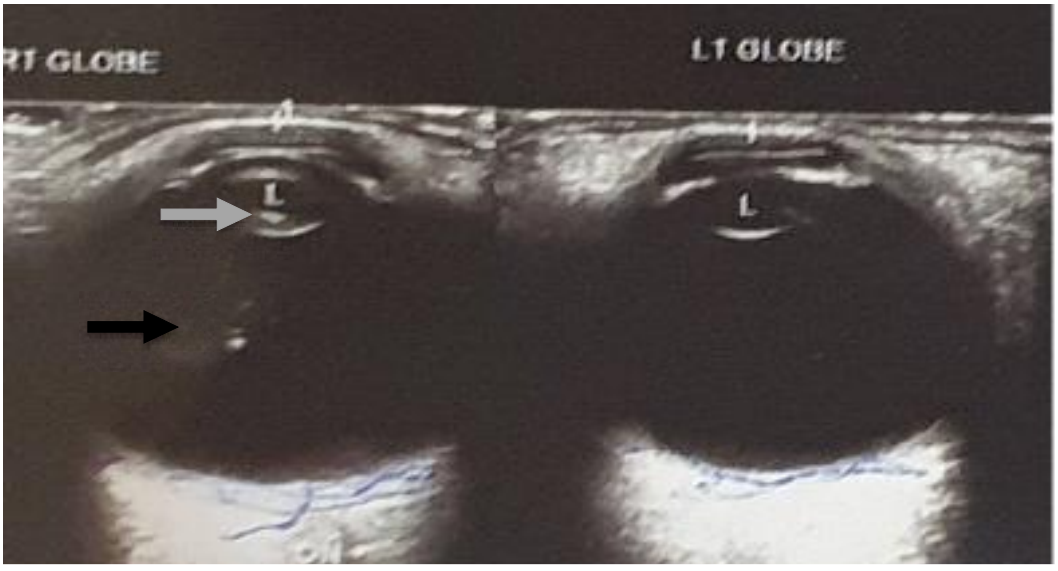

Fig. 1: B-mode ultrasound of the right and left globes. Lens is marked (l.)
Note: Increased echogenic thickening indicating cataract in right lens (grey arrow).
Echogenic particles within vitreous in right eye, suggestive of vitreous haemorrhage (black arrow)

Figure 1: B-mode ultrasound showing an echogenic thickened and echogenic lens of the right eye in keeping with cataract. There is an echogenic focus in the vitreous, indicating vitreous haemorrhage. The left globe is essentially normal.

Table 3: Clinical diagnosis among the study population.

Diagnosis	Frequency	Percentage
Cataract	51	35.9
Retinal detachment	29	20.4
vitreous hemorrhage	37	26.1
Orbital Tumor	11	7.7
Corneo-sclera laceration	8	5.6
Inflammation/Infection	8	5.6
Uveitis	7	4.9
Hyphaema	7	4.9
Dislocated lens	4	2.8
Cornea Opacity	4	2.8
Proptosis	4	2.8
Rupture globe	4	2.8
Glaucoma	5	3.5
Lens Subluxation	3	2.1
Others	25	17.6

Others: Retinopathy, Buphthamos, traumatic Iridodialysis, Refractive error, Lacrima gland calculus, Phthisis bulbi, Sclera mass, Vitreous collapse, Vitreoretinopathy, Drusen, foreign body, Choriodoretinitis, posterior synechiae, ocular hypotony and eyelid oedema.

Table 4: Common ocular ultrasound findings among the study population.

Ultrasound Findings	Number of Cases	Percentage
Pathological findings	125	88.0
Normal findings	17	12.0
PATHOLOGICAL FINDINGS		
Cataract	63	44.4
Vitreous hemorrhage	42	29.6
Retinal detachment	27	19.0
Vitreous detachment	19	13.4
Tumor	13	9.2
Dislocated lens	6	4.2
Orbital cellulitis	3	2.1
Thickened lens	3	2.1
Rupture globe	4	2.8
Others	19	13.4

***Number of ultrasound findings > 125 due to presence of multiple pathologies in the Same patient. Others: Choroidal detachment, Persistent Hyperplastic vitreous, Anterior chamber hyphaema, Drusen, Anterior chamber collapse, foreign body in posterior chamber, Phthisis bulbi, orbital cellulitis, Thickened corneal, Eyelid oedema, buphthamos, micro ophthalmia, uveitis and lacrimal gland calculus.*

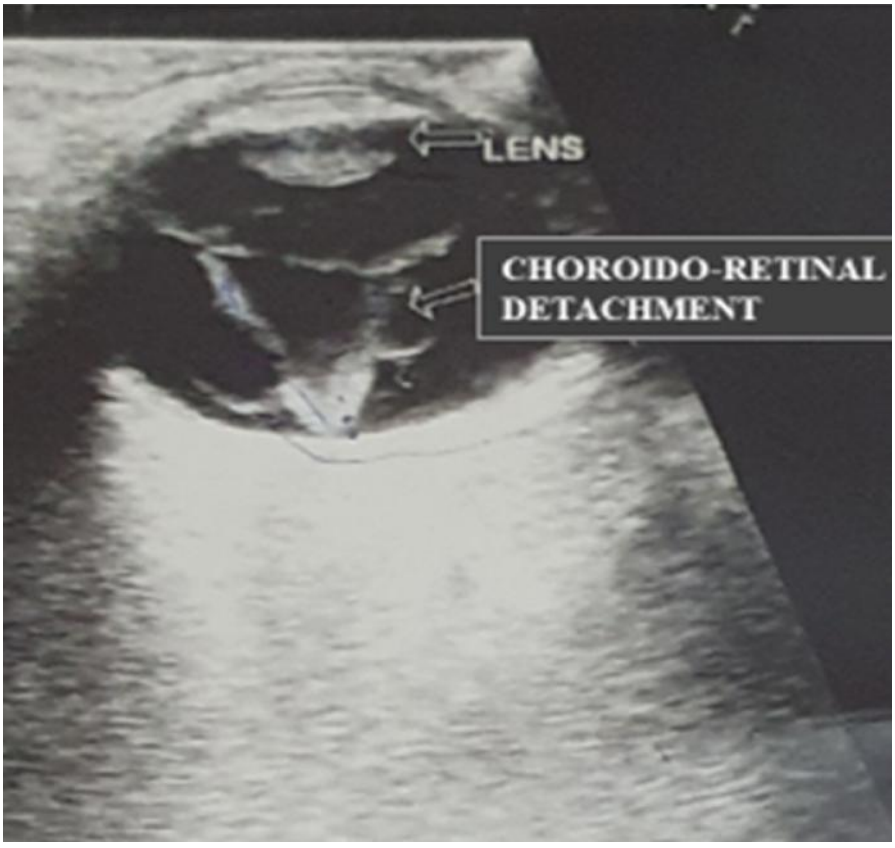

Figure 2: B-mode ultrasound of a patient with ocular trauma, showing a V-shaped echogenic structure attached to the optic nerve head and laterally to the ora serrata. Another echogenic structure is seen anterior to and attached centrally to aforementioned at the lateral and medial aspect of the eye in keeping with right eye traumatic retinal and choroidal detachment. Right eye cataract is also present.

Table 5: Comparison between Clinical findings and Ultrasound findings.

Degree of agreement	Frequency	Percentage
Full agreement	91	64.1
Partial agreement	23	16.2
Disagree	28	20.0

On ocular ultrasonography, there were no abnormal findings in 17 (12%) patients, sixty-three (44.4%) patients had cataract alone or/in association with other abnormal findings, 42(29.6%) had a vitreous hemorrhage, and 27(19%) patients had retinal detachment. In comparison, the vitreous detachment was the finding in 13.4%, orbital tumors were seen in 9.2% of the patients. Table 4. Figures 1 and 2 show images of cataract and choroid and retina detachment, which are of the common findings on ocular ultrasonography in this study.

Table 6: Diagnostic accuracy of clinical diagnosis compared with ocular ultrasonography

Diagnosis	Kappa (%)	Sensitivity	Specificity	PPV	NPV
Ruptured globe	74.3%	75.0%	99.3%	75.0%	99.3%
Cataract	70.9%	74.6%	94.9%	92.2%	82.4%
Tumor	63.6%	61.5%	97.7%	72.7%	96.2%
Vitreous hemorrhage	63.2%	69.0%	92.0%	78.4%	87.6%
Vitreous detachment	63.0%	52.6%	99.2%	90.9%	93.1%
Lens dislocation	58.6%	50.0%	99.3%	75.0%	97.8%
Retinal detachment	55.5%	66.7%	90.4%	62.1%	92.0%

Among patients who had ocular ultrasound examination to confirm the clinical diagnosis, patients whose USS and clinical diagnosis had no similarities, referred to as "Disagree" was recorded in 28 cases (19.7%), patients whose ultrasound result and clinical diagnosis were similar, referred to as "Agree" were 91 (64.1%). In contrast, those whose USS results and clinical diagnosis had some similarity but had at least one disparity, referred to as "Partially agree" was documented in 23 (16.2%) cases (Table 5).

In Table 6, Kappa test of agreement of the leading clinical diagnosis and ultrasound features showed that ruptured globe and cataract had a very good agreement with ultrasound findings; kappa agreement score, K= 74.3%, and 70.9%, respectively. While lens dislocation and retinal detachment had moderate agreement of K= 58.6% and 55.5% respectively (Table 6).

DISCUSSION

This study documented the role of ocular Ultrasound in the management of eye pathologies among patients with eye problems.

In this study, there was a preponderance of male participants. Asaleye *et al.*[7], in their study among a non-select group of patients from a Nigerian tertiary health facility in a similar geopolitical region with available radiological and ophthalmology services, found a median age of 30 years and a high proportion of trauma cases. The same study suggested that younger adults bear a larger burden of traumatic injuries [7]. Similarly, in this study, the median age of participants was 28 years, with more than 75% below 50 years, and 38% of the participants' presenting complaint was trauma/injury-related.

The long-delay in presentation to hospital is common among patients with eye diseases in Nigeria [17-20]. Severe visual impairment was indicated by Nwosu *et al.*[19] as an important factor that facilitates patients' presentation at the hospital. It is therefore not surprising that in our study, almost half of the patients presented at least three months after onset of symptoms, and 79.5% of the patients had a severe visual impairment or were already blind in the affected eye(s) at the time of presentation.

Ocular Ultrasound is a valuable technique to determine many pathologies of the eye[21], previous studies have demonstrated its high diagnostic reliability, validity, and accuracy with a sensitivity and specificity between 75% and 100%.[16,21,22,23,24] Cataract was the most frequently diagnosed pathology among participants in this study, and this may be due to a high proportion of participants with severe visual impairment or blindness in our study. Previous studies have reported cataract as the leading cause of blindness and severe visual impairment in Nigeria.[25,26] Similarly, Bangal *et al.*[27] and Asaleye *et al.*[7] also on a general ophthalmic patient population reported cataract as the most frequently diagnosed in their study. However, unlike our study, cataract was the second most diagnosed pathology after retinal detachment in a study also on a general ophthalmic patient population reported by Eze *et al.*[28]. In the posterior segment, the most diagnosed pathologies were vitreous hemorrhage, retinal

detachment, and posterior vitreous detachment. This finding is consistent with previous studies[7,27,28,29]. However, the pattern of occurrence differs between studies, we presume that differences in aetiology of orbito-ocular disease in these different geographical locations, may be responsible for this observation. Ultrasound was also able to diagnose intraocular tumours as well as provide information concerning the size, location, extension, and characteristics of the tumours.[14]

Bello and Adeoti reported on the co-morbid posterior segment lesions, which may negatively impact treatment outcomes among Nigerian patients.[30] However, these co-morbid posterior segment lesions may be missed during pre-ultrasound clinical evaluation.[7] In this study, Ultrasound identified additional pathologies or disagreed with pre-ultrasound clinical examination in 35.9% patients in which ultrasound was to confirm a diagnosis.

Also, Monsudi and Musa[31] compared the pre-ultrasound clinical examination and ultrasound findings in their study in patients with ocular trauma. Three out of eleven cases of vitreous hemorrhages diagnosed by Ultrasound also had a retinal detachment that could have been missed only on clinical grounds. This finding is in agreement with previous studies that Ultrasound provides additional information to clinical diagnosis, which is critical in the management of ocular pathologies.[8,31]

Overall, in the present study, clinical diagnosis was in concordance with ultrasound diagnosis in 64.1% patients. Further analysis showed that clinical diagnosis for cataract had a very good agreement (k=70.9%) with ultrasound results. In contrast, the clinical diagnosis of retinal detachment (k=55.5%) and lens dislocation (58.6%) had the least agreement with Ultrasound, respectively. Previous studies also reported various levels of agreement between clinical diagnosis and ultrasound diagnosis of ocular pathologies; Eze *et al.*[28] reported (k= 35.5%); Monsudi and Musa[31] reported (k = 58.9%) and Ukponmwan and Marchien[32] reported (k = 92.3%). The inconsistencies could be due to between-survey differences in sample size, patterns of ocular pathologies, and study focus. While the majority of the pathologies were either posterior segment lesions or orbital lesions in the study by Eze *et al.*[28], the study by Monsudi and Musa[31] focused solely on trauma-related eye conditions and the study by Ukponmwan and Marchien had a small sample size of 39 participants.[32] The high proportion of cataract and vision-threatening posterior segment disorders supports the recommendation for greater utilization of ultrasound for ophthalmic evaluation [7,30].

CONCLUSIONS

The aggregate of blurred vision, ocular trauma/injury, and eye ache/pain with or without headache were the most frequent presentations for orbito-ocular diseases in our environment. Cataracts, vitreous hemorrhage, retinal detachment, vitreous detachment, and orbital tumor were the top 5 ultrasonographic findings in this study. About a third of the cases had discordant diagnosis on ultrasonography compared with clinical diagnosis. We recommend the routine use of orbito-ocular ultrasonography in the evaluation of patients presenting with ocular and orbital lesions.

LIMITATIONS

We acknowledge that the number of ocular ultrasound scans recorded in this five-year period, appears rather small. However, this reflects the initially low rate of uptake of ocular ultrasound in the institution. With the recent introduction of subspecialty practice in both ophthalmology and radiology in Nigeria, recent trends suggest an increasing utilization of ultrasound in the diagnosis and management of orbito-ocular disorders in our institution. Therefore, this study only reflects our early experience with ocular ultrasound scans in our institution. A more robust study with a larger sample size is anticipated in the near future.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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