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ULTRASOUND BIOMICROSCOPY AS AN IMPORTANT DIAGNOSTIC ADJUNCT IN THE MANAGEMENT OF LIMBAL TUMORS

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ABSTRACT

Aim: The purpose of this study was to evaluate the high frequency sonographic characteristics of limbal tumors, their extent and invasion in the adjacent conjunctival and corneal tissue with the help of ultrasoundbiomicroscopy (UBM).

Material And Method: Sixty three cases of limbal tumors with conjunctival and or corneal extension were enrolled in our prospective non-randomized study and subjected to clinical and UBM examination.

Result: Sixty three eyes of 63 patients were subjected to UBM. All masses had hyperechoic, highly reflective surface with solid acoustic internal pattern in 58(89.2%) cases. With the help of 50 MHz high frequency ultrasound the posterior margin was demarcated in 57(81%) of tumors and lateral margin in 42(67%).Intraocular tumor extension was appreciated as shallowing of anterior chamber, thickening of cilliary body and breach in Descemet's membrane.

Conclusion: Ultrasound biomicroscopy has dramatically improved resolution of anterior segment structures by noninvasive means. In vivo imaging of limbal tumors along with their biometry, delineation and extension helped us to decide the treatment protocol in our patients and proved to be an important diagnostic adjunct in management of limbal tumors. In the 54 patients we operated upon the sonographic findings correlated with clinicopathological results.

Key Words: Ultrasound biomicroscopy, Limbal tumors

INTRODUCTION

Ultrasound Biomicroscopy (UBM) uses high frequency ultrasonography ranging between 20 and 50MHz.The 50 MHz probe generally gives a penetration of 5 to 6 mm and a transverse resolution of about 50 microns and an axial resolution of about 25 microns. Higher frequency units achieve greater resolution (depending on the MHz rating of the transducer), with the disadvantage of shorter tissue penetration.[6] Over the time high frequency ultrasound biomicroscopy (UBM) has become a well established method for imaging anterior segment anatomical configuration and pathological abnormalities like glaucoma, cornea, iris pathologies and anterior segment tumors. Clinical assessment to assess the extent and depth of limbal masses with conjunctival and corneal extension is generally crude and the posterior margin of the tumor are typically revealed either during surgery or histopathological examination. Clinical findings which suggest invasion in to the globe or orbit include an palpable mass in orbit, irregular anterior chamber depth, anterior chamber cells, associated scleritis, presence of synechia, an intraocular mass or spontaneous perforation of the globe.[7,8] Pavlin and Foster were the first to describe the use of high frequency ultrasound to examine conjunctival tumors.[1] In our English literature search, we found there are several reports comparing UBM n OCT in fields of glaucoma and anterior segment surgery, however studies related to defining ultrasonographic characteristics of conjunctival or limbal tumors are few. In few related studies we found that UBM provides useful information regarding anterior segment tumor configuration and invasion which later proved to be of immense help in deciding the treatment protocol.

In our study we specifically aim to assess and describe in a prospective manner the high frequency ultrasonographic characteristic of limbal tumors with conjunctival and corneal extension, their extent, configuration and the ability of sonographic waves to uncover invasion of

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tumor prior to surgical intervention. The information hence obtained regarding tumor configuration and invasion may prove to be immense help in deciding the treatment protocol of limbal tumors.

MATERIALS AND METHODS

Sixty three patients with tumors involving the limbus with conjunctival and or corneal extension who attended our oculoplasty clinic were enrolled in our prospective study done between April 2008 to March 2013 at our institute. As UBM is a non invasive OPD based procedure patients of all age and sex were included in the study. No specific exclusion criterion was predetermined in the study. All the patients enrolled in the study were subjected to a basic history taking, visual acquity testing, thorough clinical and slit-lamp examination, gonioscopy, fundus examination and B-Scan imaging.

All the patients with limbal tumors after recording of visual acquity and a thorough workup as described above were subjected to UBM imaging at the very first visit to our institute. History for drug allergy was inquired especially proparacaine and moxifloxacin eye drops which had to be instilled in the eye prior to and after the procedure. All the patients were described the procedure and consent for examination, imaging and photography were done as per the routine protocol Demographic data including patient age (in years), gender, and address was recorded. Tumor features based on slit lamp examination regarding shape (diffuse, flat, dome, sphere, mixed) color (pigmented or nonpigmented), size (diameter in millimeter), extent, location (o'clock hours), dimension, feeding vessels were noted.

After a complete work up all the patients with limbal tumors underwent UBM examination. UBM at our institute (OTI 2000) uses high frequency ultrasonograpy and requires an eye bath and reclining position of the patient to obtain images. The frequency of the transducer was set to 50MHz so the images hence acquired were of 50 micron resolution. All the patients were scanned in a supine position after anaesthetizing the ocular surface with topical proparacaine drops twice at five minute interval and after introduction of the water bath. Two dimensional images were obtained and analyzed. During UBM, scan is acquired with to and fro movement of the transducer. Depending on the distance the probe sweeps and the structures scanned underneath, cross sectional image of the cornea, iris, sclera, ciliary body, anterior chamber and anterior uveal tissue are seen. Both transverse and longitudinal scanned image can be obtained. For acquiring transverse images the probe movement should be parallel or tangential to limbus, whereas for longitudinal scans the probe is rotated 90 degree from position of transverse scan. Hence, in longitudinal scans the back-and-forth movement of the transducer becomes perpendicular to the limbus. Longitudinal and Transverse scans were acquired in all cases in the study. The photographic record was kept on paper and in electronic format. The Caliper tool and the zoom tool which were already incorporated in the machine helped in the detail biometric analysis of the tumors.

All the UBM features were recorded separately. Acoustic features (hollow/solid), internal pattern (homogenous/heterogeneous), tumor configuration (diffuse, flat, dome, sphere, mixed), tumor dimension, tumor thickness were noted along with extent of anterior, posterior and lateral margin. We recorded the visibility and demarcation of anterior posterior and lateral margin of the tumors as – margin visible or not visible. The invasion of Descemet's membrane, anterior chamber, cilliary body, anterior choroid by tumor growth was documented. The extent of posterior shadowing in presence of pigmented masses was noted.

In short, on UBM examination complete tumor analysis was done according to tumor visualization, resolution of the internal structures, pigmentation and demarcation of the margins and invasion of neighboring structure.

RESULTS

The mean age of patients with limbal tumors who underwent UBM at our institute was 48 years (range,1-84). 39(62%) were males and 24(38%) of patients were females. 36(57%) patients had right sided involvement whereas 27(43%) had left sided involvement.

Fifty two (82.5%) patients presented with a single lesion and 11(17%) patients had multinodular lesion. The most common presentation of the single tumors was as dome shaped masses .These constituted 32 (50.7%) of the total tumors. The others shapes recognized on UBM were flat in 12 (19%) and spherical in 5(7.9%) cases.

The tumor surface was hyperechoic in all patients 63(100%). Solid acoustic internal pattern was seen in 58(89.2%) and cystic internal pattern was seen in 5(7.9%) amongst all cases. The stroma was hypoechoic in 47(74.6%) and heteroechoic in 16(25.3%) patients. The Descemet's membrane and corneal endothelium appeared as a hyperechoic layer. Breach in corneal endothelial integrity was seen in 5(8%) cases. Blunting and swallowing of anterior chamber structures was seen in 4(6.30%) cases. In 51(81%) patients the posterior plane could be identified and in 42(67%) the lateral margin of the lesion could be differentiated from the surrounding structures. The UBM features of all the 63 cases enrolled for the study are mentioned in table 1 and are given below.

Fiftyfour patients were finally operated upon and the specific diagnosis according to the clinicopathological data was obtained. The results of the histopathological data post surgery we obtained are listed in table 2.

DISCUSSION

High quality high frequency ultrasonographic biomicroscopic imaging allowed preoperative imaging of limbal tumors. This technology due to its ability to penetrate through the lesion into the eye and provide images of posterior and lateral extension of tumor improved our ability to assess the depth and extent of tumor invasion. With the help of the Caliper tool and the Zoom tool in the machine, a detailed biometric tumor analysis was possible. This in detail analysis indirectly helped to overcome the obvious limitation of clinical and slit lamp examination in assessing the tumor characteristics in toto and hence proved to be very valuable in preoperative surgical planning of tumor management.

In our series we studied the various cross-sectional views of limbal tumors with UBM and recorded in detail the tumor surface characteristic, internal reflectivity, borders and its extension. The tumor surface appeared more reflective and hyperechoic as compared to the nearby normal epithelium. This can be probably attributed to hypercellularity, dyskeratosis, and different morphological characteristics of tumor cells as compared to normal cells. It was found that the tumor stroma generally showed solid acoustic internal pattern, cystic nature of the tumor was seen in only 8% of cases. This was well correlated clinically and histopathologically. Paul et al in their study of 11 cases wherein they evaluated high frequency ultrasonographic characteristic of conjunctival intraepithelial neoplasia and squamous cell carcinoma also found similar sonographic surface characteristics [3].

Ocular surface neoplasia is considered a low grade malignancy [13,14]. Recurrences of these lesions are common after surgical excision depending on the margin of involvement after surgical excision[13,14,15]. These lesions formed a major group in our study. High frequency ultrasonography allowed for the measurement of tumor thickness and tumor extensions and invasion of the surrounding structures. In about 81% of the lesions a posterior plane could be differentiated from the surrounding structure. Hence, demarcating the lesion on UBM and recording of the tumor thickness and extension proved to be of help in deciding the excisional and post excision plan to be executed. There is no doubt to the fact that the histopathological analysis still remains the gold standard for delineating deep invasion of limbal, conjunctival and corneal masses but the introduction of the use of a such minimally invasive diagnostic tool can potentially enable an optical biopsy in vivo. Intraocular extension though uncommon may occur in ocular surface neoplasia. The intraocular invasion may also be presented as scleritis and or by development of secondary glaucoma[16,17]. The morphological features of the conjunctiva, cornea, ciliary body and iris could be well studied with UBM and this helped to detect subtle penetration into the anterior chamber and involvement of anterior chamber structures. In lesions which showed deep penetration in UBM, tissue for patch grafting can be kept ready. Shields et al in a comparative study in assessing anterior segment tumors by UBM and anterior segment OCT concluded that for anterior segment tumors UBM offers better visualisation of the posterior margin and provides overall better images for entire tumor configuration compared with AS-OCT.[2]

As with any technology, there are limitations of imaging limbal lesions with high frequency sonography. One limitation is that in presence of very thick solid lesions because of the posterior shadowing it is difficult to view the posterior extent of the tumor. Although in most of our cases a plane separating the lesion from normal surrounding structures could be differentiated this device cannot rule out depth of micro-invasion which is very important especially in cases of malignancy. A greater sample size along with correlation of histopathological data regarding invasion of tumor is needed to determine the sensitivity and specificity of the technique. Although not performed in this study we later realized that this technique of imaging could also have been used for monitoring the tumor dimensions as a response to conservative treatments like chemotherapy or brachytherapy.

We further look forward to future generations of ultrasound biomicroscopy devices where with better resolution the diagnostic validity parameters of this device in deciding the extension and invasion of limbal masses will definitely improve.

CONCLUSION

The role of UBM in managing limbal tumors at this point remains as a very useful noninvasive diagnostic adjunct to the gold standard of diagnostic histopathology in delineating the extension and margins of tumor.This delineation of the tumor preoperatively is extremely useful to the surgeon in deciding the management protocol for patients of limbal tumors.

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REFERENCES

1. PavlinCJ, MC Whae JA, MC Gowan HD. Ultrasound biomicroscopy of anterior segment ocular tumors. Ophthalmology. 1992;99:1220-8
2. Carlos Bianciotto, MD, Carol L. Shields et al. Assessment of Anterior Segment Tumors with Ultrasound Biomicroscopy versus Anterior Segment Optical Coherence Tomography in 200 Cases. Ophthalmology.2011;118-7:1297-1302
3. Paul T Finger et al. High-Frequency Ultrasonographic Evaluation of Conjunctival Intraepithelial Neoplasia and Squamous CellCarcinoma.Arch Ophthalmol. 2003;121:168-172
4. DH Char, G Kundert, R Bove, J B Crawford. 20 MHz high frequency ultrasound assessment of sclera and intraocular conjunctival squamous cell carcinoma. Br J Ophthalmol. 2002;86:632–635
5. Tunc M, Char DH, Crawford JB, et al. Intraepithelial and invasive squamous cell carcinoma of the conjunctiva: analysis of 60 cases. Br J Ophthalmol 1999; 83: 98–103.
6. Pavlin CJ, Foster FS. Ultrasound biomicroscopy high frequency ultrasound imaging of eye at microscopic resolution. RadiolClinNorth Am.1998; 36:1047-1057.
7. Char DH , Crawford JB, et al. Resection of intra ocular squamous cell carcinoma.Br J Ophthalmol.1992;76:123-5
8. Tunc M, Char DH, Crawford JB et al. Intraepithelial and invasive squamous cell carcinoma of conjunctiva: analysis of 60 cases. Br J Ophthalmol.1999;83:98-103
9. Katz NR, FingerPT, McCormikSA et al. Ultrasound biomicroscopy in management of malignant carcinoma of the iris. Arch Ophthalmol.1995; 113:1462-1463.
10. Tunc M, CharDH, CrawfordB, Miller T. Intraepithelial and invasive squamous cell carcinoma of the conjunctiva: analysis of 60 cases. Br J Ophthalmol.1999; 83:98-103.
11. Mahmood MA, Al-Rajhi A, Riley F, Karcioglu ZA. Sclerokeratitis: an unusual presentation of squamous cell carcinoma of the conjunctiva. Ophthalmology 2001; 108: 553-558.
12. Conway RM, Chew T, Golchet P et al. Ultrasoundbiomicroscopy: role in diagnosis and management in 130 patients evaluated for anterior segment tumors. Br J Ophthalmol .2005; 89:950-5
13. Pizzarello LD, Jakobie FA. Bowen's disease of the conjunctiva a misnomer. In: Jakobiec FA, editor. Ocular and adenexal tumors. Birmingham (AL) 7 Aesculapius.
14. Erie JC, Campbell RJ, Liesegang J. Conjunctival and corneal intraepithelial and invasive neoplasia. Ophthalmology 1986;93(2):176-83
15. Caroll JM, KuwabaraT. A classification of limbal epithelioma. Arch Ophthalmol 1965;73:541-45.
16. Sheilds JA, Sheilds CL, Gunduz K, EagleJr RC. The 1998 Pan American Lecture. Intraocular invasion of conjunctival squamous cell carcinoma in five patients. Ophthal Plast Reconstructive Surg 1999;15(3):153-60.
17. Schlote T, MielkeJ, Rohrback JM. Massive intraocular invasion of conjunctiva by squamous cell carcinoma: a case report. Klin Monatsbl Augenhenheikd 2001;2189(7):518-21
18. Katz NR, Finger PT, Mc Cornick SA et al. Ultrasound biomicroscopy in the management of malignant melanoma of the iris. Arch Ophthalmol.1995; 113; 1462-1463.
19. Finger PT, MC CornikSA, Lombardo J, Tello C, Ritch R. Epithelial inclusion cyst of the iris. Arch Ophthalmol.1995; 113:777-780.
20. Reminik LR, FingerPT, Ritch R, Weiss S, Ishikawa H. Ultrasound biomicroscopy in the diagnosis and management of anterior segment tumors. J AM Assoc. 1998; 69: 575-581.
21. Marigo FA, Finger PT, McCornik SA, et al. Iris and ciliary body melanomas: Ultrasound biomicroscopy with histopathological correlation. Arch Ophthalmol. 2000; 118:1515-1521.
22. Marigo FA, Esaki K, Finger PT, et al. Differential diagnosis of anterior segment cysts by ultrasound biomicroscopy. Ophthalmology 1999;106:2131-2135

TABLE 1: Depicting the various UBM findings in limbal tumors.

S. no	FEATURES - UBM		NO.OF PATIENTS	S.no	FEATURES - UBM	NO.OF PATIENT
A	Solid acoustic		58	E	Posterior shadowing	3
B	Internal pattern	Homogenous	47	F	Tumor margin visibility Posterior	51
		Heterogenous	16		Lateral	42
C	Thickness (mean) mm		2 .2	G	Breach in Descemets'	5
D	Tumor shape- Flat		12	H	Involvement of angle structures	4
					Anterior chamber shallowing	4
	Dome		32			
	Sphere		5			
	Multinodular		11			

TABLE 2: Histopathological report of limbal tumors post excisional biopsy.

S. No	Clinicopathological Diagnosis	No of patients= 54
1	Dermoid	18
2	lipodermoid	1
3	Nevus	1
4	Melanoma	2
5	Haemangioma	1
6	Carcinoma in situ	24
7	Squamous cell carcinoma	7

1. Pigmented limbal mass with corneal extension.

2. UBM shows tumor involving superficial limbal area. The hypoechoic mass shows the tumor stroma. The endothelium appear intact and non-perforated radiologically. The iris and angle structures appear normal in configuration.

3. Post excision picture of the same tumor.

4. Multinodular mass at limbus overlying cornea.

5. Large mixed echogenic mass in limbal area. Both the corneal anterior and posterior surface can be appreciated as hyper-reflective structure. The hypo echoic part of tumor is invading the sclera.