Ultrasound Biomicroscopy: Role in Diagnosis of Iris and Ciliary Body Tumours

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Abstract

Background & Aim: Ultrasound biomicroscopy (UBM) is an important tool for assessing iris and ciliary body tumors. This study sought to evaluate the role of UBM in the diagnosis of iris and ciliary body tumors.

Methods: Retrospective analysis of data collected from medical records of 10 patients referred to the UBM unit, department of ophthalmology, of Cairo University, for suspected iris and ciliary body tumours from January 2003 to July 2006 and 4 patients referred to ocular diagnostic unit in King Abd El-Aziz University Hospital in Jeddah, Saudi Arabia from January 2007 to March 2009.

Results: Fourteen eyes from 14 patients were evaluated, including six ciliary body tumours, six iris naevi, and two iris melanoma using Ultrasound biomicroscope (Model DICON P45 UBM Plus Paradigm instruments). All cases of iris and ciliary body tumours patients were also evaluated with conventional A/B-scan. Results of this study revealed that ultrasound biomicroscopy offers an accurate method to evaluate tumor shape, reflectivity, and local invasion. Ciliary body and peripheral iris involvement by tumours was significantly more frequently observed by UBM than B-scan.

Conclusion: UBM is an indispensable tool for the diagnosis of iris and ciliary body tumours. This study demonstrates the superiority of UBM over conventional B-scan for the precise localization of uveal tumors, especially involving the ciliary body and peripheral iris.

Key Words: Ultrasound biomicroscopy – Uvea – Iris – Ciliary body – Melanoma.

Introduction

ULTRASOUND biomicroscopy (UBM) has dramatically improved resolution of anterior segment, from 300-400µm with conventional 10MHz ultrasoundography down to 20-50µm with tissue penetration of up to 4mm [1]. This technique allows for in vivo high resolution imaging of anterior segment masses with biometry and assessment of adjacent tissue invasion [1-4]. Recent studies have demonstrated a high correlation between UBM features of anterior uveal melanomas (UM) and histopathological features, including local extension [4]. Historically biopsy, resection, or enucleation were the main options for diagnosis or treatment of anterior segment malignancy. In many cases, UBM allows for definitive diagnosis and more conservative management, with comparable or better outcomes [6].

The study describes the importance of UBM in diagnosing fourteen patients referred for ultrasound biomicroscopic evaluation of suspected iris and ciliary body tumours.

Patients and Methods

The cases included in this study were 14 patients, ten consecutive patients referred to the UBM unit, Department of Ophthalmology, Cairo University, for ultrasound biomicroscopic evaluation of suspected iris and ciliary body tumours from January 2003 to July 2006 and 4 patients referred to ocular diagnostic unit in King Abd El-Aziz University Hospital in Jeddah, Saudi Arabia from January 2007 to March 2009. The medical records of these patients were retrospectively analyzed.

Clinical features of suspected iris nevi include a pigmented flat or slightly elevated iris lesion which is usually less than 3mm in diameter. It may cause mild distortion of the pupil and ectropion uvea.

Clinical features of suspected iris melanoma include a pigmented or non pigmented iris nodule which is at least 3mm in diameter and 1mm in thickness with a smooth or irregular surface. Associated features include papillary distortion and ectropion uveae, and occasionally localized lens opacities. Angle involvement, if extensive may give rise to secondary glaucoma.
Clinical features of suspected ciliary body melanoma include dilated episcleral blood vessels, a mass located behind the iris which may erode through the iris root or invade the angle producing secondary glaucoma and displacement of the lens which may give rise to secondary astigmatism, subluxation or the formation of a localized opacity.

Patients underwent a complete ophthalmic evaluation including gonioscopy, slit lamp photography.

- UBM was carried out utilizing Ultrasound biomicroscope (Model DICON p45 UBM Plus Paradigm instruments) which was introduced for the first time in Kasr El-Eini Hospital in 2002 and the same model exactly is present in oculardiagnostic unit in King Abd El-Aziz University Hospital in Jeddah, Saudi Arabia which was introduced for the first time in 2003.

- For measurements, the ultrasound biomicroscope was set at:
  1. 5.0 x 5.0mm field of view with 90 decibels of gain, and 2.24mm delay.
  2. The patient in supine position during the examination.
  3. Using an eye cup filled with 1.5% Methyl cellulose and physiologic saline.
  4. Probe scans the entire region of the suspected pathology.
  5. Both maximal tumour thickness and maximal tumour diameter were documented on each occasion by multiple radial and cross sectional measurements.

A/B-scan ultrasonography was performed in all patients. A/B-scan ultrasound was compared with UBM; Features assessed included the anatomical structures invaded by tumour.

**Results**

The study included 14 patients with their age ranged from (28 to 75 years) with mean age 55 years. They included 9 females (65%) and 5 males patients (35%). Table (1) showed the characteristics of patients included in the study.

Precise definition of tumour margins is crucial for successful conservative management of anterior uveal melanomas.

The study demonstrated that UBM identifies Iris and CB involvement by adjacent melanomas significantly more often than A/B ultrasound.

The following figures represent UBM, B-scan and Slit lamp photography images of the patients of the study.

<table>
<thead>
<tr>
<th>Eye</th>
<th>Right</th>
<th>Left</th>
<th>Bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iris</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciliary body</td>
<td>6</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Melanomas* (n=eyes)</th>
<th>Iris</th>
<th>Ciliary body</th>
<th>Anterior choroids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iris melanoma</td>
<td>2</td>
<td></td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Ciliary body melanoma</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table (1): Demographic characteristics of patients evaluated for iris and ciliary body tumours.

<table>
<thead>
<tr>
<th>Total patients</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total eyes</td>
<td>14</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5</td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
</tr>
<tr>
<td>Age range (years)</td>
<td>28-75</td>
</tr>
</tbody>
</table>

Table (2): *Melanomas were classified according to the anatomical region containing the maximal tumor thickness.

<table>
<thead>
<tr>
<th>Eye</th>
<th>Right</th>
<th>Left</th>
<th>Bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iris</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciliary body</td>
<td>6</td>
<td></td>
<td></td>
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</table>

Table (3): UBM vs B scan localization of uveal melanomas.

<table>
<thead>
<tr>
<th>Total melanomas (n)</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluated by UBM (n)</td>
<td>8</td>
</tr>
<tr>
<td>Evaluated by B-scan (n)</td>
<td>8</td>
</tr>
<tr>
<td>Iris melanoma (n)</td>
<td>2</td>
</tr>
<tr>
<td>Ciliary body melanoma (n)</td>
<td>6</td>
</tr>
<tr>
<td>Number detected by B-scan or UBM</td>
<td>B-scan</td>
</tr>
<tr>
<td>Ciliary body invasion by iris melanomas</td>
<td>1</td>
</tr>
<tr>
<td>Iris invasion by ciliary body</td>
<td>0</td>
</tr>
</tbody>
</table>
Fig. (1): Iris nevus (A) Slit lamp photograph, Right eye, of pigmented iris naevus (B) UBM of the naevus in (A) Demonstrates an associated thin walled cyst (c, cyst, n, naevus). (C) UBM of a typical peripheral cyst with a thin cyst wall and anechoic centre (c, cyst). Note angle closure is present in the region of the cyst.

Fig. (2): Iris melanoma. (A) Slit lamp photograph, there is a pigmented lesion in the inferotemporal quadrant near the pupillary border. Ultrasound biomicroscopy (B, Radial section; and C, Transverse section) showing bowing of anterior surface of the iris which was related to involvement of the anterior iris border by tumor cells (outlined by the arrows). The large hypoechoic, cystic space in the posterior stroma correlated with exaggerated enlarged iris vessels (star sign).

Fig. (3): Iris melanoma right eye (A-D). A, there is a pigmented lesion in the inferonasal quadrant near the pupillary border. This lesion showed growth tendency on serial UBM (B) B-scan shows a markedly thickened peripheral iris (arrow). (C) UBM iris/iris root/ciliary body shows involvement by a solid mass with variable internal reflectivity. (D) UBM higher power. The mass invades the iris root and minimally involves the pars plicata of the ciliary body, evidenced by the area of reduced reflectivity compared to the surrounding tissues. UBM proved very useful intraoperatively in defining the extent of ciliary body involvement in this case, (E) In iris melanoma. Note distortion of the posterior iris plane by tumour.
**Discussion**

The present study is describing the use of UBM in consecutive suspected ocular oncology patients. Most patients were referred by ophthalmologists who suspected the ocular lesion to be a neoplasm. The high incidence of melanoma in our series (57%) probably reflects this referral bias. The study is not derived from any previous Master or M.D. thesis. Further management of these cases after UBM was offered by the referring ophthalmologists. Ultrasound biomicroscopy could provide useful information concerning tumor borders and local extension. Tumor extension within anterior segment structures and sclera can be delineated [2,10].

Fifty-megahertz ultrasound transducers allow for 50-µm resolution with a penetration (in tissue) of 4 to 5mm. Therefore, UBM imaging most closely correlates to histopathologic features at a resolution of low-power light microscopy.
Iris melanomas are typically seen as a variably pigmented tumor or diffuse iris thickening in the inferior quadrants. [6] UBM imaged these lesions either as medium to high echoic fusiform-shaped infiltration of the iris stroma (Figs. 2, 3). In Fig. (2), the anterior surface of the iris was displaced resulting in a bowed profile due infiltration by tumour cells, also there was a hypoechoic, cystic space in the iris stroma which represent an enlarged iris vessels associated with the iris melanoma. Since preoperative definition of the depth of tumor invasion into the iris is difficult, also definition of true tumor margins can only be reached on a cellular basis with higher-power microscopy it is important that UBM images offered a good approximation of those margins (Fig. 2) [1,9].

Documented growth is the most important indicator of malignancy in differentiating iris naevi (Fig. 1). From melanoma [5,10], UBM was an indispensable adjunct to photography for assessing growth, as both maximal thickness and diameter could be reliably measured, objectively validating this important feature. However, occasionally iris tumours displaying signs suggestive of malignancy have been reported to be histopathologically benign [10]. Invasion of the CB typically appears on UBM as an area of reduced reflectivity in continuity with the iris mass, and is diagnostically important as naevi do not usually involve this structure (Fig. 3) [2,10]. Additionally, iris melanoma involvement of the iris root is an independent risk factor for metastasis [10]. UBM of iris melanomas demonstrates a variable appearance, reflecting the clinical heterogeneity attributed to differences in lesion vascularity and cellularity [11]. Reflecting the tendency for tissue distortion by melanomas, irregularity of the posterior iris surface were associated with iris melanomas in this study, however this was rarely observed in naevi (Fig. 1).

Differentiation between benign and malignant lesions, mainly those located in the iris, is still a challenge [3,15,10]. Benign lesions such as nevi can grow and invade adjacent tissues and can even recur after excision [15]. Often such tumor behavior will influence the pathologist’s determination of malignancy. Ultrasound biomicroscopy provides useful information about tumor morphology and growth patterns, but a definitive diagnosis is best reached by histopathologic examination [3].

Ultrasound biomicroscopy is particularly valuable in the evaluation of ciliary body melanomas, or uveal tumors with ciliary body extension. This is an intraocular location where slitlamp examination, gonioscopy, indirect ophthalmoscopy, and transillumination may not reveal the extent of tumor within the iris and ciliary body stroma. Most small ciliary body melanomas cannot be seen by slitlamp examination, gonioscopy, or indirect ophthalmoscopy. Even if the tumor is detectable by transcleral or transpupillary transillumination, tumor shadows can merge with the ciliary body band. Therefore, UBM provides useful information about tumor extension into the iris and ciliary body.

Sequential clock-hour imaging of ciliary body melanomas offers an important method to evaluate lateral tumor spread within the ciliary body. This technique may be of particular value in assessment of the ring melanomas.

The study had followed-up one patient with a CB tumour with a maximal diameter of 1.4mm (Fig. 4D). Serial UBM demonstrated growth in this lesion including early invasion of the iris root. The main differential diagnoses include other pigmented CB tumours such as melanocytomas and pigment epithelial adenomas/adenocarcinomas. These entities can be difficult to differentiate clinically and on UBM. All may appear as well defined CB masses with low to high internal reflectivity and invasive features [2]. In practice, many CB tumours remain undetected until they are relatively large in size.

In two cases, iris extension was characterized by disruption of the iris pigment epithelium or stromal infiltration. Infiltration of the iris was characterized on UBM by disruption of the hypoechoic line representing the iris pigment epithelium (Fig. 6). Iris stromal invasion could be seen as a change in the echogenicity of the affected area as compared with the normal-appearing iris. Disruption of the iris pigment epithelium was a consistent UBM finding that may be useful for early diagnosis of iris and ciliary body tumors.

Precise definition of tumour margins is crucial for successful conservative management of anterior uveal melanomas [5,14]. Improved tumour localisation allows tighter therapeutic margins, reducing radiation exposure to surrounding tissues and potentially reducing treatment side effects. Intraoperative assessment of the extent of CB involvement by UM is particularly challenging. Transillumination can provide useful information; however, tumour melanin content, haemorrhage, and the degree of CB pigmentation can lead to inaccuracies. The present study demonstrates that UBM identifies CB involvement by adjacent melanomas significantly more often than A/B ultrasound. The accu-
racy of UBM in defining tumour margins is supported by studies which have demonstrated a high correlation (approximately 70%) between margins in the iris and CB defined by UBM compared to histopathological margins on enucleated specimens [4,7,8]. In cases where UBM did not correlate with histopathological margins, UBM tended to overestimate the anterior tumour margin [4].

Ring melanomas often present atypically with glaucoma, retinal dialysis, or heterochromia [13]. A discrete mass is frequently not appreciated on examination, leading to delayed diagnosis [13]. Tumour thickness can vary at different CB locations, causing the ring configuration of the tumour to be difficult to appreciate by A/B-scan, especially if the tumour is <4mm thick. As enucleation rather than conservative treatment is the management of choice for ring melanoma, it is recommended to survey the entire CB by sequential UBM clock hour imaging in cases of suspected iris or CB melanoma, or in cases where an underlying ring could be responsible for other atypical ocular findings [13].

When invasion of the anterior chamber angle was observed by UBM, there was a loss in the normal acute shape of the angle, which assumed a convex or linear shape (Fig. 5C). In more advanced cases, a tissue with medium echogenicity was seen in the anterior chamber (Fig. 5C). The scleral spur and the Descemet membrane are important landmarks when evaluating the trabecular meshwork and cornea for infiltration by tumour cells [6]. This information is significant when radioactive plaque therapy is being considered. Plaque size and position relative to the tumor and other landmarks can be determined by UBM to provide optimum irradiation of the neoplasm and avoid unnecessary irradiation of normal ocular structures [6].

Conclusion:

UBM is an indispensable tool for the diagnosis of iris and ciliary body tumours. This study demonstrates the superiority of UBM over conventional B-scan for the precise localisation of uveal tumours, especially involving the ciliary body and peripheral iris. When serial observation is indicated, UBM can detect growth with greater precision. Finally, UBM is helpful in treatment planning, particularly in establishing anterior margins.

References