ULTRASOUND BIOMICROSCOPY OF CYSTIC LESIONS OF THE IRIS AND CILIARY BODY*

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ABSTRACT

Objectives: To describe and illustrate the ultrasound biomicroscopic findings in patients with one or more cystic lesions of the iris, ciliary body, or both.

Methods: Retrospective study of 263 ultrasound biomicroscopic studies performed at one institution during a 20-month period, May 1994 through December 1995. All studies were performed using the Humphrey ultrasound biomicroscope model 840.

Results: Thirty-nine of the 263 evaluated patients had one or more cystic lesions. Four different types of cysts were detected. Twenty-seven patients had one or more primary neuroepithelial cysts of the iris or ciliary body. These cysts were frequently multifocal and bilateral. All contained clear fluid and had a thin but highly reflective wall. Three patients had a stratified squamous epithelial implantation cyst. These cysts were all unifocal and unilateral. The intracavitary fluid contained multiple suspended particles (presumably desquamated epithelial cells), and the walls were relatively thick. Six patients had a neuroepithelial cyst associated with a solid tumor. Each of these cysts resembled the primary neuroepithelial cysts. Three patients had focal intratumoral cavitation. The cavity in each case contained clear fluid. The surrounding tumor tissue in each case appeared homogeneous.

Conclusions: Ultrasound biomicroscopy appears to be a valuable clinical tool for evaluating and differentiating cystic lesions of the iris and ciliary body.

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INTRODUCTION

Ultrasound biomicroscopy (UBM) is a relatively new clinical method for imaging the anterior segment of the eye in cross-section at near-microscopic resolution.[1] It yields real-time images of the anterior ocular segment with lateral and axial resolution of approximately 50 μm. UBM provides exceptionally detailed two-dimensional gray-scale images of the epibulbar conjunctiva, cornea and anterior sclera, aqueous chamber, anterior chamber angle structures, uveal and ectodermal components of the iris and ciliary body, anterior layers of the lens, zonule, and anterior vitreous.

UBM has already been used extensively in the evaluation of glaucomatous eyes and eyes with an opaque or cloudy cornea.[2,3] It has also been used to assess a smaller number of eyes having disorders and abnormalities such as anterior uveitis, sequelae of ocular trauma, retained foreign bodies, and cysts and tumors of the iris and ciliary body.[3-6] At Wills Eye Hospital, we have had the opportunity to perform UBM on a relatively large number of eyes containing one or more cystic lesions of the iris, ciliary body, or both. The remainder of this article describes and comments on our findings in these eyes.

The specific objectives of this work are (1) to describe and illustrate the UBM findings in our patients with one or more cystic lesions of the iris, ciliary body, or both and (2) to alert practicing ophthalmologists of the availability of this technology and types of information it can provide.

PATIENTS AND METHODS

We reviewed all UBM studies performed at Wills Eye Hospital between May 1994 and December 1995 (n = 263) and identified those that showed one or more cystic lesions involving the iris, ciliary body, or both. We reviewed each of these studies and the corresponding clinical records to determine the various types of lesions, their precise locations, and other features.

All studies were performed using the Humphrey ultrasound biomicroscope model 840. This unit employs a scan transducer having a frequency of 50 MHz. Clinical scanning requires a lid speculum "water bath" filled with either an isotonic saline solution or viscous fluid such as Celluvisc as a coupling agent. The oscillating tip of the scan transducer must be submerged in this fluid to obtain the anterior segment images. An individual study requires about 10 minutes per eye.

RESULTS

Thirty-nine of the 263 evaluated patients had one or more cystic lesions. Four different types of cysts were recognized.

PRIMARY NEUROEPITHELIAL CYSTS

Primary neuroepithelial cysts were present in 27 patients. These cysts appeared as well-defined lesions containing clear intracavitary fluid (Figs 1 through 6). They had thin walls composed of highly reflective neural epithelium. Individual cysts ranged in diameter from less than 0.25 mm to greater than 3 mm. Neuroepithelial cysts of the iris midzone were relatively large and had an ovoid shape in radial cross-section (Fig 1). When the pupil was dilated, the central portion of midzonal cysts projected between the iris and anterior lens capsule into the pupillary region (Fig 1). Cysts of this type were frequently multifocal (Fig 1). Neuroepithelial cysts of the iridociliary sulcus were generally somewhat smaller than midzonal iris cysts and tended to have a more spherical shape in radial cross-section (Figs 2 and 3). Larger cysts of this type frequently bowed the peripheral iris anteriorly and caused localized angle closure (Fig 3). Cysts of this type were also typically multifocal (Figs 4 and 5). Some eyes with multiple small primary neuroepithelial cysts of the iridociliary sulcus appeared to have resultant plateau iris configuration of the peripheral iris with localized angle closure (Fig 4). Neuroepithelial cysts of the pars plana region appeared as dome-shaped lesions on both radial and coronal cross-sectional slices (Fig 6). These cysts also tended to be multifocal (Fig 6).

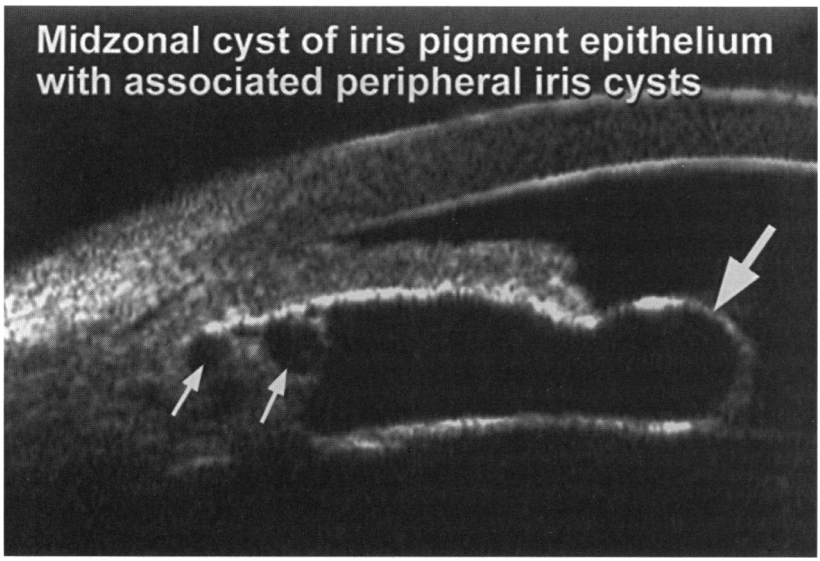

FIGURE 1

Midzonal neuroepithelial cyst of iris pigment epithelium. Note fusiform shape of primary cyst, clear intracavitary fluid, extension of central portion of cyst into pupillary region (larger arrow), and associated smaller neuroepithelial cysts of iridociliary sulcus (smaller arrows).

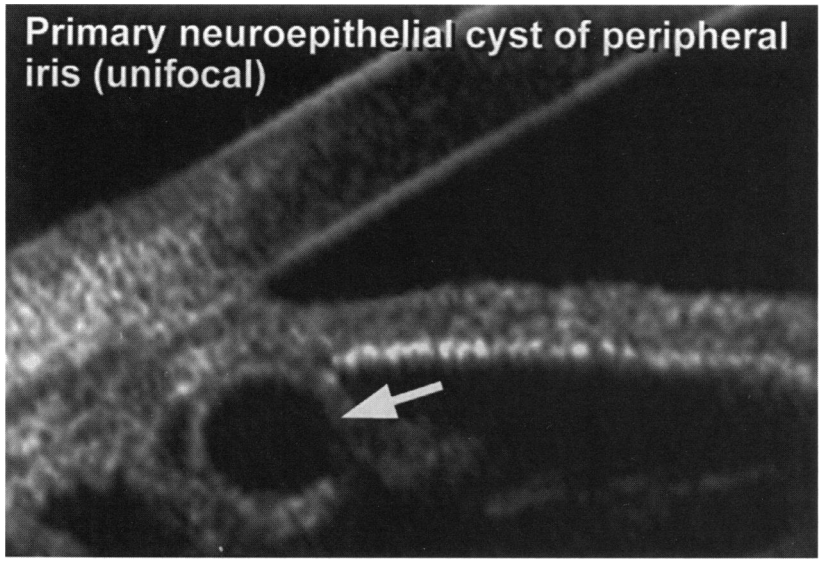

FIGURE 2
Primary neuroepithelial cyst of iridociliary sulcus (arrow). Note spherical cross-sectional shape of cyst, sonolucent intracavitary fluid, and localized secondary angle closure.

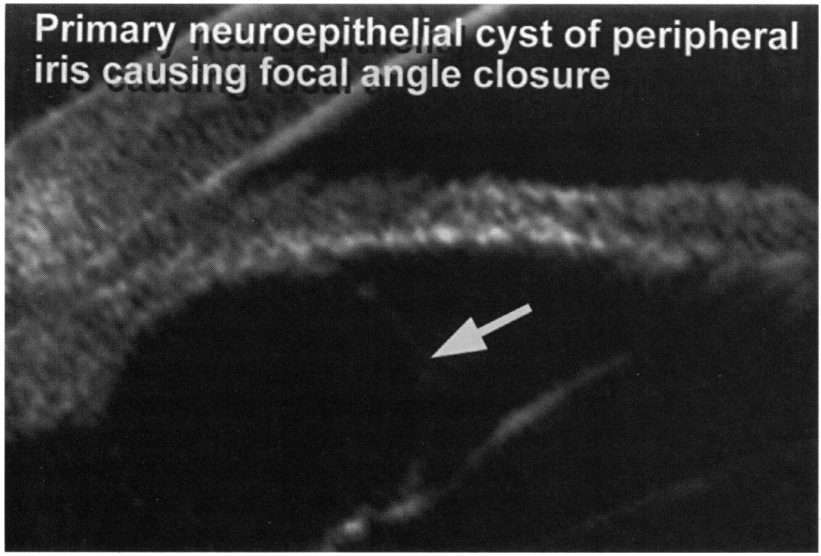

FIGURE 3
Larger neuroepithelial cyst of iridociliary sulcus. Note very thin cyst wall (arrow), spherical cross-sectional shape of cyst, sonolucent intracavitary fluid, and localized secondary angle closure.

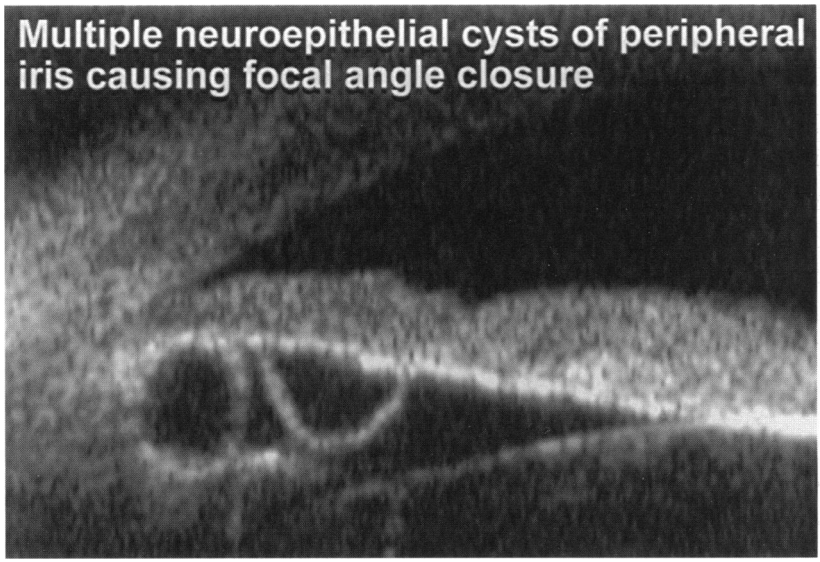

FIGURE 4
Multiple primary neuroepithelial cysts of peripheral iris causing plateau configuration of peripheral iris and localized angle closure.

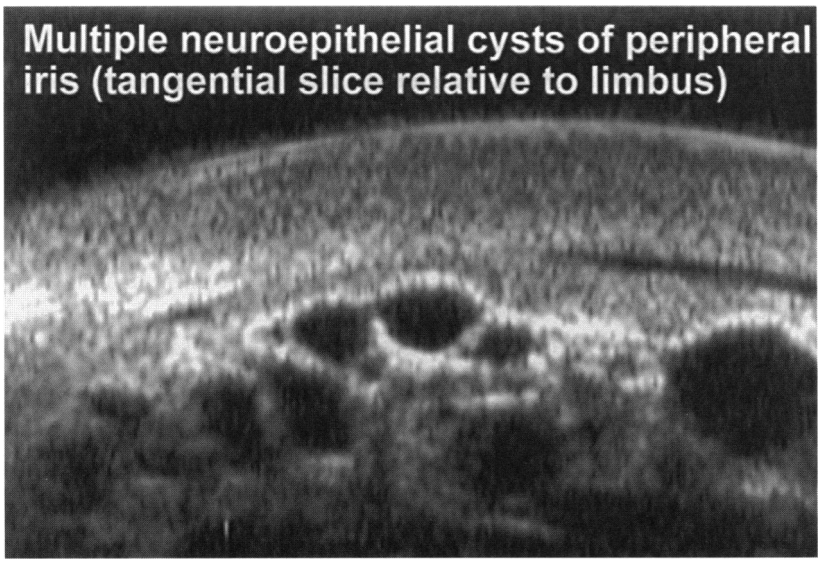

FIGURE 5
Multiple neuroepithelial cysts of peripheral iris and anterior ciliary body shown on tangential slice relative to temporal limbus. Note varied sizes of individual cysts.

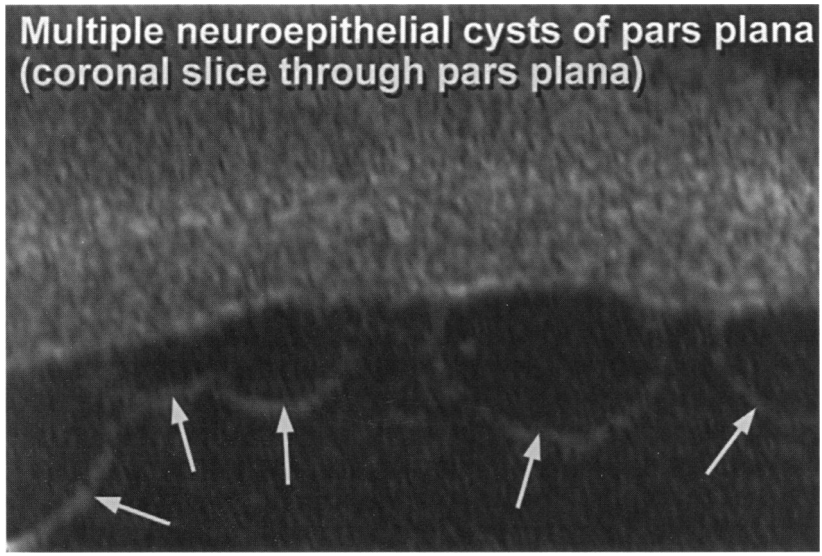

FIGURE 6
Multiple neuroepithelial cysts of pars plana (arrows) shown in coronal slice through inferotemporal pars plana. Note thin wall and sonolucent intracavitary fluid of each cyst.

Primary neuroepithelial cysts were located most commonly in the horizontal meridians (between the 2- and 4-o'clock meridians and between the 8- and 10-o'clock meridians). The larger cysts (diameter > 1.5 mm) were located exclusively in the horizontal meridians. The only cysts of this type that were located in the vertical meridians occurred in eyes containing numerous cysts.

Primary neuroepithelial cysts were multifocal in 31 of the 37 affected eyes (83.8%) in this series. Primary neuroepithelial cysts of the iris and ciliary body were bilateral in 10 of the 11 patients (90.9%) who had one or more cysts of this type in 1 eye detected on UBM imaging and who then permitted ultrasound imaging of the fellow eye. In these 11 patients, the neuroepithelial cysts were multifocal in 19 of the 21 affected eyes (90.5%).

STRATIFIED SQUAMOUS EPITHELIAL IMPLANTATION CYSTS

Stratified squamous epithelial implantation cysts were present in 3 patients. These cysts were exclusively unilateral and unifocal. Individual cysts were thick-walled and located within the stroma of the iris or ciliary body (Figs 7 through 9). The intracavitary fluid in such cysts usually contained numerous small particles (presumably desquamated epithelial cells) (Figs 7 and 8). The cells composing the walls of these cysts had less

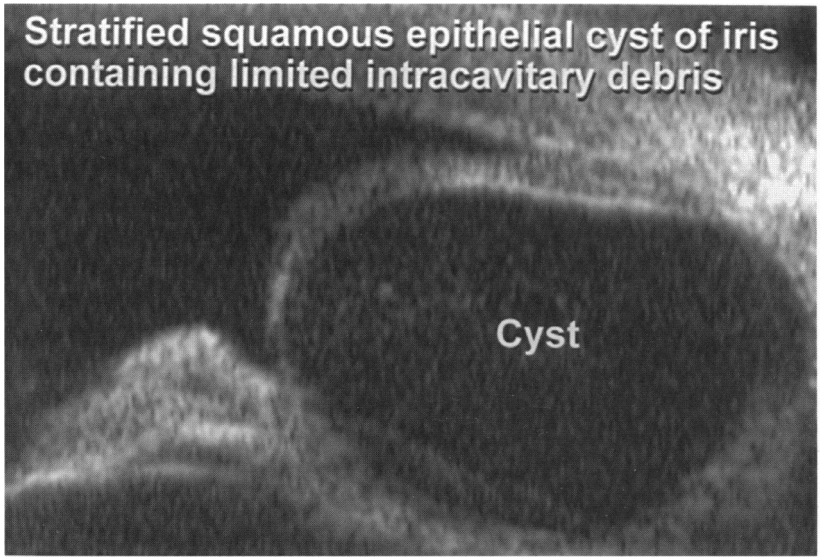

FIGURE 7
Stratified squamous epithelial implantation cyst of superior iris. Note relatively thick cyst wall, low-density particles suspended in intracavitary fluid, replacement of some of the iris by the cyst, and localized adhesion between anterior cyst wall and cornea.

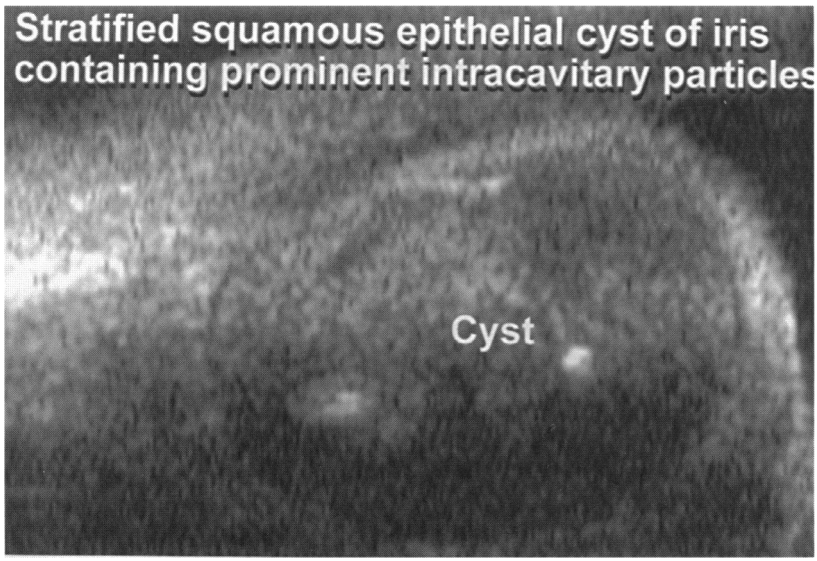

FIGURE 8
Stratified squamous epithelial implantation cyst of superotemporal iris. Note numerous particles (desquamated epithelial cells) suspended in intracavitary fluid of this cyst.

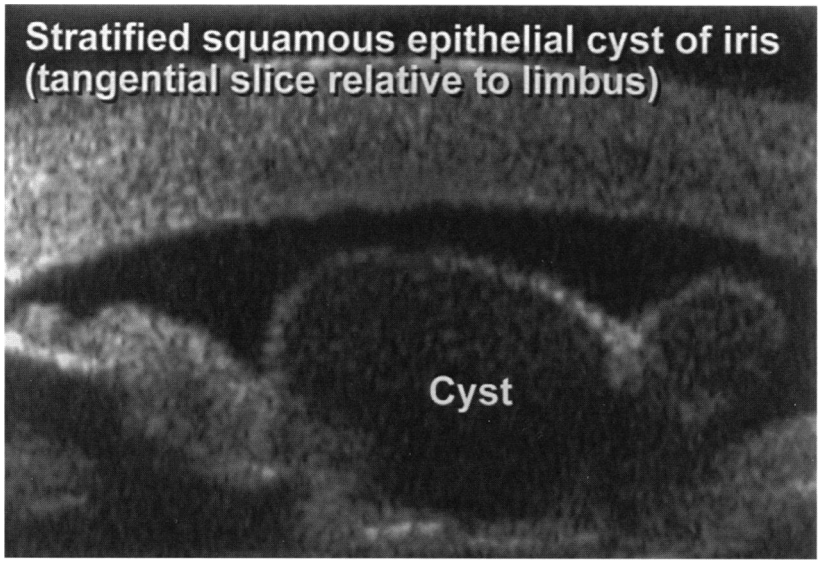

FIGURE 9
Stratified squamous epithelial implantation cyst of superior iris shown in tangential slice relative to limbus. Note bilobed configuration of cyst.

prominent reflectivity than did those of the neuroepithelial cysts. Cysts of this type tended to be larger on average than most primary neuroepithelial cysts. Some of these cysts were multiloculated (Fig 9). In contrast to the primary neuroepithelial cysts, these lesions were located in the vertical meridians. No transcleral or transcorneal tract from the epibulbar surface to the cysts could be identified in any of these eyes.

NEUROEPITHELIAL CYSTS ASSOCIATED WITH A SOLID TUMOR

Neuroepithelial cysts associated with a solid tumor were identified in 6 patients. Cysts of this type had features similar to primary neuroepithelial cysts but arose at the margins of a solid uveal tumor (Fig 10). Four of these patients had a melanocytic tumor (presumed benign nevus versus small malignant melanoma), and the other 2 had a presumed neuroepithelial tumor (adenoma of the ciliary epithelium and reactive gliosis following inflammation in 1 patient each). These cysts were usually solitary. In 1 case, the cyst was almost as large as the solid tumor. In this case, the size of the solid lesion was substantially overestimated biomicroscopically because of the associated cyst.

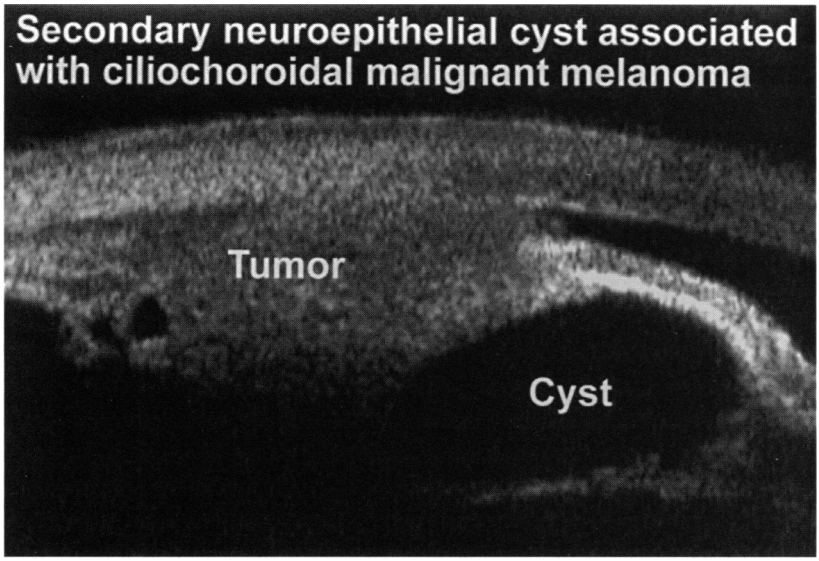

FIGURE 10
Neuroepithelial cyst of peripheral iris associated with presumed small malignant melanoma of peripheral iris and ciliary body. Note that cyst is almost as large as solid portion of lesion.

INTRATUMORAL CAVITATION

Intratumoral cavitation was detected in 3 patients, 2 of whom had a primary uveal malignant melanoma and 1 of whom had a presumed adenoma of the ciliary epithelium. These cystic lesions appeared as well-defined, spherical spaces within the stroma of the tumor (Fig 11). In all cases, the cavitation was unifocal and the intracavitary fluid was clear. The tumor tissue composing the walls of such cavities did not appear appreciably different in reflectivity from the portions of the tumor remote from the cavity. This type of cavitation must be distinguished from large blood vessels within the tumor (Fig 12) and from slitlike spaces of supraciliary effusion that are frequently noted at the margins of malignant melanomas involving the ciliary body (Fig 13).

DISCUSSION

Our findings indicate that UBM can identify cystic lesions of the iris and ciliary body reliably, including many that cannot be detected by standard methods of slit-lamp biomicroscopy and gonioscopy and are below the limits of resolution of conventional water-bath B-scan ultrasonography, computed tomography, and magnetic resonance imaging with surface coil. Our findings also show that UBM can distinguish primary from secondary

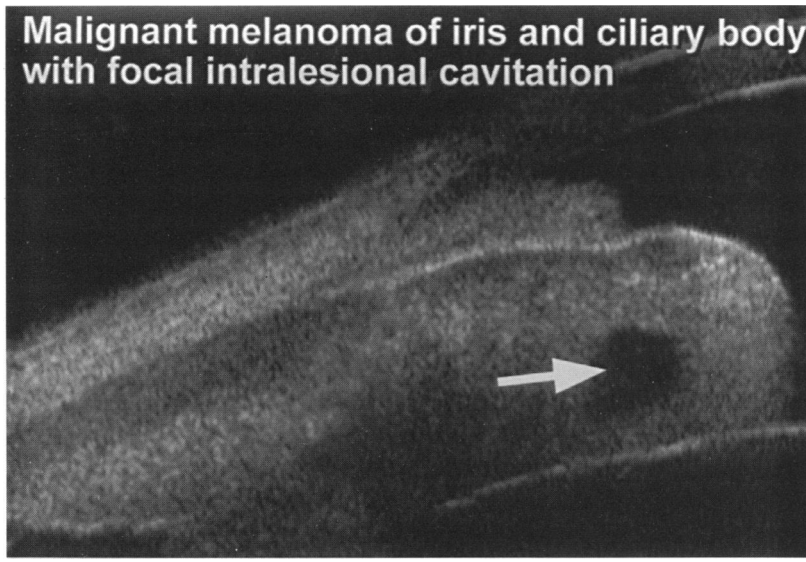

FIGURE 11
Malignant melanoma of iris and ciliary body with focal intralesional cavitation (arrow). Note somewhat shaggy borders of "cyst" and clear intracavitary fluid.

FIGURE 12
Malignant melanoma of iris and ciliary body with multiple prominent intralesional vascular channels (arrow). Unlike focal intralesional cavitation shown in Fig 11, these sonolucent foci are more slit-like in cross-sectional appearance.

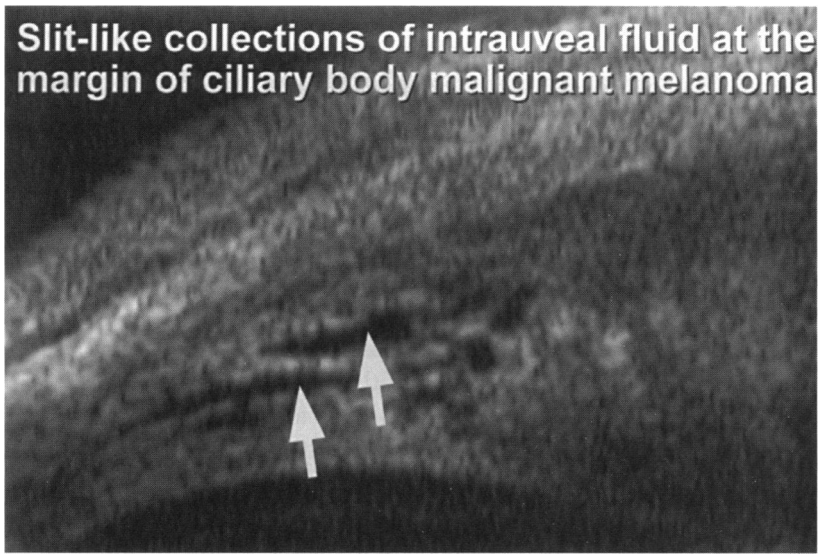

FIGURE 13
Malignant melanoma of ciliary body with marginal slit-like clefts (arrows) believed to be extracellular serous fluid within adjacent uvea (limited form of ciliochoroidal effusion).

cysts and distinguish between neuroepithelial cysts and cysts of the stratified squamous epithelium.

Our finding that most eyes containing a primary neuroepithelial cyst of the iris midzone or iridociliary sulcus actually contain multiple cysts is in disagreement with previously reported findings based on slit-lamp biomicroscopy and gonioscopy[7] and on conventional water-bath B-scan ultrasonography.[8] Shields and associates[7] described 50 patients with at least one neuroepithelial cyst of the iris midzone or iridociliary sulcus but found multiple cysts in only 4 (8%) of them. Three of the 4 had midzonal cysts, but only 1 had iridociliary sulcus cysts. The apparent reason for failure of slit-lamp biomicroscopy and gonioscopy to identify multiple cysts in most eyes is that many of the cysts are small and located in the iridociliary sulcus, where they are effectively hidden from optical view. Sidoti and coworkers[8] evaluated 52 eyes containing an iris pigment epithelial cyst using conventional B-scan ultrasonography, but these investigators did not identify multiple cysts in any eye. The probable reason for failure of conventional B-scan to detect additional cystic lesions in the evaluated eyes was that cysts smaller than 1 mm in diameter were smaller than the minimum size detectable by the instrument. In contrast, Rowe and coworkers[9] identified multiple iris cysts in 18 of 19 eyes (94.7%) that were found to

have at least 1 neuroepithelial cyst by UBM.

In our study, we also found that most patients with one or more neuroepithelial cysts of the iris or ciliary body in one eye on UBM who consented to imaging of the fellow eye had one or more cysts of the same type in that eye. This finding is also in disagreement with previously reported findings. Using slit-lamp biomicroscopy and gonioscopy, Shields and associates[7] found bilateral neuroepithelial cysts in only 6 of 50 eyes (12%). Using conventional B-scan ultrasonography, Sidoti and coworkers[8] detected bilateral cysts in only 3 of 49 patients (6.1%). In contrast, Rowe and coworkers[9] found bilateral neuroepithelial cysts in 7 of 7 patients who were found to have one or more cysts of this type in 1 eye on UBM and who then consented to UBM evaluation of the fellow eye.

As noted in the "Results" section, UBM identified some solid tumors associated with secondary neuroepithelial cysts. In 1 of our cases, the cyst was as large as the solid component of the lesion and resulted in a substantial biomicroscopic overestimation of the tumor's actual size. If a clinician bases his or her determination of a lesion's size on the extent of the bulge in the iris produced by such a mass, then he or she is likely to overestimate the prognostic importance of that lesion and possibly be more inclined to recommend excision or other intervention for the mass.

Cystic cavitation, as was detected in 3 of our cases, has been detected clinically and pathologically in occasional eyes containing a ciliary body malignant melanoma;[10] however, this type of cavitation has rarely been noted within iris melanomas. The mechanism of cavitation is usually assumed to be focal necrosis followed by reabsorption of the necrotic debris,[10] but other possible explanations have also been offered. The diagnostic and prognostic significance of this type of cavitation is unknown.

SUMMARY

Ultrasound biomicroscopy provides potentially important diagnostic and prognostic information not revealed by conventional ophthalmic examination or other currently available cross-sectional imaging methods (eg, computed tomography, magnetic resonance imaging, conventional B-scan ultrasonography). UBM clearly differentiates between solid and cystic lesions of the iris and ciliary body and also provides valuable differential diagnostic information about different types of cysts and solid lesions. On the basis of this experience, we conclude that UBM is a valuable clinical tool for evaluating and differentiating cystic lesions of the iris and ciliary body. Practicing ophthalmologists should be aware of this diagnostic technology and the types of information it can provide in patients with suspected solid or cystic lesions of the iris or ciliary body.

PROPRIETARY STATEMENT

The authors have no proprietary interest in the Humphrey ultrasound biomicroscope or Celluvisc.

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DISCUSSION

DR SANFORD M. MEYERS. I congratulate Dr Augsburger and coauthors on their excellent study. I thought it would be worthwhile to compare very briefly the relatively new technique of ultrasound biomicroscopy (UBM) with conventional B-scan ultrasound. (Of historical note, Dr Nathaniel Bronson, the late Dr Edward Purnell, and Dr D. Jackson Coleman—all members of the American Ophthalmological Society—have been pioneers in ocular ultrasonography.) The transducer frequency with UBM is 40 to 100 MHz, but with conventional B-scan ultrasound is typically 10 MHz. The lateral and the axial resolution of UBM at 60 MHz is approximately 50 μm and 25 to 30 μm, respectively, whereas conventional B-scan ultrasound at 10 MHz has a lateral and an axial resolution of about 600 μm and 187 μm, respectively.[1] With a water bath, the lateral resolution of a B-scan system (10-MHz transducer) is 300 to 400 μm. The penetration of UBM at 60 MHz and conventional B-scan ultrasound at 10 MHz is approximately 5 mm and 50 mm, respectively. Thus, with increasing transducer frequency, there is increased resolution but decreased penetration.

Dr Augsburger and coauthors report on 39 patients with cystic lesions of the iris, ciliary body, or both. In 27 patients with primary neuroepithelial cysts of the iris and ciliary body, the cysts were multifocal and bilateral in over 95% and 90%, respectively. This is in contrast to 3 patients with secondary stratified squamous epithelial implantation cysts, which were unilateral and unifocal. Six patients had neuroepithelial cysts that arose at the margins of a solid tumor and had UBM features similar to those of primary neuroepithelial cysts. They also identified intratumor cystlike cavitation spaces in 2 patients with a primary uveal melanoma and in 1 patient with a presumed adenoma of the ciliary epithelium.

In another recent prospective study of 45 patients with probable anterior segment lesions, all were clearly imaged by UBM, while only 17 were detectable by conventional B-scan; UBM easily distinguished between solid and cystic lesions.[2]

Thus, as Dr Augsburger's study shows, UBM can accurately identify cystic lesions of the iris and ciliary body, many of which are below the resolution of conventional water-bath B-scan ultrasound, and differentiate between primary and secondary neuroepithelial cysts, stratified squamous epithelial cysts, and cystic intratumor lesions

I have a few questions for Dr Augsburger and his coauthors: (1) Do data exist on the incidence of asymptomatic primary neuroepithelial cysts of the iris and ciliary body? (2) What percentage of your patients with neuroepithelial cysts of the iris or ciliary body had symptoms? (3) Are there reports on the clinicopathologic correlation of cysts seen on UBM? (4) Finally, pars plana cysts are frequently seen during examination of the peripheral retina with indirect ophthalmoscopy and scleral depression. Were such cases seen in your study?

I thank Dr Augsburger and coauthors for the opportunity to discuss their excellent study.

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DISCUSSION

ROBERT RITCH, MD. I would like to congratulate Dr. Augsburger once again on the beautiful quality of his ultrasound biomicrographs. A couple of years ago, we had looked at 14 patients with unilateral anterior uveitis of varying etiologies and found epithelial ciliary body cysts in 6 of them.

At that point, we had no control population and could not formulate a comparison with normal eyes. I would like to know two things. First, have you noticed any increased incidence of iridociliary or ciliary body cysts in patients with uveitis? Second, how did you arrive at a number of 15% of the total number of patients scanned? In other words, if the technician or fellow performing the UBM were to record the image of a cyst because it was detected, this would give a higher figure than if a fixed number of photographs were taken randomly of each eye. In the former case, 15% would be a reasonably accurate estimation of the actual prevalence of cysts in the population, whereas if photos were taken randomly with a specific number of cuts per eye, one might expect the true prevalence of cysts to be higher than detected by UBM.

WILLIAM SPENCER, MD. Dr. Augsburger, I found your paper very interesting. I wonder if you did any longitudinal studies of any of the patients with primary neuroepithelial cysts involving the iris? Clinically, these have been observed to wax and wane, and as you mentioned sometimes they are multicentric. I have studied and reported a case with Dr. Robert Foos from Los Angeles, a patient who had unilateral melanosis oculi who later developed a malenoma of the ciliary body and iris. By conventional ultrasound a ciliary body cyst was detected and it delayed the diagnosis of melanoma. The eye was eventually enucleated. In the pathology laboratory the area that looked cystic was found to contain large intratumoral lakes. So I believe your observation that these are not dilated vessels, but really are separations within the tumor, in which serum and protein as well as hemorrhage can cause intratumoral lakes, is correct.

Finally, I would like to know if those patients who had pars plana cysts were studied with respect to their serum protein levels to find out if they had any evidence of dysproteinemia. Some patients with multiple myeloma can have pars plana cysts as well as cysts of the ciliary epithelium.

Thank you very much for the opportunity to listen to your paper.

JAMES AUGSBURGER, MD. I will address the questions in the reverse order, if I may. First, with regard to the question about pars plana cysts. No, we did not evaluate the serum protein levels in any of those patients. Interestingly, all of the patients that we evaluated in this series who had pars plana cysts were being scanned for some other reason.

Regarding Dr. Spencer's question whether we have performed any longitudinal UBM studies to look at primary neuroepithelial cysts, the answer is "no", at least not yet. Once we know what the lesion is, we really do not need to repeat what I think is a relatively costly test to show

whether or not there is a change. Certainly, however, if there were an increase in the iris bulge, then I would consider repeating the UBM. Regarding Dr. Ritch's first question, is there an increased incidence of primary neuroepithelial cysts in eyes with uveitis, my answer is, "not to my knowledge." We have studied quite a few uveitis patients, many of whom had acute uveitis rather than chronic uveitis, and some of whom had a suspected intraocular foreign body. In this particular group of patients, we have not found any neuroepithelial cysts.

Dr. Ritch's second question was whether the percentage of patients in our series is equivalent to a prevalence figure. I do not think so. I believe that there is a major referral bias in this group. At least half of the patients in whom we found cystic lesions on UBM were referred specifically for evaluation of the presumed mass to determine whether it was cystic or solid. Because of the bias, I believe that the percentage of patients with cystic lesions in our patient group is a substantial overestimate of their actual prevalence in the general population.

Dr. Meyers asked about the percentage of patients with primary neuroepithelial cysts who had symptoms. My answer is, virtually none of the patients in this group had symptoms attributable to their cyst. Many of these patients were referred for evaluation of an asymptomatic mass or bulge in the iris that was detected on routine ophthalmic examination.

Dr. Meyers asked me privately about whether there were any UBM-pathologic correlation studies of cystic lesions of the types I showed you today? To my knowledge, only one CPC case report of such a case has been published to date and that case was one of a squamous epithelial implantation cyst. No UBM-pathologic correlation studies of primary neuroepithelial cysts have yet been published.

I would like to thank Dr. Meyers for his discussion and the organizers of this meeting for allowing me to present our paper.