Clinical Applications of Ultrasound Biomicroscopy for Glaucoma Care

Very high resolution of the angle with deep penetration of the angle anatomy is possible with the ABSolu A/B/S/UBM ultrasound platform.

BY MICHEL PUECH, MD

Ultrasound biomicroscopy (UBM) is a type of high-resolution ultrasound that can be used to provide noninvasive in vivo imaging of the anterior segment. It creates detailed assessments of anterior segment structures in microscopic resolution, including structures that are not clearly visible with optical devices.

The first commercial UBM device operated at an ultrasound frequency range of 50 to 80 MHz.[1] Since that time, in 1990, many advances in UBM technology have occurred. Today, UBM imaging is becoming increasingly more efficient.

ABSolu (Quantel Medical by Lumibird Medical) is an ultrasound platform that can be used to produce A- and B-scans, standardized ultrasound, and UBM with a linear probe. A new 20-MHz annular probe uses five-ring annular technology to emit alternating ultrasounds by five concentric transducers located on an annular probe. The annular probe, which increases depth of field by 70%, can provide images of the entire eye with an exceptional level of detail from the anterior part of the vitreous to the wall. The new annular probe also allows simultaneous examinations of pathologies of the vitreous, retina, and beyond. Additionally, the IMUv motion sensor allows the clinician to locate the ultrasound beam in real time in the ocular diagram.

ABSolu has clinical applications for glaucoma care. All the semi-automatic qualification tools available on this ultrasound platform facilitate examination of the iris, lens, and ciliary bodies simultaneously in patients with glaucoma. UBM provides very high resolution of the angle with deep penetration through the iris and ciliary processes, where anterior segment OCT fails. These applications are the focus of this article.

THE BASICS

The main advantage of UBM over OCT for glaucoma-related imaging is that it helps the clinician observe the anatomy of the angle in its natural state and in a dark condition.[2] This includes the ciliary body. In my clinical experience, UBM provides a clearer image of the shape, borders, and positioning of the ciliary processes compared to OCT with a poor visualization of ciliary processes.

UBM also provides accurate observations of angle anomalies, including Peter's syndrome, iris bowing, cysts, iris lesions, and synechiae between the cornea and iris. This is not possible with OCT imaging because the pigmented structures block the OCT.

DIAGNOSES

UBM with the ABSolu ultrasound platform can be performed using a filmed window for UBM or a clear scan approach that allows examination with the patient in a seated position. It is a useful imaging tool that makes quick and easy diagnoses of myriad disease states and pathologies. Below are several examples.

Angle closure. UBM can detect the risk of angle closure. It provides accurate measurements of angle opening, anterior chamber depth, angle-to-angle, and sulcus-to-sulcus. These are critical measurements for glaucoma patients. UBM can also be used to measure the lens thickness and vault.

Malignant glaucoma. UBM can be used to observe the anterior chamber and the positioning of the lens in eyes with malignant glaucoma. As malignant glaucoma can be associated with plateau iris mechanism with anterior positioning of ciliary processes, UBM can show this additional factor. This is because the UBM can penetrate the iris.

Pigmentary glaucoma. Imaging with ABSolu can show the inverted iris bowing with a wide opened angle and an increased contact between iris and lens. After peripheral iridotomy (PI), UBM can show the straight iris shape and the efficiency of PI. UBM helps to guide follow-up treatment and care (Figure 1).

Plateau iris mechanism. UBM is the perfect tool to quantify the risk of plateau iris mechanism.[3] On a UBM meridian scan, plateau iris can be defined by closed angle, anterior positioning of ciliary processes pushing the iris root forward and no identifiable sulcus. The anterior positioning of the ciliary processes can be shown with regard of scleral spur. To help

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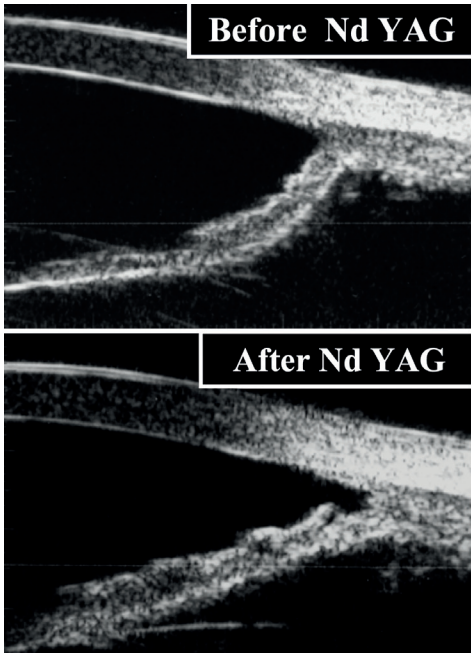

Figure 1. UBM scan on the same meridian with iris bowing inversion before PI and straight shape of the iris after PI.

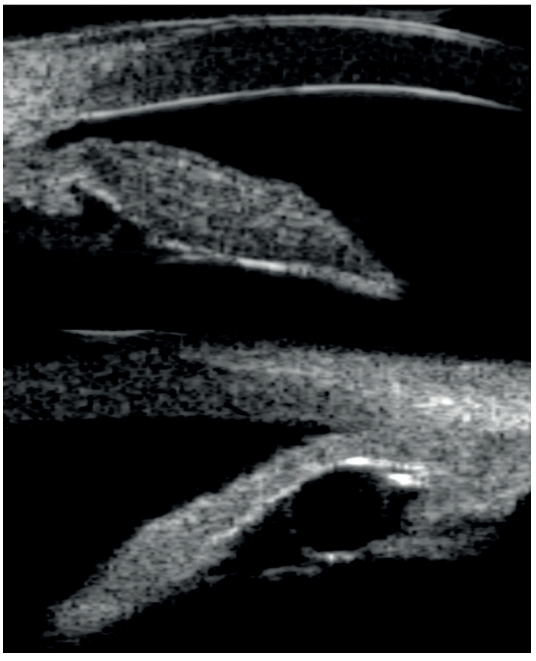

Figure 2. The upper scan depicts the iris bowing with iris thickening. At the bottom, the iris bowing is depicted with a ciliary cyst.

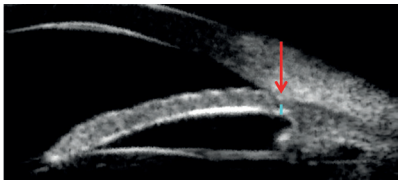

Figure 3. Anterior insertion of the iris root with a very small distance between scleral spur (red arrow) and the end of iris epithelium.

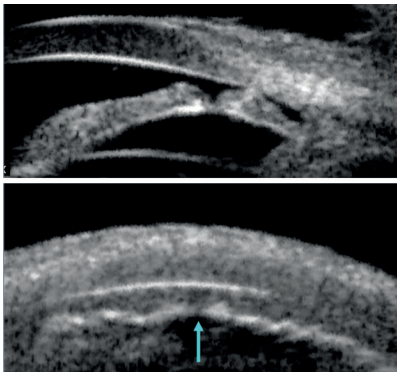

Figure 4. Incomplete PI with iris bowing.

this analysis we can draw a line passing through the limbus and the scleral spur.

Differential diagnosis of cysts. UBM also can be used to diagnose the mechanism of iris bowing: Iris or ciliary cyst against iris or ciliary melanoma (Figure 2).

Anterior insertion of the iris root. In some cases, the scleral spur may be masked by the iris root. However, the anterior insertion of the iris root can be observed by taking measurements of the distance from the scleral spur to the peripheral limit of the iris epithelium (Figure 3).

Anterior iris insertion associated with plateau iris can also be observed on UBM. In these cases, there is a very small distance between the scleral spur and the posterior part of the iris, and the ciliary processes are in an anterior position. This mixed anatomy can help guide the right follow-up and treatment protocols for patients.

COMPARATIVE IMAGES

UBM imaging of the angle can be performed before and after glaucoma treatments such as PI, iridoplasty, and filtering surgery to assess the effectiveness of these procedures. The following are two examples.

Angle closure. The status of the angle can be compared before and after PI. UBM is very useful in case of no reopening of the angle to diagnose the mechanism of PI failure (Figure 4).

Filtering surgery. The postoperative analysis of filtering surgery results is easy. The conjunctival bubble can be observed, as well as the shape of the deep sclerectomy to determine if there is a nonfunctioning filtering bleb.

CONCLUSION

UBM with the ABSolu ultrasound platform provides very high-resolution meridian scans of the angle. It achieves deeper penetration of the angle anatomy than any other optical imaging device.[4]

As a result, clinicians can now image the angle anatomy, the ciliary process, and the lens to help analyze each individual glaucoma patient. In my experience, UBM is a convenient imaging technique that helps us understand the mechanisms of glaucoma in our patients. ■

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