Ultrasound Biomicroscopy & Glaucoma Care

Visualizing angle closure and its mechanisms from screening to post-surgical assessment improves treatment outcomes.

By Ike K. Ahmed, MD, FRCSC

Many of us have utilized optical and ultrasonic imaging technologies for both the anterior and the posterior segment, so we have a good idea of where the strengths and weaknesses lie for these technologies. Training in Toronto where Chuck Pavlin, MD, and Stephen Foster, MD, FACS, invented ultrasound biomicroscope (UBM) technology, I have seen its iterations over the years. Today, it is a very practical, efficient, comfortable and high-yield tool — a fact that perhaps is a little surprising to those who haven't yet used the latest device.

UBM and anterior segment imaging play an integral role in how I screen for glaucoma, choose and assess the efficacy of treatment and improve surgical outcomes. Specifically, its anterior segment imaging capabilities are now an essential component of my workup for glaucoma patients, particularly those with questionable mechanisms of glaucoma/IOP elevation, narrow angle or angle closure.

Imaging Choices

For anterior segment imaging, our options are Scheimpflug imaging, UBM, traditional OCT and spectral domain OCT. In patients with glaucoma, Scheimpflug imaging has high reflectivity in the angle recess, which makes it very hard to assess what's happening in the angle. We can assess central anterior chamber depth, but we don't have the resolution and clarity necessary for the angle.

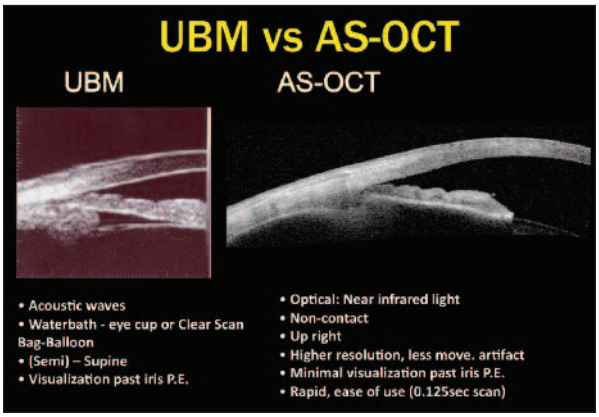

Figure 1. Comparison of UBM and OCT technologies.

UBM is very clean, comfortable and easy to use, and it gives us the visualization we need in seconds. I use the Aviso (Quantel), with the ClearScan probe cover (ESI), a monumental step forward in the utilization of UBM that makes it a fast, clean, "sit down and go" procedure.

Let's look at the advantages of UBM for glaucoma alongside OCT. The resolution is quite good with OCT, but because it uses optical waves, the big limitation is its ability to visualize what's happening behind the iris pigment epithelium. UBM's acoustic waves enable us to see behind the iris to get a complete anterior segment picture.

When we compare UBM and OCT for lesions of the iris and ciliary body, UBM gives us the ability to see the posterior borders of these lesions (iris nevi and iris cysts). We can visualize cyst walls and ciliary body cysts much better with the UBM. OCT certainly delivers very good corneal and anterior chamber angle imaging, but UBM goes deeper (**Figure 1**).

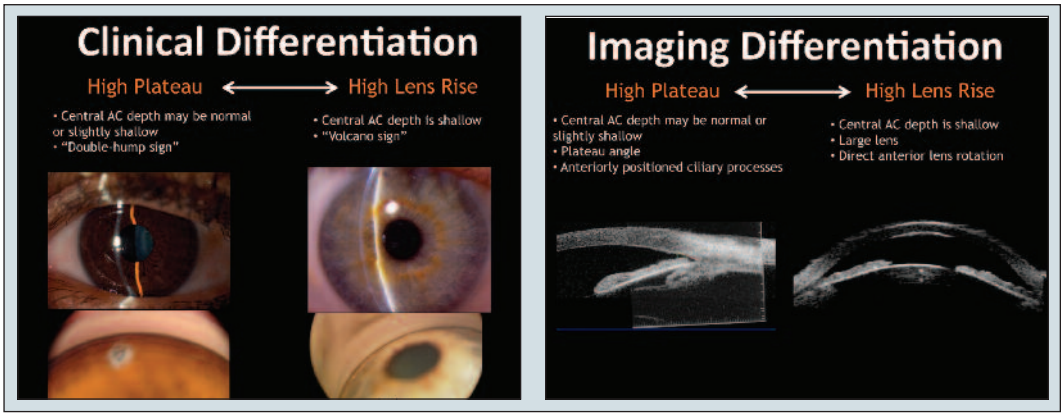

Figure 2. Differentiating high plateau from high lens rise.

Emphasis on Angle Closure

When I mention "angle closure," colleagues often say, "I don't think I see that very much. It's not going to be an issue in my patient population." But we're all aware that angle closure glaucoma typically presents as chronic or intermittent angle closure.

Most cases of angle closure are not acute, and they often masquerade as open-angle glaucoma. Every week, I see patients who are referred with open-angle glaucoma, but gonioscopy and imaging show that in fact, the patient has an angle-closure mechanism. Of course, it would have been preferable to identify this earlier.

Depending on the population, in up to 10% of cases I see narrow or occludable angles, which put patients at particularly high risk for angle closure. Although it's especially important to evaluate their angles, we really need to assess the angles in all patients with glaucoma and assess the suspects that concern us. We want to identify the different stages of angle closure:

- Primary angle closure suspects have anatomically narrow angles (180° vs. 270°).
- Primary angle closure occurs with narrow angles, raised IOP and/or peripheral anterior synechia (PAS).
- Primary angle closure glaucoma exhibits all of the above, plus disk and visual field changes. More blindness occurs from primary angle closure than from primary open-angle glaucoma.

Key to understanding angle closure is an awareness of the multiple mechanisms of angle closure and angle narrowing, as well as the effects of surgery. We need a clear picture of the angle and how it occurs.

Gonioscopy and Imaging

Clinically, gonioscopy is the gold standard in terms of our clinical observation, and we typically use an angle classification system such as the Schaffer Classification. Using this system, Grade 2 angle (20° or less) is considered narrow and at risk for angle closure.

Gonioscopy also has its drawbacks, such as the artifact from indentation, artifact from light and the inability to document. It is also difficult and therefore a significant technical skill for the clinician. Imaging, on the other hand, really allows us to have a non-contact, comfortable, objective dark room physiologic assessment of the angle. I look at the tests as adjunctive. Gonioscopy is mandatory in these situations, but imaging adds a lot more value. It enables us to assess, for example, anterior chamber depth, corneal thickness, angle opening distance and the iridocorneal angle. And we can document and follow patients as needed.

Imaging often can be quite revealing when we examine a patient. If we're not quite sure whether the patient has a real narrowing or not, imaging confirms what's going on. In this way, imaging has changed the way that we manage glaucoma. The role of imaging for the disk and retinal nerve fiber layer is often discussed in preferred practice patterns. In our practice, anterior segment imaging has become essential for assessment of the angle.

PI and Post-surgical Imaging

If we follow primary angle closure suspects (patients with narrow angles), we find that almost 20% progress to primary angle closure glaucoma in 2 weeks to 5 years – 30% over 7 years.[1] If we overlook these patients, there is a significant risk of either acute or chronic angle closure, both of which can be more problematic if they aren't addressed quickly. When I talk to my patients with narrow angles about the role of a peripheral iridotomy (PI), I tell them that treatment is important because there is

a 20-30% risk of angle closure.

Peripheral iridotomies are the clear choice, but they're not enough. One common mistake is not doing a proper assessment after PI. Studying UBM in our group, we saw that 35% of patients did not have significant opening of their angle after PI.[2] After PI, 28% of patients may still go on to develop angle closure.[3]

Why isn't PI always effective? The pupil block mechanism treated by laser iridotomy is the cause of closure for most patients, but other mechanisms are at play in a significant number of patients. Plateau iris and lens-related iris rotation (not so exaggerated as phacomorphia) are two other common conditions. Less common conditions, such as uveal effusion and malignant glaucoma, can cause angle closure as well.

Imaging has enormous value in showing us the mechanisms of the disease as well as the angle. For example, post-surgical evaluation with UBM may reveal plateau iris. If we fail to identify the problem, we might fail to prevent angle closure. Thus, we can't eliminate a patient's risk for angle closure after PI; we need to determine the other mechanisms at play.

Visualizing Closure Mechanisms

If pupil block isn't the problem, which mechanism is causing persistent closure? We look to two other common causes, plateau iris and lens-related iris rotation. We start by distinguishing between the high plateau and the high lens rise, both of which we can assess clinically by looking at the anterior chamber depth and gonioscopy.

Gonioscopy shows normal or shallow anterior chamber depth with a "double hump" or sinusoidal picture for plateau, while high lens rise has a very shallow anterior chamber depth and a "volcano" sign. However, high plateau and high lens rise are often difficult to assess using gonioscopy, but UBM technology allows us to differentiate these mechanisms more easily. And that differentiation is what directly informs our treatment decisions – lens removal versus iridoplasty, for example (**Figure 2**).

If the patient has plateau iris, we can generate a more specific diagnosis. Plateau iris configuration describes the narrow angle or closure due to plateau iris, but plateau iris syndrome combines configuration with elevated IOP and/or progressive PAS. Plateau iris glaucoma is the syndrome with disk or visual field damage. There are different ways we can treat these problems, and the detail we get from UBM imaging helps guide our choices for therapy.

Removing the crystalline lens can be quite definitive in treating angle closure or angle narrowing caused by the mechanism of lens-related rotation. Endocycloplasty can be used to shrink the ciliary processes – a very good treatment for plateau iris. The treated ciliary processes move to the posterior chamber, allowing opening of the angle. By using UBM imaging to assess patients after PI, we can identify the 35% of patients whose angle closure is not caused by pupil block, identify the mechanism that is at work, choose the appropriate treatment and see that treatment is working.

Beyond the Gold Standard

I hope we all understand the importance of angle assessment. Gonioscopy is still considered the gold standard, but UBM is a very valuable adjunct for determining the angle and its closure mechanism. I don't move forward with my treatment, whether it's screening or PI or post-PI, without proper imaging, and this enhanced modality allows this to be done quickly and easily.

We can visualize not only the outcomes of surgical treatment for angle closure, but also the path of anterior chamber tubes that we've placed in the interscleral passage and the anterior chamber. Even posterior chamber tubes, which are sometimes hard to visualize clinically, are clear with the UBM. In addition, we can assess bleb sizes with UBM to evaluate treatment outcomes.

By using UBM for these purposes, as well as to visualize the mechanisms at work in angle closure from screening to post-surgical assessment, we introduce more detailed practical information into diagnosis and treatment decisions, and we know whether treatment is effective or more therapy is required.

References

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