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M. Puech

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75011 Paris – Tél. : 01 47 00 67 14 – Fax : 01 47 00 69 99

UBM and glaucoma: diagnosis and follow-up of plateau iris

ABSTRACT: Exploration of the anterior segment by ultrasound biomicrography (UBM) allows a cross-sectional analysis of the iridocorneal angle with very good visualisation of the ciliary body. This advantage, which is specific to ultrasonography, proves very useful for assessing the risk of closed-angle glaucoma, in particular in cases of plateau iris. The diagnostic feature of plateau iris most often found is the anterior position of the ciliary processes with pressure on the iris root, causing closure of the iridocorneal angle.
Analysis of the anterior segment by UBM also allows an appraisal of other risk factors for closed-angle glaucoma, such as the crystalline lens factor, readily identified by lens rise.
Exploration by UBM also allows the follow-up of patients treated by peripheral iridotomy to evaluate degree of surgical perforation, the assessment of any persistence of a plateau iris mechanism, and guidance of specific treatments for plateau iris (iridoplasty, lens surgery, filtration surgery, etc.)
Recent ultrasonography devices, with their simpler approach to UBM examination, have prompted more frequent recourse to the UBM exploration of the iridocorneal angle, with the advantage of an iconography that is very helpful for decision-making and communication to patients.

→ **M. PUECH**
Explore Vision,
PARIS.

The utility of ultrasound biomicroscopy (UBM) in ophthalmology was indicated by Charles Pavlin in the early 1990s [1, 2]. The evolution of the instrumentation has made this technique increasingly accessible, with the advent of multipurpose ultrasonography devices that allow the use of both 10 MHz probes to explore the posterior segment, and UBM probes with frequencies above 20 MHz focused on the anterior segment. This technological advantage provides greater image resolution owing to increased ultrasound frequency.

UBM applications are found in various domains such as refractive eye surgery, monitoring of iridociliary tumours and assessment of risk of iridocorneal angle closure. The probes most suitable for applications in glaucoma and iridocorneal angle analysis use 35 or 50 MHz transducers.

Exploration of the closed iridocorneal angle by UBM, further to gonioscopy and slit lamp examination, offers the advantage of cross-sectional imaging of the different structures that form this anatomical region. UBM imaging allows a very good visualisation of the ciliary processes and of the scleral spur, which forms a fixed anatomical landmark, whereas the iris and ciliary body are dynamic features that vary with illumination and accommodation.

The definition of plateau iris usually makes a distinction between two situations:

>>> **Plateau iris configuration** is characterised by a closed angle picture

with a flat-shaped iris and a narrow anterior chamber. More recently, the "double hump" iris feature observed by dynamic gonioscopy was introduced.

>>> **Plateau iris syndrome** describes the response of a closed iridocorneal angle treated by peripheral iridotomy but without reopening of the angle after treatment.

Charles Pavlin, with the first applications of UBM, described the anterior position of the ciliary processes as being the mechanism most often found for eyes displaying a plateau iris. Many publications support this finding, highlighting a higher incidence of plateau iris among Asians [3, 4] and especially Chinese [5].

More commonly, access to UBM for angle analysis has allowed a better appraisal of the frequency of this mechanism and that of the anterior position of the ciliary processes. The crucial advantages of angle exploration by UBM arise from the very high penetration of the ultrasound frequencies behind the iris, with a very good visualisation of the ciliary processes compared with OCT images. Another advantage of UBM is the possibility of carrying out the examination in the dark with the patient lying down, which are the usual conditions in which acute glaucoma episodes are triggered.

Angle examination by UBM

Exploration of the iridocorneal angle by UBM is carried out by pseudo-immersion, in a fairly simple way with currently available instruments: a drop of local anaesthetic is instilled, and the palpebral fissure is filled with a cushion of gel. The UBM wand is positioned opposite the angle, floating on the gel, without direct contact with the eyeball, and so without any indentation of the cornea or limbus.

The wand is oriented so as to obtain a meridian cross sectional image of the iridocorneal angle.

Four cross sections, at 3H, 6H, 9H and 12H, give a good picture of the state of the angle. These cross sections can be acquired under photopic illumination, but also, thanks to the special features of ultrasonography, in mesopic conditions. All our other instruments, e.g. the slip lamp and the infrared OCT beam, illuminate the eye and so reduce the pupil diameter.

Gonioscopy also causes some degree of indentation of the cornea or of the angle, which tends to give a picture of a slightly more open angle than that usually found with UBM.

To analyse an iridocorneal angle, in particular in the case of plateau iris, the essential task is to locate the position of the scleral spur. This spur is the only stable element of the angle if there is a change in the pupil diameter or if accommodation takes place.

Analysis of angle closure risk by UBM

1. UBM and closed angle

The UBM test for closure of the iridocorneal angle allows the response of the angle in the dark to be appraised for the four main meridians:
– Risk of angle closure is deemed nil when all four meridians present an open picture.
– Risk of angle closure is deemed very high when all four meridians present a closed picture.

These criteria give an indicative value of angle closure risk.

However, the real risk of angle closure in the case of a closed picture in all four UBM images is not quantified, and is the subject of debate relative to other associated factors that can trigger an episode of acute glaucoma.

The other factors liable to trigger acute glaucoma episodes may be linked either to anatomic factors, or to dynamic factors [6]: the presence of a large lens in an anterior position, and an anterior position of the ciliary processes are aggravating anatomic conditions. More recently, the dynamics of the iris, with its variably marked contraction and its thickening during mydriasis were highlighted as a risk factor for closed angle glaucoma. The same dynamic factor can be evoked with the behaviour of the ciliary body, very clearly visualised by UBM.

2. UBM and plateau iris

UBM imaging in patients presenting a closed angle has revealed a non-negligible number of anteriorly positioned ciliary processes [7]. This position is assessed relative to the scleral spur, with usually a position of the ciliary processes behind the scleral spur marker (***Fig. 1***).

The plateau iris situation is clearly identified when most of the ciliary volume is positioned in front of the scleral spur. However, this definition is not enough, because it is common to find ciliary processes in an anterior position without the iridocorneal angle displaying a closed picture during physiological mydriasis (***Fig. 2***). The plateau iris mechanisms may be inferred if the

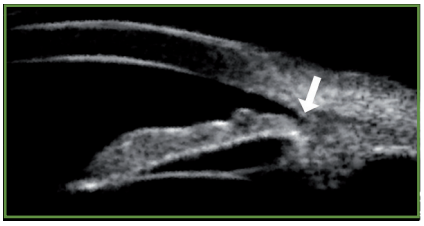

Fig. 1. Closed iridocorneal angle without plateau iris picture: the ciliary processes are positioned behind the scleral spur (white arrow).

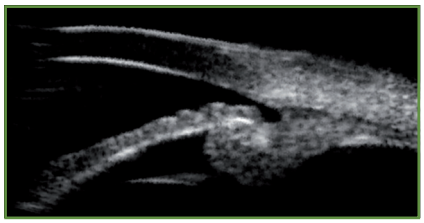

Fig. 2. Anterior position of ciliary processes relative to the scleral spur, but the angle remains open, resulting in a plateau iris anatomy without a plateau iris mechanism.

Fig. 3. Typical plateau iris mechanism with an appreciably anterior position of the ciliary body and a picture of a totally closed angle. When this situation occurs on all four main meridians, a complete plateau iris mechanism can be inferred.

anterior position of the ciliary processes is associated with a closed angle picture in most of the meridians (***Fig. 3***).

3. The lens factor (*Fig. 4*)

Exploration of the anterior segment in the case of a closed angle associated with a plateau iris mechanism can also provide information on the anatomical role of the lens in the angle closure mechanism. Measurement of lens rise seems to be an important factor in this analysis: this value corresponds to a salience of the anterior face of the lens relative to the angle-to-angle straight line on a full cross section of the whole anterior segment (whether obtained by UBM or by OCT).

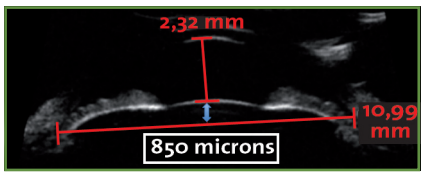

Fig. 4. Lens rise measured between the straight line joining the two iridocorneal angles and the anterior face of the lens. A large lens rise implies a lens component in the angle closure mechanism.

This lens rise may be moderate, very marked, or on the contrary negative if the lens is positioned somewhat posteriorly.

This feature was brought into refractive eye surgery by Georges Baïkoff to quantify the risk of side effects of phakic implants. Its application to closed angle and plateau iris allows an assessment of the chances of successfully acting on the opening of the angle by lens surgery. A simple cataract operation with a posterior chamber implant often causes an appreciable reopening of the angle. In the case of a plateau iris mechanism, some publications have advocated extending the plateau iris treatment by a cataract operation. This indication will depend on the degree of implication of the lens in the angle closure mechanism. Lens rise, which is fairly easy to measure, offers a good assessment criterion.

4. UBM and follow-up of treated plateau iris

The first line treatment proposed for plateau iris is laser iridotomy. This treatment has an effect on the pupil block component. Relieving this pupil block often causes the angle to reopen, including in the case of moderate plateau iris [8].

Analysis by UBM of the iridocorneal angles after peripheral iridotomy gives information on the quality of the healing of the iridotomy and on the effect produced on the angle opening.

UBM, like OCT, allows an appraisal of whether the iridotomy was perforating, and also analyses the size of the iridotomy, in particular during mydriasis.

Other features can limit the effect of laser iridotomy, such as a too-peripheral position relative to voluminous ciliary processes, and in an anterior position. The presence of iridociliary cysts can also explain, in some cases, a poor reopening of the angle after peripheral iridotomy.

For these different reasons, recourse to a UBM examination can be proposed for peripheral iridotomies that have not resulted in angle reopening as an outcome of treatment.

For this indication, the low penetration of OCT devices behind the iris clearly militates in favour of exploration by UBM.

UBM in plateau iris situations that are far advanced may reveal a large-sized perforating iridotomy, but an iridocorneal angle that remains closed on most of the meridians during physiological mydriasis, through a marked shift of the ciliary processes in front of the scleral spur.

Such a picture shows the probable limit of peripheral iridotomy with the aim of eliminating the risk of angle closure.

UBM can call attention to a possible insufficient response before peripheral iridotomy by visualisation of a marked shift of the ciliary processes. However, the most useful findings are obtained, after peripheral iridotomy treatment, in the case when a substantially perforating iridotomy relieved pupil block but left a closed angle on most of the meridians by very marked pressure of the ciliary processes on the iris root. In this situation, an additional treatment can be considered, ranging from iridoplasty to lens surgery or recourse to filtration surgery.

In the case of treatment by iridoplasty, both UBM and OCT allow the visualisation of the thinning of the iris root.

This thinning seems to work for moderate cases of plateau iris, but does not seem sufficient to counterbalance the action of voluminous, very anterior ciliary processes.

Cataract surgery in the case of an anterior position of the lens [9, 10], or a large lens, most often permit the reopening of the iridocorneal angle. However, the few

STRENGTHS

- Exploration by UBM is the only exploration that allows cross sectional imaging of the iridocorneal angle with a good visualisation of the ciliary processes.
- The plateau iris mechanism often presents an underlying anterior position of the ciliary processes.
- UBM allows the assessment of angle response after iridotomy.
- UBM allows guidance of indications for the specific treatment of plateau iris.

publications that advocate this therapeutic solution in the case of plateau iris only seldom present the grade of iris plateau mechanism, as can be observed by UBM, and very rarely mention the state of the lens before surgery. More systematic recourse to UBM exploration before this type of surgery will probably help to achieve sounder therapeutic indications.

Recourse to filtration surgery allows drainage of aqueous humour but results in only a weak reopening of the angle.

UBM is still underused for the monitoring of plateau iris situations in treatment indications and for the follow-up of the different therapeutic techniques, but can be expected to offer more and more promising applications in routine practice.

Conclusion

UBM examination in cases of plateau iris provides new information for diagnosis, and treatment follow-up and therapeutic indications.

The deeper penetration of ultrasonic frequencies compared with OCT images makes UBM a choice exploration method for appraising the role of the ciliary body in the mechanism of angle closure.

The current response to confirmed plateau iris involves carrying out a first-line peripheral iridotomy. UBM allows, after this first step, an assessment of angle reopening. If the effect is insufficient, an appraisal of the shift of the ciliary processes in front of the scleral spur also allows a judicious choice of additional treatment that can be proposed, namely iridoplasty, lens surgery or filtration surgery.

The recent ultrasonography devices are more and more versatile, with the possibility of multipurpose instruments, not only for posterior segment diagnosis, but also with high frequency probes that allow UBM analysis of the anterior segment. This evolution enables a greater number of ophthalmologists to practice exploration of the iridocorneal angle with a better assessment of plateau iris frequency and better follow-up of the different treatments proposed.

Bibliographie

1. Pavlin CJ, Ritch R, Foster FS. Ultrasound biomicroscopy in plateau iris syndrome. *Am J Ophthalmol,* 1992;113:390-395.
2. Pavlin CJ, Foster FS. Plateau iris syndrome: changes in angle opening associated with dark, light, and pilocarpine administration. *Am J Ophthalmol,* 1999;128:288-291.
3. Ang GS, Bochmann F, Azuara-Blanco A. Argon laser peripheral iridoplasty for plateau iris associated with iridociliary cysts: a case report. *Cases J,* 2008;1:368.
4. Aung T, Nolan WP, Machin D *et al.* Anterior chamber depth and the risk of primary angle closure in 2 East Asian populations. *Arch Ophthalmol,* 2005;123:527-532.
5. He M, Foster PJ, Ge J *et al.* Gonioscopy in adult Chinese: the Liwan Eye Study. *Invest Ophthalmol Vis Sci,* 2006;47:4772-4779.
6. Dorairaj SK, Tello C, Liebmann JM *et al.* Narrow angles and angle closure: anatomic reasons for earlier closure of the superior portion of the iridocorneal angle. *Arch Ophthalmol,* 2007;125:734-739.
7. Kumar RS, Baskaran M, Chew PT *et al.* Prevalence of plateau iris in primary angle closure suspects an ultrasound biomicroscopy study. *Ophthalmology*, 2008;115:430-434.
8. Ritch R. Assessing the treatment of angle closure. *Ophthalmology*, 2003; 110: 1867-1868.
9. Tran HV, Liebmann JM, Ritch R. Iridociliary apposition in plateau iris syndrome persists after cataract extraction. *Am J Ophthalmol,* 2003;135: 40-43.
10. Ng WS, Ang GS, Azuara-Blanco A. Laser peripheral iridoplasty for angle-closure. *Cochrane Database Syst Rev,* 2008:CD006746.

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