Is UBM Useful For Zonular Intergrity?

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Abstract

We conducted a study of ultrasound biomicroscopy [UBM] for 50 patients with mature senile cataract, pseudoexfoliation, trauma, or those with clinical suspicion of zonular dehiscence [n=5]. 10 had clinical zonular dialysis with phacodonesis /iridodonesis which was confirmed by UBM. Three patients were noted to have zonular dehiscence on UBM. Areas of zonular dehiscence were mapped on UBM and the UBM findings are described. Surgery could be planned accordingly and complications prevented. Sensitivity for preoperative detection of zonular loss is high with UBM. Surgical surprises can thus be avoided and better visual outcomes ensured.

Key words Zonular dehiscence, subluxation, ultrasound biomicroscopy

Introduction

One of the challenging situations in cataract scenario with an unpredictable outcome despite advances in cataract surgery, even in the hands of well trained phacosurgeons is zonular dehiscence. Such situations can be more enigmatic especially in hard cataracts as these pupils usually fail to dilate.

Ultrasound biomicroscopy [UBM] has come as a boon for visualizing structures in the angle of anterior chamber and the ciliary body area. The location of the ciliary processes and the integrity of the zonules can now be assessed, thus enabling preoperative detection of subtle degrees of subluxation. Occult zonular defects detected preoperatively, can be managed more effectively. Preventive measures can be taken to ensure maximum bag stability. These include, avoiding pressure or massage after the peribulbar block, giving I/V Mannitol to decrease vitreous up-thrust. Extra care needs to be taken, and only low fluid phaco maneuvers are carried out, and abrupt shallowing or deepening of the anterior chamber are to be avoided.

With UBM one gets images of cross sections of the intact anterior globe at microscopic resolution. It uses a high frequency ultrasound transducers (50 MHz), with a resolution of 20 μm, and structures up to a depth of 4 mm can be seen.

Occult zonular defects identified preoperatively enabled modification of surgical technique to ensure improved outcomes.

Materials and Methods

We selected patients coming for cataract evaluation and management to the Out Patient Clinic of the Ophthalmology Department at Amrita Institute of Medical Sciences between Oct. 2006 and Oct. 2007. Consecutive cataract patients with mature cataract or pseudoexfoliation syndrome or those with history of trauma were included in the study.
All patients underwent a comprehensive ophthalmic evaluation including vision assessment, refraction, slit lamp biomicroscopy, fundus examination (unless the cataract was mature) keratometry, and biometry for IOL calculation.

In addition, a UBM was done for these patients in an undilated pupil using the UBM machine from Appasamy with the 35 MHz and 50 MHz probe, a scan angle of 10-30 degrees. The probe was aligned radially along the 12 clock hours placed perpendicularly over the cornea so as to include the angle of anterior chamber, iris, the ciliary body, zonules and peripheral lens edge.

Scanning was performed under topical anesthesia using a 20 mm eye cup which was inserted between the lids and filled with saline/Ringer solution, with the patient in a supine position in standardized room lighting conditions.

Initial scan was done over the central anterior chamber to observe for any tilt of the bright reflective line of the anterior lens capsule. Scanning was then done over the iris root for 360° to assess zonules directly.

Radial scanning was performed with probe oscillations parallel to the zonules & with the focal plane of the transducer at the depth of the zonules.

To prevent a false impression of zonular defect, the long axis of the transducer was kept perpendicular to the zonular fibres, helped by asking the patient to position the eye accordingly.

In view of the familiarity with discussing the anterior segment in terms of clock hours, we recorded zonular defects in terms of clock hours as well. Beginning radial scanning at 12 o’clock position, we carried it out in clockwise fashion till 6 o’clock position with the probe marker toward the limbal side.

Then the marker was located toward the corneal side from 6 to 12 o’clock position for each eye.

All these patients subsequently underwent cataract surgery and the UBM findings were correlated with the intraoperative observations.

In those with zonular dehiscence detected clinically or with UBM a capsular tension ring was inserted during the procedure. The visual and surgical outcomes were analysed.

**Observations**

Of the 50 patients undergoing UBM, zonular dehiscence was seen in 13 patients. Positioning of the probe was very important and it had a long learning curve with fibre orientation being perpendicular to the probe. The oscillations of the UBM scan had strict radial orientation towards the limbus.

Seven patients had clinical zonular dialysis in one eye, and the other eye was normal.

Area of zonular absence as seen by UBM was less than/ = 1 quadrant in 5 cases, 3 at 1 site only & 2 at two sites. The other 2 cases had almost 180° dehiscence.

<table>
<thead>
<tr>
<th>Patients undergoing Surgery</th>
<th>Clinically diagnosed UBM [n=50]</th>
<th>Zonular loss, defect on UBM [n=10]</th>
<th>Zonular detected on UBM [n=13]</th>
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<tbody>
<tr>
<td>Coloboma</td>
<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>Trauma</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pseudoexfoliation</td>
<td>19</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>MSC/ HMSC [Fig.1]</td>
<td>33</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Homocystinuria [fig2]</td>
<td>1</td>
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<td>Marfan’s Syndrome[Fig.3]</td>
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3 patients had anterior coloboma in both the eyes with both iris and lenticular coloboma. There was absence of zonules on UBM in the colobomatous areas, and the remaining zonules were found to be firm and normal. Extent of zonular absence was noted in clock hours for each of the eyes. In all colobomas, the zonular absence was in an area larger than the iris coloboma of the same eye. The maximum extent of coloboma was 270° (n=1) and minimum<90°(n=2). Ultrasound biomicroscopy of the lens “Coloboma” revealed a greatly increased sphericity of the lens and the deficiency of zonules in the “colobomatous” area.

Capsular tension ring was used effectively in these patients increasing capsular bag stability during both phacoemulsification and IOL placement. The CTR was inserted by hand over hand method.

One patient gave a history of unilateral blunt trauma with history of a coconut falling on her a few years ago. She was found to have subluxation clinically with iridodonesis, shallow anterior chamber superiorly and a pupil that did not dilate. This was
confirmed on UBM. Zonules were missing for 180°, the ciliary body was flattened and increased lenticular sphericity was noted.

Of the 19 patients with pseudoexfoliation [PXE], two had iridodonesis, of which one had phacodonesis as well. On UBM, 4 patients with PXE had zonular dehiscence evidenced by absence of zonules and localized increase in lenticular sphericity.

Occult zonular loss was detected in 3 patients on UBM. In 2 others with mature/hypermature cataract with iridodonesis the zonular dialysis was confirmed with UBM. There were either missing zonules [n=2], or/and zonules were stretched [n=2] (fig. 3 and 4), and/or ciliary body flattening [n=2] was observed. The lenticular sphericity was increased in the area of zonular defects [n=3] (fig. 1). Other effects seen were pupillary block, angle crowding and direct iridal irritation. Angle of anterior chamber was increased [Fig. 5] in a patient with posterior subluxation.

![Fig. 1. Clumping of ciliary body processes and zonules in the right half of the field, increase in anteroposterior diameter of the lens - Indication of subtle subluxation in a mature cataract](image1)

![Fig. 2. UBM of a homocystenuria patient with B/L subluxation, managed conservatively with once daily instillation of Pilocarpine. The UBM shows deepening of AC with widening of the angle](image2)

![Fig. 3. Increase in anterior chamber depth, stretched zonules and lens flattened in patient of Marfan's syndrome with subluxation on UBM](image3)

![Fig. 4. UBM of a patient with stretched zonules](image4)

![Fig 5 Large angle of anterior chamber 51deg.on UBM in a patient with post subluxation](image5)
One patient with homocystinuria, had bilateral high myopia with subluxation and mildly raised IOP. It was managed conservatively. Patient had best corrected visual acuity (BCVA) of 6/9 in both eyes. She was on Pilocarpine 2 % twice daily as the zonular dialysis was >180 degrees in both the eyes. The extent of zonular defect found on UBM was higher than that seen clinically in a dilated pupil. The anterior chamber on UBM was found deep with iris falling backward with no support. No zonules or lens was seen in this area with flattening of ciliary body [Fig.4].

Discussion

Patients more prone to zonular dehiscence and subluxation are, those with pseudoexfoliation and hypermature cataracts in the senile age group. Also an unsuspecting, mild blunt trauma, might cause zonular dehiscence, an event the patient may have well forgotten about. The UBM can today come to the rescue for the unsuspecting surgeon, and help in the diagnosis of zonular defects. The surgeon needs to have a high degree of suspicion. Certain perioperative maneuvers can enhance the degree of subluxation, increasing the risk of dreaded complications like nucleus drop or vitreous prolapse. The safe placement of the PCIOL was impossible in these cases, until the capsular tension ring started being used for subluxated lenses almost a decade ago.

Certain steps taken during surgery can ensure a favourable outcome. These include gentle pressure if peribular is given, Preferably giving I/V Mannitol to minimize vitreous upthurst, and gentle steady manipulation of globe. The incision is to be made away from site of zonular defect and if possible opposite to it. The initiation of rhexis is difficult in subluxated lenses and this step may be an important subtle indicator of an undetected zonular weakness. The rhexis should be initiated in an area of intact zonules so that counter traction is avoided. It should be small and central, with slow careful hydrodissection at multipe sites. The use of capsular tension rings has of course revolutionized the outcome, combined with the availability of dispersive and cohesive viscoelastics. At all steps sudden shallowing of the anterior chamber as well as deepening are to be avoided. Phaco chop is the preferred method with adequate power and not a high flow rate.

One unique feature was the deposition of granular material on the zonules in PXE. This has been noted earlier, and depending on the extent has been classified into mild, moderate and severe cases. There are diagnostic criteria proposed by the Japanese for the early detection of PXE, based on the changes found in the zonules by UBM.

The preoperative diagnosis of the zonular defect can help in judging the appropriate timing of intervention. In the presence of large zonular defect, it is better not to wait till cataract is more significant in a patient with extensive zonular damage.

Conclusion

Ultrasound biomicroscopy is a sensitive and accurate method of assessing zonular dehiscence, although there is a long learning curve in mastering the technique. The orientation of the probe is important, otherwise false negative results may be high, i.e. the zonular defect may be missed. UBM can image zonules in patients suspected to have zonular dehiscence, allowing a prepared approach to careful surgery for these patients. The CTR insertion ensures good stability both for the procedure of the cataract surgery as well as for the long term placement of the intraocular lens in the bag.

Bibliography