Comparison of immersion ultrasonography, ultrasound biomicroscopy and anterior segment optical coherence tomography in the evaluation of traumatic phacoceles

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Blunt ocular trauma in the elderly can result in anterior dislocation of the crystalline lens into the subconjunctival space (phacocele). Although rare, this presentation can be missed, especially if the patient presents several days after the injury and if the lid is not everted on examination. While a careful clinical examination is adequate in the diagnosis, imaging techniques can be put to use for the accurate location of the associated sclera rupture. We report three cases of post-traumatic phacocele wherein ultrasound biomicroscopy (UBM) was compared to the anterior segment optical coherence tomography (AS-OCT) and B-scan ultrasonography (B-scan), in order to establish the best imaging tool for this condition. We concluded, based on image quality, that UBM could be the imaging modality of choice to aid in the diagnosis of phacocele.

Key words: Anterior segment optical coherence tomography, B-scan ultrasonography, phacocele, ultrasound biomicroscopy

Phacocele is a term used to describe the anterior dislocation of the crystalline lens into the subconjunctival space. It is a rare occurrence and accounts for less than 13% of all dislocations. It was first reported by Frieler in 1928.[1] Blunt trauma is the commonest etiology. Management is by surgical repair of the sclera rupture, often detected only by exploration during surgery. The phacocele itself is easily removed from its subconjunctival location. Adjunctive surgery like pars plana vitrectomy for vitreous hemorrhage is often required.

Ultrasound biomicroscopy (UBM), B-scan ultrasonography (B-scan) and anterior segment optical coherence tomography (AS-OCT) imaging are the well-established modalities for diagnosis of anteriorly located lesions and also important in diagnosing the extent of ocular trauma and aid in subsequent surgical planning.[2] We report three cases of post-traumatic phacocele who were subjected to all the three imaging modalities for the purpose of comparison.

Case Reports

All three cases were middle-aged female patients who presented with history of blunt trauma, 2 weeks to 1 month prior to presentation. Examination revealed phacoceles; all of them underwent the three imaging modalities preoperatively, after giving their informed consent. Surgical and visual outcomes were fairly good. The clinical features and management are outlined in Table 1.

Ultrasound biomicroscopy, immersion B-scan and anterior segment optical coherence tomography

In all three cases, immersion B-scan (OTI A-2000, Ophthalmic Technologies Inc, Toronto, Canada) could detect a cystic lesion with high internal reflectivity (suggestive of posterior capsule). However, the morphology and internal architecture of the cyst could not be delineated. AS-OCT (Visante 1000, Carl Zeiss Meditec Inc, Dublin, CA, USA) could detect the area of scleral discontinuity as an internal heterogeneous high reflectivity; but could not help in defining the internal details of the cyst. UBM (OTI A-2000) could demonstrate clearly a high reflective membrane in a uniform oval shape (capsule). The anterior and posterior capsule and the changes in reflectivity between the cortex (dark region) and the nucleus (bright region) could be easily appreciated. The details of the sclera like underlying thinning due to compression and area of the rupture were also noted. In case 2, fluid-like reflectivity was observed; this corresponded to intraoperative findings of vitreous around the lens. Fig. 1a shows the AS-OCT images, and Fig. 1b and 1c show the UBM images of case 1. Fig. 2a–c shows the comparison of UBM, AS-OCT and B-scan in case 2.

Discussion

Anterior luxation of the lens is a rare occurrence. Pre-requisites
Table 1: Clinical features and management of phacocele in three cases

| Case   | Mode of injury, duration | Vision         | Clinical features                                                                 | Management                                                                 |
|--------|--------------------------|----------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Case 1: 58/F, right eye | Trauma with metal rod | HM, PL+ PR accurate | Supero-temporal subconjunctival mass, aphakia, superior iridodialysis, dispersed vitreous hemorrhage without posterior dislocation of the lens. Other eye showed dense cataract and pseudoexfoliation | Phacocele removal with scleral repair. Best corrected visual acuity is 20/125 with resolving vitreous hemorrhage at 1 month after surgery. Scleral fixated intraocular lens is planned |
| Case 2: 68/F, right eye | Bull horn injury     | CF- 10 cm PL+ PR accurate | Subconjunctival mass at 12 o’clock [Fig. 3], scleral laceration adjacent to limbus from 11 to 4 o’clock, vitreous in anterior chamber, irregular pupil, aphakia, mild vitreous hemorrhage | Phacocele removal with scleral repair followed by pars plana vitrectomy with scleral fixated lens with endolaser a month later. Best corrected visual acuity 20/60 (myopic maculopathy) 5 months postoperatively |
| Case 3: 8/F, left eye | Fist injury during assault | HM, PL+ PR accurate | Chemosis, subconjunctival mass at 12 o’clock limbus [Fig. 4a and b], corneal edema, hyphema, iridodonesis, aphakia [Fig. 4c] and vitreous hemorrhage. Internal high reflective structure is noted on UBM over the cyst [Fig. 5] | Combined phacocele removal with pars plana vitrectomy and scleral tear repair. Best corrected visual acuity is 20/40 with aphakic correction 2 months postoperatively |

CF: Counting fingers, F: Female, HM: Hand movements, PL: Perception of light, PR: Projection of rays

![Image](a) Anterior segment optical coherence tomography image of the right eye showing the area of scleral discontinuity with a heterogeneous high reflectivity noted internally. The peripheral anterior chamber structures are also seen, with ruptured zonules. (b) Ultrasound biomicroscopy image of the right eye in case 1 shows the area of sclera rupture in much better detail. (c) Ultrasound biomicroscopy image over the phacocele shows a clearly demarcated structure within the subconjunctival cyst, with multiple layers of the crystalline lens

![Image](a) Ultrasound biomicroscopy image in case 2 shows well-demarcated lens with layers in subconjunctival space as compared to anterior segment optical coherence tomography image (b) and immersion B-scan (c)

for subconjunctival escape following trauma are presence of a hard lens (all three cases in our series), rigid sclera and possibly psuedoexfoliation (case 1). UBM, B-scan ultrasonography and AS-OCT imaging are the well-established modalities for diagnosis of anteriorly located lesions and are also important aids in the diagnosis of the extent
While AS-OCT is ideal for detailed imaging of structures from the surface of the eye to the iris plane, UBM is preferred for structures from the surface of the eye to the anterior vitreous. Both modalities have been described for imaging the conjunctiva, subconjunctival space and sclera. The use of AS-OCT to detect occult scleral perforation and subconjunctival dislocation has been described in a case of phacocele following blunt injury with fist. AS-OCT showed a sclera discontinuity and a heterogeneous reflection in the subconjunctival area. Another report highlights the role of UBM in the precise localization of phacocele and its utility on the surgical planning. A review of literature for phacocele shows isolated case reports and only two case series of five and eight cases each. Both of these series highlight the clinical features and outcome. The present series is the first to compare the three imaging modalities on the same patients. In our series, an immersion B-scan could detect a cystic lesion with internal reflectivity being poorly seen. AS-OCT was able to delineate the conjunctival cyst and a heterogeneous reflective membrane was noted internally; however, it could not provide accurate delineation of the lens structure. UBM, on the other hand, helped in clear delineation of the cyst as well as of the dislocated lens within the cyst. Additional details that could be discerned well with UBM were the location and extent of the sclera rupture, presence of vitreous, status of posterior capsule and the zonules. This information is useful while planning the surgery. To conclude, UBM is a useful imaging modality in the diagnosis of phacocele.

References
1. Friejer AJ. Subconjunctival lens dislocation. Am J Ophthalmol 1928;11:354-6.
2. Garcia JP Jr, Rosen RB. Anterior segment imaging: optical coherence tomography versus ultrasound biomicroscopy. Ophthalmic Surg Lasers Imaging 2008;39:476-84.
3. Prakash G, Ashokumar D, Jacob S, Kumar KS, Agarwal A, Agarwal A. Anterior segment optical coherence tomography aided diagnosis and primary posterior chamber intraocular lens implantation with fibrin glue in traumatic phacocele with scleral perforation. J Cataract Refract Surg 2009;35:782-4.
4. Sony P, Khokhar S, Panda A. Traumatic lenticele. Clin Exp Ophthalmol 2005;33:76-7.
5. Yurdakul NS, Uğurlu S, Yılmaz A, Made A. Traumatic subconjunctival crystalline lens dislocation. J Cataract Refract Surg 2003;29:2407-10.
6. Bhattercharjee K, Bhattacharjee H, Deka A, Bhattacharjee P. Traumatic Phacocele: Review of eight cases. Indian J Ophthalmol 2007;55:466-8.