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Sonographic Changes of the Lens in Traumatic Cataract

Background/Objective: The purpose of this study is to evaluate the sonographic changes of the lens that present with traumatic cataract in correlation with the age of injury.

Materials/methods: In this cross sectional study, 38 consecutively selected patients with traumatic cataract, referred to a radiology clinic were assessed by sonography. Other causes of cataract were excluded. Sonography was performed by one radiologist (M.A.K.) using ultrasound units with a 12 MHz linear transducer, and a 10-MHz mechanical sector transducer.

Results: All patients except one showed abnormal sonographic changes. Some lenses showed more than one sonographic abnormality amounting to a total of 68 abnormal findings. Setting a period of 3 months as the cut-off point, sonographic findings could be divided into the early and late onset changes. Echogenic surface, and multiple scattered fine echoes were among the early textural change seen early after traumatic cataract. Echogenic subcapsular area, echogenic cortex, and totally echogenic lens with or without structural changes were more frequent in chronic cataracts.

Conclusion: Sonographically observed changes that occur in the lens following traumatic cataract may bear some relation to those seen in senile cataract. It remains to be determined whether and how far the physico-chemical and structural changes, and hence the sonographic features of senile cataract share similar evolutionary patterns as compared with traumatic cataract. The presence of diffuse subtle echoes could be used as an indirect sign of lens rupture when the rupture site is still obscured.

Keywords: cataract, ultrasound, lens, trauma.

Introduction

Both penetrating injuries and blunt trauma to the eye may lead to cataract. Cataract can be classified according to the causes such as radiation, inflammation, trauma, and drugs. It may also be classified according to location of the opacity (nuclear, cortical, subcapsular, capsular), or age of onset (congenital, infantile, juvenile, presenile, senile)[1], or else the degree of opacity (immature, mature, hypermature).

Mechanical trauma to the eye may lead to cataract at any age. The process of maturation may take hours to days to develop in which case it precludes slit-lamp examination of posterior segment. In this setting, it is crucial to determine the integrity of posterior capsule since the surgical management with ultrasound or laser Phaco-technique which aims at emulsification and subsequent aspiration of the lens, will be much simpler and less time consuming.

The histological appearance of most types of cataracts is similar, regardless of the cause. The major structural changes of the lens in cataract comprise edema, protein alteration and disruption of the lens fibers. The damage is believed to occur by osmotic hydration following injury to the ATP-dependent ion pump disruption with subsequent influx of sodium and water into the lens.

In one longitudinal CT study by Boorstein et al[2], using attenuation criteria, it was found that the attenuation values in the traumatized, cataractous lens was markedly lower than the counterpart lens allowing for prompt therapeutic management. However, the time course of structural events, which might be amenable to monitoring in diagnostic imaging, is not clearly understood and the literature on the topic is sparse both in radiology and ophthalmology.

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Materials and Methods

From January 2001 to June 2003 (30 months), 38 consecutive patients with traumatic cataract were referred to M.A.K. Radiology Clinic for ocular ultrasound. A history of past ocular trauma was present in 36, and skull trauma in 2 cases. There were 31 males and 7 females with an age range of 3 to 48 years. Patients over 50 years of age were excluded from this study to preclude confusion between senile and traumatic cataract. The patients had no other causes of cataract. The onset of injury ranged from 1 day to 23 years. Patients with a history of remote trauma had not sought or neglected medical care because of socioeconomic problems. The types of trauma comprised penetrating and/or perforating in 18, blunt trauma in 18, and blunt or penetrating (undetermined) in 2 cases because of the remoteness of trauma. Sonography was performed by one Radiologist (M.A.K.) using Shimadzu (Tokyo-Japan), and Storz (Heidelberg-Germany) ultrasound units with a 12 MHz linear transducer, and a 10-MHz mechanical sector transducer. A silicone stand-off pad and/or a thick layer of sonographic gel placed over closed eyelids, were used with the patient in supine[3] or sitting position.[4]

Results

All of the patients except for one showed abnormal sonographic changes amounting to a total of 68 abnormal findings in 37 patients, given that some lenses showed more than one sonographic abnormality.

Setting an arbitrary cut-off point of three months the abnormal sonographic findings could be divided into the early and late changes.

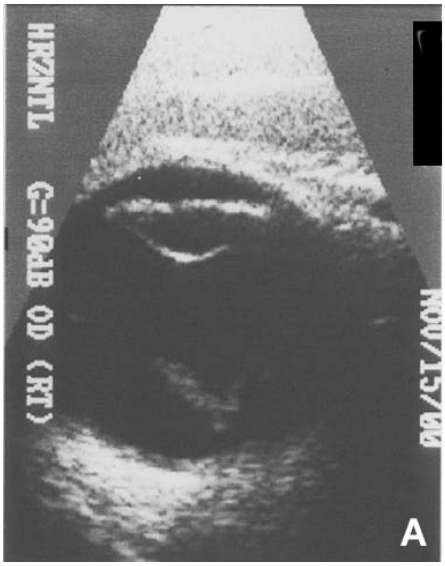
I- Early changes:

a) Echogenic surface without thickening.

In the normal lens on account of the specular reflection only the anterior and posterior lenticular poles are sonographically visible (Fig 1b). We found, however, that after mechanical trauma the entire surface would often become visible. This finding was seen in 21 patients (Fig 1a).

b) Thickened lens surface associated with increased echogenicity (Fig 2)

In 5 patients with recent trauma, the abnormal surface echogenicity extended somewhat deeper to the interior of the lens and appeared as a thickened surface.



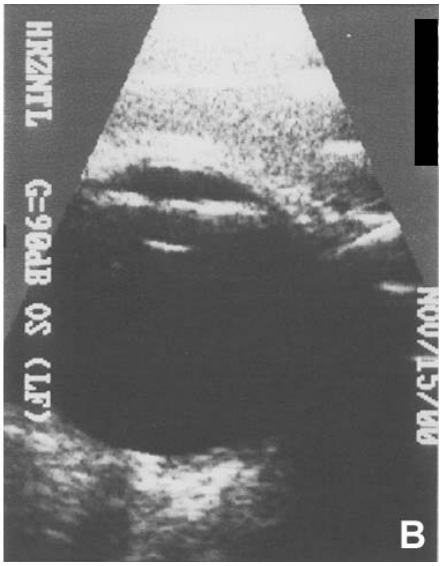


Figure 1: Ocular sonography of a 28-year old male, with a history of blunt trauma to the right eye 6 years earlier. He presented with clinical diagnosis of post-traumatic cataract of OD.

a) Note that the posterior surface of the lens reveals extended echogenicities.

b) In the normal left eye, shown for comparison, only the posterior lens pole is visible sonographically.

Figure 2: A 9-year old male with traumatic cataract, due to a penetrating trauma 6 days earlier.

Note apparently thickened and echogenic posterior surface of the lens. A flat echogenic line with posterior reverberation artifact is seen in the posterior part of the vitreous body from a foreign body.

Figure 3: A 37-year-old male, with penetrating trauma to the eye 4 days earlier, referring with traumatic cataract. Numerous echogenic foci are in the lens together with disruption of the posterior lens capsule and expulsion of lens material into the vitreous body. The AP diameter of the lens is increased causing protrusion of the iris into the anterior chamber.

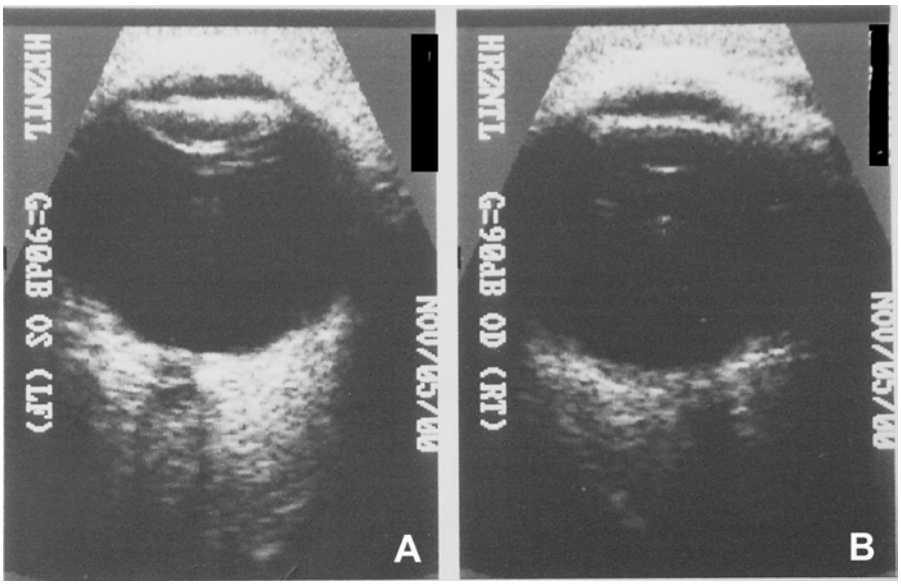


Figure 4: A 30-year-old male with a history of blunt trauma to his left eye 8 months earlier. Clinically he developed traumatic cataract of the left eye. a) Note the thin echogenic line in the posterior subcapsular area of left lens. b) Normal left eye shown for comparison, where the subcapsular area is echolucent.

c) Lens rupture (Fig 3).

A rupture was considered when there was a discontinuity along the lens capsule, which could be either with or without propulsion of the lens content into vitreous or anterior chamber.

d) Multiple fine echogenicities scattered throughout the lens (Fig 2).

The normal lens is totally anechoic, but in 2 of our patients multiple fine echoes were found scattered throughout the lens. These patients presented after 1 and 4 days after trauma. Although no rupture site was detected on sonography, the rupture was though present in surgery. Therefore this finding may be considered as a possible indirect sign of the lens rupture.

II- Predominantly Late changes:

a) Echogenic subcapsular area (Fig 4 a):

This finding was seen as a thin echogenic line in the lens periphery, and was observed in 6 of our patients. Four of which were seen after three months, and two patients after 2 days and 2.5 months following the injury, respectively.[1]

b) Echogenic cortex (Fig 5):

In two of our patients the full thickness of the lens cortex was echogenic. The patients presented as late as 4 and 9 years after the trauma.

c) Totally echogenic lens without posterior reverberation:

We encountered this finding in 10 patients. All patients had a history of trauma in excess of 7 years. Three had normal, and the remainder showed increased or decreased lens thickness. In addition, three of these lenses also had posterior reverberation artifact.

d) Hyperechoic lens with posterior reverberation artefact (Fig6):

It was seen in 3 patients. Ages of the trauma were given as 8, 13, and 15 years. This finding probably occurs because of the looping of the ultrasound between two parallel and markedly echogenic lens capsules.

III- Changes in the shape of the lens seen both in early and late stages:

a) Irregular lens surfaces without visible rupture:

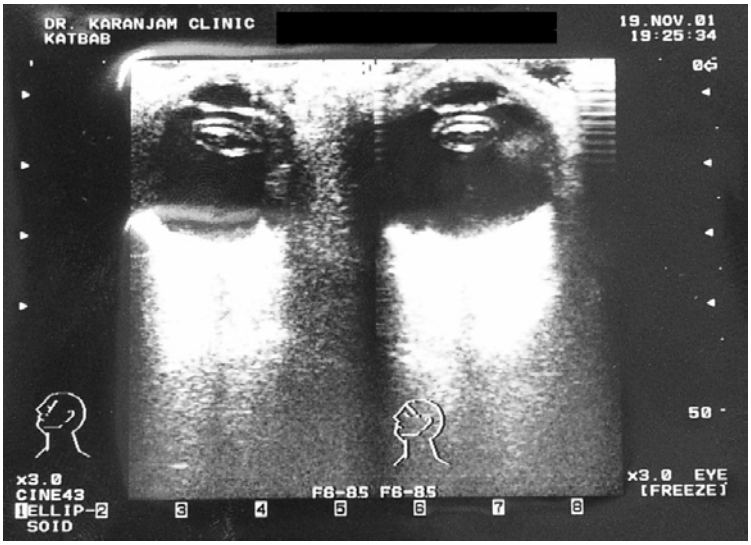


Figure 5: Traumatic cataract of the left eye with loss of vision following a blunt ocular trauma 9 months earlier. Note the presence of echogenicity in the cortex.

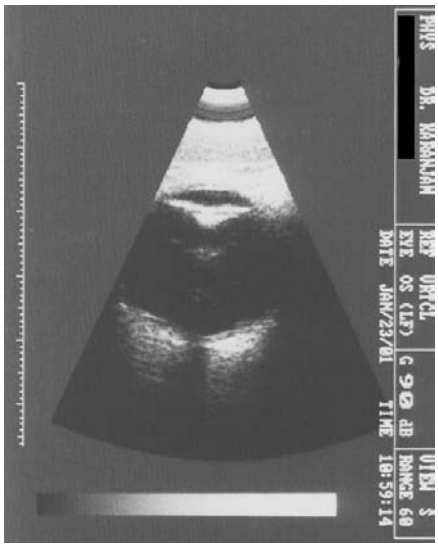


Figure 6. A 22-year-old male, with a history of blunt trauma to the eye 6 months earlier, referring for sonography with clinical diagnosis of traumatic cataract. Note that the lens is thin and hyperechoic, and posterior reverberation artifact is visible.

This finding was seen in 5 of our patients. While three patients had a history of trauma of less than 3 months, in the remaining 2 patients the event was dated 7 years earlier. This change probably occurs due to dehydration of the lens.

b) *Alteration in AP diameter*:

1- Increased AP diameter (Fig 3): Two patients; 1 day and 12 years following the trauma.

2- Decreased:

a) Mildly decreased (Fig 7): 2 patients; 7 and 75 days following trauma seen as an early finding.

b) Flattening of the lens (membranous cataract) (Fig 8): It was observed in 6 patients; one after 2 days, and others after 10 years, and thus a late finding.

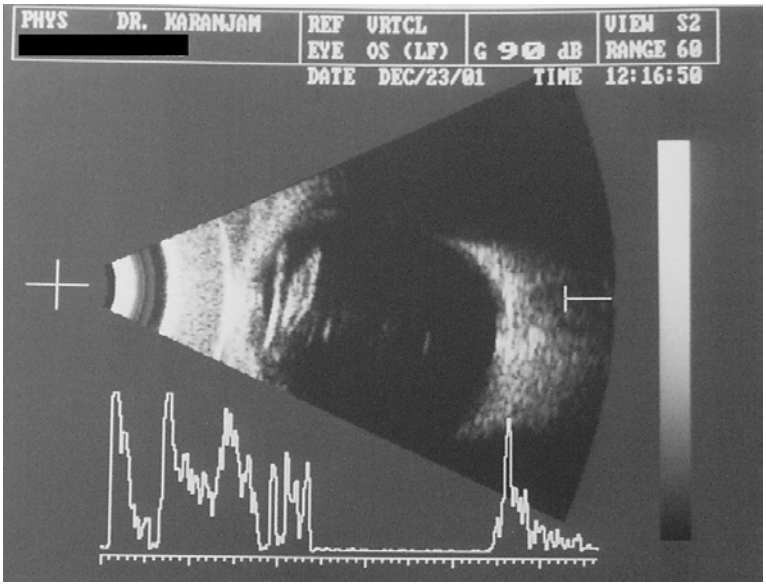


Figure 7. Patient presenting with clinical diagnosis of traumatic cataract and a history of blunt trauma to the eye 8 years earlier. The lens is sublaxated[3] and the .AP diameter is decreased.

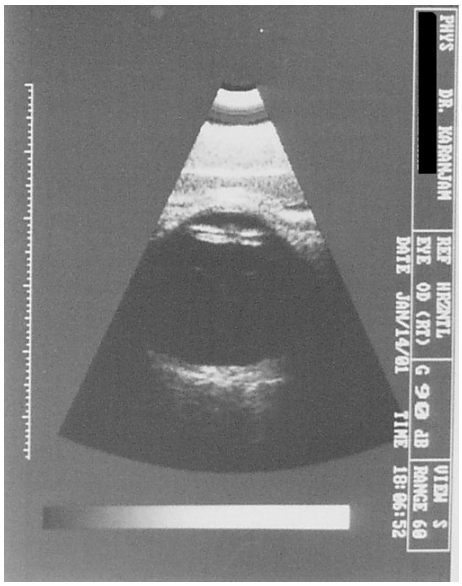


Figure 8. A 17-year-old female presenting with clinical diagnosis of traumatic cataract of right eye, and a history of blunt trauma to the eye 9 years earlier with loss of vision since that time. The lens is seen as two thin echogenic lines posterior to the iris.

Discussion

The thickness of the lens is approximately 4-5 mm in adults. The lens capsule is a basement membrane. Mild thickening of the structure can be associated with pathologic proliferation of lens epithelium, or chronic inflammation of the anterior segment.[1,8]

The most common abnormality involving the lens epithelium is posterior subcapsular cataract, which is often associated with cortical degeneration and nuclear sclerosis.[1,5] Chronic vitreal inflammation, ionizing radiation, and prolonged use of corticosteroids can cause cataract undistinguishable from those seen as a result of aging.

Interruption of the lens capsule strongly stimulates epithelial proliferation, and can occur in post-traumatic cataract.

In the normal lens sonography only the anterior and posterior poles of the lens are defined sonographically.[3,4] (Fig. 1b), however when the whole surface becomes visible and echogenic (Fig 1a) it ought to be considered abnormal. This was the most frequent abnormal finding in our study.

Presence of a uniformly echogenic lens with posterior reverberation artifact, and marked thinning of the lens follows a chronic course, and is usually seen months or even years after trauma.

Rupture of the lens is important since it may give rise to immune-mediated granulomatous inflammation (phacoanaphylactic uveitis/endophthalmitis), and occurs days to weeks after trauma[1,6]. The lens is normally echolucent and any changes in its normal texture may lead to multiple scattered echogenicities on sonographic examination and could be an indirect sign of lens rupture.[9]

When the AP diameter of the lens is increased it may block the pupil, displace the iris anteriorly and cause a secondary angle-closure or phacomorphic glaucoma[8], which constitutes an emergency situation.

Lens deformity is caused by capsular laceration, or dehydration of the lens.[7]

Echogenic cortex is seen when the cortical area of the lens is echogenic, leaving the nucleus echolucent.

Fine echoes within the lens when present in the early period post-trauma is almost always associated with lens rupture. Further studies are needed to determine whether this change could be used as an indirect sign of lens rupture.

It should be noted that the presence of the aforementioned five late sonographic changes in the early post-traumatic phase (less than 3 months) in persons younger than 50 years of age, can indicate that the etiology of the cataract is most probably unrelated to the present trauma. This may have important implications in forensic medicine. Furthermore, the presence of multiple fine echoes scattered throughout the lens could be used as an indirect sign of lens rupture, as this diagnosis greatly influences the pre-operative surgical planning.

Conclusion

Normal lens sonography and twelve types of abnormal sonographic findings were observed in these cases. Five of these changes were found to be early onset, and the other five were the late onset changes. These early and late findings could be used as predictive factors in relation to the age of the trauma, as well as reliable criteria in forensic medicine. One of the early findings is highly suggestive of lens rupture when the rupture site is obscured on slit lamp examination.

References

1. Spancer WH, ed. Ophthalmic Pathology: An Atlas and Textbook, 4th ed. Philadelphia: WB Saunders Co. 1996: 393-416.
2. Boorstein JM, Titelbaum DS, Patel Y, et al. CT diagnosis of unsuspected traumatic cataracts in patients with complicated eye injuries: significance of attenuation value of the lens. Am J Roentgenol. 1995 Jan; 164(1):181-4.
3. Munk P.L., Vellet A.D., Levin M. et al. Sonography of the eye. AJR 157:1079-1086, November 1991.
4. Erinquez G., Gil-Gibernau J.J., Garriga V. et al. Sonography of the Eye in Children: Imaging findings. AJR 1995; 165:935-939
5. Fielding J. A, Ultrasound of the Eye and Orbit in: David Sutton 6th ed, Textbook of Radiology and Imaging, Churchill Livingstone 1998.
6. Lens Induced Uveitis: p.60, Lens and Cataract, American Academy of Ophthalmology, LEO 1996-1997.
7. Lens in Fundamentals and Principles of Ophthalmology, p.72, American Academy of Ophthalmology, LEO 1998-1999.
8. Phacomorphic glaucoma: p. 61, Lens and Cataract, American Academy of Ophthalmology, LEO 1996-1997.
9. M.M. J. McNicholas, D.P. Brophy, W.J. Power,Ocular Sonography AJR 1994:163:921-926