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"ULTRASOUND BIOMICROSCOPY IN PATIENTS WITH OCULAR TRAUMA AND ITS INFLUENCE ON MANAGEMENT"

Ophthalmology

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ABSTRACT

Introduction: Ultrasound biomicroscopy (UBM) allows a detailed imaging of the anterior segment up to 5 mm depth and resolution of 50micron by using high-frequency (35 MHz) transducers.This noninvasive technique enables us to visualize cornea, sclera, angle structures, iris, lens, ciliary body, peripheral choroid, and anterior vitreous even in the presence of opaque media and provides detailed two-dimensional grey scale images. UBM can also detect small foreign bodies of various compositions, including those missed by computed tomography (CT) or B-Scan ultrasound (US).

Aim: The aim of this study is to present common UBM findings of eyes with a history of mechanical ocular trauma and to compare these findings according to the type of the trauma.

Material and Methods: Patient attending the outpatient upgraded department of ophthalmology and Emergency dept. with history of ocular trauma M.G.M.M.C. & M.Y.H. Indore were included in this study. This observational Study was done in a period of 12 months (March 2015 to February, 2016). A total of 50 patients with ocular trauma were included in this study

Result: UBM is especially superior to other methods in the evaluation of the zonular status, angle recession, PCR, cyclodialysis and the detection of small superficial, and intraocular foreign bodies. So UBM was found to be better tool in diagnosing zonular deficiency ,PAS,PCR, angle recession and small IOFB which was missed by other clinical and radiographic investigations

Conclusion: As a safe and noninvasive technique, UBM can be used in cases with closed-globe injuries, healed perforated corneas and also in cases with open-globe injuries when necessary. Other than being safe and noninvasive, greater accuracy and ease of performance are its advantages over conventional methods. However, being limited with only the anterior segment evaluation is the main disadvantage of UBM in evaluating traumatized eyes.

KEYWORDS

Ultrasound Biomicroscopy (ubm), Ocular Trauma, Pcr (posterior Capsular Rent), Iofb (intraocular Foreign Body).

INTRODUCTION

Ocular trauma has now gained the attention as a major cause of visual morbidity. It is an important preventable public health problem and an important cause of mono-ocular blindness worldwide.Ocular trauma may cause various anterior segment pathologies resulting in visual impairment or loss, such as Hyphema, Iridodialysis, Cyclodialysis, Angle Recession, Rupture of the Anterior Lens Capsule, Lens Displacement, Zonular Dialysis, Posterior capsular rent and Intraocular Foreign Body.

A meticulous evaluation and appropriate treatment of the traumatized eye are crucial in preventing visual impairment or loss because of ocular trauma. However, evaluation of these pathologies by clinical eye examination alone is often limited by trauma-related media opacities, hypo tony, and distorted anatomy. Ultrasound biomicroscopy (UBM) is a high frequency, high-resolution technique developed by Pavlin, Sherar and Foster in Toronto in 1980.

Ultrasound biomicroscopy (UBM) allows a detailed imaging of the anterior segment up to 5 mm depth and resolution of 50micron by using high-frequency (35 MHz) transducers.

This noninvasive technique enables us to visualize cornea, sclera, angle structures, iris, lens, ciliary body, peripheral choroid, and anterior vitreous even in the presence of opaque media and provides detailed two-dimensional grey scale images. UBM can also detect small foreign bodies of various compositions, including those missed by computed tomography (CT) or B-Scan ultrasound (US).

The aim of this study is to present common UBM findings of eyes with a history of mechanical ocular trauma and to compare these findings according to the type of the trauma.

MATERIALAND METHODS

Patient attending the outpatient upgraded department of ophthalmology and Emergency dept. with history of ocular trauma M.G.M.M.C. & M.Y.H. Indore were included in this study. This observational Study was done in a period of 12 months (March 2015 to February, 2016). A total of 50 patients with ocular trauma were included in this study.

Figure 1 a. Reichert Reflex Ultrasound Bio-Microscope. b. UBM immersion eye shells designed to hold the eyelids open and provide adequate reservoir for the coupling agent.

Under topical anaesthesia, an eye cup filled with distilled water as a coupling medium will be inserted between the eyelids. An ultrasound biomicroscope with a 35 MHz scan transducer providing a tissue resolution of 50 m and a tissue penetration depth of 5 mm will used to perform the UBM examinations All anterior segment components including the cornea, sclera, episclera, anterior chamber, anterior chamber angle, iris, pupil, peripheral choroid, ciliary body, pars plana, lens, peripheral retina, and the anterior vitreous were examined. Complete examination was achieved with fine manual movements of the probe and also by asking the patient to look in different positions.

Positioning of the patient for UBM examination is to recline the patient to the supine position and place an anesthetic drop in the eye to be examined. A fluid immersion technique is necessary to provide the

stand-off distance required to view the anterior ocular structures. Specially designed immersion UBM scleral shells are most commonly used to hold the eyelids open and provide a reservoir for the coupling agent. Water is most easily used in the shells as a coupling agent; however, fluid loss and air bubble obstruction during the procedure can hinder the efficiency of the examination. Methylcellulose is a good alternative because it has low sound attenuation and greater viscosity, preventing fluid loss during the examination.

During UBM examination, the probe is placed directly over the anterior ocular structures to be imaged. Structures that are closest to the probe tip are at the top of the screen, those farthest away are at the bottom. The cornea, iris, and lens can be imaged in any plane. The conjunctiva, anterior sclera, ciliary body, and ora can be imaged by adjusting the patient's gaze 180° away from the clock hour of interest. The top of the UBM display screen corresponds to the front of the transducer. There is a marker along the side of the probe that indicates the movement of the transducer in the same plane as the marker. The far left of the display screen corresponds to the area at the top of the transducer movement and the far right of the display screen corresponds to the bottom of the transducer movement.

Axial scans

The axial scan is obtained by placing the probe perpendicular to the cornea directly over the pupil. The resulting image shows the cornea and central iris on the left of the display screen, the central cornea and pupil in the center, and the cornea and central iris 180° away from the probe marker on the right. The probe marker is always oriented towards the superior or nasal hemispheres. The axial scan is ideal for accessing the anterior chamber depth and the orientation of displaced or tilted intraocular lenses.

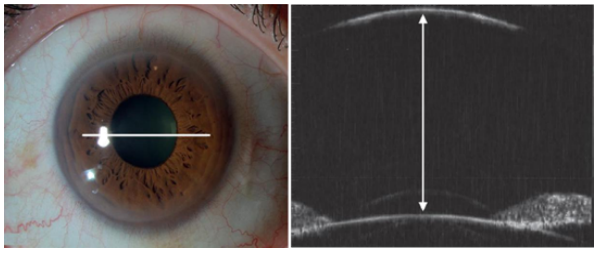

Figure 2 Axial scan. Slit lamp photograph of the anterior segment of the eye Showing the plane of an axial horizontal scan. The probe is placed perpendicular to the cornea directly over the pupil with the probe marker facing 3 o'clock (A). Corresponding UBM image showing the cornea at the top of the display, and the pupil and iris at the bottom. The scan is labeled an axial horizontal scan, AXH, which is ideal for assessing the anterior chamber depth (B, line).

Radial (longitudinal) scans

The radial scan is obtained by placing the probe perpendicular to the limbus with the marker towards the pupil. The left side of the display screen corresponds to the cornea and central iris, while the right side corresponds to the limbus and sclera (Figure 3). The longitudinal scan is the most common scan used in UBM examinations. The anterior angle is well imaged and the scleral spur easily identifiable. Angle closure can be detected, narrow angles measured and ciliary body orientation evaluated with this technique.

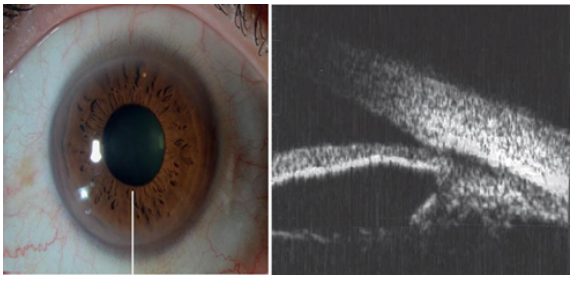

Figure 3 Radial (longitudinal) scan. Slit lamp photograph of the anterior segment of the eye showing the plane of a radial scan. The probe is placed perpendicular to the limbus with the marker towards the pupil at 6 o'clock (A). Corresponding UBM image showing the cornea and central iris on the left side of the display, and the limbus, ciliary body, and sclera on the right. The scan is labeled a longitudinal scan of 6 o'clock, L6 (B).

The transverse scan is obtained by placing the probe parallel to the limbus over the central iris at the clock hour of interest. The probe marker oriented towards the superior or nasal hemispheres. The resulting display image shows a section of the cornea and central iris of approximately 20°. To image peripheral structures, the probe can be then shifted posteriorly towards the fornix to image the peripheral iris, ciliary body processes, pars plana, and ora. The scans are labeled according to the clock hour examined. The transverse scan is ideal for the evaluation of the lateral extent of iris and ciliary body masses and for the evaluation of ciliary body processes **(Figure 4)**

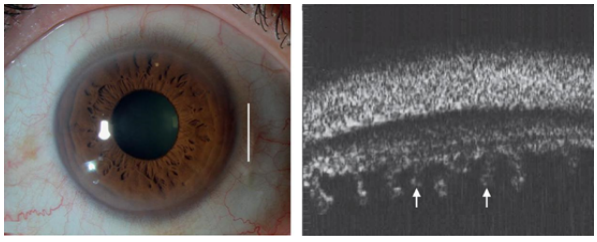

Figure 4. Peripheral transverse scan. Slit lamp photograph of the anterior segment of the eye showing the plane of a transverse scan. The probe is placed over the sclera slightly posterior and parallel to the limbus (A). Corresponding UBM image showing the ciliary body processes (B, arrows).

DISCUSSION & RESULT

In this study we have included patients of 5- 90 years of age and Most of the patients were in the age group of 26-35 years (38.70% open globe injury, 23.80% close globe injury) followed by 16-26 years of age. Studies done by Pandita A, Merriman M.et al Waikato, New Zealand and found that highest number of ocular trauma was seen in age group 15-20 (11.5%).

In our study Majority of the cases were **males accounting for 80.64%** whereas females are accounting for 19.35% in open globe injury. In close globe injury, male accounting for 66.66% and female accounting for 33.33% of total cases. Studies done by Pandita A, Merriman M.et al Waikato, New Zealand and found Men had higher rate of ocular trauma than women (74% vs 26%,). These finding were consistent with present study and predominant involvement of males were seen.

Workplace injuries was the commonest cause of injury in both open and closed globe account for 32.69% of patients, which were followed by sports injuries and home accidents. Studies done by Pandita A, Merriman M.et al Waikato, New Zealand The most frequent causes of eye injuries in men were related to outdoor activities (25.9%) and work (20.7%). In women, outdoor activity was also the highest cause (10%). In this study we found work place injuries were most common followed by sports injury and home accident which were more common in children.

Visual acuity loss seen in both open globe and closed globe and we found that in open globe injury there is severe loss of vision as compared to closed globe injury Rushik B. Patel, Parul M. Danayak found. Visual acuity assessment was done at the time of presentation. Majority of the patient with close globe injury had moderate visual loss (45%) whereas severe visual loss was seen in 25%. In open globe injury group, 60% of patients had severe visual loss

UBM, being a method that allows subsurface imaging of ocular structures at microscopic resolution, can be used for different purposes in the eyes exposed to trauma. UBM utilizes high frequency sound waves (35 MHz) with penetration of 5 mm into tissues, provides a tissue resolution of 50 μ.

In our study, UBM examination was able to identify **zonular dialysis** in 38 patients, whereas clinical examination was able to identify zonular dialyis in only 11% patients. UBM was far superior in identifying and localiing areas with zonular defects (in clock hours) than clinical examination. In cases having fewer clock hours of zonular dialysis, clinicaexamination may be equivocal, resulting in under-diagnosis of zonular dialysis. Zonular status is an important issue in deciding for the surgical technique that will be used. Although observing signs of increased lenticular mobility, such as phacodonesis and iridodonesis in slit-lamp examination can imply a zonular defect, the nature and extent of this defect cannot be correctly visualized.

Table -1. UBM and Slit Lamp Findings in Traumatic Eyes

	UBM	SLIT LAMP
Zonular dialysis	20	8
Angle recession	14	5
PAS	8	3
PCR	8	1
Lens dislocation	9	6
Iridodialysis	9	7
IOFB	4	1
Ruptured ant lens capsule	5	4
Hyphaema	9	9
Iridocorneal adhesions	8	8
Posterior synechiae	5	5
Anterior vitreous Herniation	2	2

Table -2. UBM finding of open globe injury.

	UBM	SLIT LAMP
Zonular deficiency	10	4
PAS	8	3
Iridocorneal adhesions	8	8
Lens dislocation	6	3
Iridodialysis	6	4
Angle recession	6	2
Ruptured ant lens capsule	4	3
Hyphaema	4	4
Posterior capsular rent(PCR)	4	0
IOFB	3	1

Table -3. Findings of closed group injury

Findings on ubm	UBM	Slit lamp
Zonular dialysis	10	4
Angle recession	8	3
Posterior synechiae	5	5
Hyphema	5	5
Iridodialysis	3	3
Position of lens(subluxated lens)	3	3
PCR	4	1
Anterior vitreous	2	2
Herniation		
Cyclodialysis	1	0
Focal rupture of anterior capsule	1	1
IOFB	1	0

Table -4. UBM Findings in pt. of Traumatic Cataract

	No. of patients(n=23)
Subluxated lens	6
Zonular dialysis	12
Anterior capsule rent	4
PCR	6
Viterious Herniation	2

UBM enables an accurate determination of the presence and the amount of zonular defects, particularly when appropriate techniques are used. Studies carried out by Ozdall et al. have shown that zonular deficiency was the most frequent finding in blunt ocular injury and is far underestimated by clinical examination alone. Prompt identification of the site and extent of zonular dialysis prior to the surgery helps the surgeon to plan and modify the surgical technique appropriately. Also in a study performed by Pavlin et al *trauma* was the most commonly identified cause of zonular defects.

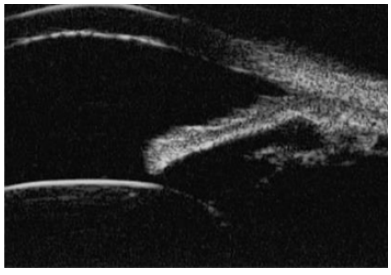

Figure No. 5 UBM Image Of Zonular Dialysis

In Open globe injury, **PAS** were present in (8 eyes 15.38%) of patients. More than half of the patients had PAS in >6 clock h of angle of AC. PAS can give post-operative surprises in terms of raised IOP. So, pre-operative diagnosis of PAS is helpful in determining the surgery and pre-operative management. Open globe trauma has caused deformation of the anterior segment of the eye. UBM has given important clues for anterior segment reconstruction. Ozdal et al also found PAS in 8.9% of patient and we found in 15.38% of patients.

UBM, a device primarily designed to assess the AC angle anatomy, has an important role in assessing the damage to the angle structures following globe injury. In the present study, **angle recession** was identified in 26%, with half of the cases (50%) having <3 clock hours AR. Clinical examination tended to underestimate AR with 9.6% cases. Though clinical examination is equally good in the diagnosis of AR and cyclodialysis, it cannot be applied in traumatized eyes because of hazy media, anatomic distortion, and excessive hypotony. UBM probe attached with nose cone piece causes minimum pressure on the globe and can be used for accurate assessment of angle pathology that occurs due to trauma. Ozdal et al. compared the angle pathology between open and closed globe injuries and found that they are more common in patients with close globe injury.

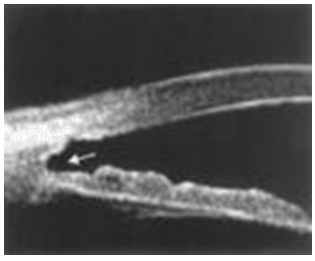

Figure No. 6 UBM Image of Angle Recession

Traumatic PCR has been studied extensively. In this study, we have studied the effect of trauma on posterior capsule. It was present in 15.38% of patients and when preoperatively diagnosed can help the surgeon to anticipate the complication during surgery. Isolated rupture is caused by acute stretching forces by blunt injury. If the PCR is large, lens hydration progresses rapidly, and intumescent cataract develops shortly after trauma that is why PCR is more detected in traumatic mature cataract.

Hyphaema is one of the commonest associations with ocular injury and it was found to be commonest ocular finding in our study also. Hyphaema is often associated with other anterior segment injuries like iridodialysis, traumatic cataract etc. hyphaema can be seen directly but to see associated findings UBM has to be used. Ozdal et al found hyphaema in 11.92% of patients of that we found in 17% of patients.

Iridodialysis, which is a disinsertion of the iris root from its insertion into the ciliary body, can also be identified with UBM. The occurrence of this pathology was more often in open-globe injuries (6eyes 19.35%), and in closed globe injury 3 eyes 19.04% almost equal in both injuries.. When the separation is small, it is of no concern either from a visual or a cosmetic viewpoint. However, when the separation is large, it may cause monocular diplopia, owing to a double pupil unsightly cosmetic effect produced by the distortion of the normal contour of the iris and pupil. So iridodialysis can be identified even in hazy media, hyphaema when slit lamp examination is not possible. Ozdal et al also found iridodialysis in their study more with open globe injury in 17.9% of patients.

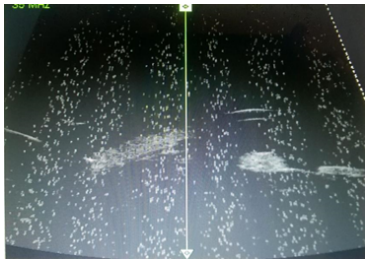

Figure no. 7 UBM image of iridodialysis.

Retained foreign bodies may lead to ocular morbidity, 1 eye of closed globe has complaint including inflammation and infection,and has glass foreign body detected on ubm and their detection is very important for the prognosis of the traumatized eye. Also three intraocular foreign body seen in open globe injury two of which cannot be identified on clinical examination.

Identification and localization of intraocular foreign bodies in eyes with opacified media or a distorted anatomy require a radiographic or ultrasonographic evaluation. IOFB made of wood or plastic can be confused with air on computed tomography (CT) scan. Magnetic resonance imaging is contraindicated in cases with suspected metallic IOFB. UBM has been reported to be helpful in detecting small and non-metallic foreign bodies. Although the 10 MHz B-Scan US is a very useful test after ocular trauma, high-frequency (50 MHz) ultrasound is reported to be much better in showing the exact location of the foreign body and the condition of surrounding tissues. Deramo E*T al* reported that UBM could detect small foreign bodies of various compositions, including those missed by CT or US. They recommended the UBM as a useful adjunct to CT and US in the detection and localization of small superficial and intraocular foreign bodies. Laroche *et al* suggested UBM as the preferred initial imaging step in searching for an occult foreign body. Barash *et al* emphasized that CT was insufficient to detect very small foreign bodies and their relationship to the surrounding tissue,compared with UBM. In our study,4 intraocular foreign bodies (7.6%) detected by UBM.

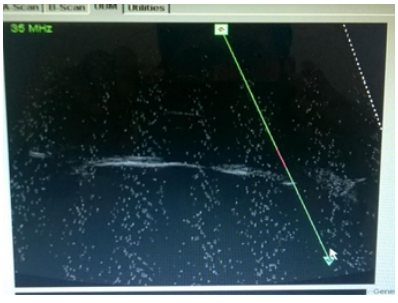

Figure No 8 UBM Image Of Foreign Body In Anterior Segment.

In this study we found Zonular dialysis in 52% of patients of traumatic cataract.PCR and subluxated lens present in 26.08% of patients.vitreous herniation were present in 8.69% of patients. Surgery for traumatic cataracts is a potentially complex procedure. Clinically, traumatic cataracts may be difficult to thoroughly assess due to the presence of other significant ocular damage including corneal scars, posterior synechiae, and vitreous hemorrhage. Frequently, surgery involves surprises regarding the integrity of the posterior capsule and zonular structure. Careful ophthalmic imaging using ultrasound technologies may result in finer pre-operative detail regarding lens support structures, and may therefore give the surgeon the advantage when planning surgery.

Imaging techniques most applicable to pre-operative evaluation include ultrasound biomicroscopy. Important modifications to technique that can be made depending on the integrity of lens support structures include adjustment of wound location, adjustment in the technique for cataract removal, and possible use of a capsular tension ring.

UBM was a contact investigation requiring a skillful operator. There was a risk of corneal injury and ocular contamination.Taken care by prescribing antibiotic drops post-examination. Use of the eye cup during UBM examination was very discomforting for the patient, and it could not be done in younger children and uncooperative patients.

As a safe and noninvasive technique, UBM can be used in cases with closed-globe injuries, healed perforated corneas and also in cases with open-globe injuries when necessary. For the evaluation of open-globe injuries, the eye cup should be inserted so that minimal pressure is placed on the globe and should be filled with sterile coupling medium. Other than being safe and noninvasive, greater accuracy and ease of performance are its advantages over conventional methods. However, being limited with only the anterior segment evaluation is the main disadvantage of UBM in evaluating traumatized eyes.

UBM is especially superior to other methods in the evaluation of the zonular status, angle recession, PCR, cyclodialysis and the detection of small superficial, and intraocular foreign bodies. So UBM was found to be better tool in diagnosing zonular deficiency ,PAS,PCR, angle recession and small IOFB which was missed by other clinical and radiographic investigations.

CONCLUSION

Demographic data revealed that Majority of the cases were males accounting for 80.64% Most of the patients were in the age group of 26-35 years (38.70% open globe injury, 23.80% close globe injury).Workplace injuries was the commonest cause of injury in both open and closed globe account for 32.69% of patients, which were followed by sports injuries and home accidents.

Visual acuity assessment of majority of the patients had severe visual loss which was more common in open globe injury. UBM was done in all patients. UBM was done at time of presentation in closed globe injury patients and after 1week of primary repair in patient with open globe injury.

The most common UBM findings of the traumatic eyes were zonular deficiency Clinical evidence of zonular dialysis as indicated by irregular anterior chamber (AC) depth and phacodonesis was present in only 15.38% when compared with UBM, which was able to detect zonular dialysis (from 3 clock hrs up to total loss of the zonules)in 38.46% of cases which was statistically significant.

Angle recession was clinically detected only in 9.6% of patients whereas UBM detected in 26.92%. PAS was clinically seen only in 5.7% of patients while UBM showed PAS in 15.38%

UBM had detected traumatic PCR in 15.38% patients while clinically it was present in only 1.9% of patients which was statistically significant. Lens subluxation (9 eyes, 17.30%), iridodialysis (9 eyes, 17.30%), IOFB 7.69%, iridocorneal adhesion (eight eyes, 25.80%), ruptured anterior lens capsule (4 eyes, 12.90%), and hyphema (nine eyes, 17.30%) could easily be identified clinically and on UBM.

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