Role of Sonography in Ocular Trauma: A Study

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Abstract

Aim: To study the various posterior segment pathologies after ocular trauma by Ultrasonography.

Introduction: The B-Scan Ultrasonography makes a pictorial representation for cross-section of the eye. Simple knowledge of anatomy combined with suspicious clinical mind makes it a wonder key to an ophthalmologist. It is a simple & quick method of imaging with no known adverse effect like that of CT or MRI. The real time, the advantage of kinetic visibility is also not there with other modalities.

Material and Method: This is a study of 100 cases of ocular trauma by B-Scan this study was conducted in department of Radiodiagnosis in Gajra Rara Medical College & Jaya Arogya Group of Hospital in close association with department of Ophthalmology.

Sample Size: 100 patients.

Summary and Conclusion: We find that B-Scan was extremely helpful in the assessment of the various posterior segment pathologies in ocular trauma & the new classification system was enormously helpful in the assessment of the prognosis.

1. INTRODUCTION

It is said that at the beginning of the creation there was darkness! God created light & he gave us eyes, to see and appreciate the beauty of the Universe. Eyes, the greatest gift of nature, are our most precious assets.

Hence, trauma to the eye has a very different dimension. Apart from the physical, it has profound impact on the mental, socioeconomic, & spiritual aspects of a person. Moreover it involves mainly the younger age group which makes a great loss to the society. Man's quest for understanding the effect of trauma to the eye, its mechanism, its pathology, consequences and complications to predict the outcome has made him run through different lanes of experiments. B-scan Ultrasonography stand out as one of the most powerful tools for its understanding. Posttraumatic opacifications of the media often makes the optical examination difficult for the treating surgeon. Moreover the patient is in agony & hence is unable often to open there for proper examination. Ultrasonography being a non-optical, non invasive technique is a valuable tool in such cases.

With the ascent of civilization, the ocular injuries are on the rise. Industry or battlefield, ocular trauma keeps maintained a disturbing percentage.

The B-Scan Ultrasonography makes a pictorial representation for cross-section of the eye. Simple knowledge of anatomy combined with suspicious clinical mind makes it a wonder key to an ophthalmologist. It is a simple & quick method of imaging with no known adverse effect like that of CT or MRI. The real time, the advantage of kinetic visibility is also not there with other modalities.

Besides, in our socioeconomic context, ultrasonography is more cost-effective too.

With the entry of ultrasonic biomicroscopy we have entered an era when even posttraumatic anterior segment pathologies can also be visualized accurately. It is now clear that a proper B-Scan evaluation of the eye prior to any intervention makes one able to assess not only the extent, nature & severity of the injury but also to formulate a surgical protocol. It also helps in the post surgical assessment of the ease for prediction of the final outcome.

Ultrasonography was first introduced as a diagnostic tool in the field of ophthalmology in the 1950s. In spite of this, most radiologists are unfamiliar with ocular anatomy and disease as depicted sonographically largely because ophthalmic sonography has principally been the domain of ophthalmologists. With the widespread availability of high resolution grey scale, real time sonography and high frequency transducers, a gradually increasing interest in ophthalmic sonography in radiologists has become evident.

The globe is the dominant structure in the anterior orbit, and its cystic structure and superficial position make it ideal for ultrasound examination. The anatomy of the eye is faithfully reproduced by high frequency ultrasound. When the light conducting media are opacified by corneal opacity cataract, hemorrhage or membranes, preventing clinical examination by ophthalmoscopy, ultrasonography is the most practical and rapid method of obtaining imaging of the posterior segment with its ability to identify the orbital walls, optic nerve, extra ocular muscles and orbital masses, ultrasound is a useful investigation in the evaluation of the orbit.

Ultrasonography has the advantage of non-invasiveness, rapidity and easy accessibility, and at energy levels used for diagnostic purposes, no adverse effects have been demonstrated.

Although Computed Tomography and Magnetic Resonance Imaging are invaluable in many orbital conditions, they cannot scan in real time, lack spatial resolution and have a considerable limitation when imaging the vitreous and retina, where ultrasound contributes more to the diagnosis of diseases. Other important disadvantages in the Indian set-up are the high cost and limitations of non-availability of CT and MRI as compared to sonography.

Hence this study will attempt to assess the role of sonography as an imaging modality of choice in the diagnosis of ocular and orbital disease,

2. AIMS & OBJECTIVES

Open Globe injury	Closed Globe Injury
Classification	Classification
Type	Type
A. Rupture B. Penetrating C. Intraocular foreign body D. Perforating E. Mixed	A. Contusion B. Lamellar Laceration C. Superficial foreign body D. Mixed

This was a study of 100 cases of ocular trauma by B-Scan conducted between October 2007 to October 2008. It was done with the following aims & objectives:

1. To study the various posterior segment pathologies after ocular trauma.
2. To classify the injuries with the aid of B-Scan evaluation & external examination as per the recent classification by the ocular trauma classification group to assess its usefulness in understanding the severity & prognosis of the cases.

He further classified injuries, into

A. Mechanical

- I. Concussions & contusions caused by blunt trauma.
- II. Penetrating & perforating injuries due to sharp objects.
- III. Effect of retained intraocular foreign bodies.

B. Non Mechanical

- I. Thermal injury
 - (a) Hypothermia
 - (b) Hyperthermia
- II. Electrical injury
- III. Radiation injury
- IV. Ultrasonic injuries
- V. chemical injuries
- VI. Stress injury
 - (a) Barometric stress
 - (b) Vibrational stress
 - (c) Acceleration stress

Another ocular injury classification scheme was proposed by **Stenberg & Pieramici et al. (Ocular trauma classification group) in 1997. [50]**

Grade	Grade
Visual acuity*	Visual acuity*
1. $\geq 6/24$	1. $\geq 6/24$
2. 6/15 to 6/30	2. 6/15 to 6/30
3. 6/30 to 5/60	3. 6/30 to 5/60
4. 4/60 with light perception	4. 4/60 with light perception
5. No light perception*	5. No light perception*
Pupil	Pupil
Positive: relative afferent	Positive : relative afferent
Pupillary defect present in affected eye	Pupillary defect present in affected eye
Negative : relative afferent	Negative : relative afferent
Pupillary defect absent in affected eye	Pupillary defect absent in affected eye
Zone	Zone
1. Isolated to cornea including the Corneoscleral limbus	1. External (limited to bulbar conjunctiva sclera, cornea)
2. Corneoscleral limbus to a point 5 mm posterior into the sclera	2. Anterior segment (involving structures in anterior segment internal to the cornea and including the posterior less capsule also includes pars plicata but not pars plana)
3. Posterior to the anterior 5 mm of sclera	3. Posterior segment (all internal structures posterior to the posterior lens capsule)

The terminologies used in the new classification has been defined by **Kuhn et al. [50]**

Proposed Ocular Trauma Terminology: Definitions of Ocular Traumatology Terms:

Term	Definition	Remarks
Eye Wall (Corneosclera)	Sclera and cornea	Although technically the wall of the eye has three coats posterior to the limb us, for clinical purposes, it is more feasible to restrict the term eye wall to the rigid structures of the sclera and cornea.
Closed globe	The eyewall (corneosclera) does not have a full thickness wound.	Caused by partial-thickness sharp force (lamellar laceration), blunt force (contusion), and superficial foreign body.
Open globe	The eyewall (corneosclera) has full thickness wound.	The cornea or sclera sustains through-and-through injury.
Rupture	Full thickness wound caused by a blunt object	The eyewall gives way under blunt force at it's weakest point, which may or may not be at the impact site.
Laceration	Full thickness corneal and/or scleral wound caused by a sharp object	The wound (globe opening_ occurs at the site of impact:
Penetrating	Single, full-thickness wound of the (corneosclera), usually caused by a sharp object	No exit wound has occurred
Intraocular Foreign body Injury	The retained foreign object causes A single entrance wound.	Technically a penetrating injury, but Clinical implications (treatment, prognosis)
Perforating	Two full-thickness wounds (entrance and exit) of the eyewall (corneosclera), usually caused by a missile	the two wounds are capused by the same agent.
Contusion	Closed globe injury resulting from a blunt object: injury can occur at the site of impact or at a distant site secondary to changes in globe configuration or momentary	No full-thickness eyewall injury.

	intraocular pressure elevation	
Lamellar	Closed globe injury of the eyewall	Partial thickness defect of bulbar
Iaceration	(Corneosclera) or bulbar conjunctive usually caused by a sharp object; the wound occurs at the impact site.	Conjunctiva or eyewall.
Superficial foreign body	Closed globe injury resulting from a projectile; the foreign body becomes lodged into the conjunctiva and/or eyewall (corneosclera) but does not result in a full thickness eyewall effect Grouped separately because of different	The force of impact may be blunt, sharp or both

3. METHOD & MATERIAL

This is a study of 100 cases of ocular trauma by B-Scan this study was conducted in department of Radiodiagnosis in Gajra Rara Medical College & Jaya Arogya Group of Hospital in close association with department of Ophthalmology.

High resolution, grey scale, real time imaging of the eye was done with ultrasonography machine using high frequency (7.5 MHZ) probe.

The study was done to understand various posterior segment pathology of eyes due to ocular trauma.

3.1. Criteria to Select Case are

- (1) Any case of blunt ocular trauma with open or closed globe injury.
- (2) Any case of penetrating or perforating ocular trauma with or without intraocular foreign body.

3.2. Observations

Table1. Distribution of Cases according to Sex off the Patients

Sex	Number of Cases	Percentage
Male	86	86%
Female	14	14%
Total	100	

The above table shows the distribution of cases according to sex of the patient. 86% of the cases were males & 14% cases were females. The male : female ratio was found to be 6.14:1.

Table2. Distribution of Cases According to the Age and Sex of the Patients

Age Group	Male	Female	Total
0-10 years	15	3	18
11-20 Years	17	1	18
21-30 Years	22	6	28
31-40 Years	22	1	23
41-50 years	4	1	5
51-60 years	0	1	1
61-70 years	2	1	3
71-80 years	1	0	1

A. Patient of all age & both sexes are included in this study.

B. Examination & Preparation of patient.

All the patients with suspected trauma were initially clinically examined in detail including recording visual acuity, torch light, examination assisted by slit lamp, direct & indirect ophthalmoscopy & intraocular pressure [where possible]

Patients with open globe injury were sent for B-Scan after repair of the wound with proper aseptic precaution.

After assuring the integrity f the patient was taken for examination under strict asepsis.

The procedure was explained to the patient to reduce anxiety. The patient was made to lie supine with full comfort.

81-90 Years	2	0	2
91-100 Years	1	0	1
Total	86	14	100

This table shows that 87% cases were is less than forty years, age group of whom 76 were males & 11 were females. 51% of the cases were between 21-40 years. Age group. 26% cases were of less than 15 years of age. Average age of our patients was 26.7 years.

Table3. *Distribution of Cases According to the Class of Injury*

Class of injury	Number of cases
Open globe injury	44
Closed globe injury	56
Total	100

44% patients were of open globe injury & 56% of cases were of closed globe injury. Ratio between closed globe injury & open globe injury was 1.27:1.

Table4. *Distribution of Cases According to Type of Injury* **Open Globe Injury**

Type	No. of cases	Percentage
Penetrating	16	36.4
Rupture	14	31.8
Intraocular Foreign body	19	22.8
Perforating	2	4.5
Mixed	2	4.5
Total	44	100

Among the 44 cases of open globe injuries, 36.4% cases were of penetrating type & 31.8% cases were of ruptures.

Closed Globe Injury

Type	No. of Cases	Percentage
Contusion	39	69.9
Superficial Foreign Body	6	10.7
Lamellar laceration	2	3.6
Mixed	9	16.1
Total	56	100

Among the 56 cases of closed globe injuries, maximum were of contusion type i.e. 69.9% & 16.1% were of mixed types.

Table5. *Distribution of Cases According to Grade of Injury*

Open globe Injury

Grade	No. of Cases	Percentage
1.	0	-
2.	0	-
3.	2	4.5
4.	24	54.5
5.	17	38.7
Uncooperative	1	2.3
Total	44	100

Among the open globe injuries, 54.5% cases were of grade 4 & 38.7% cases were of grade 5.

Closed Globe Injury

Grade	No. of Cases	Percentage
1	5	8.9
2	6	10.7
3	8	14.3
4	31	55.4
5	2	3.6
Uncooperative	4	7.1
Total	56	100

In 5 cases the grading could not be done as they were too young to tell the visual acuity & were uncooperative. One 7 yr. child was mentally retarded & hence the visual acuity could not be

taken. 19% of all the cases had grade 5 vision. The ratio of patients having grade 5 among the two classes was 8.5:1.

Table6. Distribution of Cases According to the Eye Affected of the Patient

	RE	LE	BE	Total
Closed Globe Injury	25	27	4	36
Open Globe Injury	21	23	0	44

In 50% cases left eye was affected & in 46% cases right eye was affected. Both eyes were affected in 4% cases & all were with closed globe injuries by fire cracker.

Table7. Distribution of Cases According to the Zone of Involvement

	Zones	No. of Cases	Percentage
1.	Isolated to cornea including limbus	23	52.3
2.	Corneoscleral Limbus to a point 5 mm. posterior into sclera.	17	38.6
3.	Posterior to the anterior 5 mm. of sclera	4	9.1
	Total	44	100

Closed Globe Injury

	Zones	No. of Cases	Percentage
1.	Limited to conjunctiva sclera, cornea	8	14.3
2.	Anterior segment (structures internal to cornea, including the posterior lens capsule & pars plicata).	12	21.4
3.	Posterior segment (all structures posterior to posterior lens capsule) & pars plana	36	64.3
	Total	55	100

This table shows the distribution of cases as per zones denoted by the ocular trauma classification group.

In this study, in open globe injuries, maximum involvement was in zone I (52.3%).

Among the closed globe injuries, maximum cases had zone III involvement (64.3%).

Table8. Distribution of Cases to Show the Relationship between Grade and Zone of Injury

Grade	Open Globe Injury			Closed Globe Injury		
	Zone			Zone		
	I	II	III	I	II	III
1	0	0	0	3(37.5%)	0	2(5.5%)
2	0	0	0	1(12.5%)	1(8.3%)	4(11.1%)
3.	1(4.3%)	1(5.9%)	0	2(25%)	1(8.3%)	(13.9%)
4	18(78.3%)	6(35.3%)	0	2(25%)	7(58.4%)	22(61.1%)
Uncooperative	1(4.3%)	0	0	0	3(25%)	1(2.3%)

The above table shows the relationship between grades & zones of injury.

Among open globe injuries only 13.1% cases with zone I involvement had grade 5 visual acuity where as 58.8% patients with zone II

involvement & 100% cases with zone III involvement had the same.

Among closed globe injuries only 25% of zone I patients had grade 4 or worse visual acuity whereas for zone II & III they were 58.4% & 66.6% respectively.

Table9. Distribution of Cases Showing the Relationship between Grade & Type of Injury

Grade	Open					Closed			
	Penetrating	Perforating	Rupture	Mixed		Constusion	L.I.	SFB	Mx
1	0	0	0	0	0	3	0	2	0
2	0	0	0	0	0	5	0	0	1
3	0	0	0	0	2	5	0	2	1
4	11	0	8	0	6	24	1	2	4
5	4	2	6	2	2	2	0	0	0
Uncooperative	1	0	0	0	0	0	1	0	3
Total	16	2	14	2	10	39	2	6	9

Most of the injuries presented with grade 4 vision (56%), following by grade 5(8%). The most common cause of grade 5 vision was Rupture.

Table10. Distribution of Cases According to Nature of Injury

	Domestic	Occupational	Other	Total
Closed Injury	43	9	4	56
Open globe Injury	18	20	6	14
Total	61	29	10	100

61% of injuries were of domestic nature & 29% of cases were occupational with a ratio of 2.1:1.

Among the domestic injuries 70.5% cases were of closed globe type & 29.5% cases were of open globe type. The closed globe injuries were more common in domestic injuries. The ratio between closed & open globe injuries was approx 2.4:1.

Among occupational injuries, 69% cases were of open globe type & 31% were of closed globe type & their ratio was 2.1:1.

Among closed globe injuries, 76.8% of cases were domestic & 16% cases were occupational & their ratio was about 4.8:1.

Table11. Distribution Cases According to Presence of Relative Afferent Pupillary Defect

Relative Afferent Pupillary Defect

	No. of Cases	Percentage
Open	6	40%
Closed	9	60%
Total	15	

15 cases with relative afferent pupillary defect were noted, 9 with closed globe injuries & 6 with open globe injuries.

Table12. Distribution Cases with Relative Afferent Pupillary Defect According to Grade

Relative Afferent Pupillary Defect

	No. of Cases	Percentage
1	0	0
2	1	6.66
3	1	6.66
4	8	53.33
5	5	33.33
Total	15	100

The above table shows that 88.66% of cases with relative afferent papillary defect had grade 4 or worse visual acuity.

Table13. Distribution of Cases Showing the Time Interval between Injury & Presentation at Our Hospital

Open globe injuries

Time b/w I/H	Penetrating	Perforating	IOFB	Rup.	Mixed	Total
0-24 hrs	5	2	4	10	2	23
>24 hr=48 hrs	2	0	2	2	0	6
>48 hrs-7 days	6	0	0	2	0	6
>7 day=1 mth	3	0	4	0	0	7
1 mth.-6mths	0	0	0	0	0	0
>6 mths	0	0	0	0	0	0
Total	16	2	10	14	2	44

Closed globe injuries

Time b/w I/H	Contusion	Lamellar Laceration	Superficial Foreign body	Mixed	Total
0-24 hrs	10	2	6	5	23
>24 hr=48 hrs	0	0	0	0	0
>48 hrs-7 days	1	0	0	2	3
>7 day=1 mth	13	0	0	2	15
1 mth.-6mths	8	0	0	0	8

>6 mths	7	0	0	0	7
Total	39	2	6	9	9

The above table shows that about 58% of open globe injuries presented to the hospital within 48 hrs. of injury in comparison to close globe injuries (41.07%).

43.75% of the penetrating injuries, 100% of the perforating & open mixed type injuries, 60% of

intra ocular foreign bodies & 85.7% of ruptures presented within 48 hrs.

Compared to this, only 25.64% of the contusion injuries presented within 48 hrs.

Table14. Distribution of Cases as Per B-Scan Findings

Type of Injury	Traumatic cataract	Posterior dislocated	Subluxated lens	Vitreous membrane	Vitreous hemorrhage	FB	PV D	R D	Posterior sclera rupture	Endophthalmitis	Vitreous	Disorganized Globe	Phthisis Bulbi	Normal
Open Globe Injury														
Penetrating	10	0	0	1	5	0	0	1	0	4	1	0	0	0
Rupture	6	2	0	0	9	0	0	3	0	0	0	3	0	0
OFB	7	0	0	4	6	9	0	2	0	0	0	0	0	0
Perforating	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mixed	1	0	0	0	2	2	0	0	0	0	0	0	0	0

Closed Globe Injury

Contusion	18	1	3	16	8	0	5	2	0	0	0	0	1	8
Superficial	0	0	0	0	1	0	0	0	0	0	0	0	0	5
Foreign Body														
Lamellar concretion	1		0	0	1	0	0	0	0	0	0	0	0	1
Mixed	4	0	1	1	2	0	0	0	0	0	0	0	0	4
Total	47	3	4	22	22	11	5	10	2	4	1	5	1	18

In our series, the most common B-Scan finding was traumatic cataract (47%) & the most common posterior segment finding was vitreous hemorrhage (34%).

Most commonly traumatic cataract was found in contusion group of injuries (38.3%) followed by penetrating injuries (21.24%).

Posterior dislocated lens was found in 3% cases, 2 cases with rupture & 1 with contusion.

4 cases of subluxated lens were detected, all with closed globe injuries.

Vitreous haemorrhage was more common with open globe injuries than close globe injuries (about 1.83 times) approximately 26.47% of all cases of vitreous haemorrhage were associated with rupture followed by contusion (23.53%)

Vitreous membranes were detected in 22 cases, 70% cases of which were associated with contusion injuries.

5% posterior vitreous detachment were detected all with contusion injuries.

Table15. IOFB According to Site of Location & Type

Site of Location	Type		Total	%
	Metallic	Nonmetallic		
Anterior chamber	0	1	1	8.33
Lens	0	0	0	0
Vitreous	8	1	9	75

We found 10 cases of retinal detachment; 89 out of them (i.e. 80%) were with open globe injuries & 2(20%) with close globe injuries (all contusion type).

We could detect 2 cases of posterior sclera ruptures.

5 cases had total disorganization of globe 3 of them were ruptures with loss of intra-ocular contents in whom only complex echogenic collection were found & no structures could be defined. 2 cases of perforating injuries were also associated with disorganization of globe.

One case of phthisis bulbi was detected which was disorganization with intraocular calcification.

In 18 cases, all with closed globe injuries, posterior segment was found to be normal.

11 cases of intraocular foreign bodies were seen by B-Scan.

Retina	1	0	1	8.33
Choroid	0	0	0	0
Sclera	0	0	0	0
Optic No.	1	0	1	8.33
Total	10	2	12	

We found intraocular foreign bodies in 12 cases out of 100. In majority of cases they were located in the vitreous (75% cases). The foreign body in anterior chamber was visible from outside & hence did not need to be diagnosed by B-Scan. The foreign body embedded on the optic nerve head and retina were visible ophthalmoscopically too, after the vitreous hemorrhage cleared up.

In 58.3% cases the foreign bodies entered through cornea.

About 83.3% of the foreign bodies were metallic.

4. DISCUSSION

Our study of 100 cases of ocular trauma showed a definitive male preponderance (86%), which is in close association with that quoted by **Duke Elder** (85-90%) this may be because males are more involved in outdoor activities, games etc. The male: female ratio was found to be 6.14:1 whereas that quoted by **Jakobiec** [26] is 9:1.

In our study 87% cases were less than 40 yrs. Age & 51% belonged to the age group of 21-40 yrs. This matches with that by **Jakobiec** [26] who also quoted that majority of the patients of ocular trauma were below 40 yrs of age. High predominance of ocular trauma between 21-40 Yrs. May be because of the fact that this is the age of highest activity. 18% of the patients were less than ten yrs Old & 26% of the patients were less than 15 yrs. This is close the figure given by Seidelman (21.5%) & Landesberg (23.7%). The average age of our patients was 25yrs, which falls in the most productive age of life.

Closed globe injury in our observation was more common (56%) than open globe injuries (44%). This is comparable to the study by **Liggett et al** [35] who found higher incidence of closed globe injury in an urban population. The closed globe injuries were 1.27 times more common than open globe injuries on an overall basis.

Regarding the type of injuries, in the open globe group, penetration injury was the most common, closely followed by rupture (36.4% & 31.8% respectively). Contusion was found to be the most common type of closed globe injury (69.6%). Perforating injury was found in 4.5%

cases (That reported by **Muller Jensen** [36] was 4.4% in 1964.

In our study, blunt forces were responsible for majority of the injuries.

Grading was done as per visual acuity at presentation. **Sternberg et al** [57] found visual acuity to be the strongest predictor of visual outcome in ocular trauma. In our study 93.2% of the open globe injuries had grade 4 or worse vision. 19% patients on an overall basis had grade 5 visual acuity after injury. The ratio of grade 5 vision between open & closed globe injuries was & the most common cause of grade 5 vision was ruptured. This may be because of the fact that open globe injury causes more mechanical devastation, infection, chemical effects of foreign bodies & their thermal energies also may play a role. prognostically open globe injuries seemed to be worse. B- Scan was found to be immensely helpful to assess the cause of diminished vision in ocular trauma.

In our series we found that right eye was affected in 46% cases & left eye was affected in 50% of cases. It was interesting to note that in our study 4% cases had both eyes affected & all of them had closed globe injuries by firecrackers. All of them had superficial foreign bodies on the cornea. It may be possible that in blast injuries, it is difficult for the protective reflexes to come into play between the blast & the injury & hence the chance of involvement of both eyes is highest.

In our patients, 61% cases have domestic injuries & 29% have occupational with a ratio of 2:1 According to **Desai P. et al** [18], home was the most common place for serious eye injuries followed by work place, with ratio of 1.54:1. Interestingly closed globe injuries were 2.4 times more common than open globe injuries in domestic groups & open globe injuries were 2.2 times commoner than closed globe injuries among occupational injuries. Probably because of the force involved & the nature of objects were responsible for it. Conversely domestic injuries were 4.8 times more common than occupational injuries to cause closed globe injuries.

It was interesting to note that more open globe injuries presented to the hospital within 48 hrs. than closed globe injuries.

Distribution of cases according to zonal involvement showed that most of the open globe injuries involved zone I (52.3%). This is because cornea in the part always exposed to the outside world.

Further analysis showed that as the open globe injuries progressed from zone I to zone III, visual prognosis worsened. 13.1% of open globe injuries with zone I involvement had grade 5 vision, 58.8% with zone II involvement had the same & 100% of zone III injuries had grade 5 vision in our observation. In case of closed globe injuries, the progression from zone I to zone III involvement showed similar trends. 25% of zone I had grade 4 or worse, 58.4% of zone II & 66.6% of zone III involvement had the same. Relative afferent pupillary defect was diagnosed in 15% of cases. It has been reported by various authors as a gross test for retinal & optic nerve function & strong predictor of the visual outcome (**deJuan K et al [16]**). We found that 88.66% the patients with relative afferent pupillary defect have grade 4 vision. In closed globe injuries 64.3% had zone III involvement. B-Scan was extremely helpful in assessment of zonal involvement especially in closed globe injuries especially when they had hazy media. Our finding is in accordance with **Pieramici et al [50]** in this aspect. 60% cases of relative afferent pupillary defect were associated with closed globe injuries & 40% with open globe injuries, with a ratio of 1.5:1. In one case optic disc edema & in 3 cases optic atrophy was seen ophthalmoscopically. In the rest of the cases the posterior segment could not be visualized (73%). B-Scan was extremely helpful in the assessment of these cases. In one case a foreign body was found embedded on the optic nerve head. In another case the posterior segment was found to be normal in B-Scan but subsequent removal of traumatic cataract showed optic atrophy. In four cases, total retinal detachment & in five cases foreign bodies were located along with vitreous hemorrhage. The patient with optic disc edema subsequently developed optic atrophy. Hence we also found that relative afferent pupillary defect is a good prognostic indicator our finding was in agreement with **Ahmedieh et al [1]**.

In B-Scan of 100 cases of ocular trauma, traumatic cataract was the most common finding & this matches with the observation by **Das &**

Namperumalasamy [14] In our study we found the occurrence to be 47%. Traumatic cataract may not seem to be an important diagnosis by B- Scan but it is of seminal importance in case of hazy media i.e. corneal edema or hyphaema to formulate a management especially in cases of retained I.O.F.Bs, retinal detachments & for vitrectomy procedures.

In our study, contusion was the most, common cause of traumatic cataract (38.3%), followed by penetrating injuries (21.27%). In our study 46.1% of pure contusion injuries had traumatic cataract. This matches with the report given by Davison in 1936 that traumatic cataracts occur with high incidence even with minor concussions.

We found posterior dislocated lens in 3% cases. All the cases were due to blunt injuries (66.6% cases in ruptures & 33.3% in contusion.) Incidentally one of these cases was a high myopia (-1 5D). All these cases were advised removal of the lens.

Subluxated lens was found in 4% cases, all with closed globe injuries & 75% of them due to contusion. One of these cases had associated iridodialysis & vitreous herniating into the anterior chamber with secondary glaucoma & PVD. Glaucoma was managed & then the subluxated lens was removed & the iridodialysis was repaired. With aphakic glasses the patient improved to 6/36 in the injured eye after 6 weeks of surgery. Another case was found to have macular edema after surgery. Vitreous membranes were found in 22% cases, most of whom (72.7%) were found in contusion injuries in patients who presented late for ocular examination to the hospital. They may represent resolved vitreous haemorrhages or vitreous degeneration after trauma. Approximately 18.2% of vitreous membranes were associated with intraocular foreign bodies.

In our study, vitreous hemorrhage was the most common posterior segment finding in B-scan & its incidence was found to be 34%. **Das & Namperumalasamy [14]** in 1983 reported in their study, 43 out of 175 cases of ocular trauma i.e. 24.6% had vitreous hemorrhage, the second most common diagnoses after traumatic cataract in ocular trauma. This matches with our findings.

Kwong al [33] found an unusually high incidence (70%) of vitreous hemorrhage in their series of 71 cases.

Rupture, we found, was the most common cause of vitreous hemorrhage (26%) closely followed by contusions (24%). 64.7% cases of vitreous hemorrhages were found in open globe injuries & 2 times more common than in closed globe injuries. But blunt forces (including ruptures) were responsible for majority of cases of vitreous hemorrhage

Retinal detachment had high association with vitreous hemorrhage & in 90% cases of detachments, vitreous hemorrhagic finding, 66% of intraocular foreign bodies were associated with vitreous haemorrhage. **DeJuan et al [16]** also found vitreous haemorrhage as a poor prognostic sign in penetrating ocular injuries. Hence presence of vitreous haemorrhage in ocular trauma should make one suspicious about serious posterior segment pathologies eg. Retina) detachments, IOFB etc. In our set up we conservatively managed the simple vitreous haemorrhages & the ones with retinal detachments & intraocular foreign bodies were advised immediate vitreoretinal surgery. Follow up of these patients were not available.

Intraocular foreign bodies could be identified in 12% cases. Our finding matches to the similar finding by **Das & Namperumalasany [14]** (12% i.e. 22 of 175 cases). In our series 91% of the foreign bodies were diagnosed by B-Scan. In one case the foreign body was visible in the anterior chamber from outside & B-Scan was not needed to diagnose it.

In our study vitreous was the most common site of location of foreign bodies (75%). **Williams et al [60]** also found vitreous as the most common site of location of intraocular foreign bodies (60%). **Duke Elder [22]** quoted that 70% of the foreign bodies are found in the posterior segment. Cornea was the most common site of entry in our cases is similar to the finding noticed by **Williams et al [60] & Khani et al [31]**.

About 83% of intraocular foreign bodies were metallic which is comparable to the results by **Williams et al [60]** (90%). This may be because of the fact that metallic foreign body is usually sharp & have high penetrating velocity. About 25% of IOFBs were associated with retinal detachment & 58% were associated with vitreous hemorrhage. 34% of IOFBs were associated with grade 5 vision.

- Hence presence of intraocular foreign bodies was a bad prognostic factor found in our study. In two cases of perforating injuries, both due to

gunshots, there were entry wounds visible anteriorly. B-Scan showed total disorganisation of all intraocular details & posterior scleral rupture (double perforation) & collapse of the globe. CT-Scan demonstrated the pellets near the apex of the orbit & confirmed posterior scleral rupture. **Russell, SR et al [52]** reported that B-Scan could detect only 23% cases of scleral ruptures. Both these eyes were subsequently enucleated after primary repair. Occurrence of posterior vitreous detachment in our series was 5%. All the cases were associated with contusion injuries. **Kwong et al [33]** found them to be 7.04%. We found that 10% of our series had retinal detachment. **Kwong et al [33]** reported 31% of retinal detachments in their cases. 80% of the detachments were associated with open globe injuries & most of them had zone IT & III involvement. Rupture was found to be the most common cause (30%). Among the closed globe groups contusion was the only cause of retinal detachments. One case with severe Contusion injury reported within 1 day had retinal detachment & was operated for retinal detachment. His vision improved to 6/60 in the injured eye after retinal detachment surgery. The other case was a high myopia (-25D) with retinal detachment of long duration (5yrs.) & had total retinal detachment with proliferative vitreoretinopathy & no PL. 75% cases of open globe injuries with retinal detachment had grade 5 vision.

In the absence of prompt referral, retinal detachments in open globe injuries keep a bad prognosis, in the present circumstances.

Blunt trauma (including ruptures) were responsible for majority (50%) cases of retinal detachments in our observation & this matches to the finding by **Giovinazzo et al [24] & Goffstein et al [25]** who found the same to be 70-86%.

Posttraumatic endophthalmitis was present in 4% cases, all with penetrating injuries. In 75% of the cases the injury occurred through zone I & 25% had zone II involvement. All- zone I involvement injured the lens, in this way our observation is in agreement with that of **Thompson et al [58]** who found in their analysis, lens injury as a very significant risk factor for the development of endophthalmitis in - penetrating injuries. One case, an 11 yrs. old boy, had grade 4+ flare & cells & on B-Scan was found to have exudates in the anterior vitreous & traumatic cataract. Clinically it did not seem like endophthalmitis & the culture was negative.

So the case was graded as vitritis & was put on systemic & topical steroids until the inflammation abated & then was operated for traumatic cataract under steroid cover & was advised vitreous surgery under guarded prognosis. B-Scan was extremely helpful to us to assess & formulate the management of these case.

In our series endophthalmitis was found in 24% of the penetrating injuries **Brinton et al [8]** reported 2-7% of endophthalmitis in penetrating trauma. But rural back ground, initial negligence & poor referral facility found in all our cases were probably the main responsible factors for such a high incidence. Considering the same, our results were match able to that of **Boldt If C et al [9]** who reported 30% endophthalmitis among rural patients. Total 5% of cases had disorganization of globe. 3 cases were of rupture where there was expulsion of intraocular contents. In B-Scan these cases appeared as diffuse complex echogenic collection. Two cases of perforations also had similar findings. As the structures could not be separately delineated, we kept them as a separate category. One case of phthisis bulbi was noted in the context of contusion injuries of long duration. intraocular calcification & bone formation was noted in these case. 18 cases of closed globe injury had normal B-Scan finding in the posterior segment but none with open globe injuries. Hence we can see that in open globe injury some kind of posterior segment involvement is detectable in almost all the cases, whereas in closed globe injury 32% cases escaped any detectable posterior segment changes in B-Scan.

5. SUMMARY & CONCLUSION

This was a study of 100 cases of ocular trauma by B-Scan, conducted in the JAYA AROGYA GROUP OF HOSPITALS, IN CLOSE ASSOCIATION WITH DEPARTMENT OF OPHTHALMOLOGY, IN GAJRA RAJA MEDICAL COLLEGE GWALIOR.

100 cases of ocular trauma were chosen irrespective of age or sex & examined first clinically & then by B-Scan.

A 7 MHz probe was used for evaluation through closed lids & various pathological changes were noted. Injuries were classified on the basis of the external findings, visual acuity at the time of presentation & B-Scan findings as per the

classification suggested by the **Ocular trauma** classification group in 1997.

Our major conclusions have been as below;

- (1) Most victims of ocular trauma are young males of less than 40 yrs. age.
- (2) Closed globe injuries are more common than open globe injuries in our common day to say life.
- (3) Home was the most common place of ocular injuries.
- (4) Blunt forces are a major cause of ocular trauma.
- (5) Occurrence of the different posterior segment pathologies in B- Scan were:
 - Cataract 47%.
 - Vitreous hemorrhage 34%.
 - Vitreous membranes 22%.
 - IOFB:12%.
 - Posterior dislocated lens: 3%.
 - Subluxated lens; 4%.
 - Retinal detachments: 10%.
 - Posterior scleral rupture: 2%.
 - Posttraumatic endophthalmitis 4% (25% of all cases of penetrating injuries).
 - Disorganised globe — 5%.
- Phthisis bulbi : 1%.
- (6) In B-Scan study we found that in ocular trauma lens & vitreous are highly susceptible to damage. Traumatic cataract was the most common diagnosis followed by vitreous hemorrhage in ocular trauma.
- (7) In almost all cases of open globe injuries there is some pathology in the posterior segment.
- (8) Contusion injuries are the most common cause traumatic cataract.
- (9) Subluxated and dislocated lens, vitreous haemorrhage & membrane are most commonly found in injuries with blunt forces.
- (10) Presence of vitreous haemorrhage after ocular trauma (especially open globe injuries) carries higher risk of other serious damages to the posterior segment & a poorer prognosis.
- (11) B-Scan was found to be extremely accurate in the diagnosis & localization of intraocular foreign bodies, and their nature.

(12) Vitreous was found to be the most common site of location of intraocular foreign bodies.

(13) Most of the intraocular foreign bodies were metallic.

(14) B-Scan extremely helpful in the diagnosis of posterior scleral rupture.

(15) Traumatic retinal detachment carried a poor prognosis especially in open globe injuries.

(16) Untreated penetrating injury in rural set up with delayed referral carries a high risk of posttraumatic endophthalmitis as seen in four cases.

(17) The classification suggested by the ocular trauma classification group was found to be extremely useful by us. Some of our findings support this:

A. The concept of zones were extremely useful. In both open & closed globe injuries as the injury progressed from zone I to III, the visual prognosis worsened B-Scan was found to be extremely important in assignment of zones especially in closed globe injuries hazy media.

B. Visual prognosis (grade) at presentation was found to be a very strong predictor of visual outcome. Cases presenting with grade 5 (No PL) carried bad prognosis.

C. Presence of relative afferent pupillary defect carries a poor

prognosis as it denotes injury to optic nerve & retina.

D. Open globe injuries especially ruptures were associated with higher chance of bad prognosis.

In this way we find that B-Scan was extremely helpful in the assessment of the various posterior segment pathologies in ocular trauma & the new classification system was enormously helpful in the assessment of the prognosis.

BIBLIOGRAPHY

- [1] Ahmedieh H, Soheilian M, et al: Vitrectomy in Ocular trauma Factors influencing final visual outcome. Retina 13; 107-113, 1993.
- [2] Awschalom L. and Meyers SM : Ultrasoundography of Vitreal foreign bodies in eyes obtained at autopsy. Arch Ophthalmol 100; 979-980, 1982.
- [3] Baun G. and Greenwood I; the application of ultrasonic to Ophthalmology. II. Ultrasonic slit lamp in the ultrasonic Visualization of soft tissues. Arch Ophthal, 60; 263 - 279, 1958

- [4] Bronson N R : Techniques of ultrasonic localization and extraction of intraocular and extra ocular foreign bodies. Amj. Ophthalmol 60 ; 596 -603, 1965.
- [5] Bronson H. R II Nonmagnetic foreign body localization & extraction. Am. j. Ophthalmol 58 : 133(July) 1964.
- [6] Berinstein DM. et al. : Ultrasound biomicroscopic in anterior ocular trauma. Ophthalmic surg. Lasers 28 (3); 201 - 7, 1997
- [7] Barash D. et al.: Ultrasound biomicroscopic detection of anterior ocular segment foreign body after trauma. Am.J. Ophthalmol. 126 (2) L197 - 202, 1998.
- [8] Brinton GS, Topping TM, et al. Posttraumatic endophthalmitis Arch. Ophthalmol. 102; 547 - 550, 1998.
- [9] Boldt HC, Pulindo JS, Blodi CF, et al. : Rural endophthalmitis Ophthalmology 96 ; 1722 - 1726, 1989.
- [10] Coleman DJ & Trokel SI : A protocol for B. Scan & Radiographic foreign body localization Am.j. Ophthalmol 71,p 84 - 92, 1971.
- [11] Coleman DJ : reliability of ocular & orbital diagnosis with B-scan ultrasound, ocular diagnosis. Am.j. Ophthalmol. 73 516, 1972.
- [12] Coleman DJ, Jack R. L. Franzen L.A. : Ultrasonography in ocular trauma, AM.J. Ophthalmol., 75, 279-288, 1973.
- [13] Coleman DJ, Lucas BC, Rondeau MJ, Chang S : Management of intraocular foreign bodies. Ophthalmol 64, 1647-1657, 1987.
- [14] Das. T & Namperumalasamy P.: Ocular ultrasound in preoperative evaluation of posterior segment of the eye. Ind. J. Ophthal 31; 1022, sept. 1983.
- [15] Deramo et. Al. : Ultrasound biomicroscopy as a tool for detecting & Localization occult foreign bodies after ocular trauma. Ophthalmology 106 (2); 301-5, 1999.
- [16] DeJuan E, Sternberg P, Michels R : penetrating ocular injuries : type of injuries & visual result. Ophthalmology 90; 1318-1322, 1983.
- [17] Deramo et. Al. : The role of (ultrasound) biomicroscopy in ocular traumas Trans Am. Ophthalmol. Soc. 1998 (96) 355-365.
- [18] Desari P et al. : Epidemiology & implication of ocular Trauma admitted to hospital in Scotland. J. epidemiol. Community health 50 ; 436-441, 1996.
- [19] Duke elder S : system of Ophthalmology Vol. VI. P. 5717-5718, London : Henry Kimpton; 1954.
- [20] Duke elder S : system of Ophthalmology Vol. VI, (injuries) p. 5799. London : Henry Kimpton 1954.

- [21] Duke elder S : system of Ophthalmology Vol. Vol.- Xiv part-I London : Henry Kempton 1954.
- [22] Duke elder S : system of Ophthalmology Vol. Vol.- Vi, p. 6156, London : Henry Kempton 1954.
- [23] Foster BS et. Al. : Optic nerve avulsion, Arch Ophthal. 115 (5) ; 623-30, 1997.
- [24] Giovinazzo V. J. et Al. The ocular complication of boxing Ophthalmology 94; p. 587, 1987.
- [25] Goffdstein R, Burton TC: differentiation traumatic from non traumatic retinal detachment. Ophthalmology 89, 361-368 1982.
- [26] Jakobiec F. Text Book of Ophthalmology chap. 370, p 5179.
- [27] John Shammass H : Atlas of Ophthalmology Ultrasonography & Biometry 1St ed; p. 2, 1989.
- [28] JD wicks, Howe KS : Fundamentals of Ultrasonography Technique. Chicago, Year book medical publishers, Inc. 1983, page 1-3.
- [29] Jalkh AE. Et al. : Ocular ultrasound in vitreous haemorrhage. Ind J. Ophthal. 32; 106-108, 1984.
- [30] Jarett H. et al. ; Dislocation of the lens : a study of 166 hospitalized cases. Arch. Ophthalmol. 78 ; 289-296.
- [31] Khani SC, Mukai S : Posterior segment intraocular foreign bodies. Int. Ophthalmol. Clin 35-161, 1995.
- [32] Konstas P. : Diagnostic Ophthalmic. Ultrasound. Am. J. Ophthalmol 57; 453, 1982.
- [33] Kwong JS et al. : Real time sonography in ocular trauma Am. J. Ophthalmol 158; 179-182, 1992.
- [34] Lariche et al. : Ultrasound biomicroscopic localization & evaluation of intraocular foreign bodies. Acta Ophthalmol Scand. 76(4); 491-5, Aug 1998.
- [35] Leggett. PE et al. : Ocular trauma in an urban population: Review of 1132 cases Ophthalmology 97; 859-961, 1990.
- [36] Muller Jensen K : Klin Monatsbl. Augenheilkd 145; 754-758, 1964.
- [37] Mundt GH Jr. & Hughes WF Jr. : Ultrasonics in ocular diagnosis. Am. J. Ophthalmol. 41: 488-498, 1956,
- [38] Macoul KL : Dislocated lens simulating retinal detachment by ultrasonography. Arch. Ophthal. Vol. 80, page 724, 1968.
- [39] Minix MB & Jonathan D.W. : Dislocation of lens - Diagnosis by ultrasonography. JAMA, vol. 207, No. 7; p. 1354-1355, 1969.
- [40] Mehmound et al. Phthalmic surg. vol. 24 No. 2; 1993.
- [41] Oksala A. & Lehtinen, A. : Diagnostics of detachment of the retina by means of ultrasound, Acta Ophthalmol, 35; 461-467, 1957.
- [42] Ossoining KC : Standardised echography : basic principles, clinical applications & result Int. Ophthalmol. Clin 19; 127-210, 1979.
- [43] Ossoining KC, Bigar F., Kaefring SL, Mc Nutt. L : Echographic detection & localization of BB Shots in the eye & orbit Bibl. Ophthalmol 83: 109-118, 1975.
- [44] Ossoining KC : Standardized echography : basic principles, clinical application & results. Int. Ophthalmol. Clin 19 : 127-210, 1979.
- [45] Purnell EW : Ultrasonography in ophthalmological diagnosis. In Grossmann. CC ed : Diagnostic ultrasound, New York, 1965 Plenum Press.
- [46] Penner R. & Passmore J.W. : magnetic Vs. non magnetic intra ocular foreign bodies. Arch. Ophthalmol vol. 76, p. 676, 1966.
- [47] Peyman G. : Principles & Practice of Ophthalmology, Vol. III, (1st ed), P. 1451, 1987.
- [48] Pavlin CJ et al. : Clinical use of ultrasound biomicroscopy, Ophthalmology 98; 287-295, 1991.
- [49] Pavlin CJ, Foster FS : Ultrasound biomicroscopy - High freuency ultrasound imaging of the eye at microscopic resolution.
- [50] Pieramici DJ, Sternberg P. et al. : A system of classifying mechanical injuries of the eye (globe). Am. J. Ophthalmol. Vol. 123, p. 820-831, 1997.
- [51] Runyon TE & Penner R : Comparison of localization of orbital foreign bodies by radiologic & ultrasonic methods, Arch. Ophthalmol 81; 512-517. 1969.
- [52] Russell SR, Olsen KR, Folk JC : Predictors of scleral rupture & role of vitrectomy in severe blunt ocular trauma. Am. J. Ophthalmol. 103, p. 153, 1988.
- [53] Sarti DA : Diagnostic ultrasonography text & cases. Page 1-4.
- [54] Sutton : A textbook of Radiology & imaging. Page 1349-1371.
- [55] Shalka HW : Ultrasonic diagnosis of posterior lens rupture Ophthalmic surg. 8; p. 72-76, 1977.
- [56] Seawright A.A., Bourke R.D. et al. : Intravitreal cilia in phakic penetrating eye injury. Australian & New Zealand Journal of Ophthalmology 25(2) : 133-5, 1997.
- [57] Sternberg F, deJaun e et al. : Multivariate analysis of prognostic factors in penetrating ocular injuries. Am. J. Ophthalmol. 98; 567-472, 1984.

- [58] Thompson WS et al : Endophthalmitis after penetrating trauma : Risk factors & visual acuity outcomes. *Ophthalmology*, 102; 1996-1701, 1995.
- [59] White M.E. et al. Eye injury prevalence and prognosis by setting. *South Med. J.* 82, 151-158, 1989.
- [60] Williams DF, Mieler WF et al : Results & prognostic factors in penetrating ocular injuries with retained intraocular foreign bodies. *Ophthalmology* 95; 911-916, 1988.
- [61] Zakov. AN : Ultrasonographic mapping of vitreo retinal abnormalities. *Am. J. Ophthalmol* 96; 622-631, 1983.

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