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Original Article

Ophthalmology Section

Role of B-scan in Blunt Ocular Trauma: A Cross-sectional Study

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ABSTRACT

Introduction: Ocular trauma is a significant cause of unilateral vision loss, especially in developing countries. Proper assessment of ocular damage and prompt treatment initiation after the injury have a crucial impact on the final outcome. B-scan Ultrasonography (USG) plays an important role in detecting findings that may not be evident during clinical examination.

Aim: To assess the role of B-scan in blunt ocular trauma and to determine if B-scan provides any additional advantages over clinical examination.

Materials and Methods: A cross-sectional study was conducted from May 1, 2021 to April 30, 2022, at Hind Institute of Medical Sciences, Sitapur, Uttar Pradesh, India. Fifty consecutive patients with blunt ocular trauma, presenting with hazy or opaque ocular media or unexplained visual loss during clinical examination, were evaluated in the casualty and ophthalmology Outpatient Department (OPD). The frequency of lesions such as traumatic cataract, vitreous degeneration, and retinal detachment was assessed clinically and using B-scan USG. Anterior and posterior segment manifestations of blunt trauma, including traumatic cataract, vitreous haemorrhage, and retinal detachment, were evaluated clinically and with B-scan imaging. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 22.0, including frequency counts, percentage calculations, and Kappa's statistical analysis to correlate B-scan USG and clinical findings.

Results: Majority of patients (28%) were in the age group of 21-30 years. Workplace-related injuries, particularly agricultural injuries, were the most common cause of blunt ocular trauma (30%). Traumatic cataract (44%), vitreous degeneration (8%), vitreous haemorrhage (6%), and retinal detachment (4%) were the common clinical posterior segment findings. On B-scan USG, the most frequent findings were retinal detachment (30%) and vitreous haemorrhage (28%). Choroidal detachment was noted in 2% of cases. B-scan USG was more helpful in accurately diagnosing vitreous lesions and retinal lesions (52%, 30%) compared to clinical examination (16%, 6%).

Conclusion: B-scan USG emerged as a superior diagnostic tool for identifying posterior segment lesions, including vitreous, retinal, and choroidal lesions. Lesions such as retinal detachment and vitreous haemorrhage were more easily identified using USG, especially in the presence of hazy or opaque media. Therefore, B-scan USG should be considered an integral part of all ophthalmic set-ups dealing with trauma to avoid missing significant posterior segment pathologies.

Keywords: Diagnosis, Eye injuries, Retinal detachment, Ultrasonography, Visual loss

INTRODUCTION

Ocular trauma is an important cause of unilateral vision loss, particularly in developing countries [1]. Until the end of the last century, it accounted for approximately 1.6 million cases of blindness, 2.3 million cases of bilateral visual impairment, and 1.9 million cases of unilateral vision loss worldwide, as estimated by the World Health Organisation (WHO) [2]. The overall prevalence of trauma-related eye injuries is approximately 2-6%, with as many as 97% of cases resulting from blunt trauma. The annual incidence of ocular trauma is 9.75 severe eye injuries per 1,000 adults [3].

In India, the prevalence is higher in rural areas (61.94%) than in urban areas, and almost half of all reported injuries occur in people aged 6-25 years, as reported by Maurya RP et al., [4]. Trauma may result in various forms of ocular injuries, ranging from minor insults to major functional impairment. Blunt trauma causes ocular damage through the coup and contrecoup mechanism or by ocular compression [5,6]. Apart from obvious ocular damage, blunt trauma may result in long-term effects, necessitating a guarded prognosis and vigilant follow-up. Proper assessment of ocular damage and prompt initiation of treatment after the injury has an important effect on the final outcome.

In traumatised eyes, physical examination of the globe may be difficult because of surrounding periorbital soft-tissue swelling, associated injuries, or hazy ocular media such as corneal oedema, hyphema, secondary cataract, or vitreous haemorrhage, making a thorough clinical examination difficult [7]. In the presence of such factors, imaging is necessary to assess the extent of injuries. USG has emerged as a useful technique for detecting and delineating soft tissue abnormalities of the eye and orbit, regardless of intervening opacities or tissues. It provides ophthalmologists with an instantaneous look into an eye with opaque ocular media [8]. Early diagnosis of posterior segment pathologies with B-scan in cases of hazy media helps in deciding prompt and appropriate management, thereby improving visual prognosis.

The USG, which utilises ultrasound energy for diagnostic purposes, does not damage the eye tissues, and these examinations can be repeated several times without harmful side-effects. By means of USG, objective and detailed information regarding the anatomical localisation of the eye injury can be obtained. This study aimed to assess the role of USG in blunt ocular trauma and determine if it has any additional advantages over clinical examination, as not many studies have been conducted on the same in rural areas of Uttar Pradesh, India.

MATERIALS AND METHODS

This cross-sectional study was conducted from May 1, 2021, to April 30, 2022. 50 patients with blunt ocular trauma attending the Casualty and Ophthalmology OPD of Hind Institute of Medical Sciences, Sitapur, a tertiary care hospital in Uttar Pradesh, India

were evaluated. The study was conducted after approval from the Institutional Ethics Committee (IEC) (HIMS/RD/FA/23/15) and adheres to the tenets of the Declaration.

Inclusion criteria: Patients with a history of blunt trauma with either hazy or opaque ocular media or unexplained visual loss on clinical examination were included in the study.

Exclusion criteria: Patients with known anterior or posterior segment pathology, patients with penetrating and perforating injuries, seriously ill poly-trauma patients, and patients who did not give consent were excluded from the study. Young patients (<10 years) were not included in the study as they might not cooperate for B-scan sonography.

Sample size: A sample size of 50 was calculated using the formula:

$$n=(4\ pq)/l^2,$$

where n is the sample size, p is the prevalence which was 41.7% [9], q is 100-p, and l is the allowable error which is 15%. The confidence interval was taken as 95% with a level of significance of 5%.

Study Procedure

All patients with blunt ocular trauma meeting the inclusion criteria were enrolled in the study after obtaining written informed consent. Relevant history and demographic details were noted using a predesigned questionnaire. Detailed clinical examination (Annexure 1) was done including best corrected visual acuity, anterior segment examination using a slit lamp biomicroscope, and posterior segment examination by indirect ophthalmoscopy.

Visual acuity was graded as per the criteria described by the International Council of Ophthalmology meeting in Sydney 2002 as follows: normal visual acuity ≥6/6, mild visual loss 6/9 to 6/18, moderate visual loss 6/24 to 6/60, severe visual loss >6/60 [10].

Patients with visual loss, hazy or opaque media, or a poor fundus view underwent B-scan USG using a 10 MHz frequency. After the patient was comfortably situated in either a lying or sitting position with eyelids closed, coupling gel was applied to the scanning head of the probe or the closed lids for optimal sound penetration. The scanning head was moved over the closed lid in all directions using transverse, longitudinal, and axial probe positions to ensure that representative cross-sections of the globe were obtained. Basic screening was initially performed at a high gain (i.e., 80 dB) setting, followed by an examination under lower sensitivity. Kinetic echography was performed by keeping the probe still and asking the patient to move their eyes in different gazes to determine the after movements of membranous structures. Any solid lesion detected was evaluated topographically. Quantitative echography was performed to determine the internal reflectivity of a solid lesion.

STATISTICAL ANALYSIS

Statistical analysis was conducted using SPSS version 22.0. Ultrasonographic and clinical findings were tabulated, and frequency counts and percentage calculations were performed. Kappa's statistical analysis was used to associate the B-scan USG and clinical findings. A p-value <0.05 was considered statistically significant.

RESULTS

The patients studied were in the age range of 10-80 years with a mean age of 32.84±21.12 years. The majority of the patients were in the age group of 21-30 years (14, 28%) [Table/Fig-1]. Most of the patients (39, 78%) were males.

The most common cause of blunt ocular trauma was workplace-related injuries, mainly agricultural (15, 30%). It was followed by assault (13, 26%) and domestic injuries (12, 24%). Injuries due to sticks were seen in 10 (20%) cases and with balls in 8 (16%) cases [Table/Fig-2].

Age (years)	Male (%)	Female (%)	Total (%)
10-20	11 (22)	2 (4)	13 (26)
21-30	11 (22)	3 (6)	14 (28)
31-40	8 (16)	3 (6)	11 (22)
41-50	4 (8)	0	4 (8)
51-60	2 (4)	2 (4)	4 (8)
61-70	2 (4)	0	2 (4)
71-80	1 (2)	1 (2)	2 (4)
Total	39 (78)	11 (22)	50 (100)

[Table/Fig-1]: Age/sex distribution of study patients.

Aetiology	Number (%)	Percentage (%)
Agricultural	15	30
-Stick	10 (20)	
-Wood Log	2 (4)	
-Twig	1 (2)	
-Spade	1 (2)	
-Handpump	1 (2)	
Other work place	8	16
-Iron Rod	6 (12)	
-Steel Belt	1 (2)	
-Brick	1 (2)	
Domestic	12	24
-Ball	8 (16)	
-Bat	2 (4)	
-Door	1 (2)	
-Belt	1 (2)	
Assault (including fist, stone related)	13	26
Road traffic accidents	2	4
Total	50	100

[Table/Fig-2]: Aetiology of blunt trauma.

Most patients (45, 90%) had severe visual loss, while 2 (4%) had moderate visual loss and 3 (6%) had mild visual loss.

The right eye was involved in 52% of the patients, the left eye in 46%, and 2% had injuries to both eyes. The most common anterior segment finding was traumatic cataract (44%) [Table/Fig-3].

S. No.	Findings	Number (%)	Total (%)*
1	Eyelid		16
	-ecchymosis	4 (8)	
	-eyelid tear	2 (4)	
	-eyelid abrasion	2 (4)	
2	Conjunctiva		18
	-subconjunctival haemorrhage	8 (16)	
	-conjunctival laceration	1 (2)	
3	Cornea		20
	-Corneal tear	1 (2)	
	-Corneal abrasion	4 (8)	
	-Corneal opacity (leucoma)	2 (4)	
	-Others (Stromal oedema, band keratopathy)	3 (6)	
4	Anterior chamber		16
	-Hyphema	8 (16)	
5	Iris		78
	-Traumatic iritis	12 (24)	
	-Traumatic mydriasis	11 (22)	
	-Iridodialysis	4 (8)	
	-Iridodonesis	9 (18)	
	-Sphincter tear	3 (6)	

6	Pupil		6
	-Relative Afferent Pupillary Defect (RAPD)	3 (6)	
7	Lens		70
	-Traumatic cataract	22 (44)	
	-Subluxation of lens	7 (14)	
	-Dislocation of lens	2 (4)	
	-Phacodonesis	4 (8)	

[Table/Fig-3]: Anterior segment findings on clinical examination.
*Many patients had multiple anterior segment findings

The most common posterior segment findings detected clinically were vitreous degeneration (8%), vitreous haemorrhage (6%), Commotio retinae (6%) cases, and retinal detachment (4%) [Table/Fig-4].

S. No.	Findings	Number	Percentage (%)
1	Commotio retinae	3	6
2	Retinal tear	1	2
3	Retinal detachment	2	4
4	Choroidal detachment	0	0
5	Posterior vitreous detachment	0	0
6	Vitreous haemorrhage	3	6
7	Dislocation of lens in vitreous	1	2
8	Vitreous degeneration	4	8

[Table/Fig-4]: Posterior segment findings on clinical examination.

The most common findings on B-scan ultrasonography were retinal detachment (30%), vitreous haemorrhage, traumatic cataract (28%), posterior vitreous detachments (16%). Choroidal detachment was also noted in 2% of cases [Table/Fig-5].

S. No.	Findings	Number	Percentage (%)
1	Traumatic cataract	14	28
2	Posterior capsule rupture	2	4
3	Subluxation of lens	3	6
4	Dislocation of lens	2	4
5	Posterior vitreous detachment	8	16
6	Retinal detachment	15	30
7	Choroidal detachment	1	2
8	Vitreous haemorrhage	14	28
9	Vitreous degeneration	2	4

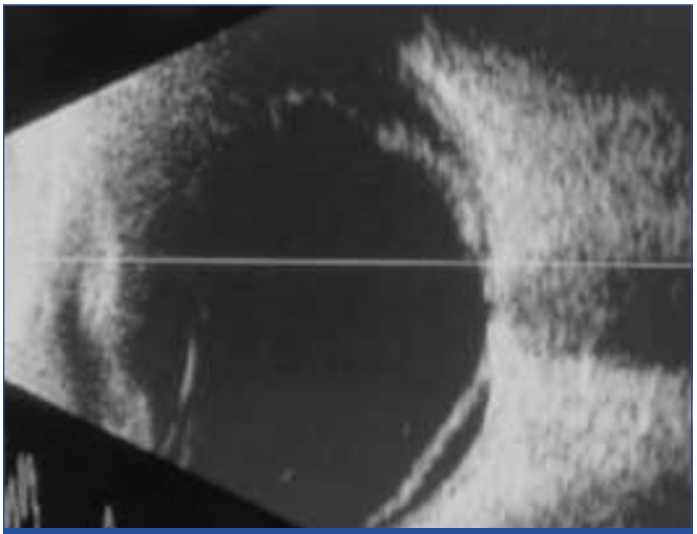
[Table/Fig-5]: B-scan USG findings.

When comparing lens lesions clinically and sonographically, fair agreement was seen between the two modalities of examination (κ=0.303, p-value <0.006). The majority of lens lesions were diagnosed clinically (62% of cases) rather than by B-scan USG (42% of cases). In relation to retinal lesions (κ=-0.750, p-value <0.001) and vitreous lesions (κ=-0.643, p-value <0.001), poor agreement was seen between the two modalities of examination. B-scan USG was more helpful in accurately diagnosing vitreous lesions (52% of cases compared to 16% of cases by clinical examination) and retinal lesions (30% of cases compared to 6% of cases by clinical examination) [Table/Fig-6].

	Clinical examination	USG examination	Kappa-value	p-value
Lens lesions				
Diagnosed	31 (62%)	21 (42%)	0.303	<0.006
Undiagnosed	2 (4%)	12 (24%)		
Vitreous lesions				
Diagnosed	8 (16%)	26 (52%)	-0.643	<0.0001
Undiagnosed	20 (40%)	2 (4%)		
Retinal lesions				
Diagnosed	3 (6%)	15 (30%)	-0.750	<0.0001
Undiagnosed	13 (26%)	1 (2%)		

[Table/Fig-6]: Comparison of lens, vitreous, and retinal lesions diagnosed by B-scan USG and clinical examination.

[Table/Fig-7] shows the incidence of retinal detachment. Choroidal detachment was accurately diagnosed in 1 case (2%) by B-scan USG but was missed on clinical examination. Hence, B-scan USG was helpful in diagnosing choroidal detachment.



[Table/Fig-7]: Retinal detachment.

DISCUSSION

Blunt injury can result in various injuries to the eyeball. Blunt eye trauma can be due to coup, countercoup, and anterioposterior compression or horizontal tissue expansion. In this study, 50 patients with blunt ocular trauma were included. Demographic details revealed that most of the patients were males (78%). Most studies worldwide on ocular trauma show a similar male preponderance [11-14]. These higher rates among men may be due to the nature of occupational exposure, participation in dangerous sports and hobbies, alcohol use, and risk-taking behaviour [15].

In this study, workplace-related injuries (30%), assault (26%), and domestic injuries (24%) were the main causes of blunt ocular trauma. This emphasises the need for the use of appropriate protective gear at the workplace and a safer workplace environment. Injury due to a stick was seen in 20% of cases and with a ball in 16% of cases. This was similar to a study done by Meena MK and Gupta V, where the most common object of injury was a stick [16]. The stick as a common object of injury may be because of exposure in occupations like farming and is also used in playing local games.

The predominant anterior segment findings on clinical examination were traumatic cataract (44%), traumatic iritis (24%), and contusion injuries to the cornea (20%). Traumatic cataract is common after blunt trauma injuries, as shown by a study done by Yusuf AYA et al., [17]. Lens lesions were more easily detected clinically (31 cases, 62%) than on B-scan USG (21 cases, 42%). Vitreous lesions were more frequently diagnosed by B-scan USG (26 cases, 52%) than by clinical examination (8 cases, 16%). Retinal detachment was also more frequently diagnosed by B-scan USG (15 cases, 30%) than on clinical examination (3 cases, 6%). Studies have shown that without B-scan, posterior segment findings may be missed [13,14,18]. It is extremely important to diagnose these conditions for effective management. During emergency presentations, these findings can be easily missed in the absence of B-scan.

Importantly, B-scan USG could accurately diagnose 2 posterior lens capsule ruptures that were not evident clinically. The diagnosis of

posterior capsular rupture preoperatively helps in proper planning of the surgery for the best possible outcome.

This study suggests that blunt ocular trauma can cause various complications that may be missed on routine clinical examination due to hazy media. B-scan USG should be an integral part of the work-up for all patients with blunt ocular injury with hazy media or unexplained visual loss. It is also essential when surgery for traumatic cataract or vitreous haemorrhage is indicated to avoid unexpected intraoperative surprises. It is suggested that B-scan should also be an integral part of all ophthalmic set-ups dealing with trauma to avoid missing significant posterior segment pathologies. B-scan can also be important in cases of multi-trauma or disoriented patients or in Intensive Care Unit (ICU) set-ups where thorough clinical ocular examination and Computed Tomography (CT)-scan may be difficult.

Limitation(s)

A larger, multicentric study is needed to further generalise the results. Additionally, children under 10 years of age were not included in this study, so the role of B-scan in these patients could not be assessed. Further studies can be conducted by including these subjects as well, as examination would be easier using B-scan since clinical examination is difficult in children, especially after trauma.

CONCLUSION(S)

Ultrasound is an important non invasive investigation that helps in the diagnosis and appropriate management of cases with hazy media due to blunt ocular trauma. In this study, B-scan USG was a better diagnostic tool in identifying posterior segment lesions (vitreous, retinal, and choroidal lesions) in patients with blunt ocular trauma. Therefore, it is suggested that prompt B-scan USG should be done in every patient with blunt ocular injury with hazy media or unexplained visual loss to avoid missing any pathology that may not be evident on clinical examination, particularly when any surgical intervention is planned.

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ANNEXURE-1

Name		Age/Sex	
Date of injury		MRD No./IP No.	
Address			
Mechanism of injury		Eye involved in injury	
History	Eye involved Diminution of vision Flashes Floaters Redness Wound in the lids Pain in the eyes Diplopia		Other injuries
Examination findings		Right eye	Left eye
Visual acuity			
Extraocular muscle movements			
Anterior segment			
Eyelid • Lid ecchymosis/Oedema • Lid laceration • Lid tear Conjunctiva • Subconjunctival haemorrhage Cornea • Corneal abrasion • Partial thickness lamellar tear • Corneal oedema • Corneal opacity Anterior chamber • Hyphaema Iris • Traumatic iridocyclitis • Iridodialysis • Iridodonesis Pupil • Sphincter tears • Traumatic mydriasis • Relative Afferent Pupillary Defect (RAPD) Lens • Traumatic cataract • Anterior capsular tear • Subluxation • Dislocation • Phacodonesis			
Posterior segment			
Vitreous • Vitreous haemorrhage • PVD (Incomplete/Complete) Retina • Retinal detachment • Retinal tear • Commotio retinae • Choroid • Choroidal detachment • Choroidal tear • Traumatic optic neuropathy • Blow out fracture of orbit			
B-scan Ultrasonography • Subluxation of lens • Dislocation of lens • Lens changes • Intactness of anterior capsule • Intactness of posterior capsule • Cataract • Vitreous haemorrhage • Vitreous opacities • Posterior vitreous detachment • Retinal tear • Retinal detachment • Peripheral choroidal detachment • Oedema of retinochoroid layer • Posterior scleral rupture • Optic nerve avulsion • Other findings			