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Original research article

A prospective study to determine the clinical profile of ultrasonographic features and visual evoked potential changes in patients of ocular trauma with opaque media

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Abstract

Aim: The aim of the present study to determine the clinical profile of ultrasonographic features and visual evoked potential changes inpatients of ocular trauma with opaque media.

Methods: A prospective observational study was conducted in the Department of Ophthalmology, AIIMS, Patna, Bihar, India, for 1 year. Total 100 patients with uniocular trauma having opaque media were included in the study. The uninvolved better eye of the patient served as control. Routine Laboratory investigations were done along with. Conjunctival swab examination and syringing of both nasolacrimal ducts and X-rays of the skull and the orbit. Special investigations included 1- Ultrasonography (USG) and 2- Visual Evoked Potential (VEP). The patients were randomly allocated into two groups of 50 each according to the arrangement of numbers in random number tables, so that one half of the patients were evaluated first by ultrasonography and the other half by Visual evoked potential testing. All the findings at follow up were noted and compared with the preoperative findings in each case to assess the diagnostic reliability of ultrasonography (USG) and to assess the prognostic value of USG and VEP regarding the final visual outcome in these patients.

Results: The study showed ocular trauma was more prevalent in the younger age groups (i.e. 31% in 10-20 yrs and 18% in 20-30 yrs), than in the elderly (6% in 40-50 years and 16% in 50-60 yrs). In this study, 78(78%) were males and 22 (22%) were females respectively. The corneal opacity was present in 27(27%) patients, hyphaema was present in 42(42%) patients, cataract was present in 72 (72%) patients, vitreous haemorrhage was present in 37 (37%) patients and intraocular foreign body was present in 7 (7%) patients. Ultrasonography detected cataract in 64 out of 73 cases (87.67%), while cataract was detected clinically in 56 out of 70 cases (95.89%).

Conclusion: USG B Scan is a very useful primary investigation to detect the posterior segment pathology in case of opaque media in traumatic eye. The VEP is affected in case of sight threatening findings. Thus VEP studies were more accurate than USG in predicting vision threatening ocular damage and the final visual outcome in this study.

Introduction

Trauma can result in wide spectrum of eye injury of the globe, optic nerve and adnexa ranging from superficial to vision threatening complications. Our understanding of pathophysiology and management of these disorders has advanced tremendously over the last 30 years, and it is critical that a standardized classification system of terminology and assessment should be used by both ophthalmologists and non-ophthalmologists when describing and communicating clinical findings. Blindness has regularly been found the most feared of all disabilities and any threat to vision is emotionally wrenching. Humans rely

heavily on vision to avoid bodily trauma, and therefore it is particularly shocking if the eye itself is injured. Ocular trauma is a preventable public health problem throughout the world. It is one of the common causes of ophthalmic morbidity and monocular blindness in all parts of the world. The global annual incidence of ocular trauma is around 55 million of which 750000 cases require hospital admission every year.[1]These injuries occur in sports, home, assault, agriculture, industrial and road traffic accident. In India reported incidence of ocular trauma varies from 1% to 5%. In India reported incidence of ocular trauma varies from 1 to 5%. The global annual incidence of ocular trauma is around 55 million of which 750000 cases require hospital admission every year. [1] While the incidence of ocular trauma has been described in the United States[2, 3], the United Kingdom[4] , Sweden[5], and Greece[6] , it has not been well studied in other industrialized countries, like Italy, where clinical research on ocular trauma is limited to the pediatric populations and [7-9] and no studies are available on adults hospitalized with ocular trauma. From a public health and injury prevention perspective, current information on eye injuries rates is needed to develop effective plans for disseminating eye injury prevention materials to the public and to earmark adequate funding for these initiatives.

This prospective study was done to determine the ultrasonographic features and VEP changes in eyes with ocular trauma having opaque media and assess their diagnostic and prognostic reliability as compared to clinical diagnosis.

Material and methods

A prospective observational study was conducted in the Department of Ophthalmology, AIIMS, Patna, Bihar, India,for 1 year. after taking the approval of the protocol review committee and institutional ethics committee.

Inclusion criteria

Total 100 patients with uniocular trauma having opaque media were included in the study. The uninvolved better eye of the patient served as control.

Exclusion criteria

- Patients of ocular trauma having no perception of light.
- Patients of ocular trauma with intraocular infection.
- Those patients having the other eye diseased.

Methods

Detailed history including chief complain, demographic profile and cause of injury were noted. Ocular examination was done systematically with noting visual acuity, pupillary reflexes, slit lamp examination of anterior segment structures, intraocular tension measured by applanation tonometer and ocular motility assessment in every patient. Gonioscopic evaluation of anterior chamber angle performed to assess angle width and also to assess if there was any foreign body located in the anterior chamber angle.

Examination of the posterior vitreous was done by 3 methods –

1. With silt lamp biomicroscope and 3 mirror contact lens: which was only possible when the media of the anterior segment was clear. The posterior opacities were examined as regards their location, colour, mobility and after movements and proximity to blood vessels. Presence of any foreign body was also noted.
2. Direct ophthalmoscopy of the affected eye – which helped to reveal opacities in the media, especially the lens and the vitreous. As patients with opaque media were selected, details of fundus could not be examined. However post treatment findings of the fundus could be examined, after the media became clear.

3. Indirect ophthalmoscopy of the affected eye: This was used for judging whether spontaneous clearing of vitreous opacities was occurring. It was also used to verify the preoperative findings in postoperative cases.

Routine Laboratory investigations were done along with. Conjunctival swab examination and syringing of both nasolacrimal ducts and X-rays of the skull and the orbit. Special investigations included 1- Ultrasonography (USG) and 2- Visual Evoked Potential (VEP). The patients were randomly allocated into two groups of 50 each according to the arrangement of numbers in random number tables, so that one half of the patients were evaluated first by ultrasonography and the other half by Visual evoked potential testing. A "cross over" trial carried out in these patients to evaluate the ultrasonographic and visual evoked potential test findings. The two diagnostic procedures undertaken are discussed below.

1. Ultrasonography (USG): Contact A scan and B Scan ultrasonography was done with the transducer of the Ultrascan Digital B4000 ultrasonography manufactured by Alcon Surgical. Inc., USA through closed lids and contact Jelly coupling. The patient lay supine on a couch each globe was scanned serially in horizontal and vertical sections with directions of gaze at 12, 1, 3, 4, 6, 7, 8, 9 and 10- O clock positions and also straight ahead. Other directions of gaze were elicited as necessary to cover the periphery through 3600.

2. Visual evoked potential (VEP): The recording of VEP was done on the Neuromatic 2000 C machine - The final average reading of the VEP was given by the computer.

All the findings at follow up were noted and compared with the preoperative findings in each case to assess the diagnostic reliability of ultrasonography (USG) and to assess the prognostic value of USG and VEP regarding the final visual outcome in these patients.

Results

The study showed ocular trauma was more prevalent in the younger age groups (i.e. 31% in 10-20 yrs and 18% in 20-30 yrs), than in the elderly (6% in 40-50 years and 16% in 50-60 yrs). The mean age of the patients was 24.9 years and the standard deviation was 14.2 years. In this study, 78(78%) were males and 22 (22%) were females respectively.

Table 1 show that the corneal opacity was present in 27(27%) patients, hyphaema was present in 42(42%) patients, cataract was present in 72 (72%) patients, vitreous haemorrhage was present in 37 (37%) patients and intraocular foreign body was present in 7 (7%) patients. Thus cataract was the commonest presentation followed by hyphaema. Most of the patients had multiple structural involvements.

Table 2 considers the different clinical categories amongst the patients. As the patients had opaque media, it was not possible to detect cases of retinal detachment, posterior vitreous detachment, vitreous bands and retinaloedema clinically. These cases were detected by ultrasonography and later on confirmed by post treatment findings. The final diagnosis stated in the Table 2 was revealed after combining initial clinical features, ultrasonographic findings and post treatment observations. Ultrasonography detected cataract in 64 out of 73 cases (87.67%), while cataract was detected clinically in 56 out of 70 cases (95.89%). 9 cases of cataract were detected clinically while they were not detected by ultrasonography. The difference in accuracy of the two modalities may be due to the fact that ultrasonography delineates the posterior segment more prominently and can delineate only the posterior lens capsule. The lens lies in a more anterior plane so some cases of cataract may not have been detected by ultrasonography.

Table 1: Different clinical diagnosis at presentation

S. No	Clinical Diagnosis	Total	Percentage
1.	Corneal opacity	27	27
2.	Hyphaema	42	42
3.	Cataract	72	72
4.	Vitreous haemorrhage	37	37
5.	Intraocular foreign body	7	7

Table 2: Comprising clinical diagnosis, ultrasonographic diagnosis and final diagnosis

S. No.	Clinical Category	+ve Clinical features No.	+ve USG findings No.	Final diag-nosis No.	Clinical findings % of accuracy	USG Findings % of accuracy
1.	Cataract	70	64	73	95.89	87.67
2.	Vitreous haemorrhage	37	50	50	74	100
3.	Retinal detachment	-	10	10	-	100
4.	Intraocular foreignbody	7	7	7	100.0	100
5.	Posterior vitreous detachment	-	5	5	-	100
6.	Vitreous bands	-	3	3	-	100
7.	Retinal oedema	-	2	2	-	100

Vitreous haemorrhage was detected clinically in 37 out of 50 cases (74%) while ultrasonography detected vitreous haemorrhage in all 50 cases (100%). Intraocular foreign bodies were both detected from the clinical features (7 cases out of 7, 100%) as well as by ultrasonography (7 cases out of 7, 100%). On comparing the total number of patients diagnosed by clinical features and by ultrasonography, it is seen that 114 out of 150 patients (76%) were detected by clinical features alone, while 141out of 131 patients (94%) were detected by ultrasonography. When the clinical features and ultrasonographic features were combined and a final diagnosis was made after consideration of post treatment observation, all 131 clinical diagnosis (100%) were achieved.

The standard error of difference between the two proportions of cases diagnosed by the two modalities was calculated using the formula (= √ (p1q1/ n1 + p2q2 /n2)) as equal to 4.66. The observed difference was (94.12- 71.22) 23.9. This is more than twice the standard error of the difference, which is 2x 4.66 = 9.12. So, the above results are significant and thus ultrasonography was a better diagnostic modality than clinical methods in opaque media. The results of Table 2 were also analyzed by the Fisher's Exact Test. The two-sided P value was calculated as < 0.0001, considered extremely significant.

Role of VEP On comparing the latency and amplitude of the visual evoked potential in control eyes, the study showed that a large proportion of the patients (33 patients, 33%) have a latency in the range of 91-110 ms and amplitude in the range of 6-10 µv. The Table 3 shows that a large proportion of patients have a delayed latency and reduced amplitude in the injured eye Thus it is clear from Table 4 that: 1. Mean latency of control eyes were within normal limits, while mean latency of injured eyes were prolonged (normal latency lies

between 95-120ms but varies from laboratory to laboratory). 2. The injured eyes showed a larger standard deviation than control eyes, indicating a greater variability about the mean. To test whether the results depicted in Table 4 are significant, the Table 5 was drawn up. The two tailed p value obtained is<0.0001 by both one sample t test and Wilcoxon rank sum test. Thus Table 5 indicates that results were significant i.e. there is a significant increase in the latency of injured eyes as compared to control eye. On comparing the distribution of VEP latencies with pre and post treatment visual acuity, the study showed: 1. Majority of the patients (98 in number, i.e. 98%) had an initial visual acuity of 6/60 or less. It also shows that 51 patients (51%) had latencies more than 120 ms that is delayed latencies and that none of these 25 patients had an initial visual acuity of 6/60 or more. 2. Majority of the cases (56 patients. 56 %) obtained a final visual acuity in the range of 6/60 to 6/18.

Table 3: Comparing the latency and amplitude of the visual evoked potential in injured eyes

Amplitude	**0 – 5**	**6 – 10**	**11 – 15**	**16 – 20**	**Total**
(μv)Latency (ms)					
91 – 100	2 %	7 (7.5%)	2%	-	11 (11%)
101 – 110	7 %	15%	-	-	22 (22%)
111 – 120	3 %	14 %	-	-	17(17%)
121 – 130	6 %	13 %	-	-	19(19%)
131 – 140	6 %	7%	-	-	13 (13%)
141 – 150	2 %	-	-	-	2 (2%)
151 – 160	6%	2 %	-	-	8 (8%)
161 – 170	8%	-	-	-	8(8%)
Total	40	58	2	-	100(100%)

Table 4: Comparing the mean latencies and standard deviations of the control and injured eyes

Eye	**Mean latency**	**Standard deviation**	**95% confidence internal**
Control Injured	98 ms 122 ms	7.605 21.58	98 ± 16.01 124 ± 42.16

Table 5: Statistical observations of latency in injured eyes as compared to control eyes

Increase in latency of the injured eye = latency of the injured eye – latency of the control eye = L	**Mean increase in latency (L)**	**Standard deviation = SD(L)(n=100)**	**Standard error of the mean**	**P value**
L	25.66	20.37	2.22	<0.0001

7 patients (7%) in the range of PR defective to PR accurate and 8 patients (8%) in the range of finger counting to 5/60. 22 cases (27.5%) obtained a visual acuity of 6/12 or better.

Table 6: Comparing the mean amplitude and standard deviation of control and injured eyes

Eye	**Mean amplitude (μV)**	**SD**	**95% confidence internal**
Control Injured	8.974 6.215	3.021 2.59	9.1± 6.128 6.3 ± 5.26

Table 7: Statistical observations of amplitude in injured eyes as compared to control eyes

Decrease in amplitude of the injured eye = amplitude of the control eye – amplitude of the injured eye = A	Mean decrease in amplitude (μV) = A	Standard deviation = S D (A)	Standard error of the mean	P Value
A	2.72	2.93	0.31	<0.0001

Table 8: The distribution of cases having good and bad visual recovery

Total No cases	%	No of cases with good recovery	%	No of cases with bad recovery	%
100	100	25	25	75	75

Table 9: The number of cases having good and bad visual prognosis and demonstrated by ultrasonography

USG	No of cases with bad visual prognosis	No of cases with good visual prognosis	Total
Positive findings indicating ocular	61	8	69
damage			
Negative Findings	14	17	31
Total	75	25	100

Table 10: Number of cases having good and bad visual prognosis as demonstrated by visual evoked potential (VEP) studies

VEP Study	No of cases with bad visual prognosis	No of cases with good visual prognosis	Total
Positive findings indicating	64	2	66
ocular damage			
Negative Findings	11	23	34
Total	75	25	100

In this study, it was seen that VEP had a better diagnostic accuracy than USG and all patients having a positive finding in VEP sustained ocular damage.

Table 12 shows that 57 patients (57%) had a post- treatment visual acuity in the range of6/60 to 6/18 while 27 patients (27%) had post-treatment visual acuity in the range of 6/12 to 6/6. 6 patients (7%) had post-treatment visual acuity in the range of PR defective to PR accurate, while the remaining 9 patients (9%) had post-treatment visual acuity in the range of finger counting to 6/60.

Table 11: sensitivity and specificity

Measures	USG	Modality	VEP
Sensitivity	86.11%		92.54%
Specificity	88.47%		97.45%
Positive predictive value	95.25%		98.78 %

Table 12: The distribution of post – treatment best corrected visual acuity amongst patients of ocular trauma

S. No.	Post – Treatment visual acuity	No cases	Percentage
1.	PR- to PR+ (poor visual acuity)	7	7
2.	F C to 5/60 (poor visual acuity)	9	9
3.	6/60 to 6/18 (low to moderate visual acuity)	57	57
4.	6/12 to 6/6 (good visual acuity)	27	27
	Total	100	100

Discussion

In the present study, 78(78%) were males and 22 (22%) were females. The increased susceptibility of males to injury is probably because of more outdoor activities and due to the fact that males are more exposed to the factors that cause different injuries e.g. industrial occupations, agriculture, feuds and so on. Male children are more involved in eye injuries due to more involvement in outdoor games such as football, cricket, gillidanda, bows and arrows and so on.[10-14] The study showed ocular trauma was more prevalent in the younger age groups (i.e. 31% in 10-20 yrs and 18% in 20-30 yrs), than in the elderly (6% in 40-50 years and 16% in 50-60 yrs). The mean age of the patients was 24.9 years and the standard deviation was 14.2 years. Whereas other studies have reported maximum cases in the age group of 20 to 40.[11-14] The incidence of injuries are in children and young adults are quite common. Studies reported an incidence of 20.8% in the age group of 11 – 20 and 30.5% in the age group of 21-30.[11] In present study, the highest incidence was noted in the age group of 10-20 years (31 patients 31%) and the second highest incidence in the age group of 20-30 years (18patients, 18%). The reason for high preponderance of patients between 10 – 30 years may be due to this age group spending more time in outdoor activities. In our study the corneal opacity was present in 27(27%) patients, hyphaema was present in 42(42%) patients, cataract was present in 72 (72%) patients, vitreous haemorrhage was present in 37 (37%) patients and intraocular foreign body was present in 7 (7%) patients. Thus cataract was the commonest presentation followed by hyphaema. Most of the patients had multiple structural involvements. Many patients had multiple structural involvements. Corneal affections were lower in the present study than most studies. This may be due to the fact that only patients presenting with opaque media were included in the present study, while other authors considered all corneal affections due to trauma, including corneal foreign bodies. The high incidence of cataract in the present study could be attributed to the same selection criteria. This is supported by the study of Partab Rai et al.(2007) which was also a study of ocular trauma with opaque media.[11] The incidence of hyphaema. Vitreous haemorrhage, retinal detachment and intraocular foreign bodies are more or less similar to other studies.

Most of the authors have reported that many patients had multiple structural involvement and a preponderance of anterior segment injuries and this is in agreement with the findings of the present study[10-12,14] The Ultrasonography detected cataract in 64 out of 73 cases (87.67%), while cataract was detected clinically in 56 out of 70 cases (95.89%). 9 cases of cataract were detected clinically while they were not detected by ultrasonography. It further confirms that ultrasonography was a better diagnostic modality than clinical methods in cases of opaque ocular media, in the present study. The accuracy of ultrasonography as determined by the present study agrees with the findings of other studies where B-Scan ultrasound findings influenced in making diagnosis, thereby aiding in management decision of ocular and orbital diseases with media opacity in upto 95% of patients[15,16] the visual evoked potential latency is delayed in injured eyes as compared to normal control eyes and this delay is statistically significant as in other similar studies.[16] In traumatic affection of the retina the delay ranges between 6 and 39 ms, but delays greater than 45 ms usually indicate optic nerve

dysfunction.[17] The amplitude of the visual evoked potential has been reduced as compared to control eyes and this reduction is statistically significant. Studies have confirmed the above findings.[18,19] The present study revealed that the visual evoked potential study was superior to ultrasonography as regards sensitivity (92.54% and 86.11% respectively), specificity (97.45% and 88.47% respectively) and positive predictive value (98.78% and 95.25% respectively) in cases of ocular trauma with opaque media.[18] In this study 57 patients (57%) had a post-treatment visual acuity in the range of6/60 to 6/18 while 27 patients (27%) had post-treatment visual acuity in the range of 6/12 to 6/6. 6 patients (7%) had post-treatment visual acuity in the range of PR defective to PR accurate, while the remaining 9 patients (9%) had post-treatment visual acuity in the range of finger counting to 6/60.

Thus, the findings of the present study are more or less similar to the findings of other authors[20-22] The percentage of patients with good visual recovery was less than some of the above authors due to the fact that only 30 patients (37.5%) reported to the hospital within 24 hours of sustaining ocular trauma. Rest of the patient had late reporting to the hospital that has hampered good visual recovery in many patients. Thus imparting proper eye health education to the people, especially to those living in remote rural areas, would be an important preventive strategy in these cases, so that, persons sustaining ocular injury, seek proper medical attention at the earliest. The study by Sheng et alreported a significantly low percentage of patients with good visual recovery because they had included only open globe injuries.[21,22] Thus open globe injuries have far worse prognosis than closed globe injuries and should be taken care of as urgently as possible.[23]

Conclusion

USG B Scan is a very useful primary investigation to detect the posterior segment pathology in case of opaque media in traumatic eye. The VEP is affected in case of sight threatening findings. Thus VEP studies were more accurate than USG in predicting vision threatening ocular damage and the final visual outcome in this study

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