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Original Research Article

Clinical profile of ultrasonographic features and visual evoked potential changes in patients of ocular trauma with opaque media – a prospective study

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ABSTRACT

Purpose: To study the ultrasonographic features and VEP changes in eyes with ocular trauma having opaque media and the effect of such changes on the visual prognosis of these patients.

Materials and Methods: A prospective study of total 80 patients with ocular trauma attending the eye outpatient department in a tertiary care hospital was conducted. Their USG B scan and VEP examination was done in the Radiology department and Neuromedicine department respectively.

Results: Blunt trauma was the cause of ocular injury in 60% of the patients, penetrating trauma in 25% and rest 15% had non-mechanical injury caused by acid burns, firecrackers.

Complications of ocular trauma e.g. cataract, vitreous haemorrhage and retinal detachment etc. could be detected to the extent of 93.12% accuracy by ultrasonography alone as compared to only 70.22% by clinical examination when both clinical examination and ultrasonography were combined together, 100% accuracy in diagnosis was reached. 96.25% of control eyes had a visual evoked potential latency, ranging between 81-110 msec and 88.75% had a VEP amplitude ranging from 6-15 μv. 66.25% of injured eyes had delayed visual evoked potential latency with the mean latency at 123 msec and about 41.25% had reduced VEP amplitude with the mean amplitude at 6.125 μv. Thus both the latency and amplitude were decreased significantly in injured eyes as compared to control eyes. Good post-treatment visual acuity was achieved in only 27.5% of patients.

Conclusions: UBM 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.

1. Introduction

Eyes have always been one of the most revered treasures given by God. However, eyes are also often susceptible even to the slightest insult and thus must be nursed with the greatest care or else disastrous consequences may result.[1]

Ocular trauma is a major cause of visual loss in recent times. Ocular traumatology is an important subject because untreated or misdiagnosed cases of ocular trauma frequently end in major anatomical and functional loss, contributing to a major social and financial burden on the inflicted. Most injuries are uniocular and are reported in the younger age groups.[2–4] Rapid industrialization, increased road traffic accidents, mechanized agriculture and unsupervised sports all contribute to the increase in the incidence of ocular trauma.[1] This is mainly due to the fact that the eyes are generally used near tools and machinery often without adequate protection. The application of more sophisticated diagnostic methods, new surgical techniques and new rehabilitation procedures, it is possible to achieve vision retention in many traumatized eyes.[5]

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Ocular injuries can be classified into blunt injuries, penetrating and lacerating wounds, chemical injuries and injuries due to retained intraocular foreign bodies.[6,7] There may be media opacities like corneal opacities, hyphaema, cataract and vitreous hemorrhage following ocular trauma. Clear visualization of the ocular structures, especially the posterior segment is not possible by conventional techniques like slit lamp biomicroscopy and indirect ophthalmoscopy due to opacity of ocular media. Since these lesions can lead to exceptional morbidity in the form of vision loss they warrant a high index of suspicion and prompt and judicious use of imaging modalities to obtain an accurate diagnosis and initiate appropriate management at an early stage.[8]

Ultrasonography and visual evoked potential are two objective techniques which are important in these situations. They have not only helped in making prompt diagnosis and providing faster management but also in assessing the prognosis.

Ultrasound bio microscopy (UBM) allows a detailed imaging of the anterior segment up to 5 mm depth by using high-frequency (50–100 MHz) transducers. A combination of A-scan and B-scan techniques are used out of which B-scan is the most important as the picture is comparable to a histological cross-section through the eye.

The visual evoked potential (VEP) is a record of computerized averaging of stimuli and picked up by surface electrodes. The visual stimuli consist of light which may be a single flash or multiple flashes at different frequencies. The flash may be diffuse (unstructured) or pattern (structured). The VEP provides information regarding the health of the central visual functions (i.e. 6 to 12 degrees of the central field), even in the presence of opacities of ocular media. An initial non-recordable VEP or one with small amplitude and/or delayed latency usually signifies poor post treatment visual prognosis.[9]

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.

2. Materials and Methods

2.1. Study type and design

Prospective observational study design was ollowed for patients of ocular trauma with opaque media.

2.2. Duration and location of study

The present study was conducted on patients of ocular trauma with opaque media attending the ophthalmology department, Calcutta National Medical College, Kolkata from January 2013 to December 2014. The ocular ultrasonographic evaluation of these patients was conducted in the radiology department and the studies on the Visual Evoked Potential (VEP) were conducted in the department of neuromedicine of the same institute.

2.3. Samplig method and sample size collection

80 patients with uniocular trauma having opaque media were included in the study. The uninvolved better eye of the patient served as control. All the patients were followed up for a period of 3 months post-treatment.

2.4. Exclusion criteria

The following patients were excluded from the study

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

3. Methods of examination

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 25 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 ultrasonograph 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 360^0.
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.

3.1. Management

After proper preoperative assessment of the patient by clinical examinations and by ultrasonography and VEP, the patients were managed accordingly. Conservative management was done in cases of vitreous haemorrhage and corneal blood staining for a period of 3 months. Surgical management depended on the type of media opacities. Intracapsular or extracapsular cataract extraction (small incision cataract surgery) with or without intraocular lens implantation, paracentesis, corneal rupture repair were performed in necessary cases.

Vitreous haemorrhage not responding to conservative management or where there was an associated retinal detachment or IOFB were sent to higher centres for further management and followed up later on.

3.2. Follow up

After surgical management or conservative management, when the ocular media became clear, the eyes were examined by direct or indirect ophthalmoscope, and by slit lamp biomicroscope and 3 mirror contact lens. In those cases where the ocular media did not become sufficiently clear after management (either conservative or surgical), to assess the posterior segment properly by the above methods, ultrasonographlc examination was repeated. This was also done in cases of vitreous haemorrhage which were managed conservatively. Periodic ultrasonographic examinations were done at monthly intervals till the media cleaned significantly to assess the posterior segment by direct or indirect ophthalmoscopy. The follow up period extended 1 or 3 months post treatment.

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.

4. Results

The study gave a general idea about the demographic profile of the patients of ocular trauma attending the outpatient department.

4.1. Demographic profile

1. The study showed ocular trauma was more prevalent in the younger age groups (i.e. 30% in 11-20 yrs and 20% in 21-30 yrs), than in the elderly (5% in 41-50 years and 15% in 51-60 yrs). The mean age of the patients was 25.7 years and the standard deviation was 15.5 years.
2. In this study, 64 (80%) were males and 16 (20%) were females respectively.

4.2. Initial clinical diagnosis

hows that at presentation, corneal opacity was present in 22 (27.5%) patients, hyphaema was present in 34 (42.5%) patients, cataract was present in 56 (70%) patients, vitreous haemorrhage was present in 30 (37.5%) patients and intraocular foreign body was present in 6 (7.5%) patients. Thus cataract was the commonest presentation followed by hyphaema. Most of the patients had multiple structural involvement.

4.3. Ultrasonoraphic diagnosis

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, ultrasonograpic findings and post-treatment observations.

Ultrasonography detected cataract in 50 out of 59 cases (84.74%), while cataract was detected clinically in 56 out of 59 cases (94.91%). 6 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 dlagnosis at presentation

S. No.	Clinical Diagnosis	Total	Percentage
1.	Corneal opacity		22 27.5
2.	Hyphaema	34	42.5
3.	Cataract	58	72.5
4.	Vitreous haemorrhage	30	37.5
5.	Intraocular foreign body	6	7.5

Table 2: Comprising clinical diagnosis, ulgrasonographic 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	56	50	59	94.91	84.74
2.	Viterous haemorrhage	30	51	51	58.82	100.0
3.	Retinal detachment	-	8	8	-	100.0
4.	Intraocular foreign body	6	6	6	100.0	100.0
5.	Posterior vitreous detachment	-	4	4	-	100.0
6.	Vitreous bands	-	2	2	-	100.0
7.	Retinal oedema	-	1	1	-	100.0
	Total	92	122	131		

Vitreous haemorrhage was detected clinically in 30 out of 51 cases (58.82%) while ultrasonography detected vitreous haemorrhage in all 51 cases (100%). Intraocular foreign bodies were both detected from the clinical features (6 cases out of 6, 100%) as well as by ultrasonography (6 cases out of 6, 100%).

On comparing the total number of patients diagnosed by clinical features and by ultrasonography, it is seen that 92 out of 131 patients (70.22%) were detected by clinical features alone, while 122 out of 131 patients (93.13%) 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 $(=\sqrt{(\frac{p1q1}{n1}+\frac{p2q2}{n2})})$ as equal to 4.56. The observed difference was (93.12- 70.22) 22.9. This is more than twice the standard error of the difference, which is 2x 4.56 = 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.

4.4. *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 (42 patients, 52.5%) 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 (78 in number, i.e. 97.5%) had an initial visual acuity of 6/60 or less. It also shows that 40 patients (50%) had latencies more than 120 ms that is delayed latencies and that none of these 26 patients had an initial visual acuity of 6/60 or more.
2. Majority of the cases (45 patients. 56.25%) obtained a final visual acuity in the range of 6/60 to 6/18. 6

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

Amplitude (μv)Latency (ms)	0 – 5	6 – 10	11 – 15	16 – 20	Total
91 – 100	2 (2.5%)	6 (7.5%)	3(3.75%)	-	11 (13.75%)
101 – 110	5 (6.25%)	11(13.75%)	-	-	16 (20%)
111 – 120	3 (3.75%)	9 (11.25%)	-	-	12 (15%)
121 – 130	5 (6.25%)	11 (13.75%)	-	-	16 (20%)
131 – 140	5 (6.25%)	6 (7.5%)	-	-	11 (13.75%)
141 – 150	2 (2.5%)	-	-	-	2 (2.5%)
151 – 160	5 (6.25%)	1 (1.25%)	-	-	6 (7.5%)
161 – 170	6 (7.5%)	-	-	-	6 (7.5%)
Total	33(41.25%)	44(55%)	3(3.75%)	-	80(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	99 ms	7.505	99 ± 15.01
Injured	123 ms	20.58	123 ± 41.16

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=80)	Standard error of the mean	P value
L	24.73	19.32	2.16	<0.0001

patients (7.5%) in the range of PR defective to PR accurate and 7 patients (8.75%) in the range of finger counting to 5/60. 22 cases (27.5%) obtained a visual acuity of 6/12 or better.

3. Out of 41 patients who had pre treatment latencies more than 120, majority i.e 29 patients had final visual acuity between 6/60 to 6/18. And none of these patients' visual acuity improved to 6/12 or more.

Table 6 shows the mean amplitude and standard deviation calculated for both control and injured eye after studying the distribution of VEP amplitude.

Thus It is evident from the Table 6 that.

1. Mean amplitude was lower in injured eyes as compared to control eyes.
2. The standard deviation of both the control and the injured eyes were close to each other, with the standard deviation of control eyes being marginally larger than that of the injured eyes. However, as co-efficient of variation was larger in injured eyes, they showed a greater variability in amplitude.

To test where the results depicted in Table 6 were significant, the following table was drawn up (Table 7)

The two tailed p value obtained is < 0.0001 by both one sample t test and Wilcoxon rank sum test.

The Table 7 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 amplitude with pretreatment and final visual outcome, The study reveals 1. 58.75 % of the injured eyes had the amplitudes in the normal range and out of them only 2 patient (2.5%) had on initial visual acuity of more than 6/60. Rest 41.25% had decreased amplitude.

2. Amplitude has varied greatly in respect of the final visual acuity. 2 patient (2.5%) having a vision in the range of PR defective to PR accurate had amplitude in the range of 6-10 μV, while on the other side, 3 patients (3.75%) having their final visual acuity in the range of 6/12 to 6/6 had amplitude in the range of 0-5 μV. 25 patients (31.25%) had visual acuity in the range 6/60 to 6/18 and an amplitude in the range of 6-10 μV.

The Table 8 reveals that 22 cases (27.5%) had good visual recovery while 58 cases (72.5%) had bad recovery prognosis. The criteria for good visual recovery was a best corrected post-treatment visual acuity of 6/12 or better, while that for bad visual recovery was a best corrected post-treatment visual acuity of less than 6/12.

From Table 9 following were calculated:

1. Sensitivity of ultrasonography (49/58 x 100) 84.48%
2. Specificity of ultrasonography (19/22 x 100) 86.36%
3. Positive predictive value of USG (49/52 X 100) 94.23%
4. Percentage of false positive cases detected %
5. By Ultrasonography (3/22 X 100) 1.36%
6. Percentage of false negative cases detected by ultrasonography (9/58 X 100) 15.52%

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

Eye	Mean amplitude (μV)	SD	95% confidence internal
Control	8.875	3.039	9.0 ± 6.078
Injured	6.125	2.78	6.2 ± 5.56

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	2.68	2.87	0.32	<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	%
80	100.0	22	27.5	58	72.5

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 damage	49	3	52
Negative Findings	9	19	28
Total	58	22	80

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 ocular damage	54	1	55
Negative Findings	4	21	25
Total	58	22	80

From Table 10 the following were calculated

1. Sensitivity of VEP studies (54/58 x 100) 93.10%
2. Specificity of VEP studies (21/22 x 100) 95.45%
3. Positive predictive value of VEP studies (54/55 x 100) 98.18%
4. Percentage of false positive cases detected to VEP studies (1/22 x 100) 4.54%
5. Percentage of false negative cases detected by VEP studies (4/58 x 100) 6.89%

After considering results depicted in the Tables 9, 10 and 11 it was observed that:

1. Visual evoked potential study was a more sensitive and specific modality to assess visual prognosis in ocular trauma patients with opaque media, than ultrasonography. The predictive value of post-treatment results by VEP is more accurate than USG.
2. The predictive value of a modality reflects its diagnostic power and the predictive value of a positive test indicates the probability with which the patient with a positive test has the disease in question.
3. 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 45 patients (56.25%) had a post-treatment visual acuity in the range of6/60 to 6/18 while 22 patients (27.5%) had post-treatment visual acuity in the range of 6/12 to 6/6. 6 patients (7.5%) had post-treatment visual acuity in the range of PR defective to PR accurate, while the remaining 7 patients (8.75%) had post-treatment visual acuity in the range of finger counting to 6/60.

5. Discussion

Evaluation of eyes with ultrasound and visual evoked potential studies were started about five decades back. Since then, many authors have used these two modalities to evaluate eyes, especially those with opaque media. The present study was conducted on eighty patients

Table 11: Summarizing the main results of table 23 & 24

Measures	**Modality**	
	USG	VEP
Sensitivity	84.48%	93.10%
Specificity	86.36%	95.45%
Positive predictive value	94.23%	98.18 %

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)	6	7.5
2.	F C to 5/60 (poor visual acuity)	7	8.75
3.	6/60 to 6/18 (low to moderate visual acuity)	45	56.25
4.	6/12 to 6/6 (good visual acuity)	22	27.5
	Total	80	100.0

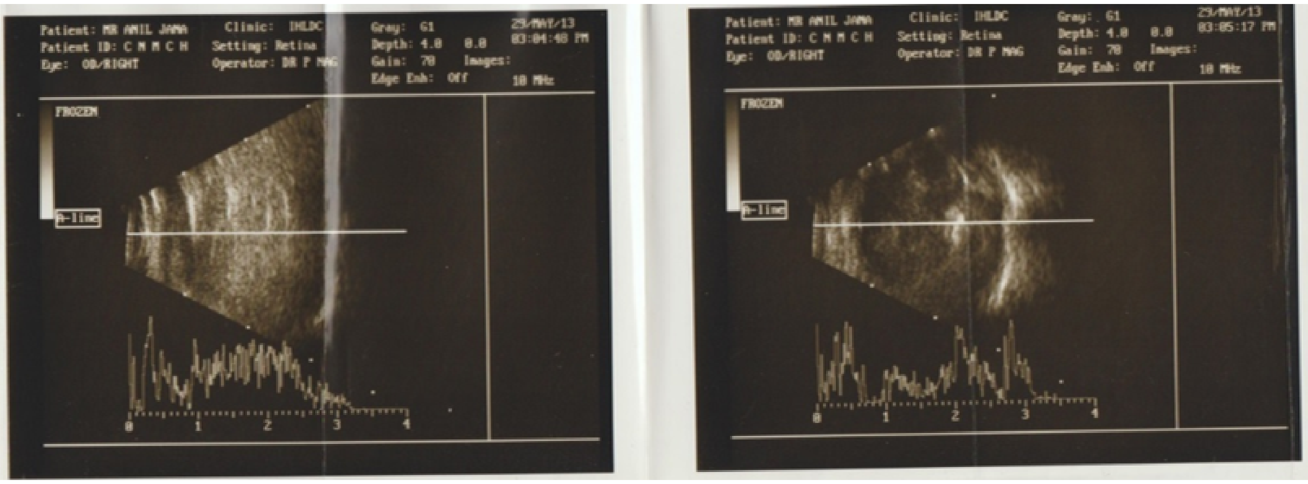

Fig. 1: USG picture showing hyperechoic areas in vitreous cavity suggestive of vitreous hemorrhage

who attended the department of ophthalmology, Calcutta National Medical College, Kolkata.

In the present study, 64 patients (80%) were males, while 16 patients (20%) 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.[9–13]

The incidence of injuries in patients upto 20 years of age was found to be quite high (36 cases, 45%). Whereas other studies have reported maximum cases in the age group of 20 to 40.[10–13] 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.[10] In present study, the highest incidence was noted in the age group of 11-20 years (24 patients 30%) and the second highest incidence in the age group of 21-30 years (16 patients, 20%). The reason for high preponderance of patients between 11 – 30 years may be due to this age group spending more time in outdoor activities.

A study of Tables 1 and 2 reveals that cataract was present in 45% of patients, vitreous haemorrhage in 38.9% of patients, hyphaema in 37.5% of patients, corneal opacity in 27.5% of patients, retinal detachment in 6.1% of patients, intraocular foreign body in 4.5% of patients, vitreous bands in 1.5% of patients, posterior vitreous detachment and retinal oedema in 0.7% of patients. Many patients had multiple structural involvement. 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.[10] The incidence of hyphaema. Vitreous haemorrhage, retinal detachment and intraocular foreign bodies are more or less similar to other studies.

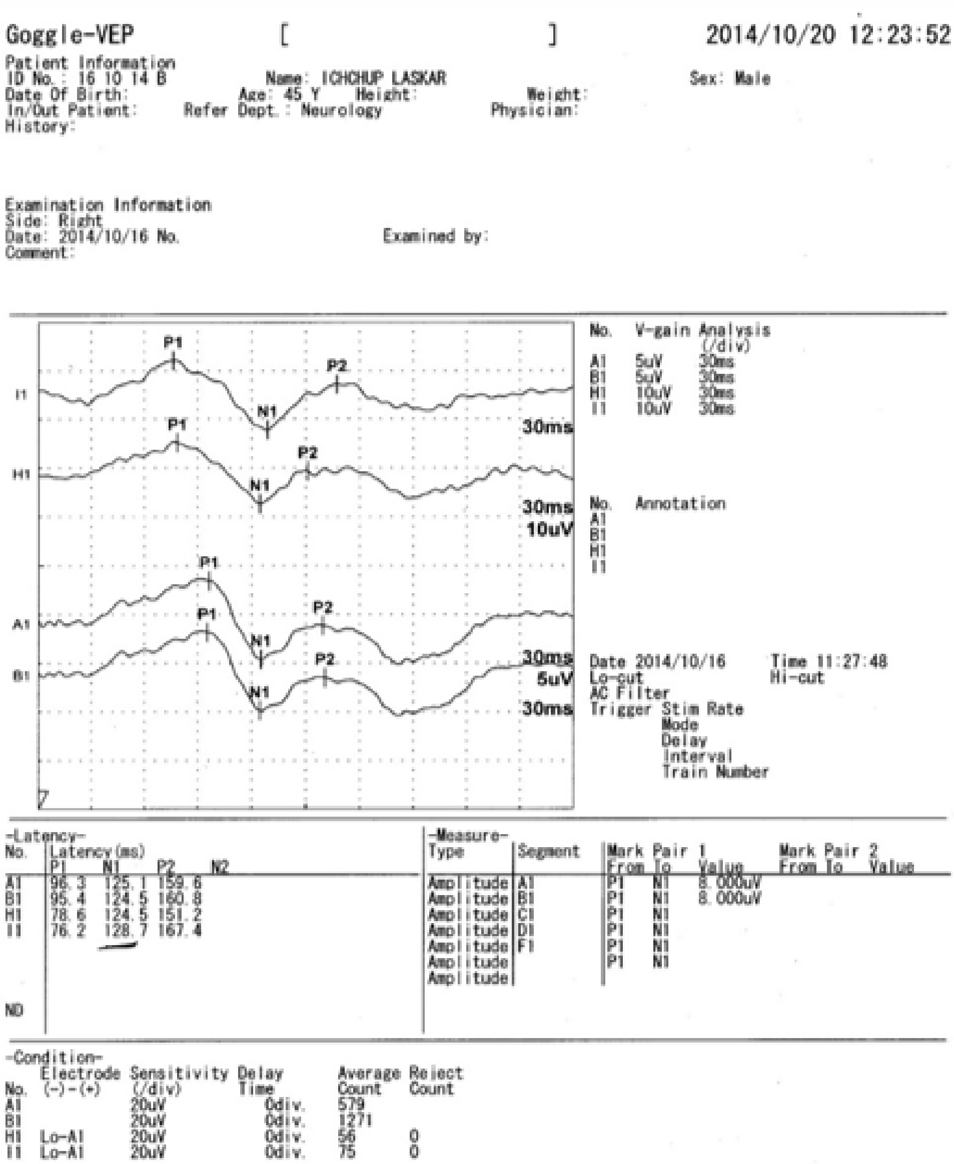

Fig. 2: VEP report showing increased latency

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.[9–11,13]

Table 2 Reveals that ultrasonography was diagnostically accurate 93.12% of patients as compared to clinical methods, by which accurate diagnosis was made in only 70.22% of patients. 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.[14,15]

It is seen from Tables 3, 4 and 5 that 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.[153,179,180] 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.[16]Tables 3, 6 and 7 reveal that 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.[17,18]

Table 11 has compared ultrasonography and visual evoked potential studies as diagnostic modalities. The present study revealed that the visual evoked potential study was superior to ultrasonography as regards sensitivity (93.10% and 84.48% respectively), specificity (95.45% and 86.36% respectively) and positive predictive value (98.18% and 94.23% respectively) in cases of ocular trauma with opaque media.[17]

Table 12 revealed that 22 patients (27.5%) had good visual recovery. Good visual acuity was obtained in 22 patients (27.5%), low to moderate visual acuity in 45 patients (56.25%) and poor visual acuity in 13 patients (16.25%). Thus, the findings of the present study are more or less similar to the findings of other authors.[19–21] 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] Thus open globe injuries have far worse prognosis than closed globe injuies and should be taken care of as urgently as possible.

6. Conclusion

The results obtained in the present study were analyzed and the following conclusions were reached.

1. Ultrasonography is essential in diagnosing the effects of ocular trauma in cases of opaque media. It supplements the clinical diagnosis, as it is not possible to assess ocular injuries fully in cases of opaque media clinically. Thus, ultrasonography is superior to clinical examination as a diagnostic modality in these cases and the best ocular assessment is obtained if the two are used together.
2. Visual evolved potential study is superior to ultrasonographic assessment in cases where the posterior segment is involved, especially in severe ocular trauma with opaque media. It can accurately predict the prognosis for central vision in cases of ocular trauma, even when ultrasonographic observations indicate otherwise.
3. In the overall assessment prognostication for final visual acuity in cases of ocular trauma with opaque media clinical findings. Ultrasonographic (features and visual evoked potential study ail have their respective roles to play. The best assessment and prognostication is obtained when all these modalities are combined together.
4. Thus clinical methods ultrasonography and visual evoked potential are valuable in assessing traumatised eyes with opaque media. A combined diagnostic and prognostic approach using all methods together is of special value in traumatised eyes with opaque media.

7. Source of Funding

None.

8. Conflict of Interest

The authors declare that there is no conflict of interest.

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