ORIGINAL ARTICLE

PREDICTIVE VALUE OF OCULAR TRAUMA SCORE IN OPEN GLOBE COMBAT EYE INJURIES

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Background: Prediction of final visual outcome in ocular injuries is of paramount importance and various prognostic models have been proposed to predict final visual outcome. The objective of this study was to validate the predictive value of ocular trauma score (OTS) in patients with combat related open globe injuries and to evaluate the factors affecting the final visual outcome. **Methods:** Data of 93 patients admitted in AFIO Rawalpindi between Jan 2010 to June 2014 with combat related open globe ocular injuries was analysed. Initial and final best corrected visual acuity (BCVA) was categorized as No Light Perception (NLP), Light Perception (LP) to Hand Movement (HM), 1/200-19/200, 20/200–20/50, and ≥20/40. OTS was calculated for each eye by assigning numerical raw points to six variables and then scores were stratified into five OTS categories. **Results:** Mean age of study population was 28.77±8.37 years. Presenting visual acuity was <20/200 (6/60) in 103 (96.23%) eyes. However, final BCVA of ≥20/40 (6/12) was achieved in 18 (16.82%) eyes, while 72 (67.28%) eyes had final BCVA of <20/200 (6/60). Final visual outcome in our study were similar to those in OTS study, except for NLP in category 1 (81% vs. 74%) and ≥20/40 in category 3 (30% vs. 41%). The OTS model predicted visual survival (LP or better) with a sensitivity of 94.80% and predicted no vision (NLP) with a specificity of 100%. **Conclusion:** OTS is a reliable tool for assessment of ocular injuries and predicting final visual outcome at the outset.

Keywords: Ocular Trauma; Ocular Trauma Score (OTS); Open Globe Injury; Visual Acuity

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INTRODUCTION

The menace of war related ocular injuries in the current era pose a huge challenge for the ophthalmologists. Improvement in modern weapon technology has resulted in more severe and visually debilitating ocular injuries, mostly affecting young combatant soldiers. Quoted incidence of war related ocular trauma during various wars from 19^{th} to 21^{st} century varied from 0.65–13%.[1,2] In comparison to domestic ocular injuries, combat ocular injuries tend to be usually bilateral, more severe and often associated with concomitant non ocular injuries and poor visual outcome. A comparison of ocular war injuries to domestic injuries by Mansur AM *et al* showed significantly higher male preponderance (84.7% vs. 75.1%), higher bilateral involvement (19.3% vs. 4.4%) and less visual improvement (28.6% vs. 44.8%) in combat ocular injuries.[3] According to Birmingham Eye Trauma Terminology (BETT) classification, ocular injuries are divided into closed globe injuries and open globe injuries.[4] Open globe injuries are often more severe and have poorer visual and anatomical outcome as compared to closed globe injuries.

As the combat ocular injury is a sudden and unexpected event with severe visual impairment, counselling of patient and family is of paramount importance especially in the context of future visual prognosis. Various prognostic models to predict final visual outcome in open globe ocular injuries are in clinical practice that include Ocular trauma Score (OTS) and Classification and Regression Tree Analysis (CART).[5,6] OTS is a simplified categorical system for objective assessment and prediction of visual prognosis in open globe eye injuries, described by Kuhn *et al*. It is based on a data analysis of more than 2500 open globe injuries in which the predictors of final visual outcome were identified. OTS is calculated by assigning numerical raw points to six variables and then scores are stratified into five OTS categories that give the probability of achieving certain visual acuity grade at six months after injury.[5] Available data from Pakistan on the validation of OTS in combat ocular injuries is scarce. The objective of this study was to validate the predictive value of OTS in patients with combat related open globe injuries and to evaluate the factors affecting the final visual outcome.

MATERIAL AND METHODS

After approval of hospital ethical review committee, a retrospective review of data of 93 patients with combat related open globe ocular injuries who were admitted in AFIO between Jan 2010 and June 2014 was done. Patients with incomplete hospital record, closed globe ocular injury only, history of previous ocular surgery, previous chronic ocular disease e.g. glaucoma, uveitis, retinopathy, and follow up of less than six months were excluded. Record of each patient was evaluated and demographic data, eye involved, mode and type of injury, initial and final Snellen best corrected visual acuity (BCVA), associated globe injuries, concomitant non-ocular injuries, type of surgical procedures and complications were endorsed on a pre-devised *pro forma*. Zones of eyeball injury were categorized on the criteria described by the Ocular Trauma Classification Group (OTCG), i.e., zone I (superficial injuries of bulbar conjunctiva, sclera and cornea), zone II (corneoscleral limbus to a point 5 mm posterior into the sclera including violation of lens and anterior segment) and zone III (posterior to anterior 5 mm of sclera including violation of the retina, vitreous, rear uvea and optic nerve).[7] Initial and final BCVA was categorized as No Light Perception (NLP), Light Perception (LP) to Hand Movement (HM), 1/200–19/200, 20/200–20/50, and ≥20/40. Visual outcome was defined as poor if BCVA was <20/200. OTS was calculated for each eye by assigning numerical raw points to six variables and then scores are stratified into five OTS categories that give the probability of achieving certain visual acuity grade at six months after injury (Table-1). Statistical analysis of the data was done using SPSS-13. Descriptive statistics, i.e., mean±standard deviation for quantitative values and frequencies along with percentages for qualitative variables were used to describe the data. Association of various variables with final visual outcome was analysed using Chi square test/Fischer exact test and a $p<0.05$ was considered significant. McNemar's test was used to analyse initial and final visual acuities. Prediction based on OTS model was compared with actual visual outcomes and sensitivity and specificity of OTS model to predict visual survival (LP or better) vs. no vision (NPL) was calculated.

RESULTS

One hundred and seven eyes of 93 male patients with combat related open globe ocular injuries were included in final analysis. Mean age of study population was 28.77±8.37 years (range: 20–62 years) with 67.74% of patients in their 3rd decade of life. Fourteen (15.05%) casualties had bilateral ocular involvement; while another 15 (16.12%) had concomitant closed globe injuries in other eye. Mode of injury, zone of involvement and type of open globe injury are shown in table-2. Thirty two (34.40%) patients sustained concomitant non ocular injuries as well, with face and limbs were the most frequently affected area (Table-2).

Presenting visual acuity was <20/200 (6/60) in 103 (96.23%) eyes with 28 (26.16%) of all eyes were NPL at presentation. However, final BCVA of ≥20/40 (6/12) was achieved in 18 (16.82%) eyes, while 72 (67.28%) eyes had final BCVA of <20/200 (6/60). Thirty four (31.77%) eyes eventually became NPL (Fig 1). Overall visual improvement at the final follow up was statistically significant in all injured eyes (McNemar test, p=<0.01). There was a positive correlation between initial and final BCVA, that was statistically significant (Spearman's r=0.283, p=0.003). Median OTS was 56 (Inter quartile Range IQR: 41–70). On the basis of OTS majority of eyes were in OTS category 1, 2 and 3 (Table-3). The proportion of final BCVA in each OTS category in our study was compared with OTS study group and results are summarized in table-3.

Final visual outcome in our study were similar to those in OTS study, except for NLP in category 1 (81% vs. 74%) and ≥20/40 in category 3 (30% vs. 41%). Our results showed better visual outcome as compared to OTS study group for visual acuity of ≥20/40 in category 4 and 5. Spearman rank correlation of OTS score with visual category was coefficient (r=0.712; p<0.001).The OTS model predicted visual survival (LP or better) with a sensitivity of 94.80% (positive predictive value=1) and predicted no vision (NLP) with a specificity of 100% (negative predictive value=0.882). Factors associated with poor visual outcome (<20/200) were perforating injury (p<0.001) and presenting visual acuity of <20/200 (p=0.010). Concomitant non ocular injury, zone III injury and IOFB did not show a significant association with poor visual outcome (p>0.05).

Table-1: OTS Calculation and probability of visual outcome

Initial Vision	Raw Points	Subtract for each diagnosis	Raw Points
NLP	60	Rupture	-23
LP/HM	70	Endophthalmitis	-17
1/200–19/200	80	Perforating Injury	-14
20/200–20/50	90	Retinal Detachment	-11
≥ 20/40	100	Afferent Pupillary defect	-10

Probability of Visual Outcome

Raw Score	OTS Category	NLP (%)	LP-HM (%)	1/200-19/200 (%)	20/200-20/50 (%)	≥ 20/40 (%)
0–44	1	74	15	7	3	1
45–65	2	27	26	18	15	15
66–80	3	2	11	15	31	41
81–91	4	1	2	3	22	73
92–100	5	0	1	1	5	94

Table-2: Demographic and clinical characteristics of the study population

Characteristic	No (%)
Eye Involved (n=93)	
Right	39 (41.93%)
Left	40 (43.01%)
Bilateral	14 (15.05%)
Mode of Injury (n=93)	
IED blast	39 (41.93%)
Mine blast	18 (19.35%)
Bomb Blast	21 (22.58%)
Gunshot	15 (16.12%)
Open Globe Injury (n=107) *	
Penetrating Injury	68 (63.55%)
Perforating Injury	26 (24.29%)
IOFB	36 (33.64%)
Zone of Injury (n= 107) *	
Zone I	39 (36.44%)
Zone II	35 (32.71%)
Zone III	33 (30.84%)
Concomitant Injuries (n=32) *	
Face	18 (77.77%)
Limbs	19 (55.55%)
Chest	7 (44.44%)
Head	3 (16.66%)
Abdomen	2 (11.11%)

*The occurrence of multiple manifestations simultaneously accounts for the % distribution of >100%

Table-3: Final visual outcome based on OTS and our study

Raw	OTS	No of	Final Visual Acuity				
OTS	Cat	Eyes	NLP	LP- HM	1/200-19/200	20/200-20/50	≥ 6/12
Score			Study / OTS n, % / %	Study / OTS n, % / %	Study / OTS n, % / %	Study / OTS n, % / %	Study / OTS n, % / %
0–44	**1**	27	22, 81 / 74	3, 11 /15	2, 7 / 7	0 , 0 /3	0, 0 /1
45–65	**2**	33	11, 33/27	11, 33/26	6, 18 /18	3, 9 /15	2, 6 /15
66–80	**3**	43	1, 2 /2	8, 19 /11	8, 19 /15	13, 30 /31	13, 30 /41
81–91	**4**	2	0, 0 /1	0, 0 /2	0, 0 /3	1, 50 /22	1, 50 /73
92–100	**5**	2	0, 0 /1	0, 0 /1	0, 0 /1	0, 0 /5	2, 100/94

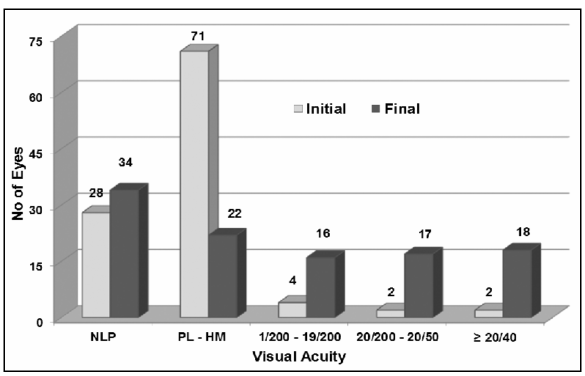

Figure-1: Initial and Final Visual Acuities

DISCUSSION

Significance of OTS is manifolds as the predictions based on OTS provide counselling, decision making, management and rehabilitation by the treating ophthalmologist that is helpful in alleviating the anxiety and uncertainty of patient and his family. OTS provide objective assessment of eye injury and give ophthalmologist a 77% chance of predicting visual outcome within (plus or minus) one visual category at the time of injury.[8,9] Kuhn F *et al* in OTS study group evaluated more than 2500 ocular injuries associated with non-combat causes and devise a methodology to predict final visual outcome at the time of initial injury.[5] OTS study stated that patient with OTS category 1 will more likely to have poorer final visual outcome as compared to a patient with OTS category 5 who will have a higher probability of having favourable final visual outcome. Various studies had validated the findings of OTS study both in adults and children in the settings of domestic and workplace ocular injuries.[8,10–14] However, spectrum of combat ocular injuries differs from domestic and workplace ocular injuries as combat ocular injuries are associated with significantly worse initial and final visual acuities, less visual improvement, more intraocular foreign bodies (IOFB) and more zone III injuries.[3] In our study, final visual outcomes were comparable to the results of OTS study with a high sensitivity and specificity to predict visual survival or otherwise. Sobaci G *et al* evaluated OTS in patients with deadly weapon related open globe injuries and reported similar outcomes as were in OTS study group except for LP/HM in category 2 (53% vs. 26%).[15] Iqbal Z *et al* in their study of 48 patients with combat related ocular injuries found comparable final visual outcomes with OTS study with the exception of NLP vision significantly less and LP/HM vision significantly more than expected in OTS category 1 and 2.[16] Monro L *et al* in their study on ocular trauma from landmines among soldiers reported that patients with open eye wounds had great probability of having an unfavourable visual outcome (visual acuity <CF) for all OTS groups.[17] Smith M *et al* found out that OTS is a reliable predictor of visual outcome in traumatic cataracts associated with combat ocular trauma and Spearman rank correlation of OTS score with visual category was coefficient in their study (r=0.64; p<0.001).[18] Mann CYW *et al* in their study compare OTS and CART as prognostic models of visual outcome after open globe injuries and reported high predictive accuracy of both the models, but the OTS had higher prognostic accuracy as indicated by 97.4 % sensitivity to predict visual survival and 100% specificity to predict no vision.[19]

Factors likely to influence visual outcome after open globe injuries include age, mechanism or type of injury, presenting visual acuity, time lag between injury and surgery, relative afferent pupillary defect (RAPD), zone of injury, retinal detachment, vitreous haemorrhage, lens damage, number of surgeries, hyphema, endophthalmitis, facial and adnexal injuries, presence and type of IOFB.[6,13,14,19,20] In our study, presenting visual acuity <20/200, and perforating injury were the factors associated with poor visual outcome. Weichel ED *et al* in a large series of combat ocular trauma victims from operation Iraqi and enduring freedom reported that the ocular injuries with the worst visual outcomes included choroidal haemorrhage, globe perforation or rupture, retinal detachment, sub macular haemorrhage, and traumatic optic neuropathy.[21] Schimdt GW *et al* in a retrospective cohort review of patients with open globe injuries found worse initial acuity, presence of RAPD, rupture open globe, posterior wound location, assault injury, orbital fracture, lid laceration, hyphema, retinal tear or detachment, vitreous haemorrhage, and lens damage as factors associated with worse final outcome.[6] In another study, Mann CYW also reported RAPD, worse initial visual acuity, lid laceration, posterior wound location, globe rupture and assault injury as the variables associated with poor visual outcome.[19] Valasov A *et al* evaluated 265 eyes of war wounded patients with final BCVA of <20/200 and found out that 77.7% of those eyes sustained open globe injuries and incidence of blindness was higher in open globe zone III injuries.[22] However, in our study zone III injuries were not significantly associated with poor visual outcome (p=0.423). Improvised explosive device (IED) blasts accounted for 41.93% of injuries in our study. Erdurman FC *et al* in their work on ocular injuries from IED's reported significantly poor visual outcome in open globe injuries and presence of RAPD.[23] Another important aspect of morbidity related to combat ocular trauma is occurrence of concomitant non ocular injuries that accounted for 34.40% cases in our series. However, concomitant non ocular injuries were not associated with poor visual outcome in our study that was similar to the findings by other authors.[21,23]

This study is the largest local study to validate the findings of OTS study analysing sufficient number of eyes to provide reliable comparisons. One of the limitations of the study was its retrospective nature with some information missing from the records such as size of wound, papillary reaction and associated complications. OTS provides quantitative prognostic information about ocular injuries and the system is simple, reliable and reproducible. It is recommended that every ophthalmologist dealing with ocular trauma should have OTS available and apply it during counselling and decision making.

CONCLUSION

OTS is a reliable tool for assessment of ocular injuries and predicting final visual outcome at the outset. It can also be applied in combat ocular trauma with high sensitivity and specificity to predict final visual outcome.

Conflict of interest: None

AUTHORS' CONTRIBUTION

QUI: Designed, data collection, manuscript writing. MI: Conceived, reviewed and finally approved manuscript. MAY: Editing, reviewed and finally approved manuscript. MAM: Data collection, statistical analysis

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