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ASSESSMENT OF VISUAL PROGNOSIS IN PATIENTS WITH OCULAR BURNS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction: Ocular burns are ophthalmic emergencies due to their visual morbidity. The extent of ocular surface involvement at the time of presentation is critically associated with visual outcome. Comprehensive ocular examination and prompt management is needed to optimize visual outcome.

Objective: This study aims to evaluate the epidemiological trends, clinical features of patients with ocular burns and to determine their relationship with visual outcome.

Methods: This prospective, cross-sectional study was conducted on 96 consecutive in-patients who were admitted in the Department of Plastic surgery and Burns in our hospital and sought opinion for ocular burns, irrespective of age and sex. The main outcome measures evaluated were clinical features of ocular burns and prognostic factors associated with visual impairment.

Results: In our study, the mean age (S.D.) of patients was 32.83+/- 18.70 years with both males and females equally affected. The most common mode of injury was thermal injury due to domestic accidents (88.5%). 74% of patients had bilateral ocular presentation. Lid burns (42.2%) and lid edema (41.1%) were the most common ocular findings. About 5.2% of eyes showed corneal involvement. About 14 eyes (7.3%) had severe ocular complications among which one eye developed phthisis bulbi. 20 eyes (16.1%) had visual acuity of less than 6/60 causing visual morbidity. In multivariate logistic regression analysis, corneal involvement ($p<0.001$) and ocular complications ($p=0.011$) had a significant association with visual impairment.

Conclusion: Corneal involvement and ocular complications are less common in facial burns due to Bell's phenomenon and protective blink reflex. However, both factors had a significant influence on visual outcome contributing to visual prognosis. Early intervention and adequate management will lead to favorable visual outcome.

INTRODUCTION

Ocular burns occur less frequently in patients with facial burns due to protective blink reflex and Bell's phenomenon. They occur more likely when the patient actively prevents lid closure while escaping from fire or when the patient is unconscious.[1-3] Ocular burns are classified as chemical injuries, thermal injuries or combined injuries (crackers) based on their etiology. Ocular involvement is more common in thermal burns whereas significant ocular injury occurs in chemical burns. [3-5] Clinical features of ocular injury are pain, photophobia, visual disturbance, lid oedema, corneal ulceration and limbal ischemia.[6,7] Ocular burns can lead to several complications like lagophthalmos, ectropion, corneal exposure with keratoconjuctivitis, phthisis bulbi and loss of vision.[8]

The severity of ocular burns is directly related to the type of causative agents, duration of exposure, area of contact and degree of penetration. Grading of ocular chemical injury is particularly helpful in predicting the visual outcome. Degree of limbal tissue involvement is a major factor for prognosis. Roper-Hall classified chemical injuries into four grades based on level of limbal ischemia and corneal involvement.[9] Dua et al included percentage of bulbar conjunctival involvement as another variable which is of prognostic significance.[10]

Ocular complications occur secondary to eyelid retraction, corneal ulceration and perforation. Adequate and prompt management helps in decreasing visual impairment. Adequate irrigation helps to clear any residual particles and neutralize the pH of the eyes. [11] Assessment of visual acuity, examination of globe and adnexa, slit lamp examination and intraocular pressure measurement are mandatory for all cases.

Periodic review and follow-up are more important as complications due to severe ocular burns will become evident over a period of time. Surgical intervention may be needed in certain cases to reduce inflammation. Amniotic membrane patching in certain cases helps to promote epithelialization and suppression of fibrosis.[12,13] Limbal stem cell transplantation and keratoplasty are recent modalities for treating ocular burns. Hence, this study was aimed to evaluate the epidemiological trends, clinical features of ocular burns and factors predicting visual prognosis among in-patients treated in our institution.

MATERIALS AND METHODS

This prospective, cross-sectional study enrolled 96 consecutive patients who were admitted as in-patients in Department of Burns and Plastic surgery, Government Kilpauk Medical College who sought Ophthalmologist opinion for ocular burns from September 2019 to March 2020 irrespective of age and sex. All patients included in the study received treatment at the earliest with immediate irrigation of fluids. Data regarding patients' age, gender, mode of injury, place of occurrence of injury, percentage of burns and nature of chemical agents were collected and analyzed. Initially anterior segment examination was carried out using torch light and corneal loupe, later with slit lamp during follow up once general condition improved. The depth of the burns and

its extent in the eyelid and the facial area were assessed. If any foreign body was present it was removed.

Clinical features like corneal, conjunctival, limbal involvement and extraocular movements were assessed and documented. Visual acuity assessment was done at bedside using Snellen's chart for distant vision. It was reassessed on day 1, then every 2 days and at time of discharge for all patients. Intraocular pressure was measured using rebound tonometry for selected patients. Bed side fundus examination was done. Prompt medical treatment was started for all cases depending on their ocular presentation with a short course of topical steroids, cycloplegics, antibiotics and lubricants. Ocular complications were assessed and treated at the follow up examination. Best corrected visual acuity less than 6/60 in an eye was considered to be visually impaired.

Statistical Analysis

SPSS version 23.0 was used for statistical analysis. Age of the participants was represented as mean +/- standard deviation in years and categorical variables were represented by frequency distribution. Independent variables such as age, gender, time of presentation, mode of injury, percentage of burns, corneal involvement and complications were entered into a binary logistic regression analysis, one at a time, with the dependant variable, visual impairment. A multivariate logistic regression analysis was performed for those independent variables which had a relationship with visual impairment ($p<0.05$). P value <0.05 was considered as statistically significant.

RESULTS

In our study, the age of the patients ranged from one year to eighty years with the mean age (S.D.) of presentation was 32.83+/- 18.70 years. Majority of patients in our study belonged to the age group of 21-40 years (52.08%) [Figure 1]. Among 96 patients in our study, 49 were males (51.04%) and 47 were females (48.96%) [Figure 1]. The involvement of burns according to the body surface area among patients is depicted in the Table 1. 14 patients (14.6%) showed severe burns of more than 70% body surface area [BSA] and 23 patients (23.9%) had moderate burns of 40-49% BSA.

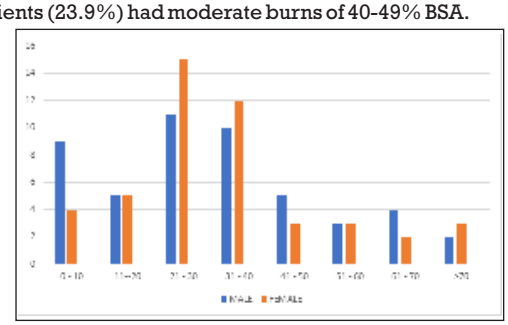

Figure 1. Bar graph depicting Age and Gender distribution of the study population. X-axis denotes age in years and Y-axis denotes the number of male and female patients.

Table 1. Involvement of burns according to the body surface area among the patients

Percentage of burns [BSA]	Cases Frequency (Percentage)
<10	16 (16.7%)
10-19	13 (13.5%)
20-29	7 (7.2%)
30-39	3 (3%)
40-49	23 (23.9%)
50-59	17 (17.7%)
60-69	4 (4%)
>70	14 (14%)

BSA – Body surface area

In our study, majority of patients [85 (88.54%)] had thermal injuries, 7 patients (7.3%) had chemical injuries and 4 patients (4.16%) had injury due to combined mechanism. The various chemical agents causing ocular injury among patients is described in Table 2. Most common mode of thermal injury was domestic accidents (88.5%). Medicolegal nature of the injury was found to be accidental in 60 (62.5%) patients, suicidal in 30 (31.25%) patients and homicidal in 6 (6.25%) patients.

Table 2. Various chemical agents causing ocular injury among the patients.

Chemical agent	Number of cases
ACID INJURY	
Sulphuric acid	2
Hydrofluoric acid	1
Carboxylic acid	1
ALKALI INJURY	
Ammonia	2
Lime	1

In our study, 71 (73.96%) patients had bilateral ocular presentation and 25 (26.04%) patients had unilateral burns with right eye commonly involved. Based on the time of presentation to our hospital, 51 patients (53.1%) reported within 6 hours of injury, 30 patients (31.3%) between 6-24 hours and 15 patients (15.6%) after 24 hours of injury. The various ocular presentations in our study are depicted in Table 3. Lid burns were present in 81 eyes (42.19%) and lid oedema in 79 eyes (41.1%). Six eyes (6.25%) presented with lagophthalmos and 22 eyes (11.4%) with conjunctival chemosis. Corneal involvement in the form of corneal ulceration, erosion and perforation were seen in 11 eyes (5.7%), among which limbal ischemia was seen in three eyes (1.56%) [Figure 2, Figure 3]. Among the six patients with firecracker injury, one patient had corneal tear, iris prolapse, hyphema, with both intra and extraocular foreign body [Figure 4]. Two eyes (1.04%) presented with traumatic cataract and two eyes with subconjunctival haemorrhage.

On follow up, four eyes (2.1%) developed cicatricial ectropion [Figure 5]. Four eyes (2.1%) had exposure keratitis and two eyes (1.04%) developed leucomatous corneal opacity. Two eyes (1.04%) developed Symblepharon [Figure 6], one eye (0.52%) developed secondary glaucoma and one eye (0.52%) developed phthisis bulbi [Table 4]. 15 patients died due to systemic complications. In our study significant fundus changes were not noted in any patient.

Table 3. Clinical ocular presentation at the time of injury.

Clinical ocular presentation	Eyes Frequency (Percentage)
Lid burns – Superficial Deep	37(19.3%) 44(22.9%)
Lid oedema	79(41.1%)
Lid retraction	3(1.5%)
Lagophthalmos – With good Bell's Phenomenon With poor Bell's Phenomenon	4(2.1%) 2(1.04%)
Conjunctival oedema	22(11.4%)
Conjunctivitis	23(11.9%)
Subconjunctival haemorrhage	2(1.04%)
Limbal ischemia	3(1.5%)
Corneal erosion	5(2.6%)
Corneal ulcer	1(0.52%)
Corneal perforation with Pseudocornea	1(0.52%)
Traumatic Cataract	2(1.04%)
Both Extraocular and Intraocular Foreign body with corneal tear with Iris Prolapse with Hyphema	1(0.52%)

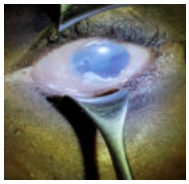

Figure 2 : A 31 year old male with acid injury showing 360˚limbal ischemia

Figure 3: A 31 year old with acid injury showing corneal perforation

Figure 4: A 13 yr old boy showing corneal tear with iris prolapse in right eye due to fire cracker injury (A-left); Post-treatment image (B-right)

Figure 5: A 26 year old male with left eye lowerlid cicatricial ectropion and corneal ulcer

Figure 6: A 28 year old male with chemical burns showing Symblepharon

Table 4. Ocular complications among the patients.

Ocular complications	Eyes Frequency (Percentage)
Cicatricial Ectropion	4(2.1%)
Anterior uveitis with secondary glaucoma	1(0.52%)
Exposure Keratitis	4(2.1%)
Symblepharon	2 (1.04%)
Corneal opacity	2(1.04%)
Phthisis bulbi	1(0.52%)

Visual acuity at the time of presentation and at the time of discharge is shown in Table 5 and Table 6 respectively. After Log MAR conversion, mean visual acuity was found to be 0.6 (6/24) at the time of presentation and 0.32 (6/12) at the time of discharge. In our study, a visual acuity of less than 6/60 was considered to be visually morbid. About 115 eyes (78.8%) had visual acuity equal to or above 6/60 at the time of presentation. Only 31 eyes (21.2%) had visual acuity of less than 6/60 thereby rendering them as visually morbid. In our study, 15 patients (15.63%) died due to systemic complications and eight children were less than 6 years of age. Excluding these 23 patients, visual impairment was analysed with factors predicting visual prognosis in all other patients. After adequate management, 126 eyes (86.3%) had visual acuity of more than 6/60. However, 20 eyes (13.7%) did not improve and was visually morbid, out of which 3 eyes (2.05%) became blind. All patients had normal intraocular pressure [IOP] at the time of presentation. Only one patient developed uveitis with secondary glaucoma with an IOP of 26mmHg.

Table 5. Visual acuity of the patients at the time of presentation.

Visual acuity	Eyes Frequency (Percentage)
6/6	17 (11.64%)
6/9 – 6/12	20 (13.70%)
6/18 – 6/24	31 (21.23%)
6/36 – 6/60	47 (32.19%)
5/60 – 4/60	13 (8.90%)
3/60 – 2/60	10 (6.85%)
1/60 - Hand movements+	4 (2.74%)
Perception of light+	3 (2.05%)
No perception of light	1 (0.68%)

Table 6. Visual acuity of the patients at the time of discharge.

Visual acuity	Eyes Frequency (Percentage)
6/6	29(19.86%)
6/9– 6/12	42(28.77%)
6/18 – 6/24	31(21.23%)
6/36 – 6/60	24(16.44%)
5/60 – 4/60	9(6.16%)
3/60 – 2/60	5(3.42%)
1/60 - Hand movements+	3 (2.05%)
Perception of light+	2(1.37%)
No perception of light	1(0.68%)

Binary logistic regression analysis revealed that the variables such as age, gender, time of presentation, mode of injury, percentage of burns, place of occurrence were not associated with visual impairment ($p>0.05$). Variable such as corneal involvement ($p<0.001$) and complications ($p<0.001$) had statistically significant association with visual impairment. Multivariate logistic regression analysis also revealed that corneal involvement and complications were significantly related to visual impairment. The results showed that corneal involvement had 47 times risk and complications had 6.6 times risk for visual impairment [Table 7].

Table 7. Logistic regression analysis of independent variables leading to visual impairment

Independent variable	Binary logistic regression Odds ratio (p value)	Multivariate logistic regression Odds ratio (p value)
Corneal involvement		
Absent	Reference	Reference
Present	0.013 (0.001)	47.16 (0.001)
Complications		
Absent	Reference	Reference
Present	0.082 (0.001)	6.60 (0.011)

DISCUSSION

This study was conducted among 96 consecutive in-patients admitted in our hospital presenting with ocular burns to evaluate epidemiological trends, clinical features and their association with visual outcome to predict visual prognosis. In our study, the mean age (S.D.) of presentation of patients was 32.83+/- 18.70 years with 51.04% males and 48.96% females. Farooq et al [14], in their study showed female preponderance (66.66%) and most patients presented between 20-30 years of age. On the contrary, males and females were almost equally affected in our study. Farooq et al also reported that accidental burns (82%) were more prevalent than homicidal (12.9%) and suicidal (5%).[14] This is similar to our study findings which showed increased prevalence of accidental burns in 62.5% of

cases.

In our study, the most common mode of injury was thermal injury due to domestic accidents (88.5%). Stern et al., in their study also stated that domestic explosions was the major cause for facial burns.[18] J. berry et al., also cited similar results to our study, with 87% of patients were due to thermal burns.[16] In another study by Sarabahi et al, 84% of ocular burns were due to chemical injury and 16% due to thermal injury.[17] Our results were different from the previous study as only in-patients burns were included and minor chemical injuries presenting in the out-patient department were excluded. Bilateral ocular burns occurred in 71 patients (73.96%) in our study as against a reported incidence of 26% of bilateral cases according to the study by Hong J et al[18].This is because of the fact that domestic accidents caused by kerosene and gas stove explosions cause extensive ocular damage.

Majority of patients in our study had more than 40% body surface area burns. However, visual impairment of less than 6/60 occurred in only 13.7% of eyes due to protective mechanism of eyelids by blink reflex and bell's phenomenon. About 15 patients (15.63%) reported to our institution after 24 hrs of injury, being treated elsewhere at a primary health care. Hence, we are unable to recommend a specific time frame for review due to lack of data regarding exact time of presentation at primary health care. However, all other patients received adequate timely intervention which showed a visual improvement in 86.3% of eyes.

In our study, lid oedema and lid burns were the most common clinical findings seen at the time of presentation followed by conjunctival chemosis and conjunctivitis. Corneal complications were seen in 11 eyes (5.7%), out of which limbal ischemia was noted in 3 eyes (1.5%). Traumatic cataract was reported in two eyes which was in concordance with results reported by Hong J et al.[18] One patient in our study had fire cracker injury with extra and intra ocular foreign body, corneal tear and iris prolapse. Adequate and timely intervention with removal of both foreign bodies and repair of corneal wound had a good prognosis on visual outcome. The subject showed visual improvement from perception of light to 6/36. This emphasises on comprehensive evaluation of all eyes with ocular burns injury.

Visual acuity is a crucial component in determining visual prognosis. In our study, 126 eyes (86.3%) recovered to a visual acuity of more than 6/60 and only 20 eyes (13.7%) did not improve and were visually impaired, out of which 3 eyes became blind. This was similar to the results obtained by Saini et al which showed 30 of 145 eyes had a visual acuity of less than 6/60 and 10% of these became blind.[19] However, any pre-existing cause for visual morbidity prior to injury could not be assessed. Pre exposure visual acuity and presence of other ocular diseases causing visual impairment could not be excluded which is a limitation of this study. Hence only the risk factors and not the exact cause of visual impairment could be evaluated.

Epidemiological data regarding prognostic factors for visual outcome is limited. In our study, despite adequate timely intervention, the degree of corneal involvement played a crucial factor in predicting visual outcome of the eyes. By multivariate logistic regression analysis, we found that corneal involvement and ocular complications were independent factors associated significantly with visual impairment whereas age, sex, mode of injury, time of presentation percentage of burns were not relevant factors. Although it is generally accepted that the causative agent has a correlation with visual impairment, the present study states that corneal involvement and complications are strongly correlated to visual outcome rather than the causative agent. Also timely and adequate management will help in reducing the ocular damage, thereby contributing to better visual outcome.

In a study on vision related quality of life in patients, age and education had a significant impact on visual acuity due to better health care access and treatment compliance. [20] We consider the disparity in our study, as most patients were illiterate and from poor socioeconomic status. They were unaware of dangerous effects of chemicals and safe household working practices. Therefore, formal education and use of protective devices should be encouraged to prevent ocular burn injuries.[21,22]

CONCLUSIONS

Ocular burns injury is comparatively rare and not life threatening but still ophthalmic complications need to be identified early due to associated visual morbidity which emphasises the importance of early ophthalmic intervention and review when ocular and adnexal injury is noted. Visual impairment is low even in higher degree of facial burns which emphasises the efficiency of Blink reflex and Bell's phenomenon. Corneal involvement and ocular complications had a significant impact on visual impairment and are considered as the prognostic factors of visual outcome. Finally, comprehensive education and reinforcement of safe working practices at both home and workplace with proper use of protective devices are crucial for reducing incidence of ocular burns injury.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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