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OCULAR CHEMICAL INJURIES: A CLINICAL STUDY

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ABSTRACT **OBJECTIVE:** To study the clinical profile and visual outcome of ocular chemical injuries. **MATERIALS AND METHODS :** The study involves cases of ocular chemical injury. Detailed history regarding the injury was taken . The visual acuity was assessed. Slit-lamp, direct, and indirect ophthalmoscopes were used to perform a thorough eye examination. Roper Hall classification was used for clinical grading. Other ocular investigations were carried out if needed. **RESULTS :** A total of 57 eyes from 49 patients were included in this study. Lower socioeconomic groups have a higher rate of chemical injuries. Alkali injuries (65%) were more common than acid injuries (35 percent). The most common etiological agent was calcium carbonate (30%). The majority of chemical injuries were unilateral (72 percent). A large percentage of patients (49%) are in grade 1 and a small percentage are in grade 4 (5 percent). The majority of individuals with grade 1 chemical injury had visual acuity greater than 6/12. The final visual acuity is determined by the initial grading and visual acuity; the higher the grade, the lesser are the chances of significant visual improvement. **CONCLUSION :** Early presentation with good presenting visual acuity is associated with a favourable structural and visual prognosis as well as fewer complications. Lower grades of injury had a better final visual outcome. Alkali injuries in grades 3 and 4 are more severe than acid injuries.

KEYWORDS : Ocular chemical injuries, alkali injuries, acid injuries

INTRODUCTION:

Ocular chemical injuries represent one of the true ocular emergencies. Chemical injury to the eye accounts for a significant portion of ocular trauma. Ocular chemical injuries constitute 7.7% to 18% of all ocular traumas.[1-4] Chemical exposure to eye results in trauma ranging from mild irritation to severe damage to the ocular surface and anterior segment which can ultimately lead to permanent vision loss.

Chemical injury can be both from acid and alkali. Alkali injuries occur more frequent and severe than acid injuries.[5] Common causes of alkali injury included lime (CaOH2), ammonia (NH3), lye (NaOH), potassium hydroxide (KOH), magnesium hydroxide (MgOH2).[6] Lime is the most common cause of alkali injury. Ammonia, which is found in household cleaning agents and lye, is associated with the most severe alkali injuries. Alkalis penetrate more readily into the eye than acids, damaging stroma and endothelium as well as intraocular structures such as iris, lens, and ciliary body. Irreversible intraocular damage has been noted to occur at aqueous pH levels of 11.5 or greater.[7] Ammonia can be detected in the anterior chamber with a rise in pH within seconds of exposure. Sulfuric (H2SO4), sulphurous (H2SO3), hydrofluoric (HF), acetic (CH3COOH), and hydrochloric (HCL) acids are the most common of acidic injuries.[8]

Hydrofluoric acid causes the most serious acid injuries due to its low molecular weight, which allows easier penetration through the stroma. The most common cause of acid injuries is sulphuric acid, which is commonly found in industrial cleaners and automobile batteries.[9]

The injury may be compounded by thermal burns from heat generated by the acid's reaction with water of the precorneal tear film.[10] Acids generally cause less severe ocular injury than alkalis as the immediate precipitation of epithelial proteins offers some protection by acting as a barriers to intraocular penetration causing more superficial damage.[11]

In addition to corneal and intraocular injury, chemical injuries results in complications due to damage to the conjunctiva and anterior orbital tissues.[12] Ischemic necrosis of the conjunctiva induces the loss of vascularisation at the limbus as well as the infiltration of leucocytes. Late sequelae of severe injuries include cicatrization of the conjunctiva with symblepharon formation and entropion.[13] The sequels of chemical injury may have significant detrimental visual and psychological effects on the affected individual. Proper management in the acute setting as well as follow up is crucial in limiting adverse effects of ocular tissue damage secondary to the chemical injury.

MATERIAL AND METHODS:

Data has been collected from patients attending Regional Eye Hospital, Kurnool, during the period of August 2019 - May 2021.

Type of study: Prospective observational study

Inclusion Criteria: All cases of ocular chemical injuries who attended the ophthalmic casualty.

Exclusion Criteria: Preexisting ocular pathology or other form of trauma.

Scoring system: Roper Hall Classification for grading of limbal ischemia in chemical burn was used.

Grade 1 Clear cornea (epithelial damage only) and no limbal ischemia Excellent prognosis

Grade 2 Hazy cornea but with visible iris detail and less than one-third of the limbus being ischemic Good prognosis

Grade 3 Total loss of corneal epithelium, stromal haze obscuring iris detail and between one-third and half limbal ischemia Guarded prognosis

Grade 4 An opaque cornea and more than 50% of the limbus showing ischemia Poor prognosis.

As soon as a case of ocular chemical injury presented to the casualty first aid was given in form of thorough irrigation with ringer lactate or

normal saline for minimum 30 minutes, pH was measured and superior and inferior fornix was examined for presence of any retained or embedded particulate matter and was removed carefully.

Detailed history of the patients and history of presenting complains was taken. The ocular examination was performed visual acuity was recorded by using Snellen's test type Chart. A thorough examination was carried out on slit-lamp, direct & indirect ophthalmoscope. Clinical grading was done by Roper Hall Classification. Other ocular investigations were done when required. Patient was managed medically and/or surgically accordingly. Final visual outcome was noted at 3 months after injury.

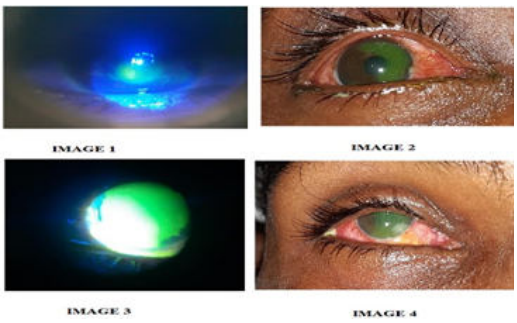

Figure 1: Images Showing Ocular Involvement In Chemical Injuries

IMAGE 1: Slit lamp image showing central epithelial defect
IMAGE 2: Image showing conjunctival congestion and epithelial defect involving half of the cornea
IMAGE 3: Slit lamp image showing complete involvement of the cornea
IMAGE 4: Image showing eyelid edema, conjunctival congestion, limbal ischemia from 4'O clock to 6'O clock and corneal epithelial defect.

RESULTS:

In the present study, 57 eyes of 49 patients were included of which 65.30%(32 patients) were adult male; 14.28%(7 patients) adult females and 20.40% (10) children. The mean age was 23 +/- 12 years. Most of the cases were laborers 75%, followed by students 25%.

Most common causative agent of chemical injury was calcium carbonate (lime) 31% followed by ammonia 12% Sulphuric acid (vitriolage, mobile battery) was the most common cause of acidic ocular injury 19% . Most of the cases had unilateral involvement 83.68 (41 cases) and only 16.32% (8 cases) in which alkali injury 33 patients (67.3%) were more than acid injury 16 patients (32.7%).

Table 1: Table showing incidence of laterality in chemical injury of eye.

Laterality	Acid Injury		Alkali Injury		Total (%)	
	No. of Patients	Percentage	No. of Patients	Percentage	No. of Patients	Percentage
Unilateral	12	24.5	29	59.1	41	83.68
Bilateral	4	8.2	4	8.2	8	16.32
Total	16	32.7	33	67.3	49	100

Table 2: Grade wise distribution of cases of chemical injury.

Grade of injury	Acid injury		Alkali injury		Total	
	No. of eye	Percentage	No. of eye	Percentage	No. of eye	Percentage
I	9	15.7	19	33.33	28	49
II	6	10.52	11	19.29	17	30
III	4	7.01	5	8.77	9	16
IV	1	1.75	2	3.50	3	5
Total	20	35.08	37	64.91	57	100

As per the Roper Hall Classification, most of eyes sustained grade I chemical injury 49% (28 eyes); followed by grade II with 30% (17 eyes): grade III with 16% (9eyes): grade IV were 5% (3 eyes). Most of the injured eye i.e. 78% had been exposed to chemical agent for a smaller duration of <15 min, only 6% with exposure of long duration of >1 hour.

It has been observed that the duration of exposure to chemical agent in most of the cases of less severe grade I and grade II injury was <15 min while more severe grade III and grade IV injury had duration of exposure of >15.

Table 3: Comparative analysis between different grades of chemical (acid / alkali) injury and visual impact at presentation.

BCVA at presentation	Acid Injury				Alkali Injury				Total
	Grades				Grades				
	I	II	III	IV	I	II	III	IV	
<_6/12	7	1	-	-	11	5	-	-	24
6/18-6/60	2	4	-	-	8	4	1	-	19
5/60-1/60	-	1	3	-	-	2	3	-	9
CF3FT-PL+	-	-	1	1	-	-	1	2	5
Total	9	6	4	1	19	11	5	2	57

Table 3 shows the visual acuity at presentation in comparison with the grading of acid/alkali injury. Higher grade of ocular injury was associated with lower visual acuity.

Table 4: Correlation between grade of injury and final visual outcome at final followup.

Final BCVA	Acid Injury				Alkali Injury				Total
	Grades				Grades				
	I	II	III	IV	I	II	III	IV	
<_6/12	9	5	-	-	18	7	-	-	39
6/18-6/60	-	1	3	-	1	3	2	-	10
5/60-1/60	-	-	1	1	-	1	2	-	5
CF3FT-PL+	-	-	-	-	-	-	1	2	3
Total	9	6	4	1	19	11	5	2	57

Table 4 depicted the visual acuity at final follow-up. This shows that the final visual acuity is dependent on the initial grading and vision, higher the grade lesser are the chances of significant visual improvement. The complications that were noted in the present study were various grades of corneal opacities in 24% eyes, symblepharon in 5%; ectropion 2%.

DISCUSSION

In the present study, the mean age of presentation was 23 +/_ 12 years emphasizing the vulnerability of young adults and school aged children. Kuckelhorn R et al.[14] in a retrospective study on the incidence and prevalence of ocular chemical injury also reported that 70% of patients were adult males, 23% were adult females and 7% were children. Singh P et al.[15] found that chemical injuries of the eyes occur most often among the age group from 20 to 40 years. Haring RS et al.[16] reported median age of 22 years in their study done in the United State in sample of 900 patients. Adult males were most commonly affected as they are more exposed to chemical in working place. Second most common group is school aged children which were accidently exposed to chemicals during playing. In the previous studies of chemical injury of eye incidence in males had been high as compared to females.

As reported by other authors as well as in this study, male outnumbered females in the frequency of chemical injury. In the present study accidental and work related injuries were more common. Kuckelkorn R et al.[14] in their study concluded that 73.8% were industrial accidents, while Midelfart A et al.[19] stated that 49% chemical injury occurred in the workplace and 28% at home due to accidental exposure. Chemical ocular injuries are more common in lower social strata.[16] Prevalence of chemical injuries decreased with betterment in socioeconomic status and was more in lower classes. Studies have also reported a higher prevalence of chemical trauma among the illiterates, with illiteracy being more frequent in the lower socioeconomic group. Moreover poor knowledge about ocular safety and involvement in practices having higher risk of ocular injuries make them more prone of sustaining chemical injuries. Alkali injuries were more common than acid injuries. Various previous studies have showed the similar results.[16-20]

According to Midelfart et al.[19] and Vajpayee RB et al.[18] and other authors have reported lime as the most common cause of alkali injuries. It was found that severe injuries i.e. grade III & IV injuries were caused by alkalis being as alkali causes more tissue damage than acids due to its deeper penetration into the ocular tissue. Most of cases in the present study had lower grade of ocular injury as they were given prompt first aid on reaching to the hospital which decreases the ongoing process of ocular damage by removing the insulting chemical agent.

CONCLUSION:

Early presentation with good presenting visual acuity carries a good

structural and visual prognosis and lesser complications. Recovery rate in lower grades were higher than the more severe grades. Despite advances in medical and surgical treatment modalities, the consequences of severe ocular chemical burns can have profound psychological, economic, and social consequences for the patient. For this reason, a proactive approach to prevention becomes the effective. For this reason, a proactive approach to prevention becomes the effective. The principles of primary prevention include knowledge of risks via patient education and utilizing proper safety equipment (eyewear) and practices, are the best measures to avoid the arduous therapeutic course for recovery of vision. For patients presenting with chemical ocular injuries, whether they occur in the workplace or at home, early recognition and prompt treatment by the treating physician remain the standards for maximal preservation of ocular tissue and provide hope for preservation of vision.

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