Original Research Paper

Volume - 12 | Issue - 09 | September - 2022 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Ophthalomology

CLINICAL OUTCOMES AND EVALUATION OF CHEMICAL INJURIES OF THE EYE

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ABSTRACT **Background:** Ocular chemical injuries are a true ocular emergency and require immediate and intensive evaluation and treatment. The sequels of chemical injury may have significant detrimental visual and psychological effects on the affected individual. Effective diagnosis and treatment within time following the initial injury often dictate the clinical course and can prevent tragic consequences. The aim of the present study is to study the clinical profile & visual outcome of ocular chemical injuries **Methodology:** A descriptive observational study was carried out including 100 eyes of 78 patients after meeting inclusion and exclusion criteria. Detailed history was taken and thorough ocular examination was carried out pertaining to the injury. Visual acuity was recorded by Snellen's chart. Clinical grading was done by Roper Hall Classification. Ocular investigations were done when required. Patients were managed medically and/ or surgically. Final visual outcome and slit lamp findings were noted at Day 1,1 Week, 1 Month and 3 months for each affected eye. **Results:** The study included 77% (60) males and 23% (18) females. Mean age was 25 ± 10 yrs. Alkali injuries (68%) was more common than acid injuries (32%). Calcium carbonate (lime) 35% was the most common etiological agent. 56% cases had unilateral involvement. Maximum patients belonged to grade 1 (51%) followed by grade II (27%) and minimum to grade IV (7%). Final visual outcome was found to be dependent on initial grade and visual acuity. **Conclusion:** Presenting visual acuity and grade are important prognostic factors. Higher grades of injuries (grade III and IV) have poorer outcomes than grade I and II. Final visual acuity is also dependent on grade of injury and presenting visual acuity.

KEYWORDS : chemical injury, lime

INTRODUCTION

Ocular chemical injuries are a true ocular emergency and require immediate and intensive evaluation and treatment. Ocular Chemical injuries constitute 7.7% to 18% of all ocular traumas [1]. 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. The sequels of chemical injury may have significant detrimental visual and psychological effects on the affected individual.

Chemical injury can be both from acid and alkali. Alkali injuries occur more frequent and severe [2]. Acids generally cause less severe ocular injury than alkalis as the immediate precipitation of epithelial proteins offers some protection by acting as a barrier to intraocular penetration causing more superficial damage[7].

Common causes of alkali injury included ammonia (NH3), lye (NaOH), potassium hydroxide (KOH), magnesium hydroxide ($MgOH_2$), and lime ($CaOH_2$) [3]. 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 the iris, lens, and ciliary body. Irreversible intraocular damage has been noted to occur at aqueous pH levels of 11.5 or greater [4]. Ammonia can be detected in the anterior chamber with a rise in pH within seconds of exposure [5]. Sulfuric (H_2SO_4), sulfurous (H_2SO_3), hydrofluoric (HF), acetic (CH_3COOH), and hydrochloric (HCL) acids are the most common causes of acidic injuries [3]. Hydrofluoric acid causes the most serious acid injuries due to its low molecular weight, which allows easier penetration through the stroma [6]. The most common cause of acid injuries is sulfuric acid, which is commonly found in industrial cleaners and automobile batteries [6]. The injury may be compounded by thermal burns from heat generated by the acid's reaction with water of the precorneal tear film [7].

In addition to corneal and intraocular injury, chemical injuries result in complications due to damage to the conjunctiva and anterior orbital tissues [8]. Ischemic necrosis of the conjunctiva induces the loss of vascularization at the limbus as well as the infiltration of leukocytes [9]. Late sequelae of severe injuries include cicatrization of the conjunctiva with symblepharon formation and entropion [9].

Although the most devastating sequelae of chemical injuries—corneal melt, limbal stem cell deficiency, and glaucoma—tend to occur over the long term, effective diagnosis and treatment in the minutes and days following the initial injury often dictate the clinical course and can prevent tragic consequences. The goals of therapy are to restore corneal clarity, normalize the ocular surface, and prevent glaucomatous optic nerve damage. If extensive corneal scarring is present, limbal stem cell grafting, amniotic membrane transplantation and possibly keratoprosthesis can be employed to help restore vision. The aim of the present study is to study the clinical profile & visual outcome of ocular chemical injuries.

MATERIAL AND METHODS

This is a descriptive observation study. Men and women with a diagnosis of chemical burns to eye who apply to the OPD/casualty of Upgraded Department of Ophthalmology, S.M.S. Medical College and Hospital, Jaipur, Rajasthan were studied.

After IEC approval study was conducted over 6 months starting from September 2021 till the sample size was attained. Sample size was calculated at 95% confidence interval expecting 47% grade 1 injuries following chemical exposure as found in reference study. At the absolute allowable error of 10%, minimum 90 eyes were required as sample size which was enhanced and rounded off to 100.

All patients fulfilling the inclusion and exclusion criteria were included. Inclusion criteria incorporated patients with ocular chemical injuries who attended the ophthalmic casualty and who gave well-informed written consent. Patients with preexisting ocular pathology or other form of trauma were excluded. Also patients with other ocular or systemic disorders that could compromise vision and Non-cooperative patients were excluded.

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 recorded by using Snellen's test type Chart. A thorough examination was carried out on slit-lamp(BQ 900 Slit lamp (Haag-Streit AG), 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 Day 1, 1 Week, 1 Month and 3 months for each affected eye

Collected data was entered in Microsoft Excel Worksheet. Mean value and Standard Deviation (SD) was calculated for all the parameters. Comparison and analysis as per the Aims and Objectives before mentioned was done with an appropriate Statistical Test. A p value less than 0.05 was considered statistically significant.

OBSERVATION AND RESULTS

In this study we included 78 patients, out of 78 patients 22 (28.2%) patients had bilateral involvement and 56(71.8%) patients had unilateral involvement. Thus 100 eyes were studied.

We observed that out of 78 patients, majority of the study population were in the age group 21-25 years of age (41.0%). Most were males (76.9%). Mean age was found to be 25.06±4.45 year. Table 1.

Table 1: Demographic characteristics of the study population

Demographic characteristics	Number of patients (N=78) n(%)
Gender	
Male	60(76.9)
Female	18(23.0)
Age group (years)	
15-20	10(12.8)
21-25	32(41.0)
26-30	27(34.6)
>30	9(11.5)
Eye involvement	
Bilateral	22(44 eyes) (28.2)
Unilateral	56(71.8)
Etiology	
Acid	25(32.1)
Alkali	53(67.9)

It was also observed that 53(67.94%) patients were affected by alkali and 25(32.05%) patients by acid. Majority (34.61%) of patients were affected from lime followed by 15 (19.23%) patients were affected by Sulphuric Acid and 10(12.82%) patients were affected by firecrackers. Table 2.

Table 2: Description of injury

Injury description	Number of patients (N=78) n(%)
Agent	
Lime	27(34.6)
Sulphuric acid	15(19.2)
Firecracker	10(12.8)
Ammonia	9(11.5)
Cement	5(6.4)
Insecticide	4(5.1)
HCL	3(3.8)
Detergent	2(2.5)
HF	2(2.5)
Cyanoacrylate	1(1.2)
Acid injury – Grade	
I	11(32.3)
II	11(32.3)
III	7(20.5)
IV	5(14.7)
Alkali injury- Grade	
I	40(60.6)
II	16(24.2)
III	8(12.1)
IV	2(3.0)

The number of patients were higher in grade one alkali injury group with 40 (60.6%) patients and in acid injury group, there are more patients in grade one and two with 11(32.35%) patients each. Least number of patients were seen in grade four of alkali injury with 2 patients.

We correlated vision at first presentation with etiology and grade. The distribution is shown in table 3.

TABLE 3: Distribution according to Grade of injury.

Vision at presentation	Acid Injury				Alkali Injury				Total
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 1	Grade 2	Grade 3	Grade 4	
<6/12	8	-	-	-	15	-	-	-	23
5/60-1/60	3	3	-	-	12	10	-	-	28
6/18-6/60	-	5	4	-	13	6	5	-	33
CF3FT-PL+	-	3	3	5	-	-	3	2	16
Total	11	11	7	5	40	16	8	2	100

In table 4 we corelated vision at follow up day 1, at follow up week 1, at follow up month 1 and at follow up month 3 with etiology.

Table 4: Vision on follow up.

Vision		Acid Injury				Alkali Injury			
		Grade 1	Grade 2	Grade 3	Grade 4	Grade 1	Grade 2	Grade 3	Grade 4
at follow up day 1	<6/12	8	2	-	-	19	-	-	-
	5/60-1/60	3	6	2	-	10	10	-	-
	6/18-6/60	-	3	3	-	11	6	5	-
	CF3FT-PL+	-	-	2	5	-	-	3	2
at follow up week 1	<6/12	9	2	-	-	21	-	-	-
	5/60-1/60	2	6	2	-	13	12	-	-
	6/18-6/60	-	3	3	-	6	4	6	-
	CF3FT-PL+	-	-	2	5	-	-	2	2
at follow up month 1	<6/12	9	2	-	-	21	-	-	-
	5/60-1/60	2	6	3	-	13	10	-	-
	6/18-6/60	-	3	2	-	6	4	6	1
	CF3FT-PL+	-	-	2	5	-	-	2	1
at follow up month 3	<6/12	9	2	-	-	21	-	-	-
	5/60-1/60	2	6	3	-	13	10	-	-
	6/18-6/60	-	3	2	1	6	4	6	1
	CF3FT-PL+	-	-	2	4	-	-	2	1

DISCUSSION

A chemical ocular burn usually occurs when a corrosive substance is accidentally introduced to the eye and/or periocular tissues. Chemical burn is considered a true ocular emergency and requires immediate and intensive evaluation and care. This type of injury is most common among men 20 to 40 years of age that typically work in industrial chemical laboratories or factories [10]. Given their younger age, the long-term disabilities that follow ocular burns could dramatically affect the patients' lives. The goal of treatment is to minimize further damage to ocular surface and ultimately restore a normal ocular surface anatomy and visual function.

A total of 78 patients were studied with ocular chemical injuries in our study. Out of 78 patients there were more number of patients between the age group of 21-25 with 32 (41.02%) patients followed by 27 (34.61%) patients in an age group of 26-30 years and 10(12.82%) patients of age group 15-20 years. Minimum number of patients 9 (11.5%) were of age group more than 6 years. Mean age was found to be 25.06±4.45 year. we found that majority 60 (76.92%) of patients were male. A study by Li T et al [11] found that the mean age of the patients was 42.8 ± 12.7 years, ranging from 19 to 74 years. Among these patients, 136 (85%) were males, with a male-to-female ratio of 5.7:1. Dubey A et al [12] found that the mean age of presentation was 22.09±13 years emphasizing the vulnerability of young adults and school aged children. Kuckelhorn R et al [13] 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 [10] found that chemical injuries of the eyes

occur most often among the age group from 20 to 40 years. Haring RS et al [14] reported median age of 22 years in their study done in the United State in sample of 900 patients.

We observed that 53(67.94%) patients were affected from alkali and 25(32.05%) patients were affected from acid. Out of 78 patients, 44 (44%) patients were bilateral and 56(56%) patients were unilateral. Li T et al [11] found that the 41 (25.6%) patients with right eye involvement, 42 (26.3%) patients with left eye involvement, and 77 (48.1%) patients with bilateral eye involvement were included.

We analysed that majority (34.61%) of patients were affected from lime followed by 15 (19.23%) patients were affected by Sulphuric Acid and 10 (12.82%) patients were affected by firecrackers. Dubey A et al [12] found that the present study accidental and work related injuries were more common while Midelfart A et al [15] stated that 49% chemical injury occurred in the workplace and 28% at home due to accidental exposure.

In the two groups, the number of patients were higher in grade one alkali injury group with 40 (60.6%) patients and in acid injury group, there are more patients in grade one and two with 11(32.35%) patients each. There were less number of patients in grade four of alkali injury with 2 patients. Dubey A et al [12] 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 and ph neutralization.

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. 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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