CLINICAL CHARACTERISTICS AND VISUAL OUTCOME OF OCULAR CHEMICAL INJURIES

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ABSTRACT

BACKGROUND

Chemical injuries to the eye is one of the true ophthalmic emergencies. Alkali injuries are more common. Immediate and prolonged irrigation followed by aggressive early management and close monitoring is essential to promote ocular surface healing and provide the best opportunity for visual rehabilitation. The major pathophysiology during chemical ocular burns causes damage to the eyelids, conjunctiva, cornea, and the anterior segment of the eye. At these locations, the damage has the potential to cause permanent visual impairment based on the volume, pH, duration of exposure, and degree of penetration of the chemical offender. The severity of injury is related to the duration of exposure, degree of penetration of chemical and the time gap between exposure and presentation to the hospital. Acids usually causes superficial damage and opacification of cornea and those with alkalis tend to present with a damage to deeper ocular structures. First treatment can form the final deciding factor for visual outcome. Chemical ocular injuries encompass a wide spectrum. There is dearth of information in injuries caused by chemical agents in Kerala, and being a tertiary care centre, Calicut Medical College which was the major source of medical care for the people from low socioeconomic, our proper intervention is the need of hour.

MATERIALS AND METHODS

The relationship between visual impairment and clinical characteristics was analysed using semi structured objective questionnaire, techniques to measure visual acuity and intra ocular pressure, slit lamp examination to investigate limbal ischemia and main visual outcome measured by regular follow up on first week, first month, and third month by looking at limbal ischemia, symblepharon, corneal haze, vascularisation, look for signs of uveitis, lens opacity, visual acuity, IOP.

RESULTS

The commonest age group to be involved was above 19 years. Maximum number of patients in the present study were males. Most of the injuries are accidental and was at workplace. Most common cause of chemical injury was found to be due to alkali 35 (70%). Steroids are given to the patients who had anterior chamber reaction and severe chemical injury which responded well. Early management showed good results.

CONCLUSION

In the present study, most common age group to be involved in chemical eye injuries was 19-56 yrs. (86%) and most patients were males. 72% of chemical injuries were occupational and due to alkali. Most of the chemical injuries were unilateral and had grade 1 chemical injury. 88% of chemical injuries were reported within 24 hrs. Topical steroids when instilled in the acute phase, inspite of an epithelial defect, showed better healing and there were no case of corneal melting. Most common complications were symblepharon, corneal vascularization and leucomatous corneal opacity.

KEYWORDS

Chemical Burns, Alkali and Acid Burns, Limbal Ischemia, Symblepharon, Occupational Hazards.

HOW TO CITE THIS ARTICLE: Velayudhan DK, Francis P, Vallon RK, et al. Clinical characteristics and visual outcome of ocular chemical injuries. J. Evid. Based Med. Healthc. 2018; 5(8), 687-691. DOI: 10.18410/jebmh/2018/139

BACKGROUND

Chemical injuries of the eye may produce extensive damage to the ocular surface epithelium, cornea, and anterior segment, resulting in permanent unilateral or bilateral visual impairment.[1] In addition to causing ocular surface injury, alkalis readily penetrate into the eye, damaging the corneal stroma and endothelium, as well as other anterior segment structures such as the iris, lens, and ciliary body. Most acidic substances tend to remain confined to the ocular surface, where they may threaten vision by producing profound disturbances of the ocular surface. Strong acids, such as hydrofluoric acid, may readily penetrate as quickly as alkalis, producing the same spectrum of ocular injury.[2]

Financial or Other, Competing Interest: None.
Submission 31-01-2018, Peer Review 04-02-2018,
Acceptance 17-02-2018, Published 19-02-2018.
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DOI: 10.18410/jebmh/2018/139

Aetiology- Most victims are young.[3,4] and in most, large series exposure occurs in industrial accidents[3,] at home, and in association with criminal assaults. Because of their more frequent presence in household cleaning agents and in many building materials, alkali injuries occur more frequently than acid injuries.[4]

Aims and Objectives- To study, the clinical characteristics and visual outcome of ocular chemical injuries.

MATERIALS AND METHODS

Study Period- A study period of 1 year which starts from January 2012 to December 2012 and 3 months of regular follow up.

Sample Size- All subjects with inclusion criteria coming during the study period were included. 50 patients were included in the study.

Settings- Department of Ophthalmology, Calicut Medical College.

Study Tool- Pretested semi structured objective questionnaire. Techniques to measure visual acuity and intra ocular pressure. Slit lamp is used to investigate limbal ischemia.

Study Subject- Patients, with chemical injury came to Calicut Medical College.

Methodology- The relationship between visual impairment and clinical characteristics was analysed and main visual outcome measured by regular follow up on first week, first month, and third month by looking at limbal ischemia, symblepharon, corneal haze, vascularisation, look for signs of uveitis, lens opacity, visual acuity, IOP.

Inclusion Criteria-

Subjects, with chemical injury, who gave consent.

Exclusion Criteria-

Critically ill patients and those who were not willing to give consent**.**

RESULTS

Age Wise Distribution.

Mean age = 31.94 ± 12.1 years.

Range: 1 year to 56 years.

Age Group (yrs.)	Number of Patients	Percentage
< 18	7	14%
>19	43	86%
Table 1 Age Wise Distribution		

Gender	Number of Patients	Percentage
Male	29	58%
Female	21	42%
Table 2. Gender Distribution		

Laterality	Number of Patients	Percentage
Unilateral	48	96%
Bilateral	2	4%
Table 3. Laterality		

Occupation	Number of Patients	Percentage
Manual labour	22	44%
Students	13	26%
House wife	14	28%
Others	1	2%
Table 4. Occupation Distribution		

Mode	Number of Patients	Percentage
Accidental	45	90%
Assault	5	10%
Table 5. Mode of Injury		

Type	Number of Patients	Percentage
acid	15	30%
alkali	35	70%
Table 6. Type of Chemical		

Fornix Burnt Area	No. of Patients	Percentage
Present	24	48%
Absent	26	52%
Table 7. Involvement of Fornix		

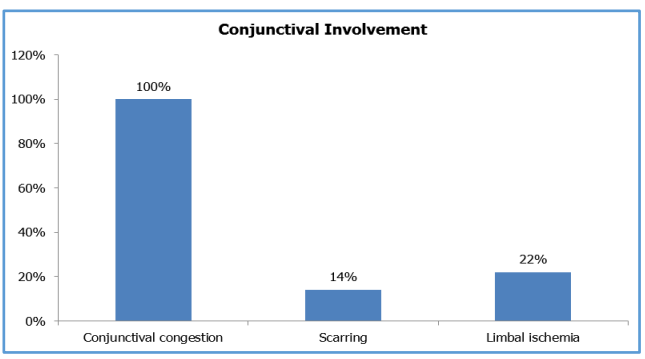

Figure 1. Conjunctival Involvement

Corneal involvement	No. of Patients	%
Epithelium	41	82%
Epithelium & stroma	4	8%
Epithelium, stroma & Descemet's folds	5	10%
Table 8. Corneal Involvement		

Visual acuity	Time of Presentation	%
6/6 - 6/12	34 68%	68%
6/18 - 6/36	13 26%	26%
6/60 - PL	2 4%	4%
no PL	1 2%	2%
Table 9. Visual Acuity in the Affected Eye		

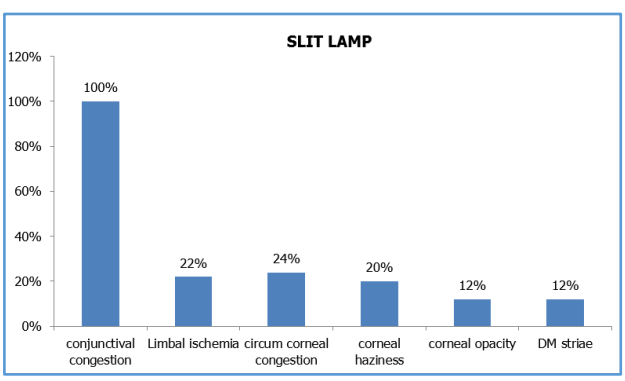

Figure 2. Slit Lamp Examination

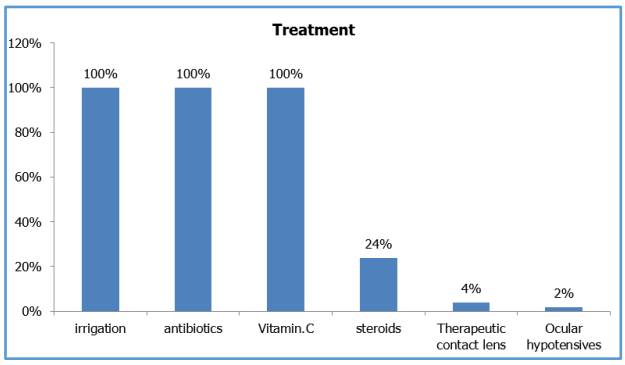

Figure 3. Treatment Given

Irrigation Time	No. of Patients	Percentage
Early	44	88%
Late	6	12%
Table 10. Irrigation Time		

ACR	At time of Presentation	Follow up 1	Follow up 2	Follow up 3
Yes	18	14	16	4
	36%	28%	32%	8%
No	32	36	33	45
	64%	72%	68%	92%
Table 11. Anterior Chamber Reaction				

Sequelae
Drop Out Rate

Follow Up 1	2%
Follow Up 2	2%
Table 12. Drop Out Rate	

No. of Patients in	Follow Up 1	Follow Up 2	Follow Up 3
Symblepharon present	10%	10.2%	10.2%
	5	5	5
Symblepharon Absent	90%	89.8%	89.8%
	45	44	44
Table 13. Symblepharon			

	Followup 1_ symblepharon		Total
	Present	Absent	
affected	5	19	24
	20.8%	79.2%	100.0%
Not affected	0	26	26
	.0%	100.0%	100.0%
Table 14. Crosstab of Follow up 1			

Pearson Chi-Square (N= 50, d. f= 1) = 6.019 P value= 0.014.

P value is <0.05, there is statistically significant association between fornix affected and development of symblepharon.

Crosstab					
		Follow up 2_ symblepharon		Total
		Present	Absent	
fornix	affected	5	18	23
		21.7%	78.3%	100.0%
	Not affected	0	26	26
		.0%	100.0%	100.0%
Table 15. Crosstab of Follow up 2				

Pearson Chi-Square (n= 50, df= 1) 6.294 P Value = 0.012 P value is <0.05, there is statistically significant association between fornix affected and development of symblepharon.

Crosstab					
		Follow up 3_ symblepharon		Total
		Present	Absent	
fornix	1 affected	5	18	23
		21.7%	78.3%	100.0%
	2 Not affected	0	26	26
		.0%	100.0%	100.0%
Table 16. Crosstab of Follow up 3				

Pearson Chi-Square (N= 50, d.f= 1) = 6.294 P Value = 0.012.

P Value <0.05, statistically significant association is present between involvement of fornix and development of symblepharon in follow ups.

Grade 1	39 (78%)
Grade 2	8 (16%)
Grade 3	1 (2%)
Grade 4	2 (4%)
Table 17. Severity of Chemical Injury	

Visual acuity in the affected eye.

Visual Acuity	Time of Presentation	Follow up - 1	Follow up - 2	Follow up - 3
6/6 - 6/12	80% 40	64% 32	74% 37	82% 41
6/18 - 6/36	14% 7	30% 15	18% 9	10% 5
6/60 - PL	4% 2	2% 1	2% 1	2% 1
no PL	2% 1	4% 2	4% 2	4% 2
Table 18. Visual Acuity in the Affected Eye				

	At time of Presentation	Follow up 1	Follow up 2	Follow up 3
Limbal ischemia	11 22%	6 12%	4 8%	4 8%
Corneal haziness	10 20%	37 74%	9 18%	5 10%
Corneal vascularisation	0	6 12%	4 8%	4 8%
Table 19. Involvement of Cornea and Limbus				

Crosstab					
		Follow up 3_ limbal ischemia			Total
		Grade 1	Grade 2	Grade 3	
Irrigation time	Early	90.9% 40	9.1% 4	0% 0	100% 44
	Late	83.3% 5	0% 0	16.7% 1	100% 6
Table 20. Crosstab of Limbal Ischemia					

Pearson Chi-Square (n= 50, d. f = 2) = 7.912[a] p value= 0.019 statistically significant association between early irrigation and development of complications.

		Follow up 3_ corneal haziness			Total
			Present	Absent	
irrigation time	1	Early	11.6%	88.4%	100.0%
			5	38	43
	2	Late	33.3%	66.7%	100.0%
			2	4	6

Table 21. Crosstab of Corneal Haziness

Pearson Chi-Square (n= 50, d. f= 1) = 2.026[a] P value= 0.155. The p value is more than 0.05 it is not statistically significant.

Crosstab				
	Follow up 3_ corneal Vascularisation			Total
		Present	Absent	
irrigation time	Early	4.7%	95.3%	100%
		2	41	43
	Late	33.3%	66.7%	100%
		2	4	6

Table 22. Crosstab of Corneal Vascularisation

Pearson Chi-Square (n= 50, d. f=1) = 5.778[a] P value= 0.016.

The P value is less than 0.05, there is statistically significant association between early irrigation and development of complications.

Relative risk= .098 with 95% Confidence Interval.

DISCUSSION

Age Incidence- In the present study the commonest age group to be involved was above 19 years (86%). The ages of youngest and oldest patients were 1 and 56 yrs. respectively. Maximum number of patients belonged to 19-56 years. This was in concordance with other studies.[5]

Gender Distribution- Maximum number of patients in the present study were males 29 (58%) and 21 (42%) females this was in concordance with several studies discussed below which also showed an increased incidence in males. In this study there is increased incidents in females compared to other studies probably due increased working women population.

Laterality- In the present study of 50 patients 48 (96%) patients had unilateral involvement and 2 (4%) patients had bilateral involvement.

Mode of Injury- In this study we can see that most of the injuries are accidental and which was at workplace.

In the present study most of the chemical injuries occurred as an occupational hazard. The studies conducted by Midelfart[6] A et al 2004 and Kuckelkorn.[7] R et al 1993 were in concordance with the present study and implying an increased incidence of chemical injuries occurring at workplace.

Type of Chemical- In the present study the most common cause of chemical injury was found to be due to alkali 35 (70%) cases. Among alkali the commonest agent implicated was lime and ammonia. This was in concordance with the study conducted by Midelfart[6] A et al 2004.

Ocular Symptoms and Signs- In the present study of 50 (100%) eyes had redness, photophobia and lacrimation. In addition more than 32% patients had defective vision. All 50 patients had conjunctival congestion 11 (22%) patients had localized blanching of conjunctiva and 9 patients had severe corneal involvement. 41 had only epithelial corneal injury, 12% has corneal opacification, 12% had folds in Descemet's membrane.

Majority of the patients at the time of presentation had a good visual acuity above 6/12. 2 patients had vision of CF 2M at the time of presentation and later on one developed symblepharon and corneal opacity.

Duration between exposure to chemicals and hospital attendance. - In this present study of 50 patients 44 (88%) patients reported to hospital within 24 hrs. while 6 (12%) patients reported 24 hours after injury. Kersjes MP et al 1987[8] in their study of 500 cases observed that most patients reported to hospital within minutes to hours and this observation was in concordance with the present study.

Steroids are given to the patients who had anterior chamber reaction and severe chemical injury which well responded and some of the patients who were not getting steroid developed anterior chamber reaction in the 1st follow up (32%) and on treatment the incidence decreased in the last follow up (8%).

In the present study 18 eyes had anterior chamber reaction at the time of presentation, in addition to topical antibiotics, ascorbate, mydriatics were put on topical steroids for 10 days. Their visual acuity before and after steroids were recorded. Most of the patient had visual acuity of 6/12 to 6/6 after steroids. One patient with initial vision of 6/60 did not improve because of pre-existing cataract. The final visual acuity after starting steroid improved. The patients who had epithelial defect and on topical steroids also healed without corneal melting. The above observation was in concordance with the study conducted by Davis AR et al 2000.

Severity of Chemical Injury- In the present study grading of chemical injury was done according to corneal epithelial defect, limbal ischemia and involvement of other anterior segment structures proposed by Ralph and Hughes and was found that maximum number of patients 39 eyes (78%) belonged to grade I, 8 eyes (16%) belonged to grade II, 1 eye (2%) belonged to grade III, and 2 eyes (4%) belonged to grade IV. This was in concordance with study of Saini JS, et al 1993.[9]

Ocular Complications Following Chemical Injury- 6 eyes developed symblepharon and corneal vascularisation occurred in 4 eyes. One eye developed leucomatous corneal

opacity. Early irrigation and other treatment with antibiotics, vitamin C, and steroids reduce the risk of developing complications.

In the present study, there is statistically significant association between early irrigation and development of complications.

Management and Follow Up- All (50) patients on arrival to the casualty or outpatient department were subjected to thorough irrigation with normal saline (0.9%) for half an hour. Double eversion of the lids was performed, and all particulate matters found in the conjunctival fornices were removed. Cases with lime injury were irrigated and treated with freshly prepared EDTA solution (0.38%). All patients underwent routine treatment with topical antibiotics, mydriatics, artificial tears, systemic doxycycline, vitamin C, topical eye ointment and pad and bandage (if there is corneal epithelial defect). 18 eyes in the acute phase (0-7 days) in addition to the above routine treatment were given topical steroids for 10 days with tapering dose.

At the end of 10 days of topical steroids all eyes including 36 eyes with epithelial defect were healed. There was no case of corneal melting. 6 patients who developed symblepharon were advised to sweep the conjunctival fornix with glass rod smeared with antibiotic ointment twice a day. One patient who had developed severe epithelial stromal injury was put on hourly fortified Reflin and fortified Gentamicin drops in addition to routine treatment and pad and bandage. At the end of 3 months the corneal injury had healed leaving behind a leucomatous corneal opacity.

Four patients with corneal vascularization and one patient with leucomatous corneal opacity mentioned above were advised penetrating keratoplasty under guarded prognosis. One of the total four patients of corneal vascularisation underwent conjunctival peritomy and got a better result.

All patients were reviewed at 1 week, 1 month and 3 month intervals. During follow up all patients were subjected to visual acuity assessment, slit lamp examination and Schirmer's test.

CONCLUSION

In the present study, most common age group to be involved in chemical eye injuries was 19-56 yrs. (86%) and most patients were males. 72% of chemical injuries were occupational and due to Alkali. Most common alkali was lime and ammonia (detergent solutions) and commonest acid was sulphuric acid.

Most of the chemical injuries were unilateral and had grade 1 chemical injury. 88% of chemical injuries were reported within 24 hrs. Topical steroids instilled in the acute phase in spite of an epithelial defect showed better healing and there were no case of corneal melting. Most common complications were symblepharon, corneal vascularization and leucomatous corneal opacity.

Early irrigation is the first foremost line of management and early and prompt treatment will reduce the risk of developing complications.

Limitations- Since this was a hospital-based study and had a small sample size was the major imitation of this study. One drop out from the study in 2nd and 3rd follow up. Similar published studies about chemical injuries are limited

Suggestions- The main group of ocular chemical injuries are occupational. Health education about first line of management (irrigation) which should be done at workplace itself. Awareness programmes about careful handling of chemicals should be given to industrial persons. Posters should be kept in the industry which contain protocol of management. Approach medical facility as early as possible. Early irrigation and removal of remnants of chemicals must be done to all patients coming with chemical injury. Precaution in keeping all chemicals at home safely, not reachable to children or mentally disabled. Strict follow up has to be ensured to identify and correct complications.

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