Original Research Article

EPIDEMIOLOGY OF OCULAR CHEMICAL INJURIES

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Abstract:

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. 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 structuressuch as iris, lens and ciliary body.

Objective: To study the epidemiology Of Ocular Chemical Injuries**.**

Methods: This prospective study was conducted among all patients who will presented with ocular chemical injuries to Government Rajaji Hospital between the period October 2012 to November 2013.

Result: The mean age of the patient who sustained ocular chemical injuries was 29.05 years. Most of the people who sustained ocular chemical injuries are domestic workers (22.5%) and students (22.5%). Urban people (65%) are prone for chemical eye injuries. Semi urban people (31.7%) and rural people (3.3%) form the minority group in this study. Most literates (76.7%) [College education-36.7%, school education-40%]are prone for chemical injuries. The Right eye was relatively more commonly affected (50%) than the lefteye (30%). In our study, there were 12 cases with bilateral injury (20%). Most of the ocular chemical injuries are accidental (61.7%), work place (21.7%) eye injuries come under second category in our study.

Conclusion: Most chemical eye burns are mild injuries with no lasting adverse effects. Immediate irrigation of the eye is the most important part of treatment. Prophylactic efforts should be increased in order to bring down the incidence of burns. Injuries caused by assault were more severe and people proportionately lost more eyes.

Keywords: Epidemiology, Ocular Chemical Injuries, burns.

INTRODUCTION

Chemical trauma to the eye forms a small but significant part of ocular trauma. Chemical ocular trauma constitutes 7 to 9.9% of reported ocular trauma. The frequency of bilateral ocular involvement has been reported from 23 to 42%. Most victims are young males and the exposure to chemicals occursin industrial accidents, at home, and in association with criminal assaults[1]. Approximately, two-thirds of the injuries are minor (Grades 1 & 2).

Acids and alkalies form the major chunk of ocular chemical burns. Alkali injuries are more commonly encountered. They are extensively used in industries and in various domestic

purposes as cleansing agents. Alkaliinjuries tend to be more severe than acid injuries, because of the quick penetration into eyes[2].

Most acidic substances tend to remain confined to the ocular surface, where they may threaten vision by producing profound disturbances of the ocular surface. However strong acids such as hydrofluoric acid, may readily penetrate as quickly as alkalis, producing the same spectrum of ocular injury[2]. Ocular chemical injuries presents in 3 phases.

1. Acute phase (immediately to 1 week after injury)

Immediately after exposure to chemical, there is disruption of cell membranes leading to loss of corneal/ conjunctival epithelium, keratocytes, corneal nerves, endothelium, blood vessels, cellular and vascular components of iris, ciliary body and lens epithelium.
In milder injuries, this may be restricted to merely corneal and conjunctivalepithelial loss.
Ocular penetration of chemical leads to stromal clouding and edema, ischaemic necrosis of perilimbal tissue, iris and ciliary body. Fibrinous iritis and cataract formation may occur in severe injuries. Intra ocular pressure is affected in a bimodal fashion. The second peak occur within a few hours and is due to aqueous outflow obstruction, and increased episcleral venous pressure, trabecular meshwork damage and inflammatory debris obstructing outflow channels.

Grade III -VI injuries have little or no re-epithelialisation with early keratocyte proliferation, first wave inflammatory cell infiltration, little or no collagenase production, and no corneal neovascularisation.

2. Early reparative phase (1 to 3 weeks after injury)

During the early phase, epithelial migration continues in less severe injury (Grade II), but becomes alarmingly delayed in more severe injury (Grade III onwards). Grade III injuries may show little or no re-epithelialisation, but a surprisingly normal appearance of the limbal region and a relatively clear cornea. As Grade IV-VI injuries involve extensive bulbar conjunctival damage and necrosis of the bulbar conjunctival epithelium associated with limbal ischaemic necrosis, there is usually little change in the clinical appearance during this phase. The combination of additional inflammation loss of limbal blood supply, lack of vascularity, may result in evidence of anterior segment necrosis and sterile corneal ulceration, even at this early stage in Grade IV injuries.

Grade II& III

Normal epithelial recovery occurs in the quadrants with intact limbal stem cells. Because progeny of the limbal stem cells usually do not cross the visual axis, there may be delayed re-epithelialization from the quadrants of limbal stem cell loss. Transient amplifying cells from limbal stem cells may migrate circumferentially into the area of limbal stem cell loss and then migrate centripetally. Pending completion of this process, epithelialization may occur from conjunctival epithelium with transient neovascularisation.

Grades IV-VI

Because complete limbal stem cell loss has occurred, epithelial recovery is rate limited by the total reliance on the slow migration of conjunctival epithelium onto the cornea. Clinical suspicion of a confirmed total limbal stem cell loss should develop by the end of the early repair phase if there is no epithelialisation inside the limbus.

3. Late Repair Phase(Three weeks to several months after injury)

The balance between collagen synthesis and collagen breakdown, which determines the presence or absence of stromal ulceration, ultimately decides the outcome of chemical injury. Progressive or recurrent corneal stromal ulceration leading to descemetocele formation, melting and perforation of the cornea is the most serious complication of chemical burns. Progressive ulceration is the main cause of loss of eye in such injuries. Recurrent less severe ulceration leads to significant visual loss due to irregular corneal surface. Corneal ulceration usually stops when the cornea is totally vascularised. Blood vessels bring in nutrients and precursors of protein and proteoglycan synthesis along with serum collagenase inhibitors, which aid inhealing. Progressive corneal vascularisation occurs after more severe alkali burns and often does not subside until entire cornea is vascularised.

A fibrovascular pannus may overgrow the cornea in moderately severe injuries. When corneal endothelium is destroyed, beyond its compensatory reserve, persistent corneal edema results along with development of retrocorneal cyclitic or iris fibrous membranes. Permanent loss of innervations may occur with resultant neuroparalytic or neurotrophic keratitis. Abnormalities of tear film are also common. Aqueous and mucin components are affected adversely. Scarring with loss of accessory lacrimal glands and / or obstruction of ductule openings of major lacrimal glands may lead to aqueous defiency. Mucin deficiency occurs due to diffuse loss of goblet cells. Mucin deficiency promotes keratinization of corneal and conjunctival epithelium. Intraocular pressure may range from hypotony to glaucoma due to primary outflow obstruction, extensive peripheral anterior synechiae, trabecular meshwork obstruction or very rarely due to increased episcleral venous pressure.

MATERIAL AND METHODS

This prospective study was conducted among all patients who will presented with ocular chemical injuries to Government Rajaji Hospital between the period October 2012 to November 2013

Inclusion Criteria

1) Patients of all age groups.
2) Patients of both sexes.
3) Patients with definite history of chemical agents fallen in the eyes.
4) Minimal follow up of one month period.

Exclusion Criteria

1) Patients with ocular trauma not caused by chemical agents.
2) Doubtful history of chemical agent fallen in the eyes.
3) Patients with poor follow up.

The type of injury was recorded and graded according to modified Duaclassification of ocular chemical injury.

Visual acuity at the time of presentation was recorded whenever possiblewith reference to patient's age and co operation during the examination.

Final visual acuity was defined as the most recently recorded, best corrected visual acuity (Snellen equivalent) of patients either discharged from follow up or the most recent follow up.

Particular attention was paid to the history to determine the nature of chemical agent fallen in the eye, locale of occurrence, immediate consulting to any ophthalmologist, delay in reporting to our institution.

A thorough examination is done under slit-lamp and amount of conjunctival damage, corneal involvement, limbal ischaemia were precisely noted. The chemical injury is graded according to Dua classification of ocular chemical injuries.

Statistical Analysis: This study is based on prospective observational study. Totally 60 subjects (36 males and 24 females) are included in this study. Mean (SD) age is 29.05 years.

RESULTS

Our study had a total of 60 patients, out of which male patients are 36 in number and female patients are 24 in number. The mean age of the patient who sustained ocular chemical injuries was 29.05 years.

Table 1: Age group distribution

Age group	Frequency	Percent	Cumulative frequency
<20	15	25	25
20-40	29	47.5	72.5
40-60	15	25	97.5
>60	1	2.5	100.00
Total	60	100.00	

Most of the people who sustained ocular chemical injuries are domestic workers (22.5%) and students (22.5%). Women while performing house chores like cleaning toilets with acids and people working in laboratories, using bleaching agent for wooden materials are more prone for ocular chemical injuries. Students and children while playing with household chemical agents and in the college while doing chemical experiments during class hours aremore

prone for accidental injuries. Professionals (20%), like people who work in gold plating industry, textile industry, cement industry comes in the latter category according to this study.

Table 2: OCCUPATION

Occupation	Frequency	Percent	Cumulative frequency
Factory worker	9	15	15
Quarry	2	3.3	18.3
Mechanic	10	16.7	35
Professional	12	20	55
Student	14	23.3	78.3
Agriculture	4	6.7	85
Others	7	15	100
total	60	100	

Urban people (65%) are prone for chemical eye injuries. Semi urban people (31.7%) and rural people (3.3%) form the minority group in this study.

Most literates (76.7%) [College education-36.7%, school education-40%] are prone for chemical injuries. Illiterates (23.3%) are more prone for accidentalchemical injuries due to contact with household chemicals.

Table 3: EDUCATIONAL STATUS

Educational status	Frequency	Percent	Cumulative frequency
School	24	40	40
College	22	36.7	76.7
Illiterate	14	23.3	100
Total	60	100	

The Right eye was relatively more commonly affected (50%) than the left eye (30%). In our study, there were 12 cases with bilateral injury (20%). Most of the ocular chemical injuries are accidental (61.7%), work place (21.7%) eye injuries come under second category in our study.

Table 4: MECHANISM OF INJURIES

Mechanism of Injury	Frequency	Percent	Cumulative Frequency
Work place	13	21.7	21.7
Accident	37	61.7	83.4
Domestic	6	10	93.4
Assault/Intentional	4	6.6	100
	60	100	

In our study Alkalies (60%) form the major chemical agent causingocular injuries compared to the acids (40%). 75% of the affected people did not visit doctor before coming to Government Rajaji Hospital. Out of 25% of the patients who had undergone previous treatment, 80% (12) visited ophthalmologists. This is suggestive of their awareness about eye injuries.

Table 5: DELAY IN PRESENTATION

Delay in presentation	Frequency	Percent	Cumulative Frequency
<24 hrs	27	45	45
1day-1week	18	30	75
1week-1month	10	16.7	91.7
>1month	5	8.3	100
	60	100	

It implies most of the chemical eye burns are mild injuries with no lasting adverse effects. Medical management can be sufficient for these eye injuries

Table 6: VISUAL ACUITY AT THE TIME OF PRESENTATION

Visual acuity on day 1	Frequency	Percent	Cumulative Frequency
6/6-6/18	39	65	65
6/24-3/60	14	23.3	88.3
<3/60	7	11.7	100
Total	60	100	

Table 7: VISUAL ACUITY AFTER 1 MONTH FOLLOW UP

Visual acuity after 1 month	Frequency	Percent	Cumulative Frequency
6/6-6/18	49	81.7	81.7
6/24-3/60	7	11.7	93.4
<3/60	4	6.6	100
Total	60	100	

DISCUSSION

The mean age of the patient who sustained ocular chemical injuries was 29.05 years. In another study done by Saini JS, Sharma A (Ocular chemical burns- clinical and demographic profile, Burns 1993, Feb 19(1);67-9) young people constituted 2/3rd of patients who attained ocular chemical injuries[1].

In Merle H, study done at France which was published in J FrOphthalmol. 2008 Sep.31(7):723-34, ocular burns, majority of victims were young[3].

As can be seen from the above comparison, majority of the victims who sustained chemical eye injuries are young people, more in the working age group. A possible explanation for this fact is most of the people, who works in factories, industries, doing household chores are

younger individuals.

A majority of the people who suffered ocular chemical injuries are male patients(60%). Female patients (40%) are comparatively less than males. This was similar to the Midefart A, et al a Norwegian found as chemical burns to the eye. Men were involved twice, as frequently as women, according to this Norwegian study[4].

The possible explanation for the fact is that generally males prefer to work in gold-plating, textile industry, cracker industry and doing white washing to the houses. The other explanation is greater liberty given to males at their workplace, than when compared to female counterparts. Over confidence and not taking adequate protective measures while working may be an additional explanation for this fact.

Taking higher risks for better acceptances in their work places, when compared to their female counter parts may be one of the reason for this male preponderance.

Our study was similar to Saini JS, Sharma A. study done, at Post Graduate Institute of Medical Education and Research, Chandigarh, which stated that people working in laboratories and factories constitute 2/3rd of patients attainingocular chemical injuries[1].

An explanation for this fact is that, people working in laboratories, factories and doing domestic chores by using acids to clean the toilets and doing white-wash are possibly in contact with the chemicals in their work place.

Either accidentally or lack of adequate safety precautions while using the chemicals, may be the reason for ocular chemical injury.

Urban people (65%) are prone for chemical eye injuries. Semi urban people (31.7%) and rural people (3.3%) form the minority group in this study. Urban people and semi-urban people who had decimal education form the main junk working in factories, laboratories, textile industries, doing white-washing to the houses, etc. They are more prone to have ocular chemical injuries becausethey have close contact with chemicals at their work place.

Most of the rural folk, indulge in agricultural labour rather than working in factories and laboratories. Because of minimal contact with chemicals in their work place, they are less prone for ocular chemical injuries.

Most literates (76.7%) [College education-36.7%, school education-40%] are prone for chemical injuries. Illiterates (23.3%) are more prone for accidentalchemical injuries due to contact with household chemicals.

Illiterates (23.3%) mostly prefer agricultural work or manual labour rather than to work in laboratories or factories. As they are less exposed to chemicals in their work place, the chances of ocular chemical injuries arenegligible.

The Right eye was relatively more commonly affected (50%) than the left eye (30%). In our study, there were 12 cases with bilateral injury (20%). In Saini JS study, 43 patients (42.1%) suffered from bilateral injuries.

The Right eye preponderance may be due to Right handedness of the people while working with the chemicals at their work place.

In our study Alkalies (60%) form the major chemical agent causing ocular injuries compared to the acids (40%). This was similar to Norwegian study by Midelfart et al, (Chemical burns to the eye. PMID 14716395), where alkalies form the most frequent chemical agent to cause eye injury[4].

In British study by Macdonald EC, et al (Br J Ophthalmol, 2009 Sep. 93(9); 1177-80) Alkalies (66.7%) were the commonest cause of ocular chemicalinjuries[5].

In Saini JS, Sharma A. study, acids and alkalies together were responsible for 80% of chemical injuries. Perhaps using lye as a bleaching agent for woodenmaterials, cleaning, silo preparation in agriculture, working with cement and plaster of paris, white washing the houses, using caustic potash in washing clothes etc. may be better explanation for using alkalies more than acids in our small scale industries and domestic work leading to more alkali induced chemical burns[1].

Most of the ocular chemical injuries are accidental (61.7%), work place (21.7%) eye injuries come under second category in our study.

Lack of proper knowledge regarding chemicals, and negligence while handling them, not taking adequate protective measures may be one of the reasons to support this fact.

75% of the affected people did not visit doctor before coming to Government Rajaji Hospital. Out of 25% of the patients who had undergone previous treatment, 80% (12) visited ophthalmologists. This is suggestive of their awareness about eye injuries.

54 patients (90%) had taken medical treatment and 6 patients (10%) had taken surgical treatment.

It implies most of the chemical eye burns are mild injuries with no lasting adverse effects. Medical management can be sufficient for these eye injuries.

Injuries caused by assault were more severe and Grade III/IV injuries require surgical correction. Visual outcome correlated with the severity of the injury.

45% of the patients presented within 24 hours to Government Rajaji Hospital after attaining ocular chemical injury. 30% of people had presented within 1 day to 1 week and 16.7% of people had presented after one month. Only 8.3% of people had presented between one week to one month.

Increasing awareness of people to ocular chemical injuries and literacy had made the people to visit the tertiary eye care centre with 24 hours of assault with chemicals.

CONCLUSION

We made an attempt to identify the age group, which sex more affected, laterality, which chemical (acid or alkali) is more common causative agent, delay in presentation, severity of injuries, the outcome of medical and surgical treatment in our set-up.

Most of the chemical injured patients are in the working age group. Young people with minimal education who work in factories, bleaching industries, laboratories, during domestic chores like white washing are more prone for chemical injuries. They must wear protective goggles and take all the necessary precaution measures while working with dangerous chemicals in their work place. In our study, males are more prone to ocular chemical injuries thanfemales. Males should not be over enthusiastic and over confident, and should necessarily take all the protective measures while working with chemicals.

There is a need to ensure adequate public awareness of the danger of alkali burns to the eye. Safety protective education and professional training, use of protective clothing at work, enhancing the concept of legal responsibility, and restricting management and use of corrosive chemicals, should be implemented. By doing so, the incidence of ocular chemical injuries may be decreased.

The results of this study emphasize that, immediate irrigation of the eye with clean water in substantial volumes, is the important immediate line of management. There should not be any delay in presenting to the doctor, if any chemical had fallen in the eye. This should be high-lighted in all the working places where chemicals are used, for increased awareness and education to overcome the wide spread negligence.

Most of the chemical eye injuries can be treated medically. Therapeutic procedures for eye burns (like amniotic membrane transplantation andkeratoplasty techniques) should be done at appropriate time and should not be delayed to bring down related visual morbidity.

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