

CLINICO-DEMOGRAPHIC PROFILE AND OUTCOMES OF OCULAR PAEDIATRIC CHEMICAL INJURIES IN EASTERN INDIA

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Abstract

The purpose of this study is to analyse demographic profile, causative factors, clinical features and outcomes of ocular chemical injuries in paediatric patients in Eastern India. This was a retrospective case-based study, of 101 patients below 18 years of age who visited our Emergency/Cornea Department from July 2018 to July 2023, with ocular chemical injuries. An Electronic Medical Record (EMR) search was done, and details of Visual acuity, anterior and posterior segment evaluation, and Dua's grading of the chemical injury were noted. Details of medical management and surgical procedures were noted including details of follow-up visits. A total of 116 eyes of 101 children who presented to our tertiary eye care centre hospital were included. The mean age was 8.63 years ranging from 6 months to 17 years. The most common causative agent was alkali, in 53.46%, of which lime was the predominantly seen, 64.81%. Acid was the causative agent in 39.60%. Chemical injuries were classified as per Dua's classification. 38.38% required surgical intervention. The Best Corrected Visual Acuity (BCVA) at 3 months follow up was better than 20/200 in 36.84%, and 63.15% had poor visual outcome. Sequelae in the follow up period were seen in 36 out of the 38 cases. Our study emphasises that, paediatric chemical injuries, when treated promptly, can provide a decent visual function. The study provides a glimpse of the trends in paediatric ocular chemical injuries in this region.

Keywords: Chemical injury, Paediatric population, Sequelae.

INTRODUCTION

Chemical injuries involving the ocular surface and adnexa, are ocular emergencies that cause extensive destruction, tissue loss and visual impairment.^[1] Ocular chemical injuries constitute 8-18% of the cases of ocular trauma.^[2] Chemical injuries can be caused by acidic or alkaline substances. Alkaline injuries are more commonly encountered as they are widely used in household chores.^[3] An article by Sen P et al, reported "chuna" or lime as the most common substance causing chemical injuries to the eye.^[4] Immediate therapy includes liberal irrigation with isotonic solutions such as isotonic saline or ringer lactate till the pH is restored to physiological levels. Acute phase treatment encompasses topical antibiotic, cycloplegic and antiglaucoma therapy. If the epithelium healing does not take place during this period, other modalities that can be instituted are extensive lubricants, punctal plugs, tarsorrhaphy. In case the epithelium is still unhealthy, surgical modalities become the mainstay, which include conjunctival or tenon's advancement, tissue adhesives, therapeutic penetrating keratoplasty (TPK), amniotic membrane transplant (AMT) or simple limbal epithelial transplant (SLET).^[5] Ocular chemical injuries in the paediatric population demands higher diligence because of the anatomical and visual challenges pertaining to children. The prognosis varies with the nature of chemical, the duration of exposure, and time of presentation.^[6] In general, early management helps prevent worsening of the condition and allows for better visual rehabilitation and amblyopia management and upholds a near normal globe configuration. Long term strategies aim to restore visual function by managing the ocular surface abnormalities and complications.^[7,8] Dua's classification has certain merits over Roper Hall classification. Roper Hall's system considers the extent of

limbal ischemia and corneal haze and though it is widely used, this system was put forth before the concept of limbal stem cells was introduced. In contrast, Dua's classification is based on limbal and conjunctival involvement. Assessment of conjunctival involvement is necessary as conjunctival epithelium provides a vital cover to the cornea. Therefore, Dua's grading system gives a better understanding of the prognosis.^[9] The main challenge seen in paediatric population is the duration of presentation, inability to assess the magnitude of damage, and unavailability of facilities in primary and secondary centres that are required to provide immediate care. Previous studies have reported the details of ocular chemical injuries; however, very few have focussed on the paediatric population. This study aims to analyse the demographic profile, causative factors, and the clinical features and outcomes of ocular chemical injuries in paediatric patients presenting to a tertiary care centre in Eastern India.

METHODOLOGY

This is a retrospective study included the data 101 patients under 18 years, who visited our Emergency/Cornea Department with ocular chemical injuries between July 2018 and July 2023. The study adhered to the Declaration of Helsinki and was approved by the Institutional Ethics Committee (IEC - 2024-193-BHR -7). The institutes Electronic Medical Records (EMR) were searched using key words in diagnosis like 'chemical injuries' and specifying the age group required. The patients' demographic, chief complaints, time of presentation, and assaulting agent, time since injury and initial treatment data were collected. Details of visual acuity, condition of the anterior segment structures, posterior segment finding, including B-scan evaluation, were collected. Grading of the chemical injury was done using Dua's classification. Details of medical management and surgical procedures were

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also collected, including follow-up visits. The data were entered in an Excel® sheet (Software version 14.1.0 [110310]/2011) (Microsoft Corporation, Redmond, WA, USA), and statistical analysis was performed with SPSS version 13.0 (SPSS Inc, Chicago, IL, USA). Mean and standard deviation were used to describe the continuous variables, while frequencies and percentages were used to describe the categorical and binary variables. Parametric and nonparametric comparisons were performed for all variables.

RESULTS

A total of 116 eyes from 101 children who presented to our tertiary eye care centre with chemical injuries were included in this study. All the case records were evaluated for clinical findings, grading, treatments, and outcomes. Among the 101 children, 58 (57.4%) were male, and 43 (42.6%) were female ($p=0.18$). The mean age of the participants was 8.63 years (range: 6 months to 17 years), with a standard deviation of 2.43 years. Forty-two patients (41.59%), belonged to the age group of 0-5 years, 26 (25.74%) belonged to the age group of 6-12 years, and 33 patients (32.67%) belonged to the group of 13-17 years. Eighty-six patients (85.1%) had unilateral involvement, and 15 (14.1%) had bilateral involvement.

In our study, the most common causative agents for chemical injuries were alkali (54 patients (53.46%)). Lime was the predominant compound seen, afflicting 35 cases (64.81%). Chemical injuries due to acidic substances accounted for 40 (39.60%) cases. In seven patients (6.93%), the causative agent was unknown. Immediate management, including liberal irrigation with isotonic solutions, was done at a primary centre in 33 (32.67%) cases. The other 68 cases (67.33%) did not have access to such facilities. Duration of presentation varied from 15 minutes to 3 years post-trauma. Twenty patients (19.80%) reached our centre within hours of the injury, with two reaching within 15 minutes. Thirty-nine (38.61%) patients reported within one day, 34 (33.66%) within 14 days, five (4.95%) within few months, and three (2.97%) visited years after sustaining trauma. Of the patients who reported to the hospital within 1 day of injury, 35 patients had a follow up visual acuity equal to or better than 0.3 log MAR ($p<0.05$).

Table 1. Best Corrected Visual Acuity in affected eye at the time of presentation

Visual acuity in affected eye in Log MAR	No. of patients
Better than 1	47
1 to 1.8	4
1.8	9
1.8 – 2.3	1
PL PR acc	8
Could not be assessed	32

Table 1 shows the presenting visual acuity in the affected eye, with 41 (40.59%) cases having vision better than 0.7 logMAR. The conjunctiva was normal in 16 (15.84%) patients. The most common conjunctival sign was congestion (65 cases (64.35%)), followed by limbal ischaemia (15 cases (14.85%)). Symblepharon formation was seen in seven (6.93%) cases. Conjunctival deposits of substances, such as lime and carbide, were seen in 10 (9.90%) cases. Necrosis was seen in three (2.97%) cases, which is an extremely severe condition. Chemosis was present in six (5.94%), abrasion in four (3.96%), subconjunctival haemorrhage in five (4.95%), discharge in two (1.98%), and papillae in one case (0.99%).

Corneal involvement included epithelial defects (29 (28.71%) cases) and corneal stromal oedema (24 (23.76%) cases). Opacification was present in 13 (12.87%) cases, and deposits were present on the corneal surface in nine cases. Superficial punctate keratitis (10 (9.90%) cases), scarring (eight (7.92%) cases), and vascularization of cornea (six (5.94%) cases) were also observed. The chemical injuries were classified as per Dua's classification (Figure 1).

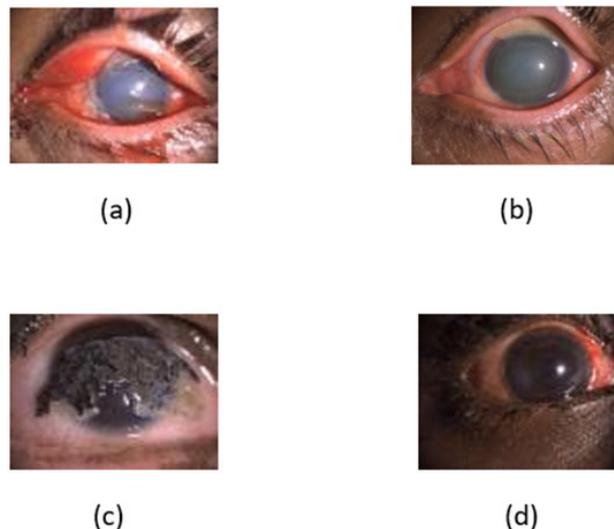


Image 2: (a) and (c) : Pre-op images of chemical injuries (b) and (d) : Corresponding Post-op images

Table 2. Best Corrected Visual Acuity in affected eye after intervention (medical/surgical)

BCVA in affected eye in Log MAR	No. of patients
Better than 1	56
1.0 to 1.8	4
1.8	5
1.8 – 2.3	6
PL + PRacc	4
Could not be assessed due to various factors such as, age being less than 3 years, un-cooperative children	26

Table 3. Classification of chemical injuries as per Dua's grading

Dua's Grading	No. of patients
Grade 1	52.47%
Grade 2	16.83%
Grade 3	14.85%
Grade 4	3.96%
Grade 5	1.98%
Grade 6	12.87%

Fifty-three (52.47%) cases were Grade I chemical injuries, 17 (16.83%) were Grade II, 15 (14.85%) were Grade III, four (3.96%) were Grade IV, two (1.98%) were Grade V and 13 (12.87%) were Grade VI. The outcomes of patients with Grade I and II injuries were much better with almost complete resolution of anatomical and physiological status of the structures, with a visual outcome between 0.3 and 0 logMAR ($p < 0.05$). Medical management was provided to all patients. The medical management comprised topical steroid (prednisolone acetate 1% eye drops), lubricants (carboxymethylcellulose 0.5% eye drops), topical antibiotics (tobramycin 0.3% eye drops, ofloxacin 0.3% eye drops, chloramphenicol and polymixin B sulphate eye drops), cycloplegics (atropine sulphate 1% eye drops), and oral medication (oral vitamin C 500 mg tablets and oral paracetamol 15mg/kg body weight).

Table 4. Surgical procedures with their Indications and outcomes

Surgical procedure	No. of patients	Indication	Outcome
Superficial keratectomy	1	Plaque over cornea	Scarring
AMG	33	Limbal ischaemia, Corneal epithelial defect, Ocular surface charring, Epithelial edema	Reduction in corneal haze, Scarring, Resolution of limbal ischaemia
SLET	16	Limbal ischaemia, Conjunctivalization of cornea	Complete resolution (9/16) Partial resolution (7/16)
Tarsorrhaphy	8	Large epithelial defect, Non-closure of eyelids due to extensive scarring	
Symblepharon release	5	Symblepharon	Recurrence of symblepharon (3/5)
Foreign body removal	5	Multiple charred foreign bodies in cornea, conjunctiva, fornices	Removal using forceps, EDTA chelation
PK	8	Extensive scarring and vascularization, Total opaque corneas	
EDTA chelation	5	Charred particles / lime particles embedded in corneal epithelial and stromal surface	Removal of particles in all cases
Corneal patch graft	1	Corneal thinning	Graft integrated with scarring, vascularization

Table 5. Post surgical intervention sequelae

Sequelae	No. of patients
Scar with vascularization	32
Symblepharon	7
Phthisis	1
LSCD	2
Nil	2

Table 6. Visual outcome post-surgical intervention in Log MAR

Visual outcome post-surgical intervention	No. of patients
Better than 1	14
1 – 2.3	12
No improvement	12

Table 7. Other studies showing different outcomes of chemical injuries

SR NO	Study	Age Range	Region	Sample size	Classification of Chemical Injury	Management		Outcome
						Medical	Surgical	
1	Mittal V et al	< 15 years	North India	4 cases	Dua's Grade 6 (all cases)	-	1. AMT at presentation 2. SLET at 4-6 months	Complete success in 1 case Partial success in 3 cases
2	Sen P et al	< 16 years	Central rural India	80 eyes of 74 children	Modified Roper Hall grading system	26 eyes	54 eyes – amniotic membrane grafting, symblepharon release, limbal stem cell transplantation, and tectonic keratoplasty. Amniotic membrane grafting was performed in acute cases.	26 eyes had BCVA better than 6/60
3	Vajpayee et al	<16 years	North India	134 children	Modified Roper Hall grading system	As per requirement	Symblepharon release, amniotic membrane grafting, allograft or autograft stem cell transplantation, and large-diameter lamellar keratoplasty	Better than 3/60 in 42 cases
4	Patil et al	< 10 years	Maharashtra	40 cases	Roper Hall – only Grade 2 and more severe injuries were included	-	-	-

In this study, 38 (38.38%) patients required surgical intervention. The time interval between presentation and surgical intervention ranged between 1-2 days, depending on requirement of general anaesthesia. Surgical management included procedures, such as corneal and/or conjunctival foreign body debridement, superficial keratectomy, amniotic membrane grafting (AMG), tarsorrhaphy, simple limbal epithelial transplant (SLET), and eyelid reconstruction (Table 4). Image 2 depicts the pre-operative and post-operative photographs of two cases. Outcomes were measured in terms of anatomical and functional outcomes, namely improvement in the visual acuity. After surgical intervention, the BCVA at the 3-month follow-up was better than 0.7 logMAR in 11 (28.94%) patients ($p = 0.068$), and the visual outcome was poor in 27 (71.05%) patients. Scar formation with vascularization was observed in 32 (84.21%) cases,

symblepharon formation was observed in seven (18.42%) cases, limbal stem cell deficiency was observed in two patients (5.26%), and phthisis bulbi was seen in one case (2.63%) (Tables 5 and 6).

DISCUSSION

Children are susceptible to chemical injuries while playing outside or in their homes. The mean age group reported in our study was 8.63 years, Which is similar to the studies by Pradanya Sen et al. and Vajpayee RB et al. where the mean ages at time of injury were 8.44 ± 4.29 years and 8.954.89 years, respectively.^[7] Most patients in our study were males, which is similar to various other studies.^[4,10,11,12] Lime or calcium hydroxide, which is a household item in the form of chuna, was the most common offending agent in our study,

which was also noted by Sen P et al and Patil et al in their study^[4,10]. Contrary to this, a study by Korzmac I et al and Dubey A et al, from Turkey reported acids, to be the prevalent offending agent in their region.^[13,14] Immediate management by irrigating the eyes was done in only one third of the patients who had access to a hospital or a doctor at the initial presentation, and majority of such patients had permanent sequelae. Similarly, Vajpayee RB et al reported that one third of patients in their study did not receive prompt treatment, which consequently led to severe damage.^[15] This emphasises the importance of first-aid treatment in ocular emergencies. Health care personnel, including paramedics, should be made aware of such simple sight-saving procedures. Although Grade 1 injuries were predominant, a significant proportion of patients also suffered from Grade 6 injuries. This is coherent with the data published by Saini and Sharma and Tschopp et al., as most of the injuries were mild.^[3,12] However, another study by Sen P et al. classified the injuries using Roper-Hall classification system and concluded reported more Grade 3 and Grade 4 injuries.^[4] In a study by Agarwal et al., 68% of the patient were advised surgical interventions in the form of autograft or allograft stem cell transplantation, lamellar or penetrating keratoplasty, symblepharon release, and amniotic membrane grafting, which is similar to this study.^[16] Post-surgical improvement in BCVA was seen in 11 patients (28.94%). However, 27 patients (71.05%) who underwent surgical interventions showed no improvement. This correlate with the post treatment scarring and vascularization. Arora A et al. reported that corneal blindness in cases of carbide injury were mostly due to limbal stem cell deficiency and its consequences, such as conjunctivalization and scarring with vascularization.^[17,18] In our study, 16 patients (42.10%) underwent SLET. Among the 16 patients, three (18.75%) showed a BCVA > 1 logMAR during follow-ups. This is similar to a study by Mittal V et al., who reported a completely epithelized, avascular corneal surface, in a quarter of their cases.^[19] Saini and Sharma reported that 70.34% of patients gained a visual acuity of 6/60 or better.^[3] In contrast, Vajpayee et al. reported that the visual acuity at follow-ups was worse than 3/60 for 64.2% of patients^[16] (Table 7).

Conclusion

Our study highlights the fact that paediatric chemical injuries, when treated in a timely fashion, can provide a good visual outcome. Many other reports have been published on this subject; however, very few actions are taken with regards to chemical injuries. This study provides a glimpse on the trends of chemical injuries specifically in paediatric population of Eastern India. Our study highlights the current prevalence of ocular chemical injures in children in Eastern India, and their subsequent ocular outcomes.

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