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Research Article

Acute Chemical Eye Injury as Result of an Assault: Clinical and Forensic Approach

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ABSTRACT

Introduction: Chemical injuries represent a significant health concern, characterized by trauma inflicted by corrosive substances, including both acidic and alkaline agents. Chemical trauma to the eye is particularly critical due to its potential for high morbidity and irreversible blindness, necessitating immediate medical intervention. Understanding clinical aspect of chemical eye injury is crucial, as it not only impacts clinical outcomes but also informs forensic management strategies. **Method:** Case reports on chemical eye injury case causing by an assault. In-depth study about the case based on clinical aspect of the disease and its management in forensic. **Results:** Presented male; 56 years old suffered from chemical burns on both eyes causing by suspected acid liquid. The acid was poured on the victim by his biological son. Examination shows limbal ischemia was 270° accompanied by corneal erosion in the right eye. Visual acuity test shows a decrease in vision for both eyes. Litmus examination of the right eye showed a pH of 6 – 7. Case management involves collaboration between clinical management by the eye department and legal management correlated to the assault by the forensic department. **Conclusion:** In a case of chemical assaults to the eyes, clinical management and prognosis of the injury suffered by patient will determine the severity of injury. This in turn, will be one of the considerations for the judges to decide
Keyword: Chemical burns, Eye injury, Forensic medicine, Case management.

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INTRODUCTION

Chemical injury is trauma caused by chemicals, such as liquids or powders with acidic or basic properties. Generally, acidic and alkaline chemicals can cause burns caused by the mechanism of breaking down body tissue proteins by acidic or alkaline chemicals that come into contact with them.[1] Chemical trauma to the eye is included in an eye emergency because of the high risk of morbidity and can even cause blindness. Epidemiologically, chemical trauma to the eye occurs in around 0.02 – 50 cases out of 100,000 cases of eye trauma per year with an estimated total of 107,000 victims experiencing blindness. Chemical trauma in the children group occurs more often in the domestic sphere, while chemical trauma in the young adult group occurs more often in the occupational sphere, especially in the industry. However, chemicals, especially acid chemicals, are starting to be frequently used as a tool to carry out attacks.[2]

The degree of severity of burns caused by acidic and alkaline chemicals depends greatly on the type of chemical, duration of exposure, concentration of the substance, and the amount of the chemical that causes trauma. Generally, injury caused by acidic chemicals has milder clinical manifestations compared to alkaline.[1,3] The severity of chemical burns can be used to determine the prognosis of the case experienced. The degree of severity and prognosis are important factors in forensic management.

CASE PRESENTATION

A 56-year-old man came to the emergency department complaining of pain in both eyes. The pain started after being splashed with a liquid which was thought to be a cleaning fluid by his biological child, 2 hours before admission. The patient cleaned his eyes using running tap water immediately after being splashed. The patient also experienced blurring vision and difficulty opening both eyes. The patient has no history of other diseases and is not taking any medications.

The patient's vital signs are within normal limits. The facial area around the eyes and nose appears reddish. Both eyelids appear swollen and the patient seems having difficulty opening his eyes. The examination of the right eye showed a palpebral spasm accompanied by oedema; white secretion appeared covering the eyeball; pericorneal injection; chemosis in the 3 - 10 o'clock area; the cornea appears cloudy; erosion of the corneal epithelium; limbal ischemia 270°, the anterior chamber is deep; iris radial with visible detail; 3 mm round pupil; post-lens light stimulation difficult to evaluate; positive fundus reflex; normal eye motoric without any pain. Eye pressure was normal per palpation. The condition of the left eye was good, there was hyperaemia on the eyelids and conjunctiva but no other abnormalities were found. Left eyeball pressure was 16 mmHg using a tonometer. Other areas of the face and body were normal.

Visual acuity examination showed a decrease in vision in the right and left eyes (2/60 and 6/12 respectively). Examination using a litmus paper showed that the pH of the right eye was 6 – 7, while the pH of the left eye was 7. The patient was diagnosed with OD chemical trauma (suspicious of acid) grade Ropper-Hall 4 with corneal erosion and OS chemical trauma (suspicious of acid) grade Ropper Hall 1.

Eye irrigation was performed until the pH became normal with indications for re-irrigation if the

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Table 1: Degree of severity chemical eye injury by Roper Hall.

Grade	Clinical findings		Prognosis
	Cornea	Conjunctiva	
I	Corneal epithelial damage	No limbal ischemia	Good
II	Corneal haze with visible iris detail	< 1/3 limbal ischemia	Good
III	Total epithelial loss, stromal haze, with obscured iris details	1/3 – 1/2 limbal ischemia	Guarded
IV	Opaque cornea, with obscured iris and pupil	>1/2 limbal ischemia	Poor

Figure 1: Eye Condition. Right – Right Eye. Left – Left Eye.

pH decreased. Patients are given treatments with topical antibiotics (Levofloxacin eyedrop), cycloplegic (Atropine eyedrop), lubricant (Carboxymethylcellulose eyedrop), anti-inflammatory (Prednisolone eyedrop), oral anti-protease (Doxycycline), and oral Vitamin C. Patient refused hospitalization and was asked to come to Eye Department of Hospital Clinic the next day.

DISCUSSION

Clinical Approach

In general, the acid that enters the eye will interact with the water composition of the tear film and the soft tissue of the eye. This reaction will produce heat which will cause tissue damage to the conjunctiva epithelium and cornea. This acidic liquid will cause tissue coagulation and collagen shrinkage. In chemical eye injury (CEI) due to acid, the proteins found in the surface layer of the eye will bind to the acid and act as a buffer that will prevent the material from entering the deeper layers of the eye.[2] If the acidic/base material enters the anterior chamber of the eye, it can cause blockage of the trabecular meshwork from denatured proteins increasing intraocular pressure (IOP). This damage can turn into scar tissue which can cause glaucoma.[4]

The severity of the CEI will determine the choice of therapy and patient prognosis. Mild chemical burns generally have a good prognosis and can be treated as an outpatient with topical medication. However, in more severe cases, more aggressive treatment is needed and outpatient treatment is not possible. Of course, in more severe trauma, the prognosis worsens and the probability of visual acuity declining is higher.[5] There are two classifications used to determine the severity of CEI, namely the Ropper-Hall Classification and Dua's Classification. The Ropper Hall Classification system is shown below.[4]

Management of CEI requires quick and appropriate action since the duration of exposure to the chemical itself is one of the factors that determines the outcome. Before going to the hospital, the patient irrigated his eyes using tap water. This action proved inadequate because, upon examination, we found the pH of the patient's right eye still in the range of 6 – 7 (acid condition). The irrigation was then repeated at the emergency department by attending residents. The main focus of irrigation is to stop further damage from chemical exposure. Eye irrigation is carried out until a neutral pH is reached. Amphoteric hyperosmolar fluids are considered more effective than iso-osmolar fluids in irrigation, but the rate of performing irrigation is considered more important.[4]

After the patient's eye pH has returned to normal, we proceed to acute phase management. The principal management for CEI is based on controlling inflammatory response and caring for epithelial defects, and complications prevention.[4] The treatment given to patients includes Prednisolone eye drops to reduce excessive inflammatory reactions. The advantages of administering corticosteroids as an anti-inflammatory in CEI are reduced immune cell migration, preventing neutrophil degranulation, and strengthening of the basal membrane and endothelial cells of the eye. However, long-term administration of corticosteroids is not recommended because it can interfere with collagen formation.[2,4]

On the other hand, ascorbic acid (Vitamin C) is an agent that promotes collagen formation. Several in vivo studies in rabbits show a significant decrease in ascorbate levels in the aqueous humour in CEI. Administration of ascorbic acid can restore ascorbic acid levels in the aqueous humour[2,6]. It can also reduce collagen degradation and the incidence of corneal ulceration.[2]A combination of corticosteroids and ascorbic acid can prevent corneal ulceration due to corticosteroids use. Patients are also given artificial tears which can improve epitheliopathy and speed up the CEI healing process.[4]

Another treatment that can reduce inflammation and the risk of corneal ulceration is the administration of anti-proteases such as tetracycline, sodium citrate, acetylcysteine, and EDTA. Doxycycline has been shown to reduce the production of pro-inflammatory cytokines (including MMP −8 and −9).[2] Doxycyclin exerts matrix metalloproteinase inhibition preventing the action of proteolysis enzymes in destroying the corneal stroma hence reducing the risk of corneal ulceration. Doxycycline is considered more effective than other drugs in its class.[4]

To prevent complications, the patient is given Atropine eyedrop, a cycloplegic drug that can paralyze the ciliary muscles.[7] Cycloplegics are needed to prevent synechia (adhesions) that can occur with CEI.[2] Atropine sulphate is an anticholinergic agent that acts directly on muscarinic receptors of structures innervated by post-ganglionic parasympathetic fibres.[4] Apart from that, giving cycloplegic can also reduce ciliary spasms thereby reducing pain.[8] Prevention of worsening is also done by administering topical antibiotics as an infection prophylaxis. Generally, fluoroquinolones are preferred as monotherapy.[2,4]

Forensic Approach

Based on the Indonesian Penal Code, assault can be categorized as maltreatment, which can be defined as an intentional injury to someone's health (article 351, section 4) and it's punishable by imprisonment for a maximum of ten years depending on the severity of the injury suffered by the victim.[9] The legal system in Indonesia places doctors as the experts who can assist in the judicial process. One of the assistances that can be provided by a doctor, especially in cases of assault, is by examining the victim and linking the medical aspects of the victim's illness/injury with the applicable legal aspects. In the case of assault, the doctor must be able to prove that the injuries suffered by the victim were a direct result of the violence they experienced.[9] Other than that, the doctor must also be able to ascertain the severity of the injuries suffered by the victim so that the court can determine the punishment given to the perpetrator. Medical treatment received by the victim should not determine the severity of the victim's injuries. The early diagnosis/assessment and consideration of patient prognosis based on their condition before medical treatment are the main factors that determine the severity of the injury.

In this case, it was stated that the patient had suffered chemical trauma to the eye, Ropper-Hall grade IV, with a poor recovery prognosis. Based on this data, it was decided that the patient's injury suffered by the patient qualified as a serious physical injury - wounds that cause

diseases that are not expected to be completely healed.[9] If the patient's condition has improved and his vision returns to the same quality as before the incident (after being treated by the hospital), the police can request a re-examination, although this is very unlikely considering the patient's serious injury.

CONCLUSION

CEI is an eye emergency that can result in blindness. Appropriate and immediate treatment are key to CEI management. The CEI injury grade classification is the basis for determining the degree of injury which will determine the legal consequences suffered by the perpetrator. Other than that, in assault cases, it is necessary to prove that the injuries suffered by the victim were indeed the result of the assault that occurred. Therefore, it is important for a forensic expert to understand the clinical aspects of the trauma that occurred.

CONFLICTS OF INTEREST

None.

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