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Title:

Systemic review in management of ocular chemical injury via irrigation

This submitted for fulfillment for the requirement for the degree of master in critical care nursing.

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الآيـه

قَالَ تَعَالَىٰ:

﴿ قُلۡ هُوَ ٱلَّذِيٓ أَنشَأَكُمۡ وَجَعَلَ لَكُمُ ٱلسَّمۡعَ وَٱلۡأَبۡصَٰرَ وَٱلۡأَفۡـِٔدَةَۖ قَلِيلٗا مَّا
تَشۡكُرُونَ ٢٣ ﴾

صدق الله العظيم

سوره الملك :الآيه (23)

□

Dedication

To my father soul

To my mother

To all my brothers and sister

To all my friends

Bakheta2018

Acknowledgement

Thanks before and after to ***ALMIGTY ALLAH*** *for given me the guidance to see and follow the right path*

I would like to express my thanks and deepest respect to my supervisor ***Dr Saneea Mohmmed*** *for her guidance in the pursue of this study.*

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Thanks all medical staff of ***Makkah Eye Hospital-Omdurman especial Dr eglal.***

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Abstract

AIM: To do Systematically review paper discussing ocular chemical injury via water irrigation

METHODS: Astudy eligibility verification form was developed for the assessment and two reviewers made independent decisions on whether to include each publication in the systematic review. Critical appraisals of study quality were undertaken independently by two reviewers using the Joanna Briggs Institute critical appraisal tools. Any disagreement that arose between the two reviewers was resolved by discussion.

RESULTS AND DISCUSSION:

The included study were observational description retrospective of medical records (Ikeda et al 2006 and saari et al 1984). pts age from 2 to 75 years old in Saari et al (1984) and for Ikeda et al (2006) age from 30 to 53 years old, however there was no attempt to address confounding factors which included severity of injury differences between comparison groups (saari et al) and time of initiation of eye irrigation in Ikeda et al. Ikeda et al looked at effect of eye irrigation with tap water at scene of injury in 53 pts while saari et al looked at effect of prolonged irrigation upon arrival to hospital in a total of 172 pts.

In the study of Ikeda et al, eye irrigation following alkali burns, the result showed a significantly lower prevalence of erosion of the eyes and good visual acuity, than the no-irrigation group.

In Saari et al. (1984), 53 pts (30.8%) received prolonged irrigation and 119 pts (69.2%) underwent conventional irrigation,final visual acuity of pts receiving both prolonged and conventional irrigation was good. The extent of damage was smaller, the visual outcome better, and the duration of treatment at the hospital and absence from work were shorter in patients treated with prolonged irrigation than without such treatment.

IMPLICATIONS AND CONCLUSIONS: As prompt important eye irrigation with tap water immediately after chemical burn or other fluid solution had better outcomes. and suggesting for its use in eye hospital settings.

نبذة مختصرة

الهدف: للقيام بمراجعة منهجية لأوراق مناقشة الاصابة الكيميائية للعين عن طريق الري بالماء

الطريقة: تم استخدام طريقه التحقق وقام اثنان من المراجعين من أهلية الدراسة للتقييم باتخاذ قرارات مستقلة حول ما إذا كان سيتم تضمين كل منشور في المراجعة المنهجية وأجريت تقييمات حاسمة لجودة الدراسة بشكل مستقل من قبل اثنين من المراجعين باستخدام أدوات التقييم الحرجة لمعهد جوانا بريجز. تم حل أي خلاف وقع بين المراجعين من خلال المناقشة.

الدراسة المشمولة كانت وصفاً راجزيًا للسجلات الطبية (Ikeda et al 2006 و saari et al 1984). نقاط العمر من 2 إلى 75 عامًا في Saari et al (1984) و Ikeda et al (2006) من عمر 30 إلى 53 عامًا ، ومع ذلك لم تكن هناك محاولة لمعالجة العوامل المربكة التي تضمنت شدة اختلافات الإصابة بين مجموعات المقارنة (saari et al) وزمن بدء ري العين في Ikeda et al. بدا Ikeda وآخرون في تأثير ري العين بماء الصنبور في موقع الإصابة في 53 مريض في حين بدا saari وآخرون في تأثير الري المطول لدى وصوله إلى المستشفى في ما مجموعه 172 مريض.

في دراسة إيكيدا وآخرون ، ري العين بعد الحروق القلوية ، أظهرت النتيجة انخفاض معدل انتشار تآكل العين وحده البصر بشكل كبير ، مقارنة بمجموعة عدم الري.

في ساري وآخرون. (1984) ، 53 مريض (30.8 ٪) تلقى الري لفترات طويلة و 119 مريض (69.2 ٪) خضعت للري التقليدي ، وكانت حدة البصر النهائية من تلقي كل من الري التقليدية لفترات طويلة جيدة. كان مدى الضرر أصغر ، وكانت النتيجة البصرية أفضل ، وكانت مدة العلاج في المستشفى والغياب عن العمل أقصر في المرضى الذين عولجوا بالري لفترات طويلة من دون مثل هذا العلاج.

الآثار والاستنتاجات:

لا توجد أدلة كافية للتوصية لممارسة ري العين بين البالغين أو الأطفال كشكل نشط من العلاج في حالات الطوارئ للحروق الكيميائية للعين.كما ان ري العين مباشرة بعد الحروق الكيميائية مهمة فورية بمياه الصنبور أو غيرها من المحاليل السوائل كان لها نتائج أفضل. واقتراح لاستخدامها في إعدادات مستشفى العيون.

List of content

Abbreviations

Abbreviations	(stander for)
PT	Patient
IOP	Intra Ocular Pressure
BSS PLUS	Balance Saline Solution
AIV SOLUTION	Related To Engineering

CHAPTER ONE

Introduction

1.1. Introduction

1.1.1 Definition :

Chemical Burns of the eye usually occur when a corrosive substance, such as acid or alkali, is accidentally introduced to the ocular surface. ...

After a chemical exposure to the eye, patients usually present with severe eye pain, reduced visual acuity, photophobia, and reflex blepharospasm.(14)

1.1.2. Epidemiology:

Chemical injuries to the eye represent between 11.5%-22.1% of ocular traumas.[1]About two thirds of these injuries occur in young men. The vast majority occur in the workplace as a result of industrial accidents. A minority of injuries occur in the home or secondary to assault. Alkali materials are found more commonly in building materials and cleaning agents and occur more frequently than acid injuries.[2]

Chemical burns represent potentially blinding ocular injuries and constitute a true ocular emergency requiring immediate assessment and initiation of treatment. The majority of victims are young and exposure occurs at home, work place and in association with criminal assaults. Alkali injuries occur more frequently than acid injuries. Chemical injuries of the eye produce extensive damage to the ocular surface epithelium, anterior segment and limbal stem cells resulting in permanent unilateral or bilateral visual impairment. Emergency management if appropriate may be single most important factor in determining visual outcome. This article reviews the emergency management and newer techniques to improve the prognosis of patients with chemical injuries(12).

Ocular chemical injuries are a true ocular emergency and require immediate and intensive evaluation and treatment. The sequelae of an ocular burn can be severe and particularly challenging to manage. Improvements in the understanding of the pathophysiology of chemical injuries, as well as advancements in ocular surface reconstruction have provided hope for patients who would otherwise have a dismal visual prognosis. After chemical injury, the goal of therapy is to restore a normal ocular surface and corneal clarity. If extensive corneal scarring is present, limbal stem cell grafting, amniotic membrane transplantation and possibly keratoprosthesis can be employed to help restore vision. {12}

1.1.3 Chemical Eye Burn Causes:

Most chemical eye injuries occur at work. Industries use a variety of chemicals daily. However, chemical injuries also frequently occur at home from cleaning products or other regular household products; these injuries can be just as dangerous and must be treated seriously and immediately.

Chemical burns to the eye can be divided into three categories: alkali burns, acid burns, and irritants.

The acidity or alkalinity, called the pH, of a substance is measured on a scale from 1-14, with 7 indicating a neutral substance. Substances with pH values less than 7 are acids, while numbers higher than 7 are alkaline; the higher or lower the number, the more acidic or basic a substance is and the more damage it can cause.

- **Alkali burns:** are the most dangerous. Alkalis-chemicals that have a high pH-penetrate the surface of the eye and can cause severe injury to both the external structures like the cornea and the internal structures like the lens. In general, more damage occurs with higher pH chemicals.

- Common alkali substances contain the hydroxides of ammonia, lye, potassium hydroxide, magnesium, and lime.

- Substances you may have at home that contain these chemicals include fertilizers, cleaning products (ammonia), drain cleaners (lye), oven cleaners, and plaster or cement (lime).

  - **Acid burns:** result from chemicals with a low pH and are usually less severe than alkali burns, because they do not penetrate into the eye as readily as alkaline substances. The exception is a hydrofluoric acid burn, which is as dangerous as an alkali burn. Acids usually damage only the very front of the eye; however, they can cause serious damage to the cornea and also may result in blindness.

- Common acids causing eye burns include sulfuric acid, sulfurous acid, hydrochloric acid, nitric acid, acetic acid, chromic acid, and hydrofluoric acid.

  Substances you have at home that may contain these chemicals include glass polish (hydrofluoric acid), vinegar, or nail polish remover (acetic acid). An automobile battery can explode and cause a sulfuric acid burn. This is one of the most common acidic burns of the eye.

  - **Irritants** : are substances that have a neutral pH and tend to cause more discomfort to the eye than actual damage.

- Most household detergents fall into this category.

- Pepper spray is also an irritant. It can cause significant pain but usually does not affect vision and rarely causes any damage to the eye(14)

1.1.4 Investigation:

Initiate Treatment **Chemical** ocular **burns** are a medical emergency and require immediate irrigation, preferably initiated at the scene of the injury. A patient who arrives in the Emergency Department with a **chemical burn** should have the affected **eye**(s) irrigated with one to two liters of sterile saline solution before attempting any exam unless there is a strong suspicion of globe rupture. After no less than 30 minutes of irrigation, litmus paper should be used to check the pH in the conjunctival fornix. pH should be between 7.0 to 7.4. If the pH is, greater than 7.4, continue irrigating until the pH is within the acceptable range.

Once the pH is within normal limits, the **eye** can be safely examined. After ensuring there is no globe rupture, the **eye** should be examined for visible foreign bodies and the lid everted to clear any debris. Fluorescein stain should be performed to assess for corneal abrasions or ulcerations, as well as slit lamp exam for injury to deeper structures in the **eye**. Intraocular pressure should be measured. Visual acuity testing should be performed. {13}

1.1.5 Pathophysiology:

Alkali: alkali agents are lipophilic and therefore penetrate tissues more rapidly than acids.[4]

Acids: acids are generally less harmful than alkali substances. They cause damage by denaturing and precipitating proteins in the tissues they contact. The coagulated proteins act as a barrier to prevent further penetration (unlike alkali injuries).[5]

1.1.6 Management:

1.1.6.1 Irrigation and solutions type:

Early irrigation is critical in limiting the duration of chemical exposure. The goal of irrigation is to remove the offending substance and restore the physiologic pH. It may be necessary to irrigate as much as 20 liters to achieve this. To optimize patient comfort and ensure effective delivery of the irrigating solution, a topical anesthetic is generally administered. An eyelid speculum or Morgan Lens® (MorTan, Missoula MT) can be used to keep the eye open, while the irrigating solution is delivered through IV tubing. There has been some debate on the most effective irrigating solutions. A study by Herr et al. compared Normal Saline (NS), Normal Saline with Bicarbonate (NS + Bicarb), Lactated Ringer's solution (LR), and Balanced Saline Solution Plus (BSS Plus, Alcon Laboratories, Fort Worth, TX) irrigating solutions to investigate which solution optimized patient comfort. They found that patients tolerated and preferred BSS irrigation compared to NS, NS + Bicarb, and LR.[12] In experiments in rabbit eyes following sodium hydroxide injury, aborate buffer solution called Cedderroth eye wash (Cedderroth Industrial Products, Upplands Vaasby Sweden) and a Diphthorine and Previn solution (Prevor, Cologne Germany) more efficiently normalized the pH compared to saline and phosphate buffer solutions.[7] Of course, early irrigation is paramount to limiting the duration of chemical exposure. If clean water is available at the site of injury and a standard irrigating solution is not, then the eyes should immediately be washed out with water.[8][9]

1.1.6.2 Medical therapy:

Patients with mild to moderate injury have a good prognosis and can often be treated successfully with medical treatment alone. The aims of medical treatment are to enhance recovery of the corneal epithelium and augment collagen synthesis, while also minimizing collagen breakdown and controlling inflammation.[3]

1.1.6.3 Standard Treatments:

a) Antibiotics: A topical antibiotic ointment like erythromycin ointment four times daily can be used to provide ocular lubrication and prevent superinfection. Stronger antibiotics (e.g. topical fluoroquinolone) are employed for more severe injuries.

b) Cycloplegic agents: such as atropine or cyclopentolate can help with comfort.
Artificial tears and other lubricating eye drops, preferably preservative free, should be used generously for comfort.

c) Steroid drops: In the first week following injury, topical steroids can help calm inflammation and prevent further corneal breakdown.[14] In mild injuries, topical prednisolone(Predforte) can be employed four times daily. In more severe injuries, prednisolone can be used every hour. After about one week of intensive steroid use, the steroids should be tapered because the balance of collagen synthesis vs. collagen breakdown may tip unfavorably toward collagen breakdown.[10]

1.1.7 long term complications:

a) **Glaucoma:** glaucoma Is Quite Common Following Ocular Injury, Ranging In Frequency From 15%-55% In Patients With Severe Burns.[8]

b) **Dry eye:** Chemical injury can destroy conjunctival **goblet cells**, leading to a reduction or even absence of mucus in the tear film. This mucus deficiency results in keratoconjunctivitis sicca (dry eye).[11]

c) **Damage to the eyelids or palpebral conjunctiva:** direct chemical damage to the conjunctiva can lead to scarring and **ectropion**. can be treated by suppressing inflammation and with early amniotic membrane transplantation or oral mucosal graft.[3]

1.1.8 Consideration:

Do not delay immediate irrigation after the injury unless there is very high suspicion for globe rupture. Ocular **burns** are a true emergency, and prompt ophthalmology evaluation is necessary. {13}

Chapter two

Methodology

2. Methodology:

2.1 Justification :

So far, water is used in decontamination of eye surface in cases of chemical injuries, but is it useful in decreasing further complication when used as a primary intervention when compared to other methods of decontamination.

2.2. Objective

2.2,1. General Objective :

- To review benefit of irrigation in chemical ocular injury in various clinical studies.

2.2.2. Specific Objective :

- To identify level of significance of irrigation in many researches.
- To compare and identify level of discrepancies between researches and trying to find overall conclusion about irrigation usage in chemical ocular injury.

2.3. Inclusion Criteria:

Randomized, quasi-randomized controlled trials and observational studies comparing the effectiveness of methods of eye irrigation among adults or children as an active form of emergency treatment for ocular chemical burns were considered for review. Studies were eligible for inclusion if methods of eye irrigation were examined within the following comparison categories: water eye irrigation, volumes, durations, flow rates and temperature of eye irrigating fluids. The types of outcome measures include immediate ocular outcomes and complications, clinical outcomes, self-reported outcomes.

2.2.4. Search Strategy:

Electronic bibliographic databases in English and Chinese were searched from inception to April 2018 and yield 8,999 citations. Other sources were searched by hand to identify studies or additional relevant source materials. The reference lists and bibliographies of all articles retrieved were scrutinized to identify further studies and added a further 22 articles. A forward search on the authors of the studies identified was also performed.

2.2.5. Methodological Quality:

A study eligibility verification form was developed for the assessment and two reviewers made independent decisions on whether to include each publication in the systematic review. Critical appraisals of study quality were undertaken independently by two reviewers using the Joanna Briggs Institute critical appraisal tools. Any disagreement that arose between the two reviewers was resolved by discussion.

2.2.6. Data Extraction:

Data extraction was performed by one reviewer using a data extraction form developed for the systematic review. Another reviewer checked for accuracy.

2.2.7. Data Synthesis:

Given the clinical and methodological diversity among the studies included in this review, the review findings are presented in a narrative form and no meta-analysis has been performed.

Chapter three

Results and Discussion:

3.1Results and Discussion:

A total of 380 papers were collected from PubMed website. The number that was excluded was 378 because of irrelevance or study design or not matching the inclusion criteria as noted before. The included study were observational description retrospective of medical records (Ikeda et al 2006 and saari et all 1984). The patient age ranged from 2 to 75 years old in saari et al (1984) and for Ikeda et al (2006) age group ranged from 30 to 53 years old, however there was no attempt to address confounding factors which included severity of injury differences between comparison groups (saari et al) and time of initation of eye irrigation in Ikeda et al.

3.1.1Type of intervention:

Ikeda et al looked at effect of eye irrigation with tap water at scene of injury in 53 patients while saari et al looked at effect of prolonged irrigation upon arrival to hospital in a total of 172 patients.

3.1.2Effect of interventions:

Ikeda et al In the study of Ikeda et al. (2006), 36 patients (49 eyes) had prompt eye irrigation at the scene of injury following alkali burns and 17 patients (29 eyes) did not have immediate eye irrigation. The range of duration of irrigation was 5–20 minutes for 26 patients and 30–60 minutes for 10 patients. All 53 patients were admitted to the emergency rooms and eye clinics in the hospital and received further irrigation for 30–60 minutes with 500 to 1,000 ml of physiological saline. The patients in the irrigation group were significantly younger than those without immediate irrigation (mean age: 30 vs. 53 years), and had significantly shorter mean time between injury and initial hospital visit (1.8 vs. 4.2 hours).

The ophthalmic examination following in-hospital irrigation showed a significantly lower prevalence of erosion of the eyes in the irrigation group (24%) than the no-irrigation group (86%). The prevalence of good visual acuity after in-hospital irrigation was significantly greater in the irrigation group than the no-irrigation group (92% vs. 21%). Three eyes in the no-irrigation group had cataracts with poor visual acuity. The study also showed that the group with immediate irrigation had significantly fewer grade 2 injuries according to Hughes' classification than the no-irrigation group (24% vs. 86% of the eyes). No patients with immediate irrigation required hospitalization, but six patients (35.3%) without immediate irrigation were hospitalized and received further treatment. The mean time from injury until corneal wound healing was significantly shorter in the irrigation group than the no-irrigation group (8 vs. 29 days) (Ikeda et al. 2006).

In Saari et al. (1984), 53 patients (30.8%) received prolonged irrigation and 119 patients (69.2%) underwent conventional irrigation. All patients immediately washed their eyes with water at the scene of injury, underwent eye irrigation with physiological saline at the local health centre or at the outpatient department, and had eye irrigation with physiological saline once again after being admitted to the two eye hospitals. Those appeared more severe on admission and within 6 hours after chemical exposure received prolonged irrigation with 1,000 ml of physiological saline over 1 to 2 hours through an intravenous line at the eye hospitals.

Of the 57 patients with acid burns, 27 received prolonged irrigation. The mean duration of treatment at hospital after prolonged and conventional irrigation, respectively, was 4.8 and 9.5 days.

For patients receiving prolonged irrigation and with burns caused by AIV solution and inorganic acids, the final visual acuity was good except the eye injured after car battery explosion. No data were provided about the final visual acuity of patients who received conventional irrigation. Of the 64 patients with alkaline burns, 22 received prolonged irrigation. The mean duration of treatment at hospital after prolonged and conventional irrigation, respectively, was 5.4 and 7.8 days

For patients receiving prolonged irrigation and with burns caused by sodium hydroxide, mortar and cement, the final visual acuity was good. For patients receiving conventional irrigation, one patient whose burns caused by mortar and cement had final visual acuity below 0.1, while the injured eye became blind in two patients whose burns were caused by sodium hydroxide. No data were provided about the final visual acuity of patients with burns caused by other alkali chemicals. Of the 51 patients with other ocular chemical burns, four received prolonged irrigation. The final visual acuity of patients receiving prolonged irrigation and conventional irrigation was good.

prolonged irrigation with one liter of physiological saline using intravenous delivery system during 1-2 hours. The extent of damage was smaller, the visual outcome better, and the duration of treatment at the hospital and absence from work were shorter in patients treated with prolonged irrigation than without such treatment. Saari KM 1984

Author name	Saaria et al (1984)	Ikaeda et al (2006)
Study subject	Time of initial eye irrigation	Effect of eye irrigation with water
Age group	(2—75)years old	(30—53)years old
Total patient	172 patient	35 patient
Result	both prolonged and conventional irrigation was good. The extent of damage was smaller, the visual outcome better	both prolonged and conventional irrigation was good. The extent of damage was smaller, the visual outcome better

Chapter four

Conclusion and Recommendation

4.1Conclusion:

- Early wash or irrigation prevent expected complication.
- initiation of eye irrigation following alkali burns, resulting showed a significantly lower prevalence of erosion of the eyes and good visual acuity .
- Three eyes in the no-irrigation group had cataracts with poor visual acuity..
- No patients with immediate irrigation required hospitalization, but six patients without immediate irrigation were hospitalized and received further treatment
- Patients with acid burn received prolonged irrigation. The mean duration of treatment at hospital after prolonged and conventional irrigation.

4.2Recommendation:

- There is insufficient evidence to determine the optimal eye irrigation methods to improve ocular and clinical outcomes.
- Further trials studies should consider the potentially confounding factors such as the time to commence eye irrigation and effects of irrigating fluids that might affect the outcomes and adopt strategies to deal with them.
- Advice those are whom exposures to chemical substance to wash their eye by water tap before arriving hospital.

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