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Occupational-related chemical ocular injuries: an analysis of 82 patients

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ABSTRACT

Objectives. To investigate the characteristics of occupational chemical eye injuries. ***Methods.*** Medical records of patients, who were registered to hospital officially as occupational chemical eye injuries between January 2010 and December 2013, were reviewed. The age, gender, injured eye, chemical agent, nature of the chemical, ocular findings, emerging complications and the information whether the patients knew the chemical agent causing the injury was recorded. ***Results.*** One hundred one eyes of 82 patients (2 women, 80 men) were included in the study. The mean age of the patients was 32.9±8.6 years (range: 19-59 years). Injury was bilateral in 19 patients. Chemical agents were not known by 53% of the patients. The most known agents were caustic agents (23%). Sulfuric acid (9%) and calcium hydroxide (4%) were other known chemical agents. The most common injury was superficial punctate epitheliopathy. Ten eyes of 9 patients had corneal edema. This injury was caused by acidic agents in 5 and alkaline agents in 3 patients. Corneoscleral perforation accompanied by chemical injury in one patient with car battery explosion. ***Conclusions.*** Most of the workers, who had eye injuries with chemicals, do not know the nature of chemical agent which caused the injury. Ocular morbidities may be decreased with the education of the workers about chemicals, working environment and protective measures.

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Keywords: Accidents; cccupational; eye injuries; burns; chemical

Introduction

Occupational related ocular injuries are one of main causes of blindness and visual impairment. One of these injuries is chemical burns of the ocular surface [1]. Ocular chemical burns may lead to financial and psycological problems for both individual and society, due to labor force loss besides long period of treatment and rehabilitation [2]. According to data of Turkish Statistical Institue (TSI), 2.3% of the workers had occupational injuries in 2013; and as a result of these injuries 65% of the workers had been away from work, or could not return to work.

A study from middle Anatolia showed that 3% of the patients that referred to the emergency because of

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burns were chemical and all of them were work related [3]. In USA, 2.4% of the all occupational injuries are eye injuries, and 0.045% of them are chemical burns in private sector[4]. A study from Turkey reported that 42% of the amniotic membrane transplantation, and 17% of the penetrating keratoplasty because of corneal perforation were performed in patients with chemical ocular injury [5, 6]. Ocular chemical burns are important public health problems, however in Turkey, this subject has not been studied in detail. In this study, we investigated characteristics of patients, who were registered to hospital officially as occupational chemical eye injury; characteristics of the injuries and chemicals, and knowledge of the patients about chemicals.

Methods

Medical records of patients, who were registered to emergency or ophthalmology department for occupational chemical eye injury between January 2010 and December 2013, were reviewed. One-hundred one chemical ocular injuries were included in the study. Age of patients, gender, chemical agent that caused injury (if the patient knows), ocular findings, ocular complications, knowledge of the patient about chemical and pH that they were exposed to were noted. This retrospective study was conducted in accordance with the Declaration of Helsinki.

Results

Total 82 patients (2 women, 80 men) were included in the study. Ocular chemical burns were 17.2% of all occupational eye injuries. The right eyes were injured in 35 patients, the left eyes in 28 patients, and both eyes in 19 patients. Mean age of the patients was 32.9±8.6 (range: 19-59) years.

In all cases, ocular surface irrigation with saline or ringer lactate solution was performed at emergency department. According to severity of cases, artificial tears, topical antibiotics, cycloplegic drugs and preservative free steroids were prescribed. In severe cases who required hospitalisation, 10% solutions of Na-citrate, Na-ascorbate and N-acetylcysteine were added to the treatment . The patient with corneoscleral perforation underwent primary repair.

Distribution of the patients according to age groups are given in Table 1. Fifty-nine percent of the patients under 30 years old were unaware of the content of the chemical agents. The unawareness of patients about the content of chemical agent was 61% in patients over 60 years old.

Table 1. Distribution of patients according to age groups and the rates of the awareness of patient about the content of chemical agent

Age (year)	n (%)	Awareness rate (%)
< 20	2 (2.5)	50
20-29	32 (39)	59
30-39	30 (36.5)	40
40-49	16 (19.5)	69
50-59	2 (2.5)	100

n=number of the patients

Totally, 35% of the patients did not know how they had been injured, and 52% of them did not know which chemical agent had caused the injury. Mostly known causes for injuries were sodium hydroxide (NaOH) or potassium hydoxide (KOH). The informations about the industrial sectors of the fifty-three patients were avaible. The industrial sectors in which the chemical eye injuries occur are shown in Table 2. The chemical contents of the agents that caused the injury are given in Table 3.

Table 2. Industrial sectors that chemical eye injuries are frequently encountered

Industrial Sector	n (%)
Cleaning	21 (39.6)
Paint and coating	12 (22.6)
Automotive and machine	9 (17)
Gas	6 (11.3)
Construction	3 (5.7)
Food	2 (3.8)

n=number of the patients

Table 3. Chemical contents of agents that caused chemical ocular injury

Chemical content	n (%)
NaOH or KOH	19 (48.7)
H_2SO_4	7 (17.9)
$Ca(OH)_2$	3 (7.7)
HNO_3	2 (5.1)
CN	1 (2.6)
NH_3	1 (2.6)
Organic acid	4 (10.3)
Cyanoacrylate	2 (5.1)

n=number of the patients

The most common ocular findings were superficial punctate epithelyopathy (68%) and conjuctival hyperemia (23%) at initial examination. Two eyes of the 2 patients were injured by battery explosion; one of them had corneoscleral perforation, and the other had hyphema.

Twenty-seven eyes of the 19 patients had conjunctival hyperemia and 14 eyes of the 9 patients had chemosis at initial examination. Seventy eyes of the 56 patients had superficial punctate epitheliopathy or minimal epithelial defect was observed. Nine eyes of 6 patients had total epitheliopathy and 10 eyes of 9 patients had corneal edema.

Discussion

Chemical injuries of the eyes are one of the ophthalmic emergencies and can cause extensive damage. These injuries are mainly encountered in industrial areas [7]. Our department also serves as a reference hospital in one of most important industrial zones of Turkey. In developed countries, the rate of such injuries is low; however in developing countries it is increasing. A study conducted in the United Kingdom, the incidence of serious chemical eye injury was 0.02 per 100 thousand people [8]. Another study from China reported that ocular chemical burns are 1.2-1.7% of all burns, and 33% of the entire chemical burns involved eyes [9]. In a study conducted in Turkey, 2% of severe ocular trauma injuries that require hospitalization are chemical injuries [10]. A study from Singapore noted that 15% of all ocular traumas were chemical burns [1]. In this study, we report that 17.2% of all occupational injuries are ocular chemical burns. Other studies, in accordance with our study, have shown that men were exposed to chemical injury more than women [7, 11, 12].

The most important factor affecting the prognosis in chemical injuries of the eye is the amount and duration of contact of the chemical with the eye [13, 14]. Rapid removal of the chemical and debris from the eye by intensive washing affect outcomes [11]. In this study, it could not be possible to obtain information about duration and amount of the irrigation to the affected eye.

Chemical injuries are two types: acid and alkaline [7]. Alkaline can be found frequently in the context of the detergent used in the home, so usually alkaline injuries are more common than acid injury [12]. We have found that acid and alkaline chemical burn rates are similar in our study. This result may be related with our study group whose injuries were occupation related.

A study in United Kingdom reported that 63% of the chemical eyes injuries are occur in work places. This ratio is 61% in Germany [11, 12]. A recent study from China reported that 86% of the all chemical burns had occurred in work places, and ocular burns had accompanied 10% of them [15].

Sulfuric acid is one of the most common causes of acid burns and usually does not cause very serious damage to the ocular surface. However especially battery explosions may lead to thermal burn besides penetrating trauma of the eye by foreign body [16]. In this study, we noticed that 7 patients were injured with sulfuric acid, and one of them had penetrating eye injury.

The most serious alkaline injury occurs with ammonia. The other agents are potassium hydroxide and sodium hydroxide [16]. While the most important cause of work-related alkaline burn is calcium hydroxide in developed countries, caustic agents are mostly responsible for the burns in developing countries [7, 17, 18]. In our study, injury with ammonia was noted only in one case. However, most frequent injuries were caused by potassium hydroxide and sodium hydroxide.

The age range in which the occupational injuries mostly occur was 18-39 years with the peak at 30-34 years according to 2013 data of the Ministry of Labor and Social Security in Turkey. In our study, the mean age was in accordance with the above data. In previous studies, it has been shown that the ocular chemical burns occur usually between 20-40 years of age [19]. Our study was compatible with the literature with regard to gender and age distribution.

According to our age groups, 59 percent of the patients under 30 years old were unaware of the content of the chemical gents. The unawareness rate was 40% between 30-39 years and 61% for the patients over 60 years old. These findings suggest that the employees do not the content of the chemical agents that they work with. We think that these results may be related to being inexperienced in younger age groups, while it may be related to increased self-confidence in older age groups.

Our study suggests that chemical ocular injuries constitute an important part of work-related injuries. The occupational injuries are not evenly distributed among the regions in Turkey and the registered data are lacking [20]. Since the number of unregistered employees in Turkey according to June 2014 data is 36% and Bursa is the second city after Istanbul in which most of the occupational injuries occur, we estimate that the real number of injuries may be far more than the available data.

Conclusions

The chemical ocular injuries may be prevented by increasing the awareness of the employees about their working conditions, the chemical agents that they work with and preventive measures (mask, goggles etc). Ocular morbidities may be minimised by educating employees about what they should do immediately in case of ocular injury and the the financial and moral burden on individuals and the society may be lessened. The emloyees should be educated about the properties of the chemical agents that they are exposed to. The gain of experience in prevention of the injuries are among the important factors, but extreme self confidence may have a negative impact.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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