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Chemical Burn Injury in Kumasi: The Trend and Complications following and Their Management

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Background: A chemical burn refers to irritation and destruction of human tissue caused by exposure to a chemical, usually by direct contact with the chemical or its fumes. The study investigated the trend and complications following chemical burns and their management.
Methods: The study involved a retrospective review of Burns Registry at the Burns Intensive Care Unit of the Komfo Anokye Teaching Hospital on patients who were admitted for burns from May 1, 2009 to April 30, 2013.
Results: Chemical burns admissions accounted for 3.5% ($n = 17$) out of the total 487 burns cases, consisting of 12 males (70.6%) and 5 females (29.4%). Mean total burns surface area was 21.9%; mean length of stay in Burns Intensive Care Unit was 9.5 days. The etiological agents for the chemical burns included the following: hot caustic soda 1 (5.9%); acid 9 (53.9%)—the most common; hot ethanol 3 (17.6%); and other chemicals such as other bases, oxidizers, solvents, etc. accounted for 4 (23.5%) etiological agents. Outcome included 11 discharges (64.7%), 6 transferred out to other wards (35.3%), and 0 deaths (0.0%). The complications included severe scar contractures in 5 patients (29.4%), loss of vision: partial/total = 2 (11.8%), gross keloidal/hypertrophic scars = 10 (58.8%).
Conclusions: Chemical burns are severe and often cause severe debilitating sequelae including partial/total loss of vision. But the current study showed that only a small population (3.5%) were affected by chemical burns and no death was recorded; society has to be continually conscious of chemicals, especially caustic agents, and hence take the necessary precautions so as to prevent these avoidable complications. *(Plast Reconstr Surg Glob Open 2015;3:e548; doi: 10.1097/GOX.0000000000000519; Published online 23 October 2015.)*

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INTRODUCTION

Chemical Burns: Magnitude of the Problem

A chemical burn is irritation and destruction of human tissue caused by exposure to a chemical, usually by direct contact with the chemical or its fumes. Chemical burns can occur in the home, work, school, or as a result of accident or assault.[1,2]

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Symptoms vary depending on the chemical, the part of the body affected, and the duration of the exposure to the chemical. Rapid first aid following exposure can limit the damage caused by the chemical. Also, chemical burns can occur when certain chemicals are accidentally swallowed, spilt on the skin, splashed in the eyes, or even breathed in the case of chemical gases.[3] Chemical burns can be caused by caustics (acids or bases) that come into contact with human tissue, with their severity related to a number of factors, including the pH of the agent, the concentration of the agent, the length of the contact time, the volume of the offending agent, and the physical form of the agent.[4] Although injuries do occur at home, the risk of sustaining a chemical burn is much greater in the workplace, especially in businesses and manufacturing plants that use large quantities of chemicals.[5,6] Morbidities associated with chemical burn injuries have also been reported. Depending on the extent of the damage, the chemical-burn-injury victim may have to undergo series of plastic surgical repairs to correct defects such as contractures and scarring and hence very costly economically.[7] Ocular injury from chemical burns does occur and may take either one of the following routes, accidentally splashing the chemical on the eyes or rubbing the eye after handling the chemicals.[3] Irritation of the eye, redness, swelling, pain, stinging, burning sensation, blurred vision, and destruction of sight are some complications from ocular injury. It is therefore advised that protective eye shields and goggles be worn when handling hazardous chemicals.[3]

Complications following Ocular Chemical Burns

Complications following ocular burns injury caused by chemicals include neovascularization and inflammation, damage to the ocular surface tissue, eyelid, cornea, conjunctiva, and degeneration of cornea or stroma.[8]

Severe Body Scarring following Chemical Burns

Contractures and scarring following chemical burns injury take a great toll on the victim's life, in some situations resulting in morbidity and reduced quality of life. Depending on the extent of the damage, victims may also be required to undergo a series of reconstructive surgeries to improve their condition and make them comfortable or remedy their appearance, which may involve some aesthetic surgeries and sometimes may develop some scars due to functional and aesthetic components.[9–11] Depending on the severity of the burns injury even after some series of surgical procedures, the victim is left with some degrees of scars as most of these deeper burns heal by scarring. Silicone gel sheets have proven to be useful in the treatment of hypertrophic scars.[12] Compression garments could also be used to prevent development of hypertrophic scars. Itching of the healed burns surface is a usual occurrence, which may require administration of antihistamines. To avoid hyperpigmentation, the healed areas should not be exposed to sunlight until they mature.[13–18]

MATERIALS AND METHODS

Study Setting

Komfo Anokye Teaching Hospital (KATH), located in Kumasi, is the second-largest hospital in Ghana and the only tertiary health institution in the middle belt of the country; it currently operates with 1000 bed capacity and an annual hospital attendance of about 679,050 patients made up of both out and inpatients (KATH records). It is the main referral hospital for the Ashanti, Brong-Ahafo, Northern, Upper East, and Upper West regions.

Data Collection

The Burns Registry at KATH Burns Intensive Care Unit (BICU) containing information on patients who were admitted for burns from May 1, 2009 to April 30, 2013 was used. Data on the sex, age, occupation, cause of injury, total burns surface area, and outcome of admissions were obtained.

Data Analysis

Descriptive statistics were used. Graphs were drawn using Microsoft Excel.

RESULTS

There were a total of 17 patients with chemical burns out of the 487 burns cases admitted to the KATH BICU from May 1, 2009 to April 30, 2013. Chemical burns admissions accounted for 3.5% of all 4-year burns admissions. The mean total body surface area burnt was 21.9%, with mean length of stay in the BICU as 9.5 days. Table 1 shows general data on the chemical burns patients in the study.

Some of the patients are shown in Figures 1–5. The patients were aged 5–47 years, consisting of 12 males (70.6%) and 5 females (29.4%) with a mean age of 26.8 years. The majority of chemical burns patients' age groups were between 21–30 years, followed by 31–40 years (Fig. 5). The etiological agents for the chemical burns included the following (Fig. 2): hot caustic soda, 1 (5.9%); acids, 9 (53.9. %)—the most common; hot ethanol, 3 (17.6%); and other chemicals such as bases, oxidizers, solvents, etc., 4 (23.5%) (Fig. 6). The remaining nonchemical burns admissions (n = 487–17= 470) were caused by open fire/flame in 221 patients (with 66 gas explosions and 16 petrol explosions), scalds in 225 patients, electricity in 13 patients, and Stevens-Johnson syndrome in

Table 1. General Data on Chemical Burns Injury Patients in the Study

No.	Age	Sex	Etiology	Occupation	Anatomical Sites Affected	Type of Reconstruction	Complications	Functional Outcome	Rehabilitation
1	34	Female	Hot ethanol	Ethanol brewer	Trunk + face	Reviewed by ophthalmologist	Loss of sight	Loss of sight	Massaging of scar + protective spectacles
2	39	Male	Hot ethanol	Ethanol brewer	Face + whole body	Reviewed by ophthalmologist	Loss of sight	Loss of sight	Massaging of scar + protective spectacles
3	23	Male	Hot ethanol	Ethanol brewer	Trunk + neck	Reviewed by ophthalmologist	Loss of sight	Loss of sight	Massaging of scar + protective spectacles
4	30	Female	Caustic soda	Soap maker	Buttocks + left lower limb + trunk	Debridement + split-thickness skin graft	Severe scarring	Contracture of lower limbs (both knees)	Physiotherapy + massaging of scar
5	41	Female	Other chemical	Soap maker	Right upper limb + trunk + face	Debridement + skin grafting	Severe scarring on chest wall + both breasts	Able to move upper limbs	Physiotherapy + massaging of scar
6	32	Male	Acid	Farmer	Right upper limb + lower limb + trunk + face	Release of contracture + full-thickness skin grafting	Recurrent contracture	Contracture of both upper limbs	Physiotherapy + massaging of scar
7	29	Male	Acid	Farmer	Left upper limb + trunk	Debridement + skin grafting	Contracture	Able to lift upper limbs	Physiotherapy + massaging of scar
8	5	Male	Acid	Pupil	Buttocks + left lower limb	Release of contracture + randomized skin flap	Fixation of scrotum to right thigh	Able to move lower limbs	Physiotherapy + massaging of scar
9	9	Male	Acid	Pupil	Left upper limb + face	Debridement + skin grafting	Scarring	Able to move upper limb	Physiotherapy + scar massaging
10	21	Male	Acid	Electrician	Genitalia + left lower limb right upper limb	Debridement + skin grafting	Contracture	Able to move both limbs	Physiotherapy
11	36	Male	Other chemical	Electrician	Right upper limb + face	Debridement + skin grafting	Gross scarring	Able to move upper limb	Scar massaging
12	17	Female	Acid	Student	Left upper limb + lower limb + anterior and posterior trunk + both breasts	Debridement + skin grafting	Scarring	Able to move both limbs	Physiotherapy + scar massaging
13	17	Male	Acid	Student	Upper right limb + left lower limb	Amputation of left big toe	Gangrene of the left big toe	Able to move both limbs	Physiotherapy
14	37	Male	Other chemical	Miner	Buttocks + right upper limb + trunk	Debridement + skin grafting	Gross scarring	Able to move hands	Physiotherapy + scar massaging
15	19	Male	Acid	Mechanic	Right upper limb + trunk	Debridement + skin grafting	Contracture	Able to move upper limbs	Physiotherapy + scar massaging
16	22	Female	Acid (assault)	Artisan	Right upper limb + trunk + face + scalp	Release of contracture + full-thickness skin grafting	Scarring + contracture	Able to move upper limbs	Physiotherapy + scarring
17	23	Male	Other chemical	Footballer	Buttocks + left upper limb + trunk	Debridement + skin grafting	Gross scarring	Able to move upper limbs	Physiotherapy + scar massaging

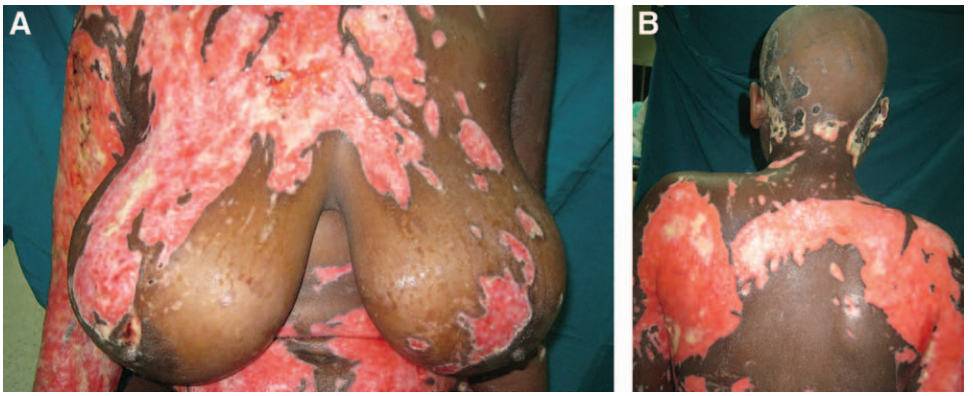

Fig. 1. A, B, Extensive ulceration and scarring due to acid burns.

Fig. 2. Severe scarring of the scalp and alopecia due to assault with acid burns.

11 patients, respectively (Fig. 7). The occupations relative to the occurrence of chemical burns were 1 footballer, 2 students, 2 electricians, 2 farmers, 2 soap makers, 1 mechanic, 1 artist, 1 miner, 2 children, 3 hot ethanol brewers (Fig. 8). Location(s) where chemical burns injuries occurred were chemical burn patient's home, 6 (35.3%), work places, 10 (58.9%), and conveyance, 1 (5.9%) (Fig. 9). The surface anatomical regions burnt by chemicals in this study were whole body, 1; face, 6; neck, 1; trunk, 10; upper limbs, 12; lower limbs, 6; buttocks, 4; genitalia, 1; and head, 1 (Fig. 10). The outcome of chemical burns included 11 discharges, 6 transferred out to other wards, and 0 deaths (Fig. 11).

DISCUSSION

Chemical burns could obstruct the sight of affected persons. The most important act is to prevent the accident from occurring, as most of these accidents are caused by carelessness and assault, eventually resulting in extensive damage to body tissues.[19] Burns outcome could be highly fatal, as the victim could lose his or her life. There could be permanent damage to parts of the body such as the eye. Cases on ocular destruction of the eye as a result of chemical burns have been reported.[20] In the study, some persons suffered injury to the face and therefore a possibility of developing some ocular injury requiring them to undergo a series of surgeries to correct the damage to the ocular surface tissue.[21–24] Complications such as scarring, contractures, hypertrophic scars, and amputation are also associated with chemical burns.[18]

Ingesting and accidental spillages often occur in children, too, especially at homes. There is therefore a need for parents to closely monitor or supervise their growing children and more so not to leave containers of these substances open or at areas where children could accidentally pull or push them, which could overturn on them and then cause serious injuries. The workplace was the highest place where these burns

Fig. 3. A, B, Scar contracture causing ectropion of the left eye due to assault with acid. C, Surgery done: an incision through the scar, releasing the contracture with a full-thickness skin grafting of the defect. Same patient as in Figure 2.

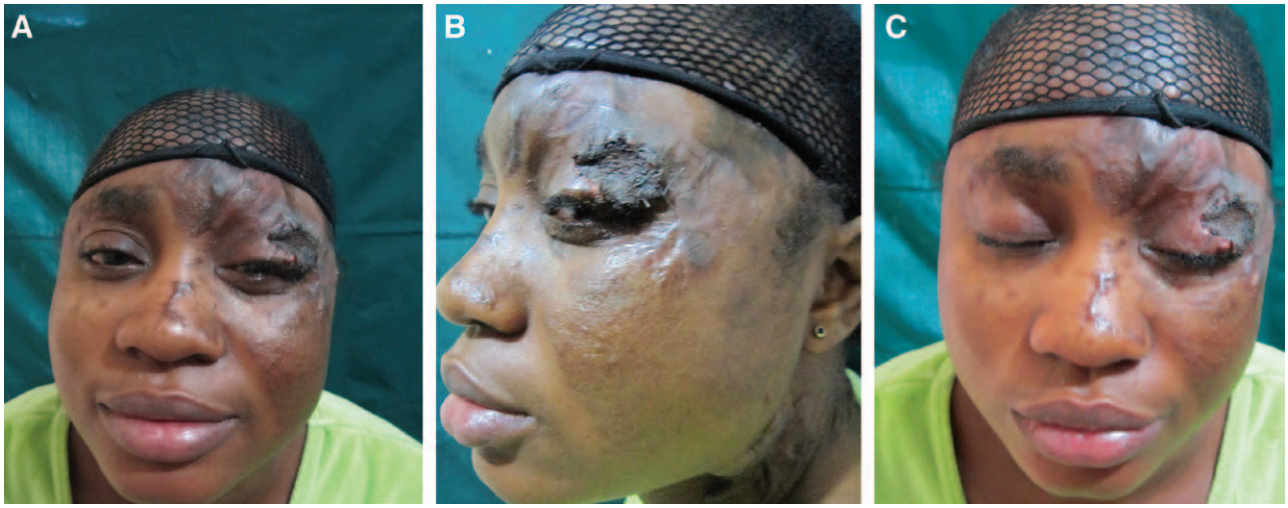

Fig. 4. A, B, C, The same patient in Figure 3, a week after surgery (contracture release and full-thickness skin grafting).

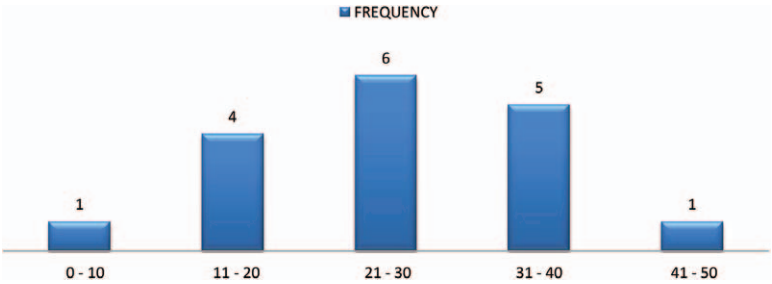

Fig. 5. Age distribution and chemical burns.

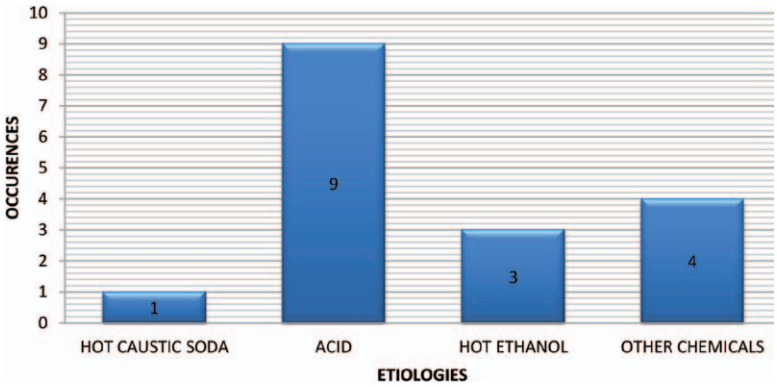

Fig. 6. Chemical burn etiologies, *n* = 17.

injuries occurred. This is also consistent with other studies.[5,25] From the study, the home was the second-highest place where the burns occurred and finally during conveyance when chemicals were transported from one place to the other, which has also been reported.[26]

The current study revealed a higher number of males than females with a ratio of 2.45:1 suffered from chemical burns with most of the burns occurring in persons in their active working age, 21–30 years. This is also consistent with a study by Fan et al,[5] which revealed a ratio of 5.11:1 of male to female suffered from chemical burns with the highest age occurrence being 20–29 years. The study by Fan et al[5] also reported industry as the most common location of chemical burns occurrence with the highest etiology as acid (46.61%), alkali (20.66%). This is also consistent with the current study, which also showed workplace as the highest location where these burns injuries occurred with acids, 53.9%, found out to be the most common cause of chemical burns injury from the study followed by bases, oxidizers, and other solvents (23.5%).

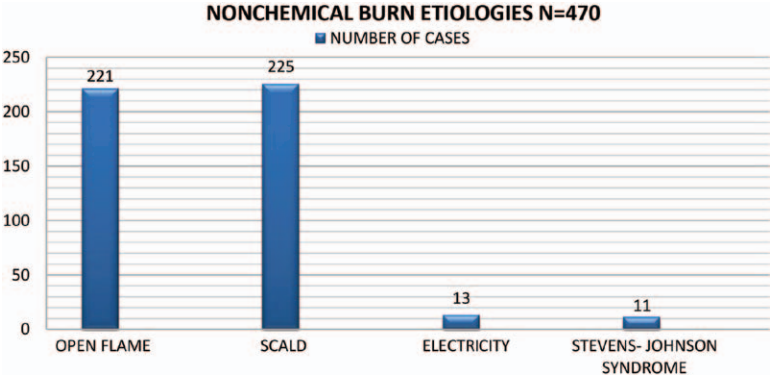

Fig. 7. Nonchemical burns in the study.

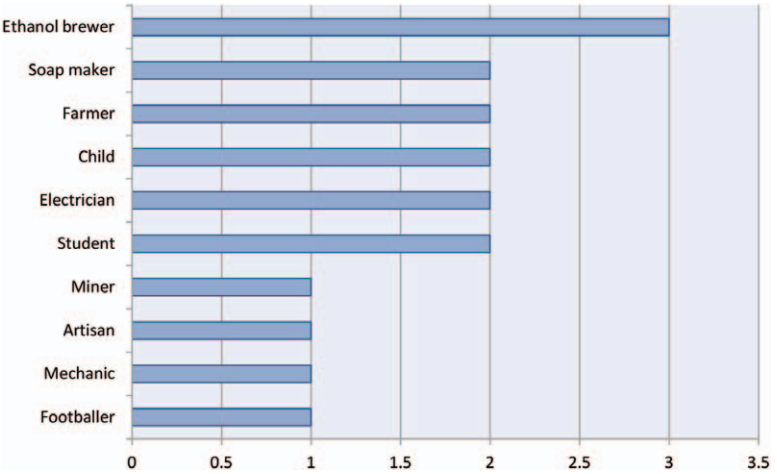

Fig. 8. Occupation and chemical burns.

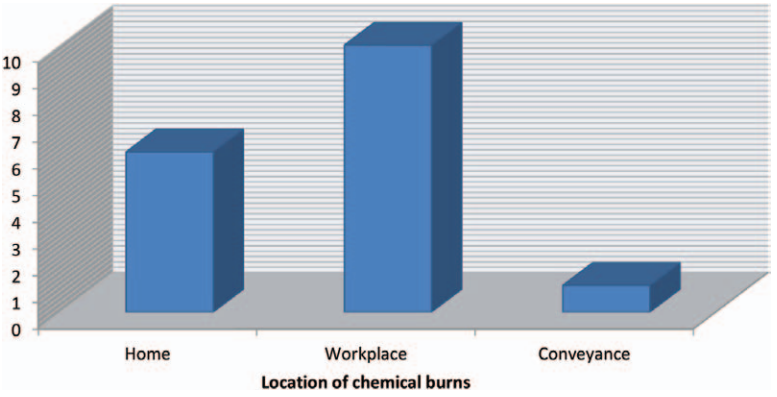

Fig. 9. Location of chemical burns occurrence.

From the study, common anatomical sites of injury were the upper limbs, which were followed closely by the trunk and then the lower limbs and face. Similar body parts such as the limbs, head, face, and neck have been reported to have suffered chemical burns injury in some patients with mortality of 0.5% (3 patients)[5]; however, there was no death recorded out of the persons who suffered chemical burns unlike other studies where deaths were recorded. In the current study, most of the patients were discharged, whereas a few were transferred out to other wards.

Chemical burns injuries resulting from criminal acts are not too common occurrences, but severe injuries, in our environment as seen in the current study. Over the 4-year period under review, a total of 3.5% (n = 17) was reported, 1 of which was assault-related. This is however not the same in some parts of the world. This implies that chemical

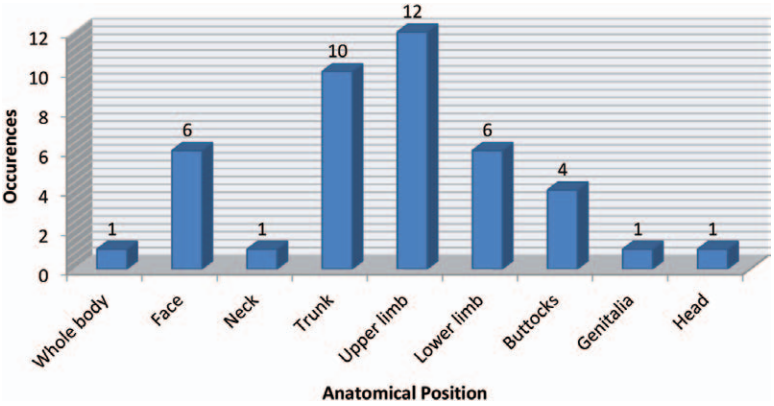

Fig. 10. Anatomical location of chemical burns injuries in the study.

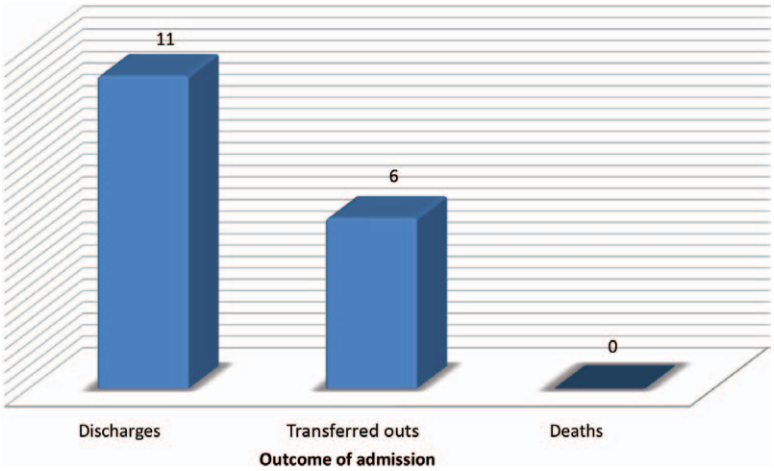

Fig. 11. Outcome of chemical burns.

burns are an uncommon cause of burns admissions in our setting compared to other etiologies such as scalding or open flames. This involves intentionally throwing chemicals that have corrosive effect on a person's face or any part of the body as a sign of punishment for wrong doing. Cases of this nature have been reported as a usual occurrence in some communities.[27,28]

CONCLUSIONS

Complications of chemical burns include scarring, infection, and poor healing with dermal burns where skin grafting may be required. Ocular burns, especially from alkali substances and hydrofluoric acid, can result in cataract formation and/or complete vision loss. Perforation and/or bleeding and respiratory compromise from upper airway edema occur with caustic ingestions in the short term and stricture formation in the long term with caustic burns to the esophagus. Public education should be promoted as it sensitizes the general public on the prevention and complications associated with burns in general.

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PATIENT CONSENT

The patient provided written consent for the use of her image.

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