

Research Article

Epidemiological Profile of Chemical Burns from the Largest Burn Centre in India

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Submitted: 18 November 2016

Accepted: 25 January 2017

Published: 28 January 2017

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Keywords

- Epidemiology
- Chemical burns
- India

Abstract

Aim: This study aims at comparing the epidemiology of chemical burns between the burn units of a developing country such as India and that of the developed countries

Materials and methods: 60 Chemical burn Patients who attended and were admitted in a tertiary burn centre of India (catering to the north Indian population), in the year 2008 were considered for the study and a comparison between the data of the burn units of the developed nation was done.

Observation: Total of 60 patients were victims of chemical burns out of a total of 6190 burn patients treated in the year 2008. Most chemical burns occurred in the age group 21- 30 years, whereas the homicidal burns occurred in 11-20 years age group.

Conclusion: Unlike the world wide incidence the relative incidence of chemical burns was less due to the higher percentage of thermal burns reported in India. The type of injury is also different from the majority of chemical burns in other countries because accidental mishaps at work place is common in developed countries while that in India they are due to accidental burns at home or homicidal burns. The main lesson learnt from this study is that prevention is the key and that the government has to come out with stricter rules and regulations regarding the manufacturing and dispensing of chemical substances especially acids in the market for consumer use and in factories.

INTRODUCTION

Chemical burns are a special type of burns. Though they have been reported with a worldwide incidence of 10.7% [1], unlike thermal burns they can cause high morbidity and mortality (30%) [1]. And range from severe cosmetic disfigurement to loss of an entire organ even if the total burn surface area is limited. The treatment of these burns in acute stage has not changed drastically over the years, but much importance has been given in its prevention. Very few studies mention about these special types of burns. Although these burns form a minor percentage of burn injuries, they vary from one country to another in terms of their independent incidences, cause of injury, age group involvement, causative agents (alkalis in USA and acids in countries like Bangladesh, China) etc. In the era of industrialisation it would be of great value to compare the epidemiology of such devastating burns between the developing and developed countries (Figure 1).

A developing country has lower living standard, underdeveloped industrial base and low human development index. Though India and china comes under newly industrialised country, in our study they are broadly considered in the

developing country category. On the contrary a developed country has higher living standard, developed industrial base and high human development index. Examples of developed countries are U.S.A, UK, Japan, Australia, Spain etc. Worldwide epidemiology shows alkalis as the most common causative agent in developed countries while acids are more common in developing countries. This research work has been carried out with the view to analyse these burns epidemiologically and compare it with that of other developed countries and to bring about newer reforms in their management (Figure 2).



Figure 1 Chemical burns (acid burn).

MATERIALS AND METHODS

6190 Burn patients who attended the emergency of the burn unit of a tertiary burn centre, India from 1st January 2008 to 31st December 2008 were considered in the study. The study was approved by the ethical review board of the institution. Both the outpatient and the admitted patients were analysed with respect to the age group categorised by each decade like less than 10 years, 11-20 years and so on, gender, area of residence like the different states of India, total burn surface area, mode of insult, place of insult, areas of burn distribution, type of surgical interventions, morbidity and mortality after an informed written consent was obtained. The results were then compared with the data gathered from the literature of the western world regarding chemical burns (Figure 3).

RESULTS

6190 burn patients who attended the burn emergency care at a tertiary burn centre, India and 60 patients [1 %] belonged to chemical burns. Out of them, 25 patients (42 %) required admission and the remaining 35 patients were treated as outpatients. The sex ratio among the chemical burns was 42:18 (male: female) {70%: 30%} [Chart 1]. The mode of insult was recorded in the ratio of 15:44:1 (homicidal: accidental: iatrogenic) [25%:73%:2%] [Chart 2]. Maximum number of patients belongs to the age group of 21-30 yrs with 27 patients, followed by the age group 11-20 yrs with 11 patients [Chart 3]. Adults above 40 yrs were the least affected (only 4 patients out of total 60). About 9 patients belonged to less than 10 years category. The ratio of homicidal cases when compared to other modes of insult was highest in the 11-20yrs category followed by the 30-40yrs category. There were no homicidal cases in children below 10 yrs category and above 80yrs category. Females are

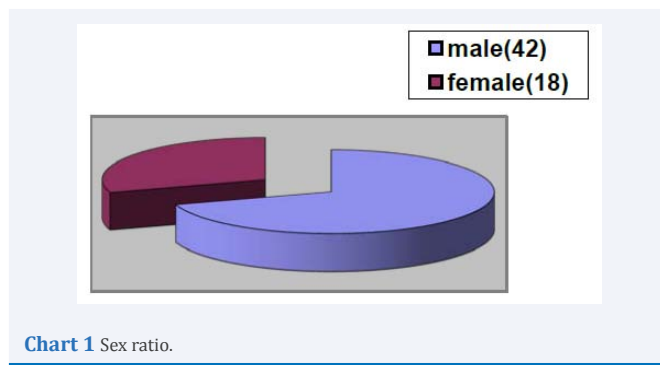


Chart 1 Sex ratio.

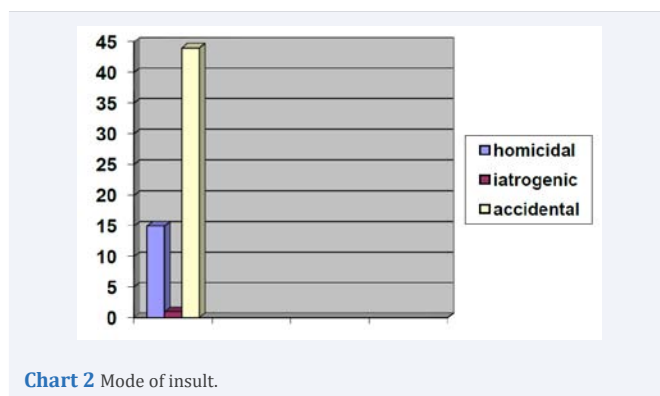


Chart 2 Mode of insult.

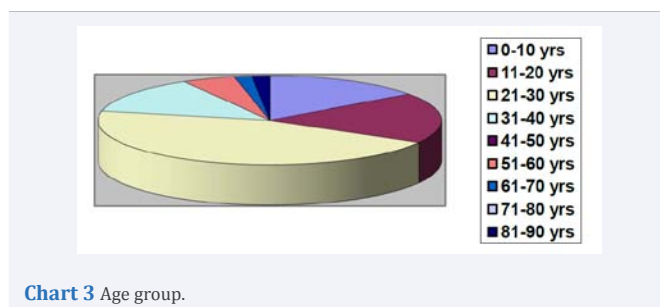


Chart 3 Age group.



Figure 2 Debridement of burn wound.



Figure 3 Split skin grafting of the raw area of face.

more affected compared to males in age groups below 20yrs. Males were predominantly affected above 20 yrs of age. Majority of burn patients had sustained minor burns (<10%). 7 cases fitted in the major burns category out of which 2 were massive (>50%) [Chart 4]. The burn of one of these 2 patients was because of the combined thermal and chemical insult. Upper limbs and face are the maximum affected and lower limbs and perineum are the least affected in this type of burn [Chart 5]. Litmus paper, tissue and sclera staining, circumstantial evidence, information about the raw materials used in factories and patient's description helped to identify the causative agent. In about 51 cases the causative agent was identified to be acid, predominantly those used in cleaning toilets (hydrochloric or sulphuric acid). In the remaining 9 cases, 5 cases were caused by factory alkalis [Chart 6]. The remaining 4 cases, the causative agents ranged from a chemical used in laboratory on a lab worker, Potassium permanganate (KMNO₄) used by quack, combination of sulphur and KOH in a cracker factory on a worker and during the usage of drainex containing NaOH. Majority of the admitted burns underwent ectropion release, split skin grafting of raw area, 1 patient required microstomia correction and another patient

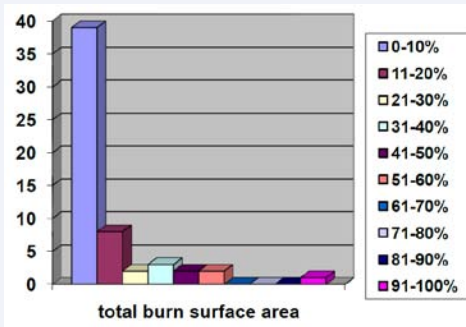


Chart 4 Post burn surface area.

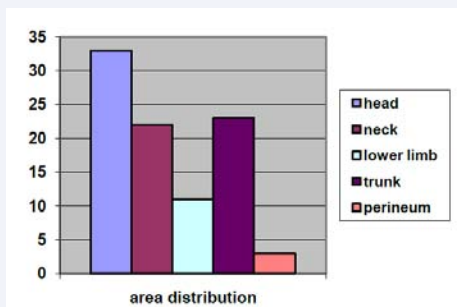


Chart 5 Site.

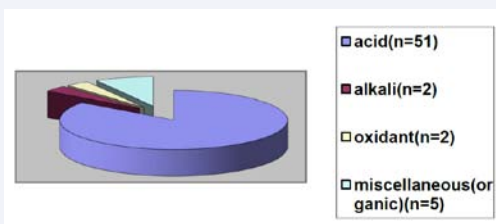


Chart 6 Agents.

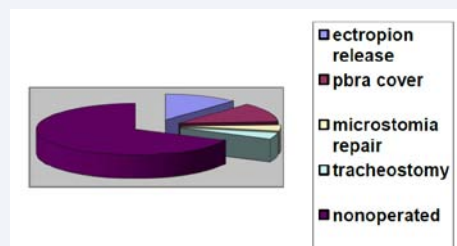


Chart 7 Interventions.

underwent tracheostomy to secure the airway [Chart 7]. 6 out of 25 (24%) admitted patients died during the course of treatment.

Most of the western literature so far published describes chemical burns in industry or factory set up i.e., accidental chemical burns in the workplace [1-5]. Studies quoted from china [6] with huge figures also describe accidental chemical burns due to a single chemical agent in a factory. Nowhere in the world can

we get a huge spectrum of chemical burns owing to various agents as in developing countries such as India. Homicidal chemical burn in the western world is also unheard of unlike India and other developing countries [2,3]

The various epidemiological factors were compared with that of western world in this study and the results logically explained.

OBSERVATIONS

Proportion of burns

Though the global incidence varies from 2.4 – 10.7 %, the developed countries showed a proportion of 7.9% in UK, 3.5% in Australia, while in developing nations like China it was 8.5% and in India it is around 1 %. Other developing countries like North Trinidad, Turkey and Welsh were 25%, 24.3% and 20% respectively. The main difference in the incidence in chemical burns between India and other nations is that the incidence of thermal burns far surpasses the incidence of chemical burns and hence the incidence which is in reality relative incidence is so less here.

Mean age

In United kingdom the mean age of patients with chemical burns was 40 yrs and in Australia it was 32 yrs of age while in India it was 25 yrs (21-30) , China 26 yrs, and North Trinidad 27.5 yrs. In our study most of the chemical burns occurred in youth. In accidental cases they majorly involved youth working at home while handling these chemicals. The same category of youths were also involved in homicidal burns where the major cause was jilted lovers, property disputes etc.

Gender

In UK, Australia and China, males were more affected than females while in North Trinidad females were more affected. In India the scenario was little different. While the study from South India [7] revealed more females were affected while that from North India (in our study) revealed more male victims. In our study the number of accidental burns where in higher number and hence the incidence of males affected were more. While in Trinidad and South India the literature studies revealed that the major cause was homicidal due to jilted workers according to their study.

Nature and locality of burns

In Australia, UK and India the majority of burns occurred in domestic set up while the majority in china was at workplace. In India still the common acids and alkalies are freely available for use in the household. The governmental laws prohibiting the same are yet to be implemented.

Total burn surface area

UK -0-22%, Australia- 3.4%, China 10% and India less than 10%. In India the TBSA involved is less than 10 % as majority are burns due to accidental spillage of small containers containing these chemicals on the patients while in developed countries the higher percentage of burn surface area is due to accidental burns in factories where the amount of exposure of these chemical burns is higher and hence the greater involvement.

In other countries the peripheries (limbs) were predominantly affected while in India the upper limbs and face (around 54%) were the chief areas while the perineal and lower limb regions (around 12%) were relatively spared. Again this observation can be reasoned out due to the accidental and homicidal cause of the burns which involves the exposed parts more commonly than the unexposed and the lower part of the body.

Causative agent

Predominantly alkaline and cement were causative agents in UK, Tasmania and acids in China and North India. In India especially the acids amounted to almost 85% especially the concentrated sulphuric and hydrochloric acids which are the chief constituents of toilet cleaning agents. The free availability of acids still in plastic unlabelled bottles is a major reason for the higher incidence of such burns in India. They are available under the broad category of Toilet cleaning acids and are given to the consumer without any prescription or warning labels. This is contrary to the study published from Nigeria [8] (another developing country) where the causative agent was unknown in the majority of the cases. The predominant chemical is normally identified in most of the studies published in the western literature as these are generally chemicals used in the workplace [2,4] (the reason being, majority of the burns happen at workplace).

Surgery

Many of these physical insults lead to deep burns resulting in need for reconstruction. Also to prevent further ongoing damage of the tissue from these harmful chemicals surgical debridement becomes mandatory in selected cases. Debridement, Post burn raw area reconstruction with skin grafts (Figures 1-3) and flaps, tracheostomy, ectropion release and microstomia correction were the different modalities of treatments in India while in Tanzania it was debridement, Ssg and primary closure. In UK it was Ssg, tangential excision and use of skin template in hand burn while in china, Ssg and conjunctival flaps were more common. In India still skin template is not widely available.

Mortality

In India 8% was the mortality while a global rate of 30% is observed. This again can be attributed to the lower TBSA of involvement in India as compared to other countries due to the difference in the place of burns involved.

DISCUSSION

Chemical burns can cause burns by one of the following mechanisms such as oxidation, reduction, corrosion, protoplasmic poisons, vesicants or desiccants [9]. Compiling the above results it can be well understood that prevention of such devastating burns is the best modality of treatment in such specialised burns. The best way to do the same would be to implement stricter rules and regulations regarding the sale and use of such chemicals. It should also be mandatory for the Government to pose more vigilant norms regarding the packaging of such chemicals instead of allowing them to be dispensed in any unlabelled plastic bottles or containers with ill fitted caps. In today's world there is growing importance of "green cleaners" [10,11] which emphasise on

the usage of naturally available substances that can be used in households for cleaning purposes. The Government has also come up with the latest law that no hospital will refuse the treatment of such chemical burns regardless of the funding capacity of the patients and such denial would lead to legal implications on the medical organisation leading to expedition in the treatment and management of such burns.

The percentage of females affected in this type of burns is more in developing countries in concordance with the data published in the study from Nigeria [8]. The age group of involvement of these burns is maximum in the age group of 21-30 (young adults). Maximum percentage of homicidal cases were seen in the age group of 11- 20 years of age, in consensus with previous studies done in the same type of population [7]. Accidental cases make up to the increased number of cases in the very young (less than 10 years of age). The predominant source of these burns is the widely and freely available toilet cleaning acids (about 85%) that are normally present in every household. These acids are diluted hydrochloric or sulphuric acids. The acids are packaged in any container ranging from easily available plastic bottles of poor quality to glass bottles. The lids and the containers are not according to the rules and regulations of dispensing such caustic chemicals. These chemicals can be procured by anyone from the market in any form they wish. As we learn from the study the majority of these patients have sustained burns due to the accidental spillage of such caustic agents at home, work place or due to vitriol age by jilted lovers or by persons of past enmity [12]. The severe morbidity and mortality associated with these burns requires very highly equipped burn units with readily available reconstructive surgeons. Still the morbidity and mortality of these patients is quite high even in such renowned burn centres.

So the best way to deal with such burns lies in the prevention of such burns. The very fact that these burns are higher in developing countries like India makes us realise that the lack of stricter regulations in the formulations and packaging of these chemicals is the main culprit and that Government should concentrate on this aspect to prevent these life threatening events. In 2013, India introduced amendment to the Indian penal code through the criminal law (Amendment) act 2013; making acid attacks a specific offence with a punishment of imprisonment up to 10 years and which can extend to life imprisonment and with fine. Toilet cleaning agents and other cleaning agents must be packaged in thicker bottles [11] which are properly labelled with good fitting lids. These agents must be stored away from the reach of kids and should be stored in locked cupboards. The other main factor for such burns is when a person tries to reach an acid bottle with an ill fitted cap kept above the head level leading to accidental spillage of the acid. Also these agents should not be available in the raw form as seen in India but rather should be available in combinations which make the nature of the agent very mild. If they could be substituted with other milder chemical or herbal agents like the "green cleaners" [12], then it would mark the end of such dangerous accidents. There are many companies claiming to be working with such agents. One group of products making environmental claims was distinctly different from the rest. They combined a mixture of essential oils from various plants with surfactants and vinegar or acetic acid. These products

are much weaker acids than those described above and are not labelled as corrosive. Whether these agents are truly green to the environment is in debate but the very idea of creating such agents is definitely a thought in the right direction and the need for the hour.

CONCLUSION

As always emphasised after considering the huge toll of morbidity and mortality caused by chemical burns it is our basic understanding that the need for the hour is the prevention aspect by enforcing stricter rules and regulations in the use of such chemicals and substituting household cleaning agents with milder less harmful or rather harmless agents.

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Cite this article

Vathulya M, Tiwari VK (2017) Epidemiological Profile of Chemical Burns from the Largest Burn Centre in India. JSM Burns Trauma 2(1): 1013.