ORIGINAL ARTICLE

Etiological agents of burn and its associated mortality - a five year study

Syed Mukarram Ali, Syed Zubair Ahmed Tirmizi, Abdul Haq, Roohi Ehsan, Syeda Fizzah Tirmizi

Abstract

Objective: To determine the frequency of various types of burn and mortality associated with the etiological agents.

Material and methods: Study conducted on 3,805 patients admitted during the period from January, 2007 to December, 2011 in a burn unit of teaching hospital of Karachi. The variables studied include gender, etiology, type of burn, mortality contributed by each etiological agent and year – wise clinical outcome.

Results: Male predominance found with 55.74% males compared to 44.25 % females. A significant difference found in burn victim trend by gender (Pearson Chi-Square test statistic =17.882; P- value = 0.001). 84.57 % admissions were due to flame burn, followed by electric (7.85%), scald (5.17%) and chemical burn (2.4%) respectively. A significant difference found in burn victim trend by percentage distribution of burn outcome (Chi-Square test statistic =100.004; P- value = < 0.001). A reduction in mortality is evident in successive years. Overall there is increased rate of discharge, mortality and LAMA (leave against medical advice) consequent upon increased burden of admission of flame burn compared to the rest of the etiological agents. Electric burn showed year wise increasing trend and male dominance while chemical burn showed female dominance.

Conclusion: Increased burden of admissions particularly due to flame burn and then electric burn with male dominance indicates risk taking attitude of males in our society. Mortality reduction in successive years is indicating effective management of burn. It requires further evaluation to achieve excellent results.

Key words: mortality, etiology, flame burn, scald, electric burn

Received
23rd December 2014
Accepted
14th June 2015

Dow Medical College, Dow University of Health Sciences, Civil Hospital, Karachi.
SM Ali
SZA Tirmizi
A Haq
R Ehsan
SF Tirmizi

Correspondence:
Dr.Mukkaram Ali
Associate Professor &
HOD Forensic Medicine,
Dow Medical College,
Dow University of Health Sciences, Karachi

Introduction:

Burn is an injury of various tissues of the body caused by heat, electricity, chemicals, radiation and scald produced by hot liquids and steam.[1] Burns, the most frequently occurring public health problem, represent an extremely stressful situation to both the victim and his family. It is still one of the leading causes of disability and mortality produced by injury in the world health organization's East Mediterranean Region and have severe economic and social consequences. It is the fourth leading cause of injury after road traffic accidents, fall and violence.[2] Nearly 11 million burns victims received medical treatment and accounted for about more than 300, 000 deaths annually.[2] Overcrowding and cooking in openly built kitchen are the major problems of the developing countries, contributing 90% of the burn victims worldwide.[2] It has been observed that males have twice the mortality as female in developed world which is contrary to developing world where females have twice the risk of males.[2] This is probably due to high risk taking activities of males in developed countries compared to kitchen accidents and more violent behavior towards the females in developing countries. The incidences of burn cases are frequently met in low to middle income countries which may be either intentional or unintentional. Intent is very difficult to determine because most of the cases occur in domestic setting and circumstantial evidence is missing. WHO reported 7.1 million fire-related un-intentional burns in 2004 with an incidence rate

of 110 per 100,000 per year globally, the highest being 243 per 100,000 per year in the South East Asia and lowest 19 per 100,000 per year in USA respectively.[3] WHO also reported 310,000 deaths in 2004 with a global mortality rate 4.8 per 100,000 per year out of which 29,000 deaths occurred in East Mediterranean Region with a mortality rate of 5.6 deaths per 100,000 per year.[4]

India reported 700,000 – 800,000 burn victims per year in which females were majorly involved.[5] Etiological agents of burn vary considerably in individuals of different communities and circumstances. Major cause of burn in USA include flame and scald accounting about 44% and 33% burn victims respectively. This is followed by burn from hot objects, electricity and chemicals respectively. Based on hospital admissions and death registers, burns due to fire or flame and hot substances represent 2.4% of all trauma cases, and responsible for 1.6 % of traumatic deaths in United States .[6] Scalding is more common in children under five years of age. It results from hot drinks, high temperature tape water in baths, hot boiling water or oil for cooking or steam. 20 – 30% burn injuries in Children is due to contact with hot objects.[7]Chemical burns accounts for 2 to 11% of all burn cases and its associated mortality is up to 30%. Many substances are responsible to produce chemical burns but common agents includes sulfuric acid used in drain cleaner and sodium hypochlorite used in bleach.[8] Electrical burns include injuries due to high voltage, low voltage or flash burns. When found in children it may be due to electric cords or electrical outlets. One of the form of electric current is by way of lightning which is struck to any person involved in outdoor activities during thunderstorm.[6,9]Lesion on external surface in electrical burn is only a small portion of the overall burn and its full deleterious effect is not evident immediately.[10]

Although age and total burnt surface area (TBSA) are considered the two important factors in the outcome of a victim of burn injury but we did not discussed the two factors in the study because much has already been described and emphasized on it in most of the research literature. Instead we tried to find out the burden of burn victims annually and then the burden contributed individually by each type of burn. Moreover this report studied the mortality in total and subsequently the individual contribution of each type of burn towards mortality.

Material and methods:

This hospital based cross sectional descriptive study was carried out in burn unit of teaching hospital of Karachi on cases admitted during a period of five years from January, 2007 to December, 2011. Case record of all burn patients who admitted during this period was scrutinized. Patient's data was collected on a Performa including gender, etiology, type of burn, mortality contributed by each etiological agent and year – wise clinical outcome. Patients who received emergency treatment for minor and superficial burn were excluded from the study.

Data was entered in a microsoft excel spreadsheet and analyzed using SPSS version 15. Frequency and percentages were calculated for qualitative variables and Chi-square test was used to calculate the p value for comparison of two groups.

Results:

This study was conducted on 3,805 patients admitted during January 2007 to December 2011, out of which 2,121 (55.74%) were male while 1,684 (44.26%) were female with male to female ratio of 1.2: 1. A steady increase in admissions of burn victims of both genders has been observed in successive years except 2011 when female admission declined a little bit. There is a significant difference found in burn victim trend by gender (Pearson Chi-Square test statistic =17.882; P-value = 0.001) (Table I)

Fire or flame burn was the leading cause of burn injury throughout the five years as highest admissions (84.57%) were recorded in burn injury as a result of flame. This is followed by electric (7.85%), scald (5.17%) and acid or chemical burn (2.4%). A trend of increase in the electric burn has been noticed with the successive year.

Table 1: *Trend of gender distribution of burn victims from year 2007 to 2011*

Gender	**Male**		**Female**	
Years	n	%	n	%
2007	295	13.9	251	14.9
2008	377	17.8	297	17.6
2009	454	21.4	417	24.8
2010	493	23.2	409	24.3
2011	502	23.7	310	18.4

Pearson Chi-Square test statistic =17.882; P- value = 0.001

Table 2: *Association of burn victims outcome with flame/fire and scald type of burn from year 2007 to 2011*

Burn Type	**Flame/Fire**						**Scald**					
Burn victims Outcome	Discharge		Expired		LAMA		Discharge		Expired		LAMA	
Years	n	%	n	%	n	%	n	%	n	%	n	%
2007	227	12.3	226	18.4	5	3.4	13	7.9	5	25	1	7.7
2008	285	15.5	250	20.3	54	37.2	19	11.6	2	10	3	23.1
2009	455	24.7	290	23.6	29	20.0	31	18.9	2	10	-	-
2010	446	24.2	252	20.5	30	20.7	65	39.6	4	20	5	38.5
2011	430	23.3	212	17.2	27	18.6	36	22.0	7	35	4	30.8

Table 3: *Association of burn victims outcome with electric and chemical / Acid type of burn from year 2007 to 2011*

Burn Type	**Electric**						**Chemical/Acid**					
Burn victims Outcome	Discharge		Expired		LAMA		Discharge		Expired		LAMA	
Years	n	%	n	%	n	%	n	%	n	%	n	%
2007	38	15.4	9	21.4	-	-	21	25.6	1	12.5	-	-
2008	37	15.0	2	4.8	5	45.5	17	20.7	-	-	-	-
2009	43	17.5	9	21.4	-	-	10	12.2	2	25.0	-	-
2010	66	26.8	14	33.3	2	18.2	16	19.5	2	25.0	-	-
2011	62	25.2	8	19.0	4	36.4	18	22.0	3	37.5	1	100

(Figure 1)

A significant decline in the mortality along with the increase in cure or discharge rate has been observed in each successive year. There is a significance difference found in burn victim trend by percentage distribution of burn outcome (Chi-Square test statistic =100.004; P- value = < 0.001). This trend is clearly indicating effective management. (Figure 2)

General trend of increasing rate of discharge and decreasing rate of mortality is observed in both flame burn and scald but overall there is increased rate of cure, mortality and LAMA (leave against medical advice) consequent upon increased burden of admission of flame burn compared to the rest of the etiological agents. Mortality from the flame burn is more marked from 2008 to 2010 while it is more in 2007 and 2011 in scald. Highest number of flame burn victims left hospital against medical advice in 2008. Most of the scald burn victim left hospital against medical advice in 2010 and 2011. (Table II)

The electric burn victims show increased frequency of discharge in successive year with highest mortality in 2010 as a result of increased admissions of electric burn patients. There were few patients of electric burn left hospital against medical advice with highest frequency in 2008. Uneven frequency distribution of discharge with increasing tendency of mortality in successive years has been observed in chemical burn victims.(Table III)

Both genders showed similar trend in flame burn and scald. Electric burn showed increasing pattern with male dominance. Chemical burn majorly involved females particularly in 2009 and 2010. (Table IV)

Discussion:

Burn injuries represent one of the most alarming and serious health problems affecting persons of all ages and civilization. Death due to burn injuries represents one of the unnatural deaths involving females as common victims. Our study has shown males dominance accounting for 55.74% of the total victims. A five year study from Khuzestan province of Iran has also reported male dominance and male to female ratio of 1.25: 1.[11] Studies from Shiraz and Taiwan have also shown similar findings of male dominance.[12,13]This finding is suggestive of male activities in high risk circumstances. Moreover the life style of our society is changing and with changing role of women as politician, executive and office bearer has influenced the gender distribution of burn victims.

This study has reported flame or the fire as the most frequent cause of thermal injuries through-

out the five years, accounting about 84.57% admissions, which is in accordance with many studies from various parts of the world.[14,15] Etiological agents differ according to the life style and standards of living of various communities of the world. Presently a wave of terrorism in Pakistan has also added the incidence of fire burn injuries among the workers of factories, warehouses as well as occupants of vehicles on highways. These accidental or intentional accidents mostly involve male population. Worldwide the use of electricity and electrical appliances is increasing with the resultant increase in the incidences of electrical burn among the various communities. Peoples are more exposed to the electric network both at the house and workplace. Electric burn in our study is comprised of 7.85% of all burn victims, next to the flame burn. An eight year review from Pristina, Kosovo has reported 17.25% incidence of electrical injuries of all patients admitted with burn which is very high. Studies from USA, China and Slovakia has reported 3%, 3 – 5% and 2.5% incidence of electric burn injuries which is low compared to our study.[16] An Egyptian study has reported 27% electrical injuries of all burns involving mostly the work-related injuries.[17] This finding reflects the living standards as well as the mode of transmission of electric supply to the population. Flame is the most frequent cause among the adults whereas the scald or burn from hot liquid remains the leading cause among the children with one or the other is dominating, depending upon the population studied in specific period of time. Scald in our study contributed small proportion accounting about 5.17% of all burns. Most of the studies have reported flame as the leading cause of burn injuries, followed by scald.[18,19] In studies from Finland, Spain and Turkey scald was found to be more prevalent than any other type of burn injury.[20,21,22] Reason of low frequency of scald in our study might be the age composition of the sample selected for study. Scald commonly involves children who do not have extensive burn, requiring only outpatient management without hospitalization. Generally flame injuries are more common than scald among the admitted patients. In our society children are generally considered gift from God and thereby given extraordinary care and supervised by their parents. In terms of chemical burns, males are exposed at workplaces while females in our society become victims, when chemical is thrown over them due to enmity or marriage disputes between the families. Children accidently ingest or contact with the chemicals like acids, alkalis and bleach or drain cleaner at homes. This study has reported 2.4% chemical burn which is in accordance with various studies showing 1 -4% external corrosion of skin as a result of contact with chemicals.[23,24]

Our study has tried to find out the effectiveness of burn management practiced during the five year study period. An encouraging result has been observed by noticing an obvious decline in the mortality rate with an increasing rate of discharge after the patient is cured throughout the five years. It has also been observed that the magnitude of admissions of burn victims is on progress in successive years. A review article on burn injuries in Europe has concluded a decline in incidence and mortality beside male predominance.[25] The decrease incidence of burn in Europe is basically due to increase awareness of dangerous situation related to burn through prevention programs and developing standard for electronic equipment through regulations. The increase incidence of burn injury in Karachi, Pakistan is due to a number of factors including increasing population as a result of urbanization, poor living standard, congested colonies with open kitchen system beside poor and open electric network, lack of awareness campaign of hazardous situations and total absence of regulations for electric supply and standard in electrical equipments.

Our study has reported 34.1 % overall mortality for the five year study period although a significant decline is evident each year, indicated by 44.1 % mortality in 2007 which has reduced to 28.3% in 2011. Flame is still the leading cause of mortality contributing overall 32.3% of mortality in five years. This is followed by electrical burn (1.1 %), scald (0.5 %) and chemical burn (0.2 %) respectively. High mortality ranging be-

tween 19% and 36.12% has been documented in various studies from Pakistan.[26,27,28] Very high mortality rate ranging from 50 % to 59 % is also reported from various parts of India.[29,30] Systematic review on articles published in Europe has estimated mortality rate between 1.4 % and 34%.[26] Mortality rate will be high where hospitalized patients will have total burn surface area (TBSA) ≥ 30 %. Studies from the Europe have reported a trend of decline in mortality rate over the last 30 years. Spanish study showed a decline from 24% to 12% between 1992 and 1995 and again 2001 to 2005.[31]Turkey has reported a reduction from 38% to 30% between 1988 and 1992 versus 1993 and 1997.[32]

Most of the literature has reported flame or scald as the major etiological agent of burn associated with the mortality of the patient. Our study has shown that flame burn constituted the huge proportion of admitted patients and thereby left other types of burn far behind in terms of admissions, discharge rate and mortality. Scald and chemical burns in our study has shown a negligible proportion of admissions and consequent mortality. Different studies have reported high mortality among the patients having flame burn with inhalation burn injuries.[26,33] Flame burns are usually associated with extensive involvement of the body requiring hospitalization which is reflected in our study. Chemical burns are usually of minor nature requiring outpatient management thereby making small proportions of admitted patient and consequent mortality. Females in our society are the main victims of chemical burns due to rivalry or marriage and divorce disputes requiring hospitalization. This has been documented in our study as females dominate in this particular section of burn. Electrical burn has shown a devastating increase in our study with 1.1 % mortality next to the flame burn. Electrical burn is one of the multisystem injury that possess high morbidity and mortality and shown in various reports.[34,35]

Conclusion:

The study identifies significant difference in trend of burn victims by gender and percentage distribution of burn outcome. Increased burden of admissions particularly due to flame and then electric burn with male dominance indicates risk taking attitude of males in our society. Although the mortality is high in our study, a trend of increased burden of admission associated with remarkable increase in rate of discharge and year wise decline in mortality is evident. This trend is clearly indicating effective management of burn victims. Awareness programs regarding the safety measures to avoid hazardous situation at homes and work places are required to reduce the frequency of burn incidences at public level.

Contribution:

All authors contributed significantly to the concept, design and data analysis. Dr. Syed Zubair Ahmed Tirmizi, Dr. Syed Mukarram Ali and Dr, Abdul Haq prepared performa for data collection, selected literature and performed statistical analysis. Dr. Syed Zubair Ahmed Tirmizi finally drafted the manuscript, helped by Dr. Syed Mukarram Ali, Dr. Abdul Haq and Dr. Roohi Ehsan. Dr. Abdul Haq, Dr. Roohi Ehsan and Syeda Fizzah Tirmizi collected the data, participated in data analysis and wrote initial draft. Final draft was critically revised by S. Zubair Ahmed Tirmizi and Syed Mukarram Ali. All authors read and approved the manuscript.

Conflict of Interest: None

References:

1. Othman N, Kendrick D. epidemiology of burn injuries in the East Mediterranean Region: a systematic review. BMC Public Health 2010;10 (1):83.
2. Peck MD. Epidemiology of burns throughout the world. Part I: Distribution and risk factors. Burns : journal of the International Society for Burn Injuries 2011; 37 (7): 1087–1100.
3. Annual incidence(000s) for selected causes, in WHO regions(a) estimates for 2004[http://www.who.int/global burden disease/ estimates regional/ en/ index.html] webcite
4. WHO: summary: Deaths (000s) by cause, in WHO regions (a) estimates for 2004. WHO;2004.
5. Ahuja, RB; Bhattacharya, S . "Burns in the developing world and burn disasters.". BMJ Clinical research ed. 2004; 329 (7463): 447–9.
6. National Trauma Data Bank : Annual Report Version 8.0. Edited by Nathens AB, Fantus RB. The American College of Surgeons Committee on Trauma;2008.
7. Eisen, Sarah; Murphy, Catherine (2009). Murphy, Catherine; Gardiner, Mark; Sarah Eisen, eds. Training in paediatrics : the essential curriculum. Oxford: Oxford University Press. p. 36. ISBN 978-0-19-922773-0.)
8. Hardwicke, J; Hunter, T; Staruch, R; Moiemen, N . "Chemi-

cal burns--an historical comparison and review of the literature.".Burns : journal of the International Society for Burn Injuries2012; 38 (3): 383–7.
9. Tintinalli, Judith E. (2010). Emergency Medicine: A Comprehensive Study Guide (Emergency Medicine (Tintinalli)). New York: McGraw-Hill Companies. pp. 1374–1386. ISBN 0-07-148480-9.
10. Simmons R. Emergency management of electrical burns. J Emerg Nurs 1997;3(2):13 – 15.
11. Ekrami A, Hemadi A, Kalantar E, Latifi M, Kayedani A. Epidemiology of hospitalized burn patients during 5 years in Khuzestan province, Iran. Iranian Journal of Clinical Infectious Disease 2010;5(1):40 – 44.
12. Ansari.Lari M, Askaian M. Epidemiology of burn presenting to an emergency department in Shiraz, South Iran. Burns 2003;29:579 – 81.
13. Chien Chien W, Pai L, Lin C. . Epidemiology of hospitalized burn patients in Taiwan. Burns 2003;29:582 – 88.
14. Groohi B, Alaghehbandan R, Lari AR. Analysis of 1089 burn patients in province of Kurdistan, Iran. Burns. 2002;28(6):569–574.
15. Hemeda M, Maher A, Mabrouk A. Epidemiology of burns admitted to Ain Shams University Burns Unit, Cairo, Egypt. Burns. 2003;29(4):353–358
16. Buja Z, Arifi H, Hoxha E. Electrical burn injuries. An eight year Review. Ann Burns Fire Disasters 2010; 23(1):4 – 7.
17. Hemeda M, Maher A, Mabrouk A. Epidemiology of burns admitted to Ain Shams University Burns Unit, Cairo, Egypt. Burns. 2003;29(4):353–358.
18. Groohi B, Alaghehbandan R, Lari AR. Analysis of 1089 burn patients in province of Kurdistan, Iran. Burn 2002; 28: 569 – 74.
19. Rossi LA, Braga EC, Barrufini RC, Carvalho EC. Childhood burn injuries: Circumstances of occurrences and their prevention in Ribeirao Preto, Brazil, Burns 1998;24: 416 – 9.
20. Barret JP, Gomez P, Solano I, Gonzalez-Dorrego M, Crisol FJ. Epidemiology and mortality of adult burns in Catalonia. Burns. 1999;25:325–329.
21. Aldemir M, Kara IH, Girgin S, Guloglu C. Factors affecting mortality and epidemiological data in patients hospitalised with burns in Diyarbakir, Turkey. S Afr J Surg. 2005;43:159–162.
22. Papp A. The first 1000 patients treated in Kuopio University Hospital Burn Unit in Finland. Burns. 2009;35:565–571.
23. Arshi S, Sadeghi-Bazargani H, Mohammadi R, Ekman R, Hudson D, Djafarzadeh H, Delavari A, Sezavar H. Prevention oriented epidemiologic study of accidental burns in rural areas of Ardabil, Iran. Burns. 2006;32(3):366–371.
24. Al-Shehri M. The pattern of paediatric burn injuries in Southwestern, Saudi Arabia.West African Journal of Medicine. 2004;23(4):294–299.
25. Brusselaers N,Monstrey S, Vogelaers D, Hoste E, Blot S. Severe burn injury in Europe: a systematic review of the incidence, etiology, morbidity and mortality. Crit Care.2010;14(5):R188.
26. Muqim R, Zareen M, Dibag, Hayat M, khan I. Epidemiology and outcome of burns at Khyber Teaching Hospital Peshawar. Pak J Med Sci 2007;23:420 – 4.
27. Khan N, Malik MA. Presentation of burn injuries and their management outcome. J Pak Med Assoc. 2006;56:394 – 7.
28. Ibran E, Mirza FH, Memon AA, Farooq MZ, Hassan M. Mortality associated with burn injury – a cross sectional study from Karachi, Pakistan. BMC Research Notes. 2013;6:545.
29. Jayaraman V, Ramakrishnan MK, Davies MR. Burns in Madras, India: An Analysis of 1368 patients in one year. Burns 1993;19: 339 – 44.
30. Shanmugakrishnan RR, Narayanan V, Thirumalaikolundusbramanian P. Epidemiology of burns in a teaching hospital in south India. Indian J plast Surg 2008; 41 (1) :34 – 37.
31. Galeiras R, Lorente JA, Pertega S, Vallejo A, Tomicic V, de la Cal MA, Pita S, Cerda E, Esteban A. A model for predicting mortality among critically ill burn victims. Burns. 2009;35:201–209.
32. Anlatici R, Ozerdem OR, Dalay C, Kesiktas E, Acarturk S, Seydaoglu G. A retrospective analysis of 1083 Turkish patients with serious burns, Part 2: burn care, survival and mortality. Burns. 2002;28:239–243.
33. Shin SD, Suh GJ, Sung J,Kim J. epidemiologic characteristics of death by burn injuryfrom 1991 to 2001 in Korea. Burns. 2004;30:820-8.
34. Adukauskiene D, Vizgirdaite V, Mazeikiene S. electrical injuries. Medicina. 2007;43:259 – 66.
35. Maghsoudi H, Adyani Y, Ahmadian N. Electrical and lightning injuries. J Burn Care Res 2007;28:255 – 61.