Egypt, J. Plast. Reconstr. Surg., Vol. 43, No. 3, October: 365-369, 2019

Epidemiological Study of Mass Casualties at A Tertiary Burn Center in Ain-Shams University: Management and Outcomes

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ABSTRACT

Purpose: To report, analyze different aspects of mass casualty incidents resulting from household fires due to explosion of gas cylinders presented to our Burn Unit from 2013 to 2017.

Methods: Data of all burn mass casualty incidents from admitted to the Burn Emergency Unit of Ain Shams University, Cairo, Egypt; from January 2013 to December 2017 were collected from the Burn Unit and its Intensive Care Unit records, reviewed and described.

Results: Six incidents from flame burn caused by household explosion of gas cylinders took place in the past 5 years. 33 victims were involved in the incidents and admitted to our unit; male: female ratio was 2.7:1. The ages of the admitted patients ranged from 2.6y-51y. The extent of burns ranged from 10-68% of TBSA affecting head and neck, torso and extremities. A total numbers of 44 operations were performed to all the patients during their stay in the form of emergency escharotomies in 12 patients and 32 sessions of excision of the deep partial and full thickness burns and split-thickness skin grafting in 19 patients. All patients survived and discharged uneventfully except only for 4 deaths (12%) with mean hospital stay duration of 30 days. Complications that developed in the admitted cases include wound infections (12.50%), hypertrophic scars (12.50%), altered skin color (8.33%) and psychotic manifestations (6.24%).

Conclusion: Retrospective analysis of the therapeutic data of these cases demonstrates that management of mass burn causalities requires pre-designed disaster planning, well equipped center, trained personnel and these are the key elements in successful management.

Keywords: *Mass casualties burn – Management – Outcome.*

INTRODUCTION

Owing to the great expansion of technology the quality of burn care had been progressing throughout the years in every aspect; understanding the pathophysiology of burns, fluid resuscitation, dressing materials and surgical treatment of burn wound **[1]**. Modern advances did not stop at just achieving survival but continued to knock further aspects as the amendment of post burn scarring, avoiding contractures with proper rehabilitation post-treatment and providing active emotional support therapies and restoration of quality of life **[1-3]**.

Despite these advances some problems are yet prevalent and still considered a great health risk as prevention of burn accidents especially in developing countries where burn is considered as accredited to poverty, high population density and unawareness. Burns prevention in these countries could be a national program to offer sufficient funds and lead to proper coordination of district, regional and tertiary care centers. Another problem is the management of multiple patients in a single burn incident would severely overwhelm the resources of a burn care facility in a situation well known as “mass casualty incident”. This differs from multi-patient incident where there is more than one patient but the agency has sufficient resources to handle **[4-7]**.

The job and capacity of each burn facility differ in between organizations depending upon their own resources. International Society for Burn Injuries Guidelines declared a classification for burn facilities; Type A: Facilities that provide resuscitation treatment only, Type B: Facilities that provide both resuscitation and post-resuscitation treatment and Type C: Facilities that provide rehabilitative and reconstructive treatment only.

In Cairo, Egypt; there are only 2 Type B & C burn care facilities (including both adult and pediatric) with sufficient number of burn patients. These facilities to maintain such standard healthcare are strained on a daily basis with routine daily operations and standard burns admissions, however unexpected gush in the event of burn disasters, limits the capacities they have. In our Burn Care Unit in Ain Shams University, the current capacity is 4 casualties at any one time; if there are more than 4 victims the term “mass casualty” is used.

The International Society for Burns Injuries (ISBI) has published guidelines for the management of multiple or mass burns casualties, and recommends that 'each country has or should have a disaster planning system that addresses its own particular needs. However, in the absence of a consistent and interoperable national system for major incident management in Egypt and following Al-Ayyat train fire disaster in 2002 with more than 383 deaths **[8]**, an agreement was made in our university to establish a local response strategy to a burn mass casualty situation.

This included properly trained burn specialists including plastic surgeons, anesthesiologists, nurses, physiotherapists and psychiatrics were involved in the planning, preparing, and coordinating an appropriate response for such event and responsible of improving local emergency response for burn victims in a timely manner through providing triage, assessment, resuscitation, escharotomy, medical and surgical supervision of patients in our burn center.

The commonest mode of burn injury is flame burn; mostly related in our country to malfunctioning cooking gas cylinder or kerosene pressure stoves. These are cheap contraptions without safety features and burns occur when carbon deposits block the kerosene vapor outlets. In this study we aimed to report and analyze different aspects of mass casualty incidents due to flame burn that presented to our Burn Unit over a period of 5 years.

There is no single study that particularly concentrated on mass casualty incidents in Egypt and we hope to attract national media attention to search for measures that could minimize the risk of future disasters and develop a plan and a special approach to both prehospital and hospital management of these victims.

MATERIAL AND METHODS

Data of all burn mass casualty incidents from admitted to the Burn Emergency Unit of Ain Shams University, Cairo, Egypt; from January 2013 to December 2017 were collected from the burn unit and its intensive care unit records, reviewed and described. In addition to the demographics of the patients; data concerning the hospital stay, medical and surgical treatment of each of them were recorded from the initial emergency triage until discharge. All these data were recorded for each subject and analyzed with SPSS Version 12.0 (SPSS, Inc., Chicago, IL, USA).

RESULTS

Six mass casualty incidents from flame burn caused by household explosion of gas cylinders took place in the past 5 years (1.2 events per year). A total of 33 victims were involved in the incidents and admitted to our unit; 3 incidents in 2013, 2014 and 2015 each involved 6 patients, 3 incidents in 2016 (2 occasions) and 2017 each involved 5 patients (Tables 1-7).

Table (1): A statistical summary of the five years.

# People admitted	33
Age range of patients admitted	3-53 years
Mean age of patients	22.7 years
Male:female ratio of patients	2.7:1
Range of total burns surface area (TBSA) of patients	10-68%
Mean TBSA	25.7%
Mean length of stay (LoS) of survivors	30 days
Total deaths	4

Table (2): Statistical data for 2013.

	Sex	Age	TBSA %	Degree	Inhalation injury	Co-morbidities	Outcome
1	Male	20	45	2nd	+ve	–ve	Death
2	Male	30	10	2nd	–ve	–ve	Follow-up
3	Male	20	34	2nd/3rd	+ve	–ve	Death
4	Male	35	15	2nd	–ve	–ve	Follow-up
5	Male	42	10	2nd	–ve	–ve	Follow-up
6	Male	15	16	2nd	–ve	–ve	Follow-up

Table (3): Statistical data for 2014.

	Sex	Age	TBSA %	Degree	Inhalation injury	Co-morbidities	Outcome
1	Female	32	25	2nd	+ve	–ve	Follow-up
2	Female	8	38	2nd	–ve	–ve	Follow-up
3	Male	6	40	2nd	–ve	–ve	Follow-up
4	Male	45	38	2nd	–ve	–ve	Follow-up
5	Male	22	20	3rd	–ve	–ve	Follow-up
6	Male	16	12	2nd	–ve	–ve	Follow-up

Table (4): Statistical data for 2015.

	Sex	Age	TBSA %	Degree	Inhalation injury	Co-morbidities	Outcome
1	Male	24	22	2nd/3rd	–ve	–ve	Follow-up
2	Male	20	12	2nd	–ve	–ve	Follow-up
3	Male	32	22	2nd	–ve	–ve	Follow-up
4	Male	21	30	2nd	–ve	–ve	Follow-up
5	Male	20	45	2nd	–ve	–ve	Follow-up
6	Male	15	16	2nd	–ve	–ve	Follow-up

Table (5): Statistical data for 2016 (A).

	Sex	Age	TBSA %	Degree	Inhalation injury	Co-morbidities	Outcome
1	Female	40	35	2nd	–ve	–ve	Follow-up
2	Female	16	28	2nd	–ve	–ve	Follow-up
3	Female	18	33	2nd/3rd	+ve	–ve	Death
4	Male	35	15	2nd	–ve	–ve	Follow-up
5	Male	32	25	1st/2nd	–ve	–ve	Follow-up

Table (6): Statistical data for 2016 (B).

	Sex	Age	TBSA %	Degree	Inhalation injury	Co-morbidities	Outcome
1	Female	18	49	$2^{nd}/3^{rd}$	+ve	–ve	Follow-up
2	Female	40	35	$2^{nd}/3^{rd}$	–ve	–ve	Follow-up
3	Male	51	18	$2^{nd}/3^{rd}$	–ve	–ve	Follow-up
4	Male	35	15	2^{nd}	–ve	–ve	Follow-up
5	Male	42	10	2^{nd}	–ve	–ve	Follow-up

Table (7): Statistical data for 2017.

	Sex	Age	TBSA %	Degree	Inhalation injury	Co-morbidities	Outcome
1	Male	2.6	68	$2^{nd}/3^{rd}$	–ve	–ve	Death
2	Male	21	18	2^{nd}	–ve	–ve	Follow-up
3	Male	32	15	$2^{nd}/3^{rd}$	–ve	–ve	Follow-up
4	Female	51	14	2^{nd}	–ve	+ve	Follow-up
5	Female	26	22	2^{nd}	–ve	–ve	Follow-up

All patients were conscious at the time of presentation to the Emergency Unit; 73% were males (n=24) and 27% were females (n=9) with a male: female ratio was 2.7:1. The ages of the admitted patients ranged from 2.6y-51y with a mean of 22.72 years Fig. (1). The extent of burns ranged from 10-68% of TBSA with a mean of 25.75 varying between 2^{nd} and 3^{rd} degree burns affecting head and neck, torso and extremities.

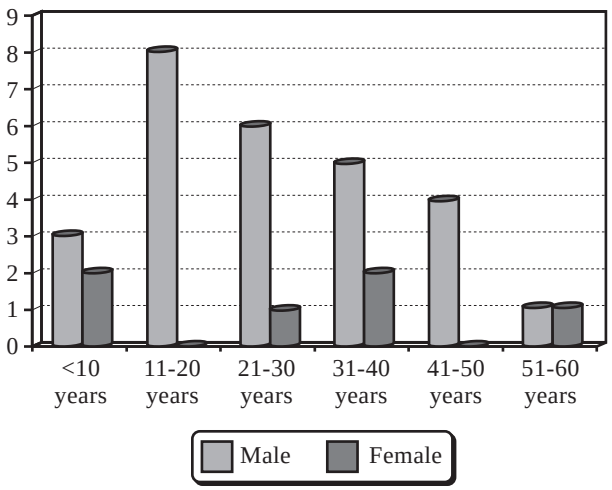

Fig. (1): Demographic data of burn injuries (n=33).

Lower limbs sustained maximum injures 21 (29%), followed by upper limbs 15 (20.0%), head and neck 10 (14%) back 3 (4%) anterior abdominal wall 9 (12%) chest 8 (11%) buttock 7 (10%). Hence total numbers of injuries body region wise were 73 with an average of 2.21 injuries per victim (Fig. 2).

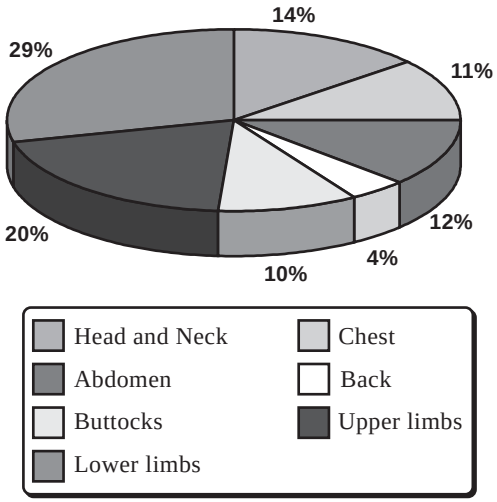

Fig. (2): Distribution of burn injuries body region wise (n=73).

Following triage, 14 patients were intubated in the emergency room and were transferred to the Intensive Care Unit (ICU). Patients with potential inhalation injury were resuscitated and also admitted to the ICU while the remaining 19 patients were resuscitated and admitted to our burns care unit. None of the patients suffered any associated injuries with only 1 patient with diabetes mellitus.

Inhalational injury was suspected clinically and diagnosed using bronchoscopy in 5 patients (15%) patients within 24h of admission. A total numbers of 44 operations were performed to all the patients during their stay in the form of emergency escharotomies in 12 patients for circumferential burns of the extremities and 32 sessions of excision of the deep partial and full thickness burns and split-thickness skin grafting in 19 patients.

All patients survived and discharged uneventfully except only for 4 deaths (12%) with mean hospital stay duration of 30 days. The survived patients continued to present to the out-patient clinic for dressing of the residual raw areas with no deformity was found in the follow-up 2 months later.

Complications that developed in the admitted cases include wound infections in six (12.50%), hypertrophic scars in 12.50%, dyschromia in 8.33% and psychotic manifestations in 6.24%. Ten (25.64%) cases from the out-patient clinics developed wound infection and 10.26% post-burn contractures.

DISCUSSION

Mass casualty incidents are a major public health problem that requires a rapid, synchronized and cooperative response. Although the incidence

of burn injury is higher in developing countries due to poverty, poor education, incorrect public traditions, increased population density; this event can face both low and high socioeconomic countries with a more profound outcome low-income regions due to rapidly consuming the ordinary existing resources **[9-11]**.

Awareness with previous mass casualty incidents even with the poor documentation of their different characteristics in literature and media is very important in planning of similar events in the future. In this study, we reviewed our experience with mass casualty incidents resulting from household fires due to explosion of gas cylinders presented to our burn within the last 5 years. There was just one incident in the years 2013, 2014, 2015, 2017 and two cases in 2016.

The overturning and explosion of fuel tankers, killing or causing disabilities to many people has been reported several times. The likelihood of a cylinder explosion is exponentially remote even if cylinders are extremely damaged by forceful blows to the container shell. For a flammable gas within its flammable limits in air (or oxidizing gas) to ignite, an ignition source must be present. There are many possible ignition sources in most workplaces including open flames, sparks and hot surfaces. Propane cylinders are designed to withstand impact without rupturing or exploding **[12,13]**.

Injuries and death due to burns are daily occurrence like road traffic accident. Victims are mostly infants, children and old peoples, while in case of mass casualty the victims may be of any age group. The ages of patients admitted were between 2.6 and 51 years, with a mean age of 24.6 years, where most of the patients (67%) were in the age groups between 11 and 40 years with dropping off at extremities of ages. The ratio of males to females was found to be 2.7:1; this male predominance was reported by other studies **[14]**.

As the age increases, survival rate also decreases, hence the higher the patients age the lower survival rate. It is suggested that the principal determinant whether a patient lived or died was the size of the burn and the age of the patient. Our study does not match with this known trend in literature **[15,16]**, as the 4 deaths reported were not the highest percentages of burn and all of them were young in age.

We think the cause of death was the concomitant inhalation injury and the increased depth of burn which we suggest that they have more adverse effect on the survival rate of patients other than TBSA that is considered the major risk factor in predicting the outcome of burns **[17]**. Olaitan et al., **[18]** in a study in Nigeria. These differences in mortality in relation to TBSA could be due to the set-up of the treatment centers, since KATH-BICU has state of the art facilities and fully trained health personnel.

Rehabilitation of each burn patient typically includes physiotherapy, occupational therapy, splinting and reconstructive surgery in future years to correct deformities. From the evidence found it appears that when mass disasters occur, usually only small number of casualties will have burns with intensive hospital management indicated, most being small percentage burns potentially treated as outpatients **[19]**.

We hope this study could make all crews understand the roles and responsibilities of operating in the framework of a MCI incident to guarantee patient, public, and personnel safety and also we aim to train the community in order to enhance burn trauma care in the pre-hospital scene and attract national media attention as this could ensure sufficient funds are available and lead to proper research and coordination of district, regional and tertiary care centers.

Conclusion:

By analysis of the therapeutic data of these population, that management of mass burn causalities requires pre-designed disaster planning, well equipped center, trained personnel and these are the key elements in successful management.

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