MANAGEMENT OF MASS CASUALTY IN RANA PLAZA TRAGEDY, THE WORST INDUSTRIAL DISASTER IN BANGLADESH

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Abstract

Introduction: On April 24, 2013, Rana Plaza, an 8 storied building accommodating 5 garment factories, a bank, a number of commercial shops and offices collapsed at Savar, Dhaka, Bangladesh, while more than 4 thousand people were working inside. A massive rescue operation was carried out in following 21 days by the Government of Bangladesh involving all of her associated organs with a key role played by the Armed Forces. A total of 2438 injured victims were rescued between 24 Apr 2013 to 10 May 2013 including a female garment worker who was rescued after 17 days of the building collapse. The death toll finally reached to 1132 including 2 rescue workers. This unprecedented disaster was mitigated by extraordinary responses from almost all the organs of the government and also from non-government bodies. All available medical resources were utilized for immediate, short term and long term management of the injured victims.

Objective: This study is aimed to find out the pattern of injuries in the victims of this catastrophe and also the management of mass casualty in Rana Plaza tragedy which occurred due to the multistoried commercial building collapse.

Methods: This observational study was conducted on pre-hospital, in-hospital and post-hospital management of the victims of the disaster. Each of the injured individual was tracked for a period of more than 3 months. Data were collected from interviews, observation and by studying the records of field medical units, secondary and tertiary hospitals and rehabilitation centers.

Results: This was the deadliest garments factory accident in the history causing 1132 deaths and 2438 injured cases. The rescue operation was carried out upto 14 May 2013. Removal of the whole collapsed building rubbles took 21 days and 1127 dead bodies had been recovered. Two rescuers died during rescue operation. Out of 2438 casualties 407 were brought to CMH Savar, 28 victims of serious injury were evacuated to CMH Dhaka where only one patient died. One thousand and seven hundred casualties were taken to Enam Medical College and Hospital, Savar and 105 patients were taken to National Institute of Traumatology and Rehabilitation (NITOR). Two hundred and twenty six patients received management in other private clinics. Out of 2438 patients, 951 received prolonged hospital treatment of which blunt trauma was found in 225(23.66%) cases, soft tissue injuries in 149(15.67%) cases, fractures in 137(14.41%) cases, crush syndrome in 46(4.84%), head injuries in 40(4.20%), limb loss in 33(3.47%) and other non lethal injuries were observed in 321(33.75%) cases. Three patients expired during treatment due to complications like acute renal failure, ARDS and complication of head injury. Up to 26 Jul 2013, 36 cases were found disabled due to sequelae of head

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injury, spinal injury, fracture of long bones of limbs and injury of peripheral nerves. Among the patients of mass casualty commonest complication or presentation was acute stress reaction in 44.92 percent of patients.

Conclusion: Management of mass casualty in this building collapse provides us with a valuable experience which may be utilized in dealing with similar disasters that might take place in any densely populated city in an earthquake prone country like Bangladesh.

Key-words: Mass casualty, Acute stress reaction, Acute renal injury.

Introduction

A mass casualty incident is defined as any event resulting in a number of victims large enough to disrupt the normal course of emergency and health care services[1]. On 24 April 2013, Bangladesh was struck by the worst industrial disaster where Rana Plaza, an 8 storied building housed with 5 garments manufacturing factories, branch of a bank, number of commercial shops and offices collapsed at Savar, near capital Dhaka. On that morning more than 4 thousand people were working inside, majority of whom were female garment workers. A massive rescue operation was carried out in following 21 days by the Government of Bangladesh, involving all her related organs. The Armed Forces of Bangladesh was tasked to coordinate the whole operation. The field units of Army Medical Corps along with their civilian counterparts carried out triage and instituted first aid resuscitation and arranged evacuation of the cases to military hospitals and similar civilian facilities. A total of 2438 injured victims were rescued between 24 Apr 2013 to 10 May 2013 including Reshma, a female garment worker who was rescued after 17 days of the building collapse. The death toll finally reached to 1132 including 2 rescue workers. This unprecedented disaster was mitigated by extraordinary responses from almost all the organs of the government and also from non-government bodies. All available medical resources were utilized for immediate, short term and long term management of the injured victims. This study was conducted to find out the pattern of injuries caused by this catastrophe and to document the pre-hospital, in hospital and post hospital management. The rescued victims were taken to Combined Military Hospital, Savar, Enam Medical College & Hospital Savar, National Institute of Traumatology Orthopaedic & Rehabilitation (NITOR) and some other private clinics and hospitals. On 03 Aug 2013, seventy two patients received treatment and 77 patients were placed under rehabilitation and occupational program on the same day at Centre for Rehabilitation for the Paralyzed (CRP)[2], Savar Dhaka.

Materials and Methods

This is an observational study carried out on 2438 patients who were the victims of Rana Plaza tragedy and were rescued alive from collapsed building. The hospitalized study population were 951 patients who had been admitted to CMH Savar, Enam Medical College & Hospital and NITOR. From the moment of rescue each of them was followed up for a period of more than 3 months. Relevant data from laboratory investigations were documented. All the stages of treatment and evacuation were monitored. Frequent interviews were carried out with rescue workers, physicians, social workers, authorities of hospitals and other bodies. Data were analyzed and converted into results by adopting simple statistical procedures.

Results

Our peripheral level 2 hospitals had no previous experience to deal with huge number of patients of mass casualties. The casualties were taken mainly to three Hospitals namely CMH Savar, Enam Medical College & Hospital and NITOR. Four hundred and seven cases were evacuated to CMH Savar; out of which 236 (55.53%) cases were admitted. One thousand and seven hundred cases were evacuated to Enam Medical College & Hospital out of which 610 (35.88%) cases were admitted. One hundred and five cases were managed at NITOR.

JMPHC Bangladesh. Vol 9, No 2 (December) 2013

11

Among rest of the victims, at CMH Savar in 171 cases and at Enam Medical College Hospital in 1090 cases, management was given without documentation. Two hundred and twenty six patients were managed with simple first aid. Total 951 patients were admitted for prolonged hospital management. Two hundred and thirty six cases were admitted to CMH Savar, 610 cases were admitted to Enam Medical College & Hospital and 105 cases were admitted to NITOR. Types and pattern of the injuries of the admitted victims of the above mentioned hospitals are shown in Table-I.

Table-I: Pattern of injuries in the victims of Rana Plaza tragedy.

Pattern of injuries	CMH Savar	Enam Medical College Hospital	NITOR	Total	Percentage (%)
Blunt trauma	75	146	04	225	23.66
Soft tissue injury	49	84	16	149	15.67
Fracture	28	49	60	137	14.41
Crush syndrome	08	28	10	46	04.84
Head injury	10	30	0	40	04.20
Limb loss	03	16	14	33	03.47
Non lethal Injuries	63	257	01	321	33.75
Total patients	236	610	105	951	100

Total dead bodies recovered from the rubbles of collapsed building were 1115. Twelve victims died within short time after rescue and 03 patients died during treatment due to complications of head injury, renal failure and Acute Respiratory Distress Syndrome (ARDS). Accidentally 02 rescuers died during rescue operation (Table-II).

Table-II: Recovery of dead bodies from collapsed building.

Date	No of dead body	Percentage
24 Apr 2013	127	11.27
25 Apr 2013	132	11.71
04 May 2013	297	26.35
05 May 2013	44	03.91
07 May 2013	100	08.87
08 May 2013	118	10.47
09 May 2013	173	15.35
12 May 2013	136	12.07
Total	1127	100

Study revealed that blunt trauma was found in 225 (23.66%) cases, 149 (15.67%) sustained soft tissue injuries and 137 (14.41%) sustained fracture. 46 (04.84%), 40 (04.20%), 33 (03.47%) and 321 (33.75%) cases sustained crush syndrome, head injuries, amputation of limbs and non-lethal Injuries respectively.

694 documented patient's analysis revealed that number of female patients was more i.e. 444 (63.98%) and male patients was 250 (36.02%). Female to male ratio was 1.78:1. Regarding age, 88 (20.68%) cases belonged to age group of ≤ 20 yrs, 377 (54.32%) cases belonged to age group of 21-30 yrs, 88 (12.68%) cases to age group of 31-40 yrs, 21 (03.03%) cases to age group of 41-50 yrs and 06 (0.86%) cases were aged above 50 yrs which are shown in Table-III.

Table–III: Age and sex distribution of patients (n=694)

Age in years	Female	Male	Total	Percentage (%)
≤ 20	160	42	202	29.11
21-30	227	150	377	54.32
31-40	48	40	88	12.68
41-50	07	14	21	03.03
≥ 50	02	04	06	0.86
Total	444	250	694	100

Mean age 35 years SD=±12.75

Figure-1 shows distribution of medical complications like acute stress reaction, heat related illness, hypovolaemic shock and acute kidney injury. The well maintained documents of 236 patients at CMH Savar revealed that common presentation was acute stress reaction in 106(44.92%) cases. Heat related illness was found in 79(33.47%) cases, hypovolaemic shock in 41(17.37%) cases, and acute kidney injury (AKI) in 13(5.51%) cases as shown in Pie Diagram. Collected medical documents from laboratory of CMH Savar revealed that in 150 suspected cases, haemoglobin levels were estimated.
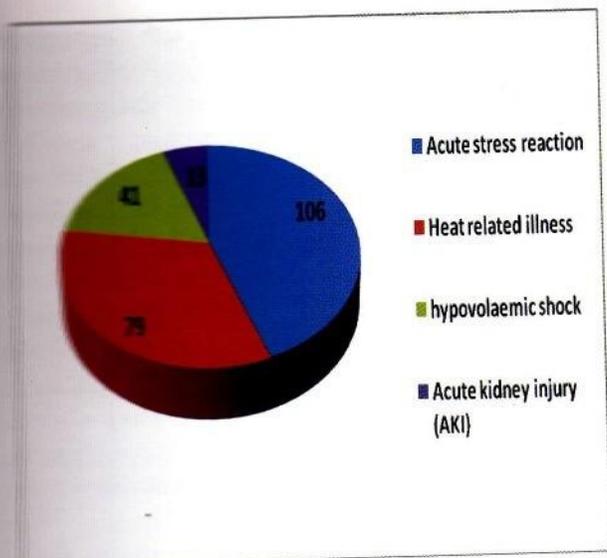
JAFMC Bangladesh. Vol 9, No 2 (December) 2013

12

- Acute stress reaction
- Heat related illness
- hypovolaemic shock
- Acute kidney injury (AKI)

Fig-I: Pie Diagram showing Medical Complications of Patients (n=236)

Out of 124 female patients 102(82.26%) were anaemic with haemoglobin level of ≤11.5 gm/dl and 22(17.74%) of female patients had haemoglobin level of ≥11.6 gm/dl. Out of 26(17.33%) male patients 21(80.77%) were anaemic with ≤13.0 gm/dl of Hb and 05(19.23%) male patients had haemoglobin level of ≥13.0 gm/dl as shown in Table-IV.

Table-IV: Haemoglobin levels of the patients (n=150).

Gender	\<8.5	8.6-10	10.1-11.5	11.6-13.0	≥13.0	Total
			Haemoglobin level (gm/dl)			
Female	04	50	48	22	0	124 (82.67%)
Male	03	0	07	11	5	26 (17.33%)
Total	7 (4.67%)	50 (33.33%)	55 (36.67%)	33 (22%)	5 (3.33%)	150 (100%)

Laboratory documents also revealed that serum electrolyte estimation was done in 80 suspected cases. Electrolyte abnormalities were found in 56(70%) cases. Hypokalaemia was the most common electrolyte abnormality occuring in 36(45%) patients. Hyperkalaemia was found in 03(3.75%), hypernatraemia in 11(13.75%) and hyponatraemia in 06(7.5%) cases. The study also revealed that in massive multistoried building collapse acute stress reaction was the common presenting medical condition.

Table-V: Electrolyte Imbalance among study subjects (n=80)

Complication			
Hyperkalemia	Hypokalaemia	Hypernatraemia	Hyponatraemia
03 (3.75%)	36 (45%)	11 (37.75%)	06 (7.50%)

Discussion

In the morning of 24 Apr 2013, an 8 storied commercial building, Rana Plaza at Savar collapsed. It is considered to be the deadliest garment factory accident in the history, as well as one of the deadliest accidental structural failures in modern human history. The study revealed that in Rana Plaza tragedy, a total of 2438 victims were rescued alive, out of which 12 patients died within a very short time of starting management after recovery and 03 patients died during management due to complications of head injury, acute renal failure and ARDS . Total dead bodies recovered from the collapsed building were 1115. Two rescuers died accidentally during rescue operation.

Out of 951 hospitalized patients 225 (23.66%) sustained blunt trauma involving head, chest, abdomen, back and extremities. Soft tissue injuries were found in 149 (15.67%) cases which included injury to eyes and abdominal organs, contusion of lungs, muscles, skin, nerves and tendons. Fractures were found in 137 (14.41%) cases which involved extremity bones, vertebrae, ribs and pelvic bones. Crush syndrome were found in 46 (04.84%) cases. Crush injuries was responsible to give rise to dangerous complications of crush syndrome and acute renal failure. Head injuries were found in 40 (04.20%) cases. Amputation of Limbs to rescue the victims from inside the rubbles of collapsed building was done in 33 (03.47%) cases, out of which upper limb amputation was done in 11 and lower limb amputation in 22 cases[3].

The results of our study are similar to that of the study done on patients from the Marmara earthquake in Turkey on 17 Aug 1999 in which at least 20 000 people died and 30 000 were injured[4].

JAFMC Bangladesh. Vol 9, No 2 (December) 2013

13

Different types of non-lethal injuries like cut-injury, abrasion and haematoma were found in 321 (33.75%) cases. In this study all 2438 patients sustained various degrees of physical and psychological trauma due to massive building collapse. Most of the patients received resuscitative measures with I.V fluid infusion before admission into the hospital. In this study, the most common medical complication observed among the 236 well documented cases at CMH Savar was acute stress reaction. Symptoms of acute stress reaction resolved itself completely within few days and some cases turned into post traumatic stress disorder (PTSD)[3,5].

The study revealed that the number of patients presenting with hypovolaemic shock was 41(17.37%). This study also showed that 13(5.51%) patients of hypovolaemic shock progressed to acute kidney damage. Massive building collapse or industrial accidents, earthquakes and mining disasters are the causes of rhabdomyolysis[4,6]. Rhabdomyolysis occurs after prolonged continuous pressure on muscle and characterized by systemic involvement[7]. Extensive rhabdomyolysis is often lethal unless promptly and vigorously treated[8]. Rhabdomyolysis can lead to hyperkalaemia, acidosis, acute renal failure and hypovolaemic shock[6,8]. Early extrication and administration of intravenous fluid are important in preventing renal failure[6,9]. Complications of rhabdomyolysis can be prevented by early vigorous treatment. Rapid intravenous isotonic fluid infusion had been recommended as a prophylactic treatment against the development of acute renal failure[6,8,9]. The type of nutrition is important in renal failure. Diet should contain high calorie with carbohydrates together with restriction of potassium intake because of the well known effect of potassium on myocardial function[10]. In this study, out of 13 renal failure patients 12 cases had complete smooth recovery without dialysis. One patient developed ARDS and was transferred to higher centre and finally expired. Too much transfusion, sepsis syndrome, oxygen toxicity, pneumonia, disseminated intravascular coagulation can cause ARDS as shown in other studies[8,11]. In this study haemoglobin estimation was done in 150 suspected cases out of which number of female patients was 124(82.67%) and male patients was 26(17.33%). The study revealed that out of 124 female patients 102(82.26%) were anaemic with haemoglobin level of ≤11.5 gm/dl and among male

patients 21(80.77%) were anaemic with haemoglobin level of <13.0 gm/dl. This figure of anaemia coincides with our national nutritional status and was similar to that of other studies done in Bangladesh[12,13]. Serum electrolyte estimation was done in 80 clinically suspected cases at CMH Savar. In the study serum electrolyte abnormalities were found in 56(70%) cases; out of which hypokalaemia was observed in 36(45%) cases, hyperkalaemia in 03(3.75%) cases, hypernatraemia in 11(13.75%) and hyponatraemia in 06(7.5%) cases. Hyperkalaemia and hyponatraemia would have been more common than hypokalaemia and hypernatraemia respectively[6,8], but in this study hypokalaemia and hypernatraemia were more common than hyperkalaemia and hyponatraemia. It may be due to non judicious and improper use of intravenous fluid and delay in collecting blood samples for serum electrolyte estimation after receiving intravenous fluid. Maximum value of serum potassium level in this study was 6.5 mmol/l which needed careful management because of well known effect of potassium on myocardial function[10]. One of the volunteer rescuers accidentally burnt 80% of his body. He was sent to National University Hospital, Singapore for better treatment but finally he had to sacrifice his life for the humanity. Rana Plaza collapse was an eye opener to realize the need for preparedness for disaster management, disaster reduction drills and exercises. These kinds of drills and exercises are included in "Comprehensive Disaster Reduction Drill Plan" in the country like Japan which is carried out by the national government in cooperation with local governments and relevant organizations[14]. The study revealed that CMH Savar is a level 2 Hospital with limited capacity, manpower and equipment facility. Efficient management of mass casualties was a great challenge for this CMH but extra manpower support of a medical team from CMH Dhaka and equipment support from AFIP Dhaka made it successful. Long term follow up of disabled patients and their rehabilitation are badly needed.

Conclusion

Management of mass casualty in this building collapse provides us with a valuable experience which, if needed can be utilized in future while dealing with similar disasters taking place in densely populated city areas of Bangladesh.

Rana Plaza before collapse

Rana Plaza after collapse

Rescue operation 1st day of collapse

Rescue operation 17th day of collapse

Picture of rescue operation

JAFMC Bangladesh. Vol 9, No 2 (December) 2013

15

Victims of Rana Plaza Tragedy

Rescued with amputation of upper limb

Rescued with amputation of upper limb

A volunteer rescuer of Bangladesh Fire Brigade & Civil Defence sacrificed life for humanities

JAFMC Bangladesh. Vol 9, No 2 (December) 2013

16

Rehabilitation program of disabled Rana plaza victims at CRP

INJURED GARMENTS WORKER

❖ RESCUED AFTER AMPUTATION OF LOWER LIMBS

❖ REHABILITATION WAS DONE WITH ARTIFICIAL LOWER LIMBS AT NITOR

❖ ON 28 SEPTEMBER 2013

❖ ARTIFICIAL LIMBS WERE ARRANGED BY PROSTHESIS FOUNDATION H R H THE PRINCES MOTHER , THAILAND

Rehabilitation of disabled victim with artificial lower limb

JAFMC Bangladesh. Vol 9, No 2 (December) 2013

17

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